http://dergipark.org.tr/en/pub/anatomy
doi:10.2399/ana.23.001s

anatomy
An International Journal of Experimental and Clinical Anatomy

Abstracts of the 1st National Neuroimaging Congress & 2nd Joint German-Turkish Symposium on Human Neuroscience

7–9 September 2023, Ankara, Türkiye

Anatomy 2023;17(Suppl 1):S1–S38 ©2023 Turkish Society of Anatomy and Clinical Anatomy (TSACA)

Conferences

(C-1 — C-6)

C-1

Cortical gradients of functional integration

Daniel S. Margulies

Centre National de la Recherche Scientifique (CNRS) UMR 7225, Frontlab, Institut du Cerveau et de la Moelle Epinière, Paris, France

Understanding how the cerebral cortex transforms distinct sources of information into cohesive experiences requires knowledge of how functional integration emerges from cortical structure. Insights into functional processing streams indicate that cortical areas are arranged stepwise, representing functional gradients along the cortical surface. Having been largely restricted to describing processing within specific sensory modalities, how do these principles generalize and extend to the surrounding association cortex? Building on recent work characterizing a principal axis of cortical organization, I will present a line of research that investigates the role of cortical geometry in enabling convergence across distinct modalities. By describing how the spatial layout of the cerebral cortex shapes its function, this line of research proposes a framework for understanding structural constraints that contribute to the integrated nature of cognition.

Keywords: Cognition, functional integration, functional gradients, sensory modalities

C-2

Neuroergonomics: observing the "brain at work" in everyday life

Hasan Ayaz

Science and Health Systems, School of Biomedical Engineering, Drexel University, Philadelphia, PA, USA

The understanding of the brain functioning and its utilization for real-world applications is the next frontier. Existing studies with traditional neuroimaging approaches have accumulated overwhelming knowledge but are still limited in scope, i.e. only in artificial lab settings and with simplified parametric tasks. As an interdisciplinary new field, neuroergonomics aims to fill this gap: Understanding the brain in the wild, its activity during unrestricted real-world tasks in everyday life contexts, and its relationship to action, behavior, body, and environment. Following significant conceptual and methodological improvements within the last decades, wearable neuroimaging sensors, electroencephalography (EEG) and near-infrared spectroscopy (NIRS) are now widely adopted to study the neural mechanisms underlying human perceptual, cognitive, and motor functioning and with recent mobile incarnations, with a focus on real-world contexts. EEG and NIRS record complementary correlates of brain function, electrophysiological activity and cortical oxygenation changes, respectively. Despite the progress, there are still significant shortcomings that plague their full utilization. This talk will discuss emerging trends for applications, from aerospace to medicine, with diverse populations and towards clinical solutions. We will review recent studies, such as mental workload assessment of specialized operators performing standardized and complex cognitive tasks and development of expertise during practice of complex cognitive and visuomotor tasks (ranging from aircraft piloting and robot control). Various recent synergistic applications for human-human and human-machine interaction, interpersonal neural synchronization and brain computer interfaces, highlight the potential use and are

ushering the dawn of a new age in applied neuroscience and neuroengineering.

Keywords: Neuroergonomics, neuroimaging, real-world tasks

C-3

Magnetic particle imaging for neuroimaging

Emine Ülkü Sarıtaş

Department of Electrical and Electronics Engineeringand National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye

Magnetic Particle Imaging (MPI) is a rapidly developing modality in medical imaging, featuring ideal image contrast and high sensitivity. MPI already offers several critical applications, including but not limited to stroke and traumatic brain injury imaging, angiographic imaging, stem cell tracking, lung perfusion imaging, and interventional imaging. Imaging with MPI utilizes a hardware system that is completely different from existing medical imaging modalities such as X-ray, CT, PET or MRI. The main advantages of MPI are that it is non-invasive and does not use any ionizing radiation. In addition, MPI utilizes iron oxide-based magnetic nanoparticles asimaging tracers, a class established as safe for use in humans. In recent years, neurovascular imaging has emerged as one of the most important application areas of MPI. With the widespread use of preclinical MPI systems, pivotal studies have been carried out to showcase the potential of MPI in this area. In light of these promising findings, human-sized MPI systems for neuroimaging are now being developed both in research laboratories and in companies producing commercial MPI systems. This talk will present the principles, current applications, and potential impact of MPI, especially in the field of neuroimaging.

Keywords: Magnetic particle imaging, MPI, neuroimaging

C-4

A roadmap towards precision cortical imaging

Emma Robinson

Department of Biomedical Engineering, School of Biomedical Engineering and Imaging Sciences, King's College London, London, UK

The organisation of the human cerebral cortex varies significantly across humans, in ways that break the assumptions of traditional image analyses, which perform diffeomorphically constrained image registration to a single population-average template based on folding. In this talk, I will describe ways to increase the sensitivity of neuroimaging studies to detect more subtle features of cortical variability at an individual level: from a guide to functionally-aligned cortical surface analysis, to describing new opportunities for precision imaging made possible through use of deep learning. I will show examples of where we have used these tools to map cortical organisation, model phenotypes, and build biomechanical and generative models of neurodevelopment and degeneration.

Keywords: Neuroimaging, deep learning, cortical organization mapping

C-5

Heart-brain interactions: of love and death

Arno Villringer

Department of Neurology, Max Planck Institute for Human Cognitive and Brain Sciences, and Clinic for Cognitive Neurology, University Hospital, Leipzig, Germany

While for a long time in human history it was assumed that the heart was important for emotional and cognitive functions, in today's "rational" world the role of the heart is often reduced to its function as a pump that supplies the body with blood. However, more and more studies are showing that the heart actually contributes to daily cognitive and emotional functions. Evidence is accumulating that much of cognition and emotion – perhaps all – represent integrated (body) cardioneural states and as such are constantly dependent on an intact heart-brain interaction (HBI). I will show how even simple perceptual tasks are dependent on HBI and also on breathing. It follows that any disturbance of the HBI will alter our emotions and cognition. Such disturbances can be caused, for example, by medication and recreational drugs. Long-term and/or repeated psychosocial stress can also have a negative impact on HBI. In particular, I will outline how long-term changes in HBI could be of great importance for the development of cardiovascular diseases such as hypertension and cardiac arrhythmias, as well as mental disorders such as anxiety and depression.

Keywords: Cognition, emotion, heart-brain interaction

C-6

On-going and task-based dynamics of brain functional connectivity

Tamer Demiralp

Hulusi Behçet Life Sciences Research Laboratory, Neuroimaging Unit, Istanbul University, Istanbul, Türkiye; Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

A set of large-scale brain networks, assumed to represent different functional domains, can be extracted from the functional magnetic resonance imaging (fMRI) data recorded during the "resting-state" (rs-fMRI). The temporal covariances among the BOLD fluctuations of brain regions, which presumably reflect functional connectivity (FC), results into rest-

ing-state (RSN) or intrinsic connectivity networks (ICN) with relatively stable spatial patterns within individuals. Therefore, ICNs have been widely used for evaluating functional differences among subject groups and for the evaluation of functional abnormalities in neuropsychiatric disorders. Covariance metrics averaged over long task-based fMRI data segments also revealed patterns similar to ICNs. Conversely, tasks associated with strong or long-lasting modulations/plasticity in brain circuitry (such as learning) provided ICN-like patterns in task-dependent activation contrasts. On the other hand, dynamic FC (dFC) estimations with sliding temporal windows have revealed changes in the internal FC and in the interactions of the ICNs with other ICN's nodes both along the resting-state and during tasks. Therefore, better understanding of brain functional organization requires the investigation of how the task-based dynamics of brain modularity relates to the resting-state ICNs. Whether the dFC patterns correspond to metastable or intermediate re-configurations of the ICNs or whether they represent more segregated or more integrated modules need to be answered. To our opinion, such analyses should not be limited to time-domain but should utilize phase-based FC metrics in frequency-domain, which were relatively less studied in the fMRI-based brain connectivity literature but can provide important information about simultaneous roles of specific brain regions in different functional modules. At the Neuroimaging Unit of Hulusi Behçet Life Sciences Research Laboratory (HUBAL) of Istanbul University, in collaboration with the Institute for Biomedical Engineering - Boğaziçi University, we performed a range of studies focusing on the above issues, the results of which I will summarize during my speech.

Keywords: Dynamic functional connectivity, frequency-domain, fMRI, functional connectivity, intrinsic connectivity networks

Panels

(PN1 — PN3)

Panel 1

(PN-01—PN-04)
Electroencephalograpy (EEG) Studies
8 September 2023, 09.00–10.30
Mimar Kemaleddin Hall

PN-01

What do we learn from EEG, ERP and event related oscillations (EROs)?

Canan Başar Eroğlu

Department of Psychology, Faculty of Arts and Sciences, Izmir University of Economics, Izmir, Türkiye

Hans Berger recorded the first Human EEG in 1929. The use of EEG reached a maximum within 10 years. However, 1960s EEG research became less attractive, since the development of CT and MRI became more interest for the neuroscientists. In 1998, Mountcastle has reported about the paradigm-changing by means of analysis methods in EEG research "He emphasized that using brain oscillations have become conceptual and analytical tools for the understanding of cognitive processes". Because of the different properties of frequency bands, we also emphasize the combined application of several analytical methods such as power spectra, wavelet decomposition, adaptive filtering of event-related potentials, and inter-trial coherence. These combined analyses procedure gives the most profound approach to understanding of EEG responses. In the last decade, brain oscillations are considered as functional building blocks of sensory –cognitive processes. Our research team has investigated delta, theta, alpha, beta and gamma frequency bands in both healthy and patients with schizophrenia. According to our studies, psychopathologies have to be investigated in multiple oscillatory frequency ranges in multiple locations to understand the nature of disorders. Therefore, I would like to present examples from our studies that investigated neuropsychiatric disorders in such a way especially Schizophrenia. Ours research group Schizophrenia is a complex mental disorder with impairments in integrating sensory and cognitive functions, leading to severe problems in coherent perception (Başar-Eroğlu, Schmiedt-Fehr, & Mathes, 2013). Based on our studies this impairment is accelerated during multistable perception (Başar-Eroğlu et al., 2016, 2018, 2023). Specifically, inter-trial coherence of frontal theta was impaired in patients with Schizophrenia during visual perception. As a summary, comparison of the results of the neuropsychiatric disorders may lead us to important conclusions related to the web of brain oscillations. Consecutively, we could gain new insights to approach brain function. We conclude that all our

recent studies on Schizophrenia indicate a malfunction such a coexistence and cooperative action with deficit being reflected in alterations in multiple frequency bands.

Keywords: EEG, event related oscillations, schizophrenia

PN-02

Translational EEG studies in epilepsy

Sacit Karamürsel

Koç University, School of Medicine, Department of Physiology, Istanbul, Türkiye

In this talk, some examples of translational studies using both scalp and invasive EEG recordings in combination with neuromodulation techniques will be presented. Despite the recent advances in neural engineering to process oscillatory brain activity in different scenarios such as brain machine-interfaces, not much progress has been done toward the interpretation of local field potentials (LFPs) and electrocorticogram (ECoG) with computational intelligence for clinical decision-making. In this talk, our efforts towards mapping cortical and subcortical regions during awake brain surgeries using machine learning and neural signal processing will be summarized, and unique opportunities and future challenges will be described. Analysis of high-frequency oscillations (HFO) in scalp and invasive EEG data obtained with high sampling rates to determine the location of the epileptic focus and possible seizure time in patients with treatment-resistant epilepsy is one of the hottest research topics today. Cortical mapping to decide the resection site in these patients and the induction of seizures or seizure markers by stimulation during this process will also be discussed in this talk. Corticocortical evoked potentials (CCEP) are one of the additional methods used to determine the seizure onset zone. The conversion of EEG from multiple channels into 3D sound (3D sonification) is one of the other methods we are studying in this field. Modulation of EEG and seizure markers with tDCS (transcranial direct current stimulation) is another therapeutic aspect of our studies.

Keywords: EEG, epilepsy, HFO, tDCS, neuromodulation

PN-03

A discussion on the use of in-house and publicly available EEG recordings

Tolga Esat Özkurt

Department of Health Informatics, Graduate School of Informatics, METU, Ankara, Türkiye

Even though the scalp EEG is relatively cheap and non-invasive compared to other neuroimaging methods, the necessary steps such as designing the experimental paradigm, recruiting relevant participants and data acquisition itself usually require a considerable amount of time, labor and finance. Therefore, collecting comprehensive, high-dimensional and high-quality datasets becomes worthwhile if thoughtful hypotheses, research questions and experimental outputs could be offered alongside adequate neurotechnological equipment, infrastructure and personnel. Recently, clinical and cognitive neurophysiological data sharing has become prevalent in an accelerating manner. Not only do publicly available datasets eliminate the cost of acquisition tasks, but even more importantly, they provide opportunities for multiple reanalyses by different researchers and objective criteria for comparison in the respective literature. In this talk, I will present some comparative results for a recently suggested biomarker extracted from both in-house collected and open neurophysiological data of patients with Parkinson's Disease. The findings of the analyses will be discussed along with the potential pros and cons of using open data. In addition, I will discuss our recent studies on EEG biometrics that utilized publicly available resting-state data from the same perspective.

Keywords: Biometrics, EEG, open data, Parkinson's disease, resting-state

PN-04

Understanding the dynamics of perceptual processing with electroencephalogram

H. Hulusi Kafalıgönül

Interdisciplinary Neuroscience Program, Aysel Sabuncu Brain Research Center, Bilkent University, Ankara, Türkiye

The daily experiences typically involve dynamic and changing stimuli (e.g., moving objects) which require adaptive behavior, thereby making sensory and perceptual dynamics crucial for interacting with a dynamic environment. Human perception is a highly dynamic process, and fundamental questions on the timing and dynamics of perceptual processing remain largely unanswered. Accordingly, my research has focused on the temporal dynamics of sensory and perceptual processing with a particular emphasis on vision. Using dynamic paradigms and illusions, we take an integrative approach combining both experimental and theoretical components. Due to its high temporal resolution, EEG (electroencephalogram) technique plays a critical role in our research. In this panel talk, I will mainly present how EEG technique can complement and even guide existing approach in psychophysical/behavioral and theoretical frameworks. Specific examples of multisensory research, contextual influences on perception, sensory plasticity, and cortical organization in adulthood will be provided. In the last part of the panel presentation, the limitations of the technique and future directions will be discussed. In this respect, specific applications of EEG in complicated and dynamic paradigms,

data-based analyses approach, and interpretations of the data will be further discussed.

Keywords: Temporal dynamics, cortical dynamics, sensation, perception, EEG

Panel 2

(PN-05—PN-08)
Functional Near Infrared Spectroscopy (fNIRS) Studies
8 September 2023, 14.00–15.30
Mimar Kemaleddin Hall

PN-05

Role of fNIRS in neuropsychiatry

Ata Akın
Department of Medical Engineering, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

The network theory approach, which has recently come to the fore in brain research, has led to a more inclusive understanding of local changes in brain physiology. With this theory, it has been shown that the networks between the healthy brain and the diseased brain show a difference. In our research carried out over the last 5 years, we have developed approaches that can quantify the changes in these networks with fNIRS. In this presentation, I will share an analysis approach that reveals the difference of these networks, especially in patients with Schizophrenia and Obsessive Compulsive Personality Disorder. We claim that the biomarker obtained as a result of the analysis based on graph theory summarizes the brain dynamics and can be used for diagnostic purposes in this form.

Keywords: Graph theory, fNIRS, obsessive compulsive personality disorder, schizophrenia, network theory

PN-06

Investigating neural correlates of social interaction processes through fNIRS hyperscanning

Murat Perit Çakır
METU, Department of Cognitive Science, Informatics Institute, METU ; METU TAF Modeling and Simulation Research and Development Center, Ankara, Türkiye

In the last decade, there has been a significant increase in the number of hyperscanning studies that focus on simultaneous monitoring of the brain dynamics of multiple participants while they are engaged in social activities. The fNIRS method is popularly employed in current hyperscanning studies due to its robustness to movement artifacts and increasing portability/wearability thanks to advances in fNIRS sensor design. Studies conducted in the fields of linguistics, cognitive science, social psychology, and developmental psychology have shown that during social interactions, as the interlocutors establish a sense of common ground, there is also an increase in the degree of coordination and synchronization among their speech and actions across multiple levels. Current findings encompass various levels including the organization of turn-taking in conversation, formation of shared concepts, increased syntactic compatibility between speakers' sentences, a higher level of coordination in gaze distribution towards people and objects in the vicinity, and overlaps in body oscillations of speakers. Hyperscanning studies aim to reveal the neural correlates of these processes. Pioneering studies in this field have shown that in conditions of cooperation and competition, where two individuals either try to press a button simultaneously or before the other, there is an increase in inter-brain connectivity measurements in the right superior frontal cortex in the cooperation condition in contrast to the competition condition. Over 100 studies conducted to date have examined systematic brain-to-brain coordination patterns across multiple participants during tasks involving various levels of social interaction, such as pressing buttons, singing together, storytelling, playing rock-paper-scissors, game-theory based decision-making, collaborative problem-solving, and playing Jenga. Recent meta-analyses and review articles focusing on the common patterns reported in these studies draw attention to brain-to-brain coordination in the right prefrontal, superior-frontal, and temporo-parietal junction regions, which may be related to the formation and maintenance of joint attention, and in the frontopolar and inferior/middle frontalgyrus regions, which may be associated with the formation of shared value judgments and theory of mind. The diversity of social interaction scenarios in current studies and the presence of control conditions used for comparison purposes indicate that these effects cannot be explained solely by factors such as pulse synchronization, neural responses to the rhythm of the experimental flow and stimuli, or mechanical coordination between physical movements. Future studies testing these findings in more free-form social interaction situations are expected to yield more detailed findings about the formation of joint attention and shared understanding, and the observed inter-brain effects will also provide useful information for understanding individual brain dynamics.

Keywords: Social neuroscience, hyperscanning, inter-brain connectivity, optical brain imaging, fNIRS

PN-07

The potential of fNIRS based BCI system designs as clinical decision support systems in psychiatry

Sinem Burcu Erdoğan
Department of Medical Engineering, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Diagnosis of most neuropsychiatric disorders relies on subjective measures which makes the reliability of final clinical decisions questionable. Within this talk, I will discuss the potential of fNIRS based brain computer interface system designs as clinical decision support systems in the field of psychiatry. I will present some recently published work of our group which focused on objective classification and accurate identification of several neuropsychiatric and neurological disorder states through integration of supervised machine and deep learning methods with i) fNIRS only biological features and ii) a combination of fNIRS derived features, clinical and behavioral performance data obtained from neuropsychiatric test measures. More specifically, I will discuss the comparative efficacy of combining distinct classifiers with different feature selection and feature extraction steps in correctly labelling the presence of disease states that include migraine, impulsivity, schizophrenia and bipolar disorder at the single-subject level. Our results highlight the promise of exploring prefrontal cortical neurofunctional features as distinctive and objective biomarkers of neuropsychiatric or neurological disorders which are associated with alterations in frontal lobe function. Our results also highlight the potential of exploring fNIRS-BCI system designs for objective identification and differential diagnosis of major neuropsychiatric disorders that have overlapping behavioral symptoms across each other and are hard to distinguish when decisions are based solely on observation, self-report, interview, and/or rating scales.

Keywords: Brain computer interface, deep learning, fNIRS, clinical neuroscience

PN-08

Experimental and clinical applications of functional near infrared spectroscopy and functional diffuse correlation spectroscopy

Aykut Eken

Department of Biomedical Engineering, TOBB University of Economics and Technology, Ankara, Türkiye

Functional Near Infrared Spectroscopy (fNIRS) has been used in an exponentially increasing number of studies over the years in areas such as cognitive and clinical neuroscience, brain-computer interface, neuroergonomics. Compared to a hemodynamic response-based technique such as functional magnetic resonance imaging, it is a preferred functional neuroimaging modality due to its portability, ease of use, tolerance to motion artifacts and higher temporal resolution. Functional Diffusion Correlation Spectroscopy (fDCS), which has a similar physical principle with fNIRS, is a technique based on measuring cerebral blood flow (CBF) from near-infrared light intensity-based-autocorrelation obtained from photon detectors. While fNIRS gives us information about the oxy and deoxyhemoglobin concentrations it measures and tissue oxygen metabolism, fDCS gives us more local microvascular CBF information. According to studies, fDCS is a system that is three times more sensitive to brain-to-scalp sensitivity than fNIRS. When used together with fNIRS, it also enables the estimation of a neurologically critical biomarker such as the cerebral metabolic rate of oxygen ($CMRO_2$). In this talk, the applications of fNIRS on various psychiatric and neurological populations and the fDCS system will be introduced in general, and functional neuroimaging and neurological applications of fDCS will be mentioned.

Keywords: Functional near infrared spectroscopy, functional diffuse correlation spectroscopy, clinical neuroscience, cognitive neuroscience

Panel 3

(PN-09—PN-12)

Magnetic Rezonance Imaging (MRI) Studies

8 September 2023, 16.00–17.30

Mimar Kemaleddin Hall

PN-09

The neuroimaging correlates of cognitive impairment in AD and PD

Hakan Gürvit

Department of Neurology, Istanbul University School of Medicine, Istanbul, Türkiye

Advances in neuroimaging enabled us to demonstrate with great precision the progressive neuropathological changes that were previously only detectable through autopsy studies in patients experiencing neurodegenerative diseases. In the last quarter of the previous century, following the emergence of computerized tomography first and subsequently magnetic resonance imaging, cognitive impairment was interpreted as reflected in the general sulcal enlargement associated with cortical atrophy; starting with the new century, it has become possible to quantitatively measure the volumes of critical cerebral structures involved in cognitive impairment, evaluate them with visual scales, and assess the changes in the structural and functional connectivity of neural networks they form using structural and functional connectivity analyses. Istanbul University's HUBAL is a laboratory established to adapt sophisticated cognitive neuroimaging methods to our university and country. In its relatively short history, it has translated a substantial number of academic productions into publications. In this presentation, the results of our published and unpublished studies related to neuroimaging studies on cognitive impairment in Alzheimer's and Parkinson's diseases will be discussed, and brief projections for the future will be made.

Keywords: Alzheimer's disease, fMRI, Parkinson's disease

PN-10

A narrative of a longstanding collaboration for fMRI

Orhan Murat Koçak
Department of Psychiatry, Başkent University, Ankara, Türkiye

In this presentation, a journey belongs to the establishment of one of the longstanding cognitive neuroimaging collaborations in Ankara and current projects of this partnership will be narrated. In 2005, the first pilot of a task based fMRI session was achieved. The study group was from the physiology department of Ankara University. The study was associated with cognitive control in obsessive compulsive disorder. Since this date, in Ankara, many fMRI studies have been succeeded by different study groups. Today, two fMRI studies have been planned to begin in NÖROM, very soon. One of these studies is associated with functional neurobiology of semantic neighborhood density, and the second is a study of somatic symptom disorder etiopathogenesis.

Keywords: fMRI, semantic neighborhood density, somatic symptom disorder

PN-11

Top-down and bottom-up processing of biological motion in the human brain

Burcu Ayşen Ürgen
Bilkent University, Ankara, Türkiye

Visual perception of the body movements of other living things (aka biological motion) is critical in many tasks ranging from survival in the wild to communication and interaction in social life. Perception of biological motion is supported by a network of regions in the occipitotemporal, parietal and premotor cortex in the primate brain. However, most studies to date studied BM under attention tasks, and how it is processed when attention is directed away lacks thorough examination. A handful of human behavioral studies show that when presented as a task-irrelevant distractor in the periphery, BM impairs performance on a task at the fovea. In the present study, we investigated whether the brain regions that process BM are recruited when attention is directed away from BM and how attentional load at the center modulates this processing. Human participants underwent a functional MRI study in which they performed an attentionally demanding task at the fovea while BM in the form of point-light displays was presented in the periphery as distractors. We manipulated the attentional load at the center. Univariate analysis and MVPA show that frontoparietal attentional regions were more active when the attentional load was high than when it was low as expected. More importantly, we found that motion-sensitive areas in the occipitotemporal cortex were recruited in the presence of task-irrelevant BM stimulus even when attention was directed away from it. Furthermore, during the low attentional load condition, BM-related activation was stronger than in the high attentional load condition, suggesting that if there are available attentional resources, they can be allocated to even task-irrelevant distractors, consistent with load theory. Thus, our results show that BM can be processed in the periphery even when it is not the focus of attention, and this process is modulated by the attentional load of the perceiver.

Keywords: Visual perception, biological motion perception, attention, fMRI, MVPA

PN-12

Effects of autonomic activity during sleep and wakefulness on spatiotemporal brain dynamics

Pınar Senay Özbay
Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye

During functional MRI (fMRI) experiments, various tasks or stimuli can be presented to the individual, or resting instructions can be given. As the brain performs different functions or responds to external stimuli, blood flow and oxygen levels change in active brain regions. Through fMRI methods and statistical calculations, these changes are detected, and functional maps of brain activity are created. It is well known that fMRI signal variations covary, in part, with fluctuations in systemic physiology, including cardiac rate, respiration and also peripheral physiology. These physiological phenomena may interact with both behavioural state (e.g., arousal, sleep stage) and cohort characteristics (e.g., age, sex, diagnoses), and thus a greater understanding of their effects is likely to be important for most studies. Understanding the underlying mechanisms of these phenomena may not only inform denoising decisions but may also reveal new insights about the brain's functional architecture and disease mechanisms. Our recent work showed strong correlations between peripheral vascular tone, which is a proxy for sympathetic activity, fMRI global signals and autonomic arousals during light sleep. It has also been shown that cerebrospinal fluid (CSF) pulsatile movement during sleep may induce removal of metabolic waste. Pulsations may also be induced by direct pressure effects from cardiac and respiratory cycles. For example, deep inspirations that alter intravascular CO_2 will lead to cerebral blood volume changes and can create CSF pulsations through an autonomic pathway with accompanied variations in the vascular tone. To investigate this possibility, we asked our subjects to take cued deep breaths, a task previously shown to lead to fMRI global signal (GS) reductions. We demonstrated an alternative pathway for the generation of CSF pulsations that relies on autonomic regulation of cerebral vascular tone during alert conditions. In this seminar, I will discuss the interactions between systemic physiology and the brain's fMRI signal, spatiotemporal brain dynamics during sleep and wake, and the implications of arousal state on CSF dynamics.

Keywords: fMRI, physiology, sleep

Oral Presentations
1st National Neuroimaging Congress
(OP-01 — OP-20)

Session 1
(OP-01—OP-05)
7 September 2023, 14.30–16.00
Mimar Kemaleddin Hall

OP-01

Behavioral and neural correlates associated with visual search in cereebral visual impairment

Zahide Pamir[1], Claire E. Manley[2], Corinna M. Bauer[3], Peter J. Bex[4], Daniel D. Dilks[5], Lotfi B. Merabet[2]

[1]Department of Psychology, Bilkent University, Ankara, Türkiye; [2]Department of Ophthalmology, Massachusetts Eye and Ear, Harvard Medical School, Boston, MA, USA; [3]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA; [4]Department of Psychology, Northeastern University, Boston, MA USA; [5]Department of Psychology, Emory University, Atlanta, GA, USA

Objective: Cerebral visual impairment (CVI) is a brain based visual impairment characterized by deficits in visual function and higher order visual perception. Individuals with CVI have difficulties recognizing familiar individuals in a crowd and following moving traffic. Visuospatial processing impairments are often present in this population. The clinical profile of CVI has been termed dorsal stream dysfunction (DSD) and is ascribed to impaired visual processing abilities resulting from early injury and maldevelopment occurring along the dorsal visual pathway. However, the role of visual processing areas within the ventral stream and their associated neurophysiological correlates have remained largely uncharacterized.

Methods: We investigated fMRI responses within early as well as higher-order visual cortical areas while participants viewed and performed a visual search task within a complex and dynamic naturalistic scene. Behavioral performance was collected from CVI participants (n=14) and neurotypical controls (n=16) using a virtual reality (VR)-based desktop environment combined with eye tracking. Participants were instructed to search and follow a human target walking in a hallway. Task difficulty was manipulated by altering the number of individuals in the surrounding crowd.

Results: We found that CVI participants took longer to find the target, and their eye gaze patterns were less accurate and precise. Analysis of fMRI data within predetermined regions of interest revealed that response profiles were similar in both groups within early visual and frontal areas. Consistent with DSD, responses along dorsal stream areas were reduced in CVI. Unexpectedly, visual areas along ventral stream showed the opposite response profile, with greater activation compared to controls. We speculate that this activation profile reflects impaired top-down suppression of task-irrelevant information.

Conclusion: In summary, these results suggest that in the context of early brain injury and maldevelopment, impaired visuospatial processing abilities in CVI are associated with differential patterns of activation along both the dorsal and ventral visual streams.

Keywords: Cerebral visual impairment (CVI), dorsal stream dysfunction, dorsal stream, ventral stream, visual search

OP-02

Investigation of the neural basis of contextual novelty and its effect on memory processes using fMRI

Emre Harı[1], Tamer Demiralp[2]

[1]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; Neuroimaging Unit, Hulusi Behçet Life Sciences Research Laboratory, Istanbul University, Istanbul, Türkiye; [2]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; Neuroimaging Unit, Hulusi Behçet Life Sciences Research Laboratory, Istanbul University, Istanbul, Türkiye

Objective: In this study, it is aimed to investigate the effect of contextual novelty (CN), which is defined as stimuli encountered in an unexpected context, on its neural bases and memory processes using fMRI method.

Methods: Ten right-handed healthy participants were included in the study. Participants performed a memory task in the MR device, which included the encoding phase, which included stimulus images in (In Context-ICo) and out (Out Context-OCo) of a specific semantic context, and the recall phase, where they evaluated these stimuli and distractors as old (target), similar, and new. Preprocessing and GLM analysis were performed using SPM12. For activation analysis, ICo and OCo stimuli were compared in coding, while correct response percentages were used as covariates in recall, and old and new conditions were compared. Flexible factorial design was used in the comparisons, and the clustering threshold was set as $p<0.001$ and the cluster-level significance threshold was pFWE-corrected<0.05. Post hoc com-

parisons were made using paired sample t-test for clusters in which a significant difference was found between the old and new conditions.

Results: In OCo compared to ICo, increased activation was detected in the right hemisphere, middle occipital gyrus, fusiform gyrus, parahippocampal cortex, inferior-superior parietal cortex, precuneus and left hemisphere, angular gyrus, precuneus, superior parietal cortex. In the recall phase, a significant difference was found between the old and new conditions in the right cuneus, superior occipital, supramarginal, angular gyri and bilateral precuneus. In post hoc analyzes of the old (Target) condition, increased activation was detected in the bilateral precuneus, right cuneus, and right superior occipital cortex in OCo compared to ICo. Also, participants showed better memory performance in BAD stimuli compared to BAI stimuli ($p<0.05$).

Conclusion: CN provides a marked increase in activation in specific cortical areas of the brain and better memory performance.

Keywords: Contextual novelty, memory processes, functional magnetic resonance imaging

OP-03

Behavioral and neural investigation on the effect of spatial attention on surround suppression

Merve Kınıklıoğlu[1], Hüseyin Boyacı[2]

[1]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye; Interdisciplinary Neuroscience Program, Bilkent University, Ankara, Türkiye; [2]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye; Interdisciplinary Neuroscience Program, Bilkent University, Ankara; Department of Psychology, Bilkent University, Ankara, Türkiye; Department of Psychology, JL Giessen University, Giessen, Germany

Objective: The responses of a neuron to stimuli in its receptive field may be suppressed by the stimuli presented in its surround. This phenomenon is called "surround suppression" and although it is known to be affected by spatial attention, there is no study that directly investigates how the spatial extent of attention modulates surround suppression in human motion perception. Here, we studied the effect of spatial attention on surround suppression in the V1 and hMT+ of human subjects (n=10, 8 female), utilizing psychophysics, fMRI, and computational modeling.

Methods: We presented a high-contrast (98% Michelson contrast) drifting central grating (diameter: 1.5°) alone or surrounded by a drifting annular grating (width: 9.2°) with a 1.3° gap between them. Importantly, the drift directions of the central and annular gratings could be the same or opposite. Under two attention conditions, participants were instructed to either limit their attention to the central grating (Narrow Attention, NA) or to both gratings (Wide Attention, WA).

Results: First, in a behavioral experiment, we found that surround suppression was significantly stronger under the WA condition compared to the NA condition for the same-direction trials. Next, we conducted a mixed-design fMRI experiment and found that neural suppression in the hMT+, but not in V1, significantly increased as the extent of spatial attention increased in the same-direction trials. Further, we found that hMT+ activity better captures the behavioral results. Finally, we show that incorporating smaller vs. larger multiplicative attentional gain in the normalization model (Reynolds & Heeger, 2009) can successfully predict neural activity patterns and associated behavioral outcomes.

Conclusion: Taken together, our results show that spatial attention has a critical role on the behavioral consequences of surround suppression, in which hMT+ plays an important role. This research was supported by the Scientific and Technological Research Council of Türkiye (ARDEB-Project No. 120K956).

Keywords: Attention, center-surround interaction, surround suppression, motion perception, normalization, fMRI

OP-04

Sex-specific influence of oxytocin receptor gene polymorphisms on structural and functional-anatomical connectivity

Kutlu Kaya[1], Deniz Önal[2], Yasemin Kartal[3], Murat Timur Budak[1], Erdem Karabulut[4], Kader Karlı Oğuz[5], Bilge Pehlivanoğlu[1]

[1]Department of Physiology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [2]Department of Physiology, Faculty of Medicine, Balıkesir University, Balıkesir, Türkiye; Department of Physiology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [3]Department of Physiology, Faculty of Medicine, Kırklareli University, Kırklareli, Türkiye; Department of Physiology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [4]Department of Biostatistics, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [5]Department of Radiology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; Department of Radiology, Faculty of Medicine, University of California Davis, Sacramento, CA, USA

Objective: Studies showed that different single nucleotide polymorphisms (SNPs) in the oxytocin receptor (OXTR) gene influence socio-emotional behaviors. However, sex-specific differences between SNP with structural and connectome-level features have not been comprehensively investigated. Therefore, we aimed to evaluate the structural and connectome-level influence of rs53576, rs1042778, and rs2254298 SNPs among male and female young adults.

Methods: Structural and connectome-level analyses were performed using T1-weighted structural, diffusion tensor, and resting-state functional images obtained with a 3-Tesla MR scanner (Siemens, Erlangen, Germany) from 61 participants (27 females; 34 males). Blood samples were collected from the participants

and grouped into homozygotes (GG) and heterozygotes (T or A-carriers) for each SNP to investigate sex-specific differences. Statistical significance was evaluated after post-correction with corresponding imaging analysis.

Results: Female and male participants were similar regarding demographic characteristics. We found that males had a larger cortical surface area (cSA) and subcortical volume in different homozygous and heterozygous allele carriers. Males indicated larger volumes of the amygdala, caudate, ventral diencephalon, putamen, and hippocampus, including the larger cSA in different SNPs, except for the heterozygous rs2254298. Particularly, homozygous rs225498 showed a greater influence on cSA differences, while the same effects were observed for heterozygous rs53576 and rs1042778. Differences in cortical volume were primarily observed in heterozygous allele carriers. Females exhibited greater functional and anatomical connectivity compared to males. There was more functional and anatomical connectivity for homozygous rs225498 and heterozygous rs1042778. These connections were mainly observed in the temporal regions of the functional connectome and the temporal and subcortical areas of the anatomical connectome.

Conclusion: Our study provides comprehensive structural and connectome findings on how genetic variations and sex interact to shape the brain, contributing to the development of approaches to specific neuropathological conditions and understanding of individual socio-emotional differences. Our study was supported by Hacettepe University Scientific Research Projects (No:TSA–2018–17643).

Keywords: Oxytocin receptor gene polymorphism, sex, structural MR, functional connectome, structural connectome

OP-05

Dynamic changes in brain intrinsic connectivity networks during cognitive interference resistance

Eylem Ümmü[1], Elif Kurt[1], Tamer Demiralp[2], Ali Bayram[1]

[1]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [2]Hulusi Behçet Life Sciences Research Laboratory, Neuroimaging Unit, Istanbul University, Istanbul, Türkiye; Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Cognitive interference resistance is the ability to target-oriented use of cognitive resources during cognitive competition in the presence of distracting stimuli. In this study, the connectivity changes of intrinsic connectivity networks (ICN) during the interference resistance were investigated by dynamic connectivity analyses.

Methods: Functional data from 27 healthy participants were recorded with the 3T-MRI during the Multi-Source Interference Task. After preprocessing, ICNs were determined by independent component analysis. Regression analyses were performed between the ICN components' time series and the experimental design, also between the dynamic connectivity calculated by the sliding window analysis and the task load function. T-tests were performed to determine the network components that are modulated by the task and whose modulation varies across conditions, and the inter-condition variation of dynamic connectivity between the task-modulated networks.

Results: The lateral visual network (VN), dorsal attention network (DAN), executive control network (ECN), and cerebellum displayed increased intra-network positive connectivity in the interference condition compared to control (pFWE<0.05). Conversely, the limbic network and default mode network (DMN) exhibited increased intra-network negative connectivity (pFWE<0.05). When the dynamic network connectivity modulated by the task was examined, it was determined that the dynamic connectivity modulated by the interference resistance was detected between the DAN and the lateral VN in the interference condition compared to the control (pFWE<0.05).

Conclusion: Increased intra-network connectivity of lateral VN, DAN, and ECN during interference resistance support their role in attention and cognitive control. The DMN's elevated negative connectivity can be interpreted as increased suppression of the DMN. Interference resistance involves detecting relevant stimuli, directing attention purposefully, and filtering irrelevant stimuli. In this context, increased dynamic connectivity between lateral VN, linked to visual-spatial attention in processing complex visual stimuli, and DAN, involved in stimulus detection and purposeful choices, overlaps with interference resistance processes.

Keywords: Cognitive ınterference resistance, dynamic connectivity, functional magnetic resonance ımaging, independent component analysis, intrinsic connectivity networks

Session 2

(OP-06—OP-10)

7 September 2023, 14.30–16.00

NÖROM Conference Hall

OP-06

Investigation of figurative language and motor resonance interaction: evidence from neuromodulation over the motor cortex

Hazel Zeynep Kurada[1], Miguel Jimenez Bravo[2], Chiara Giacobbe[3], Ignacio Obeso[4]

[1]Department of Speech & Language Therapy, Faculty of Health Sciences, Hacettepe University, Ankara, Türkiye; [2]Department of Linguistics and Eastern Studies, Complutense University, Madrid, Spain; [3]Department of Psychology, University of Campagnia Luigi Vanvitelli, Caserta, Italy; [4]HM CINAC (Centro Integral de Neurociencias Abarca Campal), Hospital Universitario HM Puerta del Sur, HM Hospitales, Madrid, Spain

Objective: It is well known that observing actions and understanding sentences with motor actions activates corresponding motor processes in the observer-comprehender. This interaction of primary motor areas between words and phrases that indicate physical movement is defined as motor resonance. While many studies in the literature show that there is a direct relationship between literal expressions containing physical actions and the motor system (Desai et al., 2011; Desai et al., 2010), it is still an ongoing discussion whether expressions containing motor action trigger the motor system when they are used in a figurative context. The current study aimed to address how language and transparency (different types of idiomatic expressions) affect motor resonance in the primary motor cortex.

Methods: Twenty-six Spanish and eleven Turkish participants underwent continuous theta burst (CTBs) stimulations to the primary motor cortex (M1) area. Following CTBs applications, participants underwent an Overt Priming Task with Self-Paced Reading task on a PC.

Results: Linear mixed effects models analysis revealed a facilitation effect in sentences with literal motor actions. All participants processed transparent idiomatic sentences much faster than opaque idiomatic ones after cTBS application compared to the sham condition. We argue that the facilitation effect in transparent idioms is because the distance between the figurative and literal meaning is much closer in transparent idioms, and literal meanings of transparent idioms included a hand motor verb.

Conclusion: Our results confirm the embodied approach, supporting the idea of a functional role of the M1 area for comprehension of motor actions, and we propose novel motor resonance results among different types of idioms. This research was supported by TUBITAK 2219 International Post-Doc Fellowship Program (Project No: 1059B192200694).

Keywords: Motor resonance, idiom, embodiment, action verb

OP-07

Investigation of the effect of tDCS on emotion recognition skills with resting-state EEG oscillations

Saliha Şahintürk[1], Ayşe Ece Yazar[1], Erol Yıldırım[2]

[1]Research Institute for Health Sciences and Technologies (SABITA), fiNCAN Laboratory, Istanbul Medipol University, Istanbul, Türkiye; [2]Department of Psychology, School of Humanities and Social Sciences, Istanbul Medipol University, Istanbul, Türkiye

Objective: Emotion recognition, which is defined as the process of interpreting the emotional state of individuals by looking at their facial expressions, is important in the healthy conduct of social relations and communication. When the literature is examined, it has been observed that studies on the effect of Transcranial Direct Current Stimulation (tDCS), one of the brain stimulation methods, on emotion recognition are limited. In this study, it was aimed to examine the effect of anodal stimulation of the ventromedial prefrontal cortex (vmPFC), which is one of the important regions in emotion recognition from facial expressions, on emotion recognition and EEG oscillations.

Methods: The study is a single-blind randomized-control group study conducted with 54 healthy participants aged 18–40 years. Before and after brain stimulation, "ADFES-BIV emotion recognition task" and "Mind Reading from the Eyes Test" were applied and resting state EEG recordings were taken. The change in task performances and brain oscillations was analyzed by Repeated Measurement Two-Way ANOVA.

Results: While there was no significant difference in emotion recognition tasks between groups in the pre-post measurements ($p>0.05$); significant difference were observed in some channels EEG frequency bands ($p<0.05$).

Conclusion: The lack of positive effect of tDCS on emotion recognition may be due to the fact that the tDCS may not have created the desired effect in the targeted region because of the vmPFC region is located in the lower part of the prefrontal lobe, and also the changes that EEG frequencies which are modulated similarly to some pathological processes. In addition, it is thought that this finding supports the idea that brain oscillations can be affected by stimulation, leading to deterioration in cognitive functions. Future studies to be carried out for better understand this effect are important.

Keywords: Brain oscillations, EEG, emotion recognition, tDCS, ventromedial prefrontal cortex (vmPFC)

OP-08

Pain decoding under analgesic conditions using functional near infrared spectroscopy and transfer learning

Aykut Eken[1], Sinem Burcu Erdoğan[2], Gülnaz Yükselen[2], Süveyda Şanlı[1], Hasan Eren Yardımcı[1], İlayda Özger[1], Murat Yüce[2]

[1]Department of Biomedical Engineering, TOBB University of Economics and Technology, Ankara, Türkiye; [2]Department of Biomedical Engineering, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Pain decoding using hemodynamic responses is an objective but challenging approach due to the variable nature of hemodynamic response. Moreover, the effects of different analgesic conditions increase the complexity of this problem.In this study, we aimed to decode the intensity level of nociceptive stimuli under analgesic conditions by utilizing fNIRS derived hemodynamic responses and a deep transfer learning approach.

Methods: A previously collected fNIRS dataset collected from 14 healthy male volunteers was utilized. Each subject had two site visits where they were orally administered with a morphine or a placebo pill. At each site visit, subjects had 4 fNIRS scans which were taken during a nociceptive stimuli protocol a)before and b) after 30,60,90 minutes of drug administration. 6 noxious and 6 innocuous stimuli were given to left thumb. After data preprocessing, a deep learning model was trained on the pre-drug dataset to classify painful and non-painful stimuli. Then, the knowledge obtained in this model was then transferred to classify post-drug dataset.

Results: Accuracy performance of the pre-drug model was 0.97. Accuracy of post morphine drug models were 0.91 after 30 min, 0.90 after 60 min and 0.91, after 90 min. For placebo administration, they were found as 0.92 after 30 min, 0.92 after 60 min, 0.91 after 90 min respectively. Statistical comparison of performance metrics showed that accuracy values were significantly higher in pre-drug models compared to post-morphine and post-placebo models.

Conclusion: Our deep transfer learning approach showed that knowledge obtained from a pre-drug model trained by using hemodynamic responses can be used to decode pain level after drug administration. We demonstrate the potential of fNIRS derived signals for transferring information from a model trained with baseline data to models built for different clinical or daily life conditions where collection of training data may not be feasible/practical to build novel ML or DL models.

Keywords: fNIRS, pain, analgesia, deep learning, transfer learning

OP-09

A study on orthographic neighborhood effect in lexical retrieval: a pupillometry study

Hazal Artuvan Korkmaz[1], Özgür Aydın[2]

[1]Department of Physiology, School of Medicine, Ankara University, Ankara, Türkiye; Brain Research Center, Ankara University, Ankara, Türkiye; Neuroscience and Neurotechnology Excellence Joint Application and Research Center, Ankara, Türkiye; [2]Institute of Health Sciences Interdisciplinary Neuroscience Program, Ankara University, Ankara, Türkiye; Faculty of Languages History and Geography, Ankara University, Ankara, Türkiye; Neuroscience and Neurotechnology Excellence Joint Application and Research Center, Ankara,Türkiye

Objective: The orthographic neighborhood of a target word refers to the set of words that are orthographically close to that word. During reading, orthographic neighborhood typically has inhibitory effects in languages with transparent orthography, while there are inconsistent results in languages with opaque orthography. We used pupillometry in the orthographically transparent Turkish, to investigate the effect of orthographic neighborhood and demonstrate the processing differences between real and pseudowords with low orthographic neighborhood.

Methods: The study included 34 healthy right-handed adults (18 females, mean age=26.5, SD=7.77). Participants were asked to read the real/pseudowords displayed in the screen. Their pupil measurements were recorded using the Eyelink 1000 Plus eye-tracking system. The stimuli consisted of real/pseudowords with low orthographic Levenshtein distance (OLD20) values (high orthographic neighborhood), and pseudowords with high OLD20 values (low orthographic neighborhood). The data were preprocessed using the PupilPre() package in R. Base-corrected pupil changes were taken as the dependent variable, and the interaction effects of this variable with the OLD20 (low/high) and Word Type (real/pseudoword) factors were analyzed using Generalized Additive Mixed Model.

Results: For pseudowords, the pupil dilated more for high-orthographic neighborhood ($F=3.66$, $p>0.01$). In the case of high orthographic neighborhood, when comparing real and pseudowords, pupil dilation increased in the real word condition ($F=2.75$, $p<0.05$). In the interaction between time and OLD20, while an increase in OLD20 had no effect on pupil dilation for real words with high orthographic neighbourhood, pupil dilation for pseudowords was found to be sensitive to time and OLD20 ($F=3.65$, $p<0.001$).

Conclusion: The findings support those obtained in languages with transparent orthography. The higher pupil dilation of pseudowords with high orthographic neighbourhoods compared to those with low neighbourhoods suggests that lexical retrieval is forced on these words. The results suggest that lexical competition is an important processing mechanism independent of semantics.

Keywords: Lexical processing, orthographic neighborhood, pseudoword, pupil size, pupillometry

OP-10

Investigation of the influence of autonomous sensory meridian response on the prefrontal cortex using fNIRS

Sezgi Fırat Özgür[1], Kutlu Kaya[1], Kardelen Pekaslan[1], Serkan Karaismailoğlu[1], Murat Perit Çakır[2], Okan Arıhan[1], Ayşen Erdem[1]

[1]Department of Physiology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [2]Cognitive Science Program, Informatics Institute, Middle East Technical University, Ankara, Türkiye

Objective: Autonomous sensory meridian response (ASMR) is a phenomenon triggered by specifically designed videos and sounds, inducing a feeling of relaxation in individuals. Previous studies have demonstrated that ASMR stimuli lead to tempo-

rary improvements in pain symptoms and enhanced performance in cognitive tests for ASMR-sensitive individuals. Most studies on ASMR have primarily relied on surveys or recording brain activity in a limited area (e.g., fMRI). Allowing individuals to experience ASMR in a more comfortable setting and concurrently examining its influence on the prefrontal cortex will contribute to a better understanding of this phenomenon at the physiological level.

Methods: 26 healthy volunteers (9 men) were included in this study. While participants comfortably watched ASMR and control videos, prefrontal cortex activity was recorded using an fNIRS device (fNIR Devices, Maryland, USA) with 16 channels. The oxy- ([HbO]), deoxy- ([HbR]), and total hemoglobin ([HbT]) concentrations were obtained using the modified Beer-Lambert law. After the experiment, participants completed an information form and were divided into two groups based on their ASMR sensitivity: sensitive (n=13) and non-sensitive (n=13). Responses to ASMR videos between the groups were evaluated using the Mann-Whitney U test, while the responses of ASMR-sensitive individuals to ASMR and control videos were compared using the Wilcoxon test.

Results: ASMR-sensitive individuals had significantly lower [HbR] values (median=–0.33 μM) compared to non-sensitive individuals (0.34 μM) in channel 7 (p=0.01). When comparing ASMR and control video responses in ASMR-sensitive individuals, [HbR] responses to ASMR videos were lower than those to control videos in channels 1, 4, and 10 (–0.48, 0.11, and –0.44 μM, respectively, vs. 0.20, 0.81, and 0.24 μM; p<0.04 for all).

Conclusion: Our study contributes to understanding the influence of ASMR videos on prefrontal activation in sensitive individuals and provides valuable physiological insights into this phenomenon.

Keywords: ASMR, fNIRS, prefrontal cortex, cortical activation

Session 3
(OP-11—OP-15)
7 September 2023, 16.30–18.00
Mimar Kemaleddin Hall

OP-11

Classification of movements in the same limb in brain computer interface systems

Cansu Hatıl[1], Eda Akman Aydın[2]

[1]Department of Electrical and Electronics Engineering, Institute of Science and Technology, Gazi University, Ankara, Türkiye; [2]Department of Electrical and Electronics Engineering, Faculty of Technology, Gazi University, Ankara, Türkiye

Objective: Brain-computer interfaces (BCI) are systems that provide direct communication between the human brain and the environment. In BCI systems, it is difficult to distinguish motor imagery of different movements in the same limb using electroencephalography (EEG) signals because these imagined movements have close spatial representations in the motor cortex area. Movement-related cortical potentials (MRCP) are low-frequency potentials that appear in the EEG signal before the onset of movement and continue during movement, with amplitude values varying between 5–30 V. MRCP signals are used in BCI systems to determine the beginning of the movement and which movement is made. In this study, it was aimed to determine movements in the same limb using MRCP signals.

Methods: For this purpose, Discrete Wavelet Transform and ensemble classification methods were used. The proposed method was tested on a dataset containing EEG signals corresponding to hand opening and palm grasping movements recorded from 10 patients with spinal cord injury.

Results: The accuracy obtained for the binary classification of hand opening and palm grasping movements is 71.7%. According to the results, although the accuracy rate was higher in experiments involving post-movement periods, the pre-movement accuracy rates were also determined successfully.

Conclusion: Accordingly, MRCP signals observed before the onset of movement can be used to determine movement in BCIs.

Keywords: Brain-computer interface, movement detection, EEG signals, movement-related cortical potentials, discrete wavelet transform, ensemble classification

OP-12

Detection of amotion in major depressive disorder via machine learning approaches based on ERP

Tuğçe Ballı[1], Bernis Sütçübaşı[2], Emine Elif Tülay[3], Barış Metin[4]

[1]Department of Management Information Systems, Faculty of Economics, Administrative and Social Sciences, Kadir Has University, Istanbul, Türkiye; [2]Department of Psychology, Faculty of Humanities and Social Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [3]Department of Software Engineering, Faculty of Engineering, Muğla Sıtkı Koçman University, Muğla, Türkiye; [4]Department of Neurology, Faculty of Medicine, Üsküdar University, Istanbul, Türkiye

Objective: The field of recognizing emotions through physiological signals is rapidly evolving, yet most studies have primarily focused on healthy participants. However, considering that depression is a highly prevalent psychiatric disorder with a significant impact on emotion processing, this study aimed to compare the performance of various machine learning

approaches in classifying emotions using the EEG of individuals diagnosed with Major Depressive Disorder (MDD).

Methods: The study included a sample of 15 healthy controls (HC) and 15 drug-naïve patients diagnosed with MDD, selected based on evaluations by an experienced psychiatrist and Beck Depression Inventory scores. Positive, neutral, and negative images from the International Affective Picture System (lAPS) dataset were presented to subjects. For each emotional class, mean amplitudes of event-related potentials (ERP) including P200, P300, early, middle, and late LPP were computed and used as features for classifiers. Random Forests, Gradient Boosting (GB), and AdaBoost classification algorithms were trained to classify emotions. The analysis evaluated separate contributions of ERP features, as well as explored the combined effects.

Results: The GB classifier demonstrated the highest accuracy almost for all analyses. Within the MDD group, the P200 component was the most discriminative among ERP components, with the highest accuracy of 88.89% in classifying negative versus neutral stimuli. When combining all ERP components together as the feature set, the classifier achieved the highest accuracy of 85% in classifying positive versus neutral stimuli. The same set of features was extracted for the HC group and used to feed the classifiers; however, the accuracy rates were not as high as those observed in the MDD group.

Conclusion: The finding of the study showed that the GB classifier had the highest performance in terms of accuracy in distinguishing emotions. The findings may provide valuable insights for the development of reliable diagnostic and treatment monitoring strategies for emotional processing in MDD.

Keywords: Classification, EEG, emotion recognition, machine learning, major depressive disorder

OP-13

Determination of electrophysiological biomarkers to diagnose depression from alpha band using machine learning methods

Farhad Nassehi[1], Aykut Eken[1], Asuhan Par[2], Sinan Yetkin[2], Osman Eroğul[1]

[1]Department of Biomedical Engineering, TOBB University of Economics and Technolog, Ankara, Türkiye; [2]Department of Psychiatry Clinic, University of Health Sciences, Ankara, Türkiye

Objective: Depression, a prevalent psychiatric disorder, affects millions worldwide according to the World Health Organization. Currently, depression diagnosis relies on clinical questionnaires interpreted by experts. Neurophysiological imaging techniques, like electroencephalography (EEG), are increasingly used for diagnosing and studying depression. This study aims to identify neurophysiological biomarkers for depression diagnosis using Alpha band spectral features in resting-state EEG signals.

Methods: This study included 22 diagnosed depression patients and 25 age-gender matched healthy individuals. During a 5–minute resting EEG session with eyes closed, EEG signals were recorded from 19 electrodes based on the 10–20 system. Simultaneously, Electrooculography (EOG) signals detected eye movements and removed their influence through regression analysis. Using a signal-slicing approach, data augmentation resulted in 132 epochs from patients and 150 epochs from the control group. EEG signals were bandpass filtered in the 0.5–64 Hz range and cleaned from eye movement artifacts using EOG signals and regression analysis. Power Spectral Density (PSD) was calculated using the Welch method, generating 76 features in the 8–13 Hz Alpha band, such as mean, total power, maximum, and relative alpha power. The obtained features were used as input for K-Nearest Neighbors (KNN), Support Vector Machines (SVM), AdaBoost, and Multilayer Perceptron (MLP) classifiers.

Results: AdaBoost showed the highest performance with 95% Area Under the Curve (AUC) and 87.25% accuracy. Using the ReliefF feature selection method, 28 relevant features were selected. When provided as input, AdaBoost achieved the best performance with 96% AUC and 90.41% accuracy. The selected 28 features primarily consisted of mean and total power values from different electrodes, consistent with findings from existing statistical studies.

Conclusion: These results suggest that the Alpha band's spectral mean and total power can serve as neurophysiological biomarkers for depression diagnosis.

Keywords: Depression, electroencephalography, machine learning, alpha band, feature selection

OP-14

Functional connectivity alterations associated with cognitive and motor impairment in Parkinson's disease

Ani Kıçik[1], Ali Bayram[2], Elif Kurt[2], Emel Erdoğdu[3], Esin Öztürk Işık[4], Hakan Gürvit[5], Tamer Demiralp[6]

[1]Department of Physiology, Faculty of Medicine, Demiroğlu Bilim University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [3]Department of Psychology, Faculty of Arts and Sciences, Işık University, Istanbul, Türkiye; [4]Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye; [5]Behavioral Neurology and Movement Disorders Unit, Department of Neurology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [6]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Parkinson's disease (PD) has a heterogeneous cognitive profile and its pathophysiology has not been completely clarified. In this study, functional connectivity (FC) changes were investigated in PD patients and in PD subgroups classified

according to cognitive and motor performance, using resting state functional magnetic resonance imaging (rs-fMRI) data.

Methods: 55 PD patients diagnosed with PD according to the UK Brain Bank Diagnostic Criteria and 24 healthy controls (CH) matched for age, education and gender were enrolled in the study. Resting state fMRI data were collected using a 3T MR imaging device (Phillips, Achieva, The Netherlands) at Istanbul Medical Faculty. PD subgroups were generated using a clustering algorithm according to the scores of UPDRS-III, Stroop and Benton judgment of line orientation tests. Seed-based FC analysis was performed using the AAL3 atlas covering 112 seeds and CONN toolbox. Network-Based Statistics (NBS) method was used in the FC analysis to compare HC with the PD and with the PD sub-groups.

Results: As a result of FC analysis, there was a significant decrease in FC between the somatomotor network (SMN) and visual regions in PD patients compared to the SC group ($p<0.05$, FWE-corrected). In the comparisons of PD subgroups and HC, PD patients with worse motor performance showed reduced FC in the SMN ($p<0.05$, FWE-adjusted); PD patients with worse visuospatial performance showed FC alterations at visual-SMN cortical connections in a subnetwork covering large visual regions ($p<0.05$, FWE-corrected).

Conclusion: In our study, a significant decrease in FC was detected between SMN and visual regions in PD. These FC alterations indicate impaired visual-motor integration in PD. Moreover, our results also showed that besides the motor impairment in PD, the visuospatial impairment observed in PD causes increased visual-SMN disconnection. This study supported by TUBITAK #115S219.

Keywords: Parkinson's disease, functional connectivity, seed-based analysis, cognitive impairment

OP-15

A recurrent cortical model accounts for neural and behavioral effects of expectation on perceptual processes

Buse Merve Ürgen[1], Hilal İrem Baştürk[2], Hüseyin Boyacı[3]

[1]Department of Psychology, TED University, Ankara, Türkiye; Aysel Sabuncu Brain Research Center & National Magnetic Resonance Research Center, Ankara, Türkiye; [2]Interdisciplinary Neuroscience Program, Bilkent University, Ankara, Türkiye; Aysel Sabuncu Brain Research Center & National Magnetic Resonance Research Center, Ankara, Türkiye; [3]Department of Psychology and Interdisciplinary Neuroscience Program, Bilkent University, Ankara, Türkiye; Department of Psychology, Justus Liebig University, Giessen, Germany; Aysel Sabuncu Brain Research Center & National Magnetic Resonance Research Center, Ankara, Türkiye

Objective: Expectations can strongly influence perceptual processes, with unexpected stimuli being detected slower than expected ones. However, the neural mechanisms underlying these behavioral effects remain controversial with some neuroimaging studies implicating facilitatory, others suppressive influences. In this regard, predictive processing models can offer a currently underutilized framework.

Methods: We implemented a three-layered recurrent cortical model (Heeger, 2017) and modeled our previous human data (n= 8, Ürgen & Boyacı, 2021) to investigate the computational mechanisms underlying the behavioral effects of expectation. Using three previous fMRI studies (1: Egner et al. 2010; 2: Kok et al. 2011; 3: Aitken et al. 2020), we also tested whether model predictions match neural evidence. We simulated efMRI experiments with our optimized parameters and obtained BOLD responses with GLM. Results were analyzed with 2 (trial type: expected, unexpected) X 2 (expectation validity: 75, 50) repeated-measures ANOVAs and post-hoc t-tests.

Results: Model-fitting results revealed a main effect of expectation ($F(1,7)=18.511$, $p=0.004$) with significantly higher iteration numbers for unexpected trials ($t(7)=3.220$, $p=0.015$). Thus, when actual input differs from expectations, the sensory process requires prolonged computations. Simulated BOLD responses also mostly paralleled empirical data. Consistent with studies on V1 (studies 2 & 3), our model predicted expectation facilitation in lower layers ($F(1,7)=5.811$, $p=0.047$; $F(1,7)=6.019$, $p=0.044$). On higher-order layers, our model predicted marginally significant expectation facilitation for both stimuli (houses and faces) ($F(1,7)=4.973$, $p=0.061$) and overall higher responses to the preferred stimulus type (e.g. FFA: faces). Empirical data on FFA (study 1) corroborates these except showing a trend toward expectation suppression with face stimuli.

Conclusion: Overall, our findings demonstrate that a parsimonious recurrent cortical model can explain both behavioral and neural effects of expectation on sensory processes.

Keywords: Computational modeling, cortical model, expectation, prediction, predictive processing, visual perception

Session 4

(OP-16—OP-20)

7 September 2023, 16.30–18.00

NÖROM Conference Hall

OP-16

Decreased delta and theta responses during emotional stimuli in underground miners: an event-related oscillation study

Samet Çelik[1], Ebru Yıldırım[2], Bahar Güntekin[3]

[1]Department of Experimental Psychology, Bartın University, Bartın, Türkiye; [2]Program of Electroneurophysiology, Vocational School, Istanbul, Istanbul Medipol University, Türkiye; [3]Department of Biophysics, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: Studies show deterioration in emotion regulation skills regarding behavioral and mental disorders in underground mine workers. For this reason, in this study, the change in the electrophysiological responses of miners to emotional stimuli was examined by the event-related oscillations method.

Methods: The study sample consisted of 19 underground workers and a matched aboveground control group ($p>0.05$). Neutral, negative, and positive pictures taken from the International Affective Picture System (IAPS) were shown to the participants, while EEG recordings were made from 20 channels. Within the scope of this study, event-related power spectrum and phase locking analyzes were performed in delta (0.5–3.5Hz) and theta (4–7Hz; 50–400ms and 400–800ms) frequency bands.

Results: According to the statistical analysis, In the first time window, the group main effect was statistically significant for theta phase locking and power spectrum ($p<0.05$). In the second time window, the group main effect is significant for the theta power spectrum but not for phase locking ($p>0.05$). In delta responses, a significant difference was found for negative stimuli in the power spectrum; In the phase-locking analysis, the main group effect was significant ($p<0.05$). Considering the correlation of event-related responses with underground working duration, a statistically negative significant correlation was found between the theta power spectrum and the working duration ($r=-0.54–-0.75$; $p<0.05$). In all of the findings found to be significant, the miners' values were found to be lower.

Conclusion: Studies with healthy samples emphasize the importance of prolonged theta and delta responses in emotion processing. In addition, it is known that there is deterioration in theta and delta responses to affective stimuli in different psychiatric and neurological disorders. In this study, it was observed that miners could not occur an electrophysiological response to emotional stimuli like healthy ones.

Keywords: EEG, emotion, worker health, social cognition, event-related oscillations, underground workers

O-P17

Classification of right extremities with artificial neural networks using motor imagery EEG

Mustafa Yazıcı[1], Mustafa Ulutaş[1], Mukadder Okuyan[2]

[1]Department of Computer Engineering, Faculty of Engineering, Karadeniz Technical University, Trabzon, Türkiye; [2]Department of Physiology, Faculty of Medicine, Karadeniz Technical University, Trabzon, Türkiye

Objective: Brain-Computer Interface (BCI) is a technology that enables a computer or other external device to be controlled by signals received from the human brain. The signals obtained with EEG recording in right hand and right foot motor imagery are classified. The signals are first filtered in the mu band, converted to the source level, and then it was aimed to obtain the highest accuracy values in the motor imagination of the right hand and right foot.

Methods: BCI Competition dataset with EEG data from 5 subjects is used in the study. The signals are first filtered in the mu band. Then, it is projected to Brodmann areas with the sLORETA method with Brainstorm software. Common Spatial Pattern (CSP) features are extracted on the source signals obtained and Artificial Neural Networks (ANN) is used in classification. A single hidden layer and 10 nodes are used. The method parameters are chosen empirically.

Results: Both lobes of S1F, S1H, CMA, SMA, pSMA, PMd, PMv regions, M1H_L and M1F_L (the most significant regions) are included in each combination. Accuracy values are obtained for the five subjects, in order, by dividing the number of correct predictions of the test data by all test data. Accuracy values of 69.64%, 100%, 66.73%, 88.57% and 91.90%, respectively, are obtained for the five subjects.

Conclusion: For individuals who have brain damage or who cannot perform motor movement for a different reason, the classification of motor imagination EEG signals and the understanding of one's thoughts will increase the quality of life of individuals. In this study, classification is calculated with the signals obtained after EEG neuroimaging. It is thought that the difference between the accuracy values among individuals, the difference in the number of training, tests and the focus of the subjects on the experiment are effective.

Keywords: EEG, brain computer interface, motor imagery, neuroimaging

OP-18

Does atipamezole switch off the state transitions of sleep and absence status-like activities?

Melis Yavuz[1], Filiz Onat[2]

[1]Department of Pharmacology, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [2]Department of Medical Pharmacology, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Dexmedetomidine induces a two-phase of events: an initial period of absence status-like activity followed by sleep, then an immediate switch from sleep to the second period of absence status-like events (Yavuz et al, 2022). We aim to explore the effects of the de-activation of 2AR by atipamezole on these state transitions induced by dexmedetomidine in Genetic Absence Epilepsy Rats from Strasbourg (GAERS).

Methods: Specific α2AR agonist, dexmedetomidine (2.5 μg), was administered via intracerebroventricular injection to adult GAERS (n=8) to induce absence status-like events. When the

initial absence status-like events were triggered, atipamezole (1 mg/kg) was injected intraperitoneally. Electroencephalography (EEG) recordings were obtained 30 min before the initial administration of dexmedetomidine and 2 hours after atipamezole. The duration of SWDs and prolonged SWDs; we defined as absence status-like activities and the anesthesia sleep between were analyzed.

Results: Following dexmedetomidine injection in adult GAERS, initial absence status-like activity with duration of 128±13.74 min that abruptly converts to a sleep-anesthesia was triggered. When the 31.43±2.53 long sleep anesthesia was over, it abruptly switched to prolonged chain of SWDs in 100% of the animals. Atipamezole suppressed the prolonged seizure activities for 120 min and no activity above 1 min has been observed in the EEGs ($p<0.01$). SWDs with a duration of 10–16 sec still occurred with atipamezole. The mean duration at the 140th min of SWDs with atipamezole (15.2±3.8; n=4) was similar to the control groups of naïve GAERS: (14.2±1.8; n=4), which SWDs are expressed spontaneously.

Conclusion: Activation of α2AR triggered a switch mechanism between prolonged SWDs, anesthesia sleep, and subsequent return to SWDs, but atipamezole recovered sleep activity as expected as well as absence status by removing two phase of events. This finding provides evidence that α2AR receptor targets may be the switch mechanism between the sleep and SWDs.

Keywords: Spike-and-wave discharges, sleep, alpha 2 adrenergic receptor, dexmedetomidine, atipamezole

OP-19

Hemispheric synchronization patterns associated with shooting performance in archers

Hasan Batuhan Dirik, Hayri Ertan

Department of Movement and Training Sciences, Faculty of Sport Sciences, Eskişehir Technical University, Eskişehir, Türkiye

Objective: Sustainable attention, effective visual-spatial perception, and motor control skills are crucial for achieving exceptional athletic performance. The identification of neural markers involved in success has provided significant contributions to athletes and practitioners in the field by supporting performance improvement and generating new ideas. The study aimed to investigate hemispheric synchronization patterns in the brain's electrical activity during successful and unsuccessful shots using EEG.

Methods: Sixteen elite archers participated, performing 36 shots each. Successful shots were closest to the target center, while unsuccessful shots were farthest. Transformed EEG data using surface Laplacian filtering were divided into five sub-bands (theta, alpha1, alpha2, beta1, beta2) based on alpha peak frequencies. Phase Locking Value (PLV) was used to calculate synchronization values of electrode pairs for successful and unsuccessful shots. A linear mixed model compared EEG data across frequency bands. Fatigue levels were assessed using the Visual Analog Scale (VAS), and Pearson correlation analyzed the relationship between fatigue and shooting performance.

Results: Statistical analysis revealed significant bilateral hemispheric synchronization in the occipital and frontal regions for successful shots ($p<0.001$–0.05). Unilateral synchronization was observed in the left central-occipital and right central-temporal regions ($p<0.001$–0.05). Unsuccessful shots showed bilateral synchronization in the central and temporal regions ($p<0.001$–0.05), with asymmetrical differences. There was no significant correlation between fatigue levels and shooting performance ($r=-0.043$, $p>0.05$).

Conclusion: These findings demonstrate distinctive synchronization patterns associated with shooting performance. Successful shots exhibit increased cortical synchronization during visual-motor tasks. These results have the potential to serve as a theoretical reference for enhancing athletes' performance.

Keywords: Electroencephalograph, focusing, archery, synchronization

OP-20

Electrophysiological results of lexical semantic processing in patients with primary progressive aphasia

Seren Düzenli Öztürk[1], Duygu Hünerli[2], Yağmur Özbek İşbitiren[2], Didem Öz[3], Özge Yılmaz Küsbeci[4], Görev G. Yener[5]

[1]Department of Speech and Language Therapy, Faculty of Health Sciences, Izmir Bakırçay University, Izmir, Türkiye; Neuroscience and Cognitive Research Application and Research Center, Izmir Bakırçay University, Izmir, Türkiye; [2]Department of Neurosciences, Institute of Health Sciences, Dokuz Eylül University, Izmir, Türkiye; [3]Department of Neurology, Faculty of Medicine, Dokuz Eylül University, Izmir, Türkiye; Global Brain Health Institute, University of California, San Francisco, CA, USA; Brain Dynamics Multidisciplinary Research Center, Dokuz Eylül University, Izmir, Türkiye; [4]Department of Neurology, Faculty of Medicine, Izmir University of Economics, Izmir, Türkiye; [5]Faculty of Medicine, Izmir University of Economics, Izmir, Türkiye; Izmir Biomedicine and Genome Center, Izmir, Türkiye; Brain Dynamics Multidisciplinary Research Center, Dokuz Eylül University, Izmir, Türkiye

Objective: Primary Progressive Aphasia (PPA) is a type of dementia based on language and speech disorder characterized primarily and gradually by selective degeneration of left perisylvian language network. The current study aims to investigate N400 event-related potential (ERP) of patients with Primary Progressive Aphasia (PPA) in comparison with healthy elderly controls.

Methods: Fifteen PPA patients (11 males, 4 females; age mean for group=63, SD=7.48) and 11 healthy controls (8 males, 3

females; age mean for group= 64.09, SD=9.32) were included in the study. Cognitive functions of all participants were evaluated with a detailed battery of neuropsychological tests. EEG data were collected with the semantic priming and lexical decision paradigm. Repeated measures ANOVA included Group [2 levels: PPA patients, healthy controls] as a between-subject factor, and Condition [2 levels: related, unrelated word pairs] as a within-subject factor. Since semantic priming effect was evident under the central electrodes for Turkish, the analyses focused on the central region electrodes.

Results: A repeated-measures ANOVA revealed a significant interaction effect of GROUP X CONDITION in a time window of 350 ms and 500 ms [$F(1,24)=7.670$, $p=0.011$, $\eta p^2=0.242$]. Post hoc analysis showed that mean N400 amplitudes were higher for semantically unrelated targets compared to semantically related ones in healthy controls ($p=0.017$). No significant difference was obtained for mean N400 amplitudes between unrelated and related words in PPA patients ($p=0.233$).

Conclusion: The N400 ERP component is seen as being related to a reflection of lexical-semantic retrieval. These results indicate that degeneration of language networks in PPA is associated with altered patterns of N400 ERP. Such a marker could prove to be advantageous for dissecting semantic memory dysfunctions in PPA patients. This work has been supported by İzmir Bakırçay University Scientific Research Projects Coordination Unit, under grant number KBP.2021.009

Keywords: Primary progressive aphasia, lexical-semantic processing, N400, event related potentials, EEG

Oral Presentations
German-Turkish Symposium Session
(OP-21—OP-25)

9 September 2023, 14.00–15.30

Mimar Kemaleddin Hall

OP-21

Time perception and stress interaction on different stress-response levels

Gözde Vatansever[1], Sertaç Üstün[2], Filiz Çetinkaya[1], Güvem Gümüş Akay[3], Metehan Çiçek[4]

[1]Department of Interdisciplinary Neuroscience, Institute of Health Sciences, Ankara University, Ankara, Türkiye; [2]Department of Physiology, School of Medicine, Ankara University, Ankara, Türkiye; [3]Brain Research Center, Ankara University, Ankara, Türkiye; [4]Neuroscience and Neurotechnology Center of Excellence (NÖROM), Ankara, Türkiye

Objective: Negative emotions affect our perception of time. It was shown that we tend to perceive durations longer than it actually is if there is a stimulus that elicits negative emotions. This study aims to illuminate how stress distorts our perception of time and which neural pathways are involved.

Methods: Healthy, right-handed volunteers (n=22, 8 female, age=24±3.34y) were scanned in the MRI while performing a time reproduction task and a space reproduction task as a control condition. Session included two stressful and two not- stressful runs. Participants were given negative feedback during the stressful runs. Cortisol samples were collected at 5 different time points throughout the session. Participants were divided into two groups as high and low-stressed by the median of the cortisol increase rate. Images were analyzed via SPM12 on MATLAB. A 2 (high-/low-stressed groups) by 2 (time/space task) x 2 (stressed/not-stressed runs) ANOVA was conducted. Significance level was $p<0.005$.

Results: Three-way interaction results (group-task-stress) were significant in the left orbitofrontal cortex ($F=16.80$, $p<0.001$) and left insula ($F=15.01$, $p<0.001$). Left dorsolateral prefrontal cortex ($F=19.99$, $p<0.001$), left medial temporal gyrus ($F=18.69$, $p<0.001$), left supplementary motor area (SMA) ($F=17.26$, $p<0.001$), and left inferior parietal cortex ($F=16.70$, $p<0.001$) was significant for the stress-task interaction. Left-SMA was also found significant for the group-task interaction ($F=16.22$, $p<0.001$).

Conclusion: The three-way interaction findings of the study (insula and orbitofrontal cortex), are consistently activated in both time perception and stress tasks. SMA is known as one of the crucial regions for time perception and it was activated with a frontoparietal network in the stress-task and group-task interaction. It was suggested that the frontoparietal cortex is responsible for higher cognitive processes related to time perception. Based on these findings, it can be argued that the stress-time interaction of these regions is differentiating between high and low-stressed individuals.

Keywords: fMRI, stress, time reproduction

OP-23

The neurogenetic basis of the dual-route theory of reading: evidence from developmental dyslexia

Sema Acar Ünalgan[1], Lars Meyer[2], Claudia Männel[2], Ben Maassen[3]

[1]Department of Language and Speech Therapy, Izmir Bakırçay University, Izmir, Türkiye; Neuroscience and Neurotechnology Center of Excellence (NÖROM), Ankara, Türkiye; [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [3]Center for Language and Cognition, University of Groningen, Groningen, Holland

Objective: This study aims to enhance the understanding of neurobiological link between the genetic underpinnings and neuroanatomy of developmental dyslexia (DD) by integrating a molecular genetic approach and diffusion-tensor imaging. We particularly aimed to investigate the neurogenetics of the dual-route theory of reading, based on the evidence from DD.

Methods: The previously proposed neuroanatomical counterparts of the dorsal sublexical and ventral lexical routes, the arcuate/superior longitudinal fasciculus (AF/SLF) and inferior frontal occipital fasciculus (IFOF), respectively, were bilaterally delineated in 16 typical readers and 16 readers with DD. The study was conducted at the Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany. In order to investigate the genetic underpinnings, the correlations of the median fractional anisotropy (FA) along the AF/SLF and IFOF with dyslexia- associated genetic risk alleles were examined. In order to investigate the neuroanatomical counterparts of the sublexical and lexical reading routes, behavioral phenotypes including sublexical and lexical processing were correlated with the median FA values of the AF/SLF and IFOF.

Results: The overall findings partially corroborate the dual-route theory of reading: Although no evidence for the neuroanatomical counterpart and genetic association of the ventral lexical route was found, the lateralization index of the AF/SLF showed a significant correlation with the sublexical cluster scores and the median FA values of the left AF/SLF displayed a trend. This may indirectly support the conclusion that the AF/SLF serves as the neuroanatomical counterpart of the dorsal sublexical route. Furthermore, we observed a significant correlation between the genetic risk allele DCDC2-rs71745442 and the median FA values of the left AF/SLF, suggesting that the DCDC2 gene might specifically express in the neuroanatomical correlate of the dorsal sublexical route.

Conclusion: The findings provide evidence on the neurogenetic basis of the dorsal sublexical route. However, given the small sample size, generalizability of the findings require further evidence.

Keywords: DCDC2-rs71745442, diffusion-tensor imaging, fractional anisotropy, molecular genetic approach, neurogenetic of developmental dyslexia, the arcuate/superior longitudinal fasciculus

OP-24

Motor imagery of linked movements enhances motor adaptation

Magdalena Gippert

Otto Hahn Group Cognitive Neurogenetics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Objective: Most movements in daily life do not occur in isolation but are embedded within a sequence. Linked movements like this have been shown to influence the execution of prior and following motor actions and can even facilitate adaptation during reaches through opposing force-fields. We investigated whether the facilitative effect of linked movements could also be achieved with kinesthetic motor imagery of prior movements. Additionally, we aimed to identify neuronal correlates of motor imagery predicting such motor learning.

Methods: Movement kinematics (exoskeleton robot, Kinarm Lab) and EEG (64 electrodes) of 60 participants were recorded to investigate direction-specific adaptation during a reach of the right arm in an interference force-field paradigm. We compared performance of three experimental groups: 1) no prior movement (visual static cue) 2) active prior movement, 3) motor imagined prior movement.

Results: In line with previous research, we showed that active prior movements facilitate adaptation to opposing force-fields, while visual static cues do not. Moreover, we found that motor imagery of prior movements can induce motor adaptation as well. In addition, our initial results indicate that post-imagery synchronization of alpha and beta oscillations can serve as an indicator of successful motor adaptation.

Conclusion: Altogether our results go beyond a simple demonstration that motor imagery resembles performance of an actual movement in the brain. We show that the neuronal processes, underlying motor imagery of parts of a motor sequence, can be related to motor adaptation. This suggests that imagining a linked movement can be used to enhance motor performance of real movements.

Keywords: EEG, movement kinematics, motor imagery

OP-25

Frequency-varying modular organization in resting-state fMRI

Hüden Neşe[1], Ahmet Ademoğlu[1], Tamer Demiralp[2]

[1]Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye; [2]Hulusi Behçet Life Sciences Laboratory, Istanbul University, Istanbul, Türkiye

Objective: Examining within and between-network interactions of intrinsic connectivity networks (ICNs) is a powerful approach to understanding the mechanism behind integrative and segregative processes in the brain. With the emergence of time-varying functional connectivity analysis, many studies focused on identifying the spatiotemporal structure of ICNs. However, comparatively less effort has been devoted to investigating network dynamics in the frequency domain. In this study, we aimed to examine the frequency-selective changes in the organization of resting-state functional connectivity networks.

Methods: We used resting-state fMRI data of 96 participants from the HCP dataset. First, we computed the phase-based connectivity matrix for each frequency band and applied modularity analysis. Then we identified flexible brain regions that simulta-

neously participate in different modules via different frequency bands. Then, we calculated two graph metrics (participation coefficient and within module degree z-score) for each brain region. Finally, we compared flexible and inflexible regions in terms of correlations between their graph metrics and subjects' behavioral data.

Results: We showed three main modules consistent over frequency bands; one dominated by visual network, one dominated by somatomotor network, and a cognitive module. Attention networks were distributed to these three main modules. Our results indicated that most of the flexible parcels, which we called integrative regions, belonged to attention networks, especially the salience ventral attention network. Using a permutation-based test, we showed that integrative regions showed higher correlations between their graph metrics and subjects' behavior than inflexible regions.

Conclusion: These results emphasized the integrative role of attention networks. More importantly, these findings revealed that examining functional connectivity changes in the frequency domain is a promising approach to understanding the interactions among ICNs using multiband frequency analysis.

Keywords: Flexibility, frequency domain, functional connectivity, modularity, phase-based connectivity, resting state fMRI

Poster Presentations

(PP-01 — PP-42)

1st National Neuroimaging Congress
Poster Session 1
(PP-01—PP-29)
8 September 2023, 13:00–14:30
Poster Area

PP-01

The effect of stress levels on emotion regulation and emotion recognition from the perspective of polyvagal theory

Beyza Aytekin[1], Fatma Akın[1], Evrim Gülbetekin[1], Hatice Gül[2], Ece Varlık Özsoy[1]

[1]Department of Psychology, Akdeniz University, Antalya, Türkiye; [2]Department of Therapy and Rehabilitation, Physiotherapy Program, Akdeniz University, Antalya, Türkiye

Objective: The polyvagal theory gives a new perspective to the mammalian autonomic nervous system, has drawn a different approach to improve social behavior by providing a biological explanation for behavioral responses. The theory suggests that functional social behavior correlates with the ability to regulate vagal tone. The contribution of this study will be to investigate whether vagus tone can be increased by tactile stimulation without the need for any electrical vagus stimulating device like tVNS.

Methods: Within the scope of the study, 18 participants were randomly assigned to the control and experimental groups. In the pretest, the participants were asked to answer the RMET test and after an average of 2 hours, the participants were recalled to the laboratory for the posttest phase of the experiment. In the control condition of the posttest, the participants' stress was increased by the motor noise, and during this sound, tactile stimulation was applied to their shoulders as a placebo, and they were asked to solve the RMET test again immediately afterwards. In the experimental condition, tactile stimulation was applied to 4 muscle groups by the expert physiotherapist in a way to stimulate the vagus nerve of the participants with the same sound given in the control condition, at the end of the procedure, the participants solved the RMET test again. In both conditions, EMG data were collected from the participants' sternocleidomastoideus muscle during the auditory stimulus and touch procedure.

Results: ANOVA was used for repeated measures to compare both within-group and between-groups for RMET score results and EMG data. There was no significant result in terms of RMET scores and EMG data between the experimental and control conditions.

Conclusion: No effect of tactile vagus nerve stimulation on emotion recognition ability and electrical activity of muscle movements was observed.

Keywords: Emotion recognition, muscle activity, polyvagal theory, RMET, self-regulation

PP-02

Examination of experts and novices brain activity during aesthetic evaluation of abstract and representational paintings

Miray Peker[1], Erol Yıldırım[2]

[1]Institute of Health Sciences and Technology Research (SABITA) – fiNCAN Laboratory, Istanbul Medipol University, Istanbul, Türkiye; [2]Institute of Health Sciences and Technology Research (SABITA) – fiNCAN Laboratory, Istanbul Medipol University, Istanbul, Türkiye; Department of Psychology, Faculty of Humanities and Social Sciences, Istanbul, Türkiye

Objective: Neuroaesthetics is a field that examines the aesthetic evaluation of objects and the neural basis of artistic creativity. In this study, it was aimed to compare the event-related brain oscillations and hemodynamic changes in the brain of experts and novices during the aesthetic evaluation of abstract and representational paintings.

Methods: 33 healthy and volunteer individuals aged 20–35 were included in the study. The experimental group consists of 16 participants who are professionally interested in painting (expert), and the control group consists of 17 participants and people who are not interested in painting (novice). In the experiment, 40 images (representational and abstract) were presented in 2 different categories, and while the images were evaluated in terms of aesthetics, EEG recordings from 29 channels and fNIRS recordings from 18 channels were taken simultaneously. Delta and theta responses related to the recorded event during the evaluation were analyzed by Wavelet power spectrum analysis and hemodynamic responses were analyzed by block analysis method.

Results: Significant differences were found between hemispheres, groups and locations in EEG findings. It was observed that delta and theta oscillations gave a stronger response in experts and anterior-frontal, frontal, fronto-parietal and occip-

ital regions were more active than other regions. In addition, while the delta band is dominant in the left hemisphere, theta rhythm is prominent in the right hemisphere. In fNIRS findings, it was understood that premotor and primary motor areas play an important role in aesthetic evaluation and oxyhemoglobin concentration is higher in representational paintings.

Conclusion: In line with the findings obtained, it was thought that specialization in the field of painting and the type of painting may affect the electrophysiological power, oxyhemoglobin concentration and the number of activated regions during the visual aesthetic evaluation. This research was supported by TUBITAK (222S630).

Keywords: Abstract/representational, aesthetic evaluation, art expertise, EEG, fNIRS

PP-03

The effects of motor imagery and action observation-based plyometric training on muscle architecture and jump performance of adolescent soccer players

Murat Emirzeoğlu[1], Özlem Ülger[2]

[1]Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Karadeniz Technical University, Trabzon, Türkiye; [2]Faculty of Physical Therapy and Rehabilitation, Hacettepe University, Ankara, Türkiye

Objective: Lower limb muscle-tendon injuries are the most common injuries in adolescent soccer players. The primary aim of this study was to examine the effects of motor imagery and action observation-based (MI+AO) plyometric training (PT) on the pennation angle (PA), muscle thickness (MT) and fiber length (FL) of the vastus lateralis (VL) and biceps femoris long head (BFlh). The secondary aim was to evaluate the effects of training on single leg jump performance.

Methods: Thirty-six healthy adolescent soccer players (age: 13.91±1.05 years, height:162.22±10.20 cm, weight: 52.09±8.33 kg) were randomly assigned to PT (n=17) or control (n=19) groups. Athletes in both groups continued their routine training programs. PT group also participated in 3 sessions of training per week for 8 weeks. Athletes watched the prepared videos and imagined jumping. Muscle images were taken using the ultrasound probe. Outcomes were assessed at baseline, 4, 8, and 12 weeks.

Results: There was no significant change in the muscle architecture parameters in the control group during 8 weeks ($p>0.05$). The dominant (mean difference=2.40±3.45°, $p=0.01$) and non-dominant side (mean difference=3.32±3.75°, $p=0.01$) VL PA was higher in the PT group at week 4 compared the baseline. Similarly, there was a significant increase in dominant side VL MT (mean difference=0.15±0.19 cm, $p=0.03$), non-dominant side VL MT (mean difference=0.24±0.23 cm, $p=0.01$), and dominant side BFlh MT (mean difference= 0.21±0.31 cm, $p=0.03$). Both sides jump performance was significantly better in the PT group at weeks 4 and 8 compared to baseline (mean difference=16.71±11.76 to 22.88±12.19 cm, $p<0.01$). In time x group interactions, non-dominant side VL PA ($p=0.03$) and MT ($p<0.01$), dominant side BFlh MT ($p=0.04$), and both side jump performance ($p<0.01$) were higher in the PT group.

Conclusion: This research provides the first evidence that MI+AO PT improves muscle architecture. It is recommended that future research be conducted in injured athletes and using neuroimaging tools.

Keywords: Athletic performance, motor imagery, neuroscience, ultrasonography

PP-04

Migraine duration has an effect on brain oxygenation in dominant and non-dominant pain hemispheres: a preliminary fNIRS study

Nilüfer Zengin[1], Vesile Öztürk[2], Çağdaş Güdücü[3]

[1]Department of Biophysics, Health Science Institute, Dokuz Eylül University, Izmir, Türkiye; [2]Department of Neurology, Faculty of Medicine, Dokuz Eylül University, Izmir, Türkiye; [3]Department of Biophysic, Faculty of Medicine, Dokuz Eylül University, Izmir, Türkiye; Department of Sleep and Conscious States, Health Sciences Institute, Izmir, Türkiye

Objective: It is known that recurrent and long-lasting migraine attacks results in the structural and functional changes in the brain. The aim of this paper is to investigate the relationship between clinical features of migraine (attack frequency, pain intensity and disease duration) and prefrontal hemodynamics in interictal episodic migraine patients.

Methods: Victoria Stroop test was used to evaluate frontal executive functions. The prefrontal oxy-hemoglobin (HbO), deoxy-hemoglobin (HbR) and total hemoglobin (HbT) activities at the baseline and during Stroop interference effect were measured by Functional Near-Infrared Spectroscopy (fNIRS). Eight migraine patients with aura (mean age 25.75±1.55 years) and 12 migraine patients without aura (mean age 28.25±1.90 years) participated in the study.

Results: Migraine patients reported their dominant and non-dominant pain hemipheres where their migraine headaches have been frequently experienced: five of them have faced headache in the left side, 6 patients have observed right-sided migraine headache and 9 patients have suffered from bilateral pain. The results showed that there was a positive correlation ($r=0.90$, $p=0.034$) between disease duration and right HbO

activity whereas a negative correlation (r=-.95, p=0.013) was found between disease duration and left HbR activity during Stroop interference effect in migraine patients whom dominant pain side was left hemisphere. However, there was no significant correlation between attack frequency and pain intensity and both left and right HbO, HbR and HbT activities at the baseline and during Stroop interference in those patients. Moreover, in migraine patients whom dominant pain side was right hemisphere, no significant correlation was found between migraine clinics and both left and right HbO, HbR and HbT activities at baseline and during the Stroop effect.

Conclusion: To conclude, this is the first fNIRS study that demonstrated differences in brain oxygenation even in episodic migraineurs depending on disease duration. In the future, more participants will be included in the study.

Keywords: Migraine, disease duration, stroop interference, frontal oxygenation, functional near-Infrared spectroscopy

PP-05

Evaluation of the mirror neuron system activation in a stroke patient

İrem Eşme[1], Bülent Cengiz[2], Murat Zinnuroğlu[3], Zafer Günendi[3], Ali Emre Turgut[1], Kutluk Bilge Arıkan[4]

[1]Department of Mechanical Engineering, Middle East Technical University, Ankara, Türkiye; [2]Department of Clinical Neurophysiology, Faculty of Medicine,Gazi University, Ankara, Türkiye; [3]Department of Physical Therapy and Rehabilitation, Faculty of Medicine, Gazi University, Ankara, Türkiye; [4]Department of Mechanical Engineering, TED University, Ankara, Türkiye

Objective: This study investigates Mirror Neuron System (MNS) activation in stroke patients using EEG data during motor learning stages after a stroke. The study tests the hypothesis that as motor learning progresses and the patient actively engages, the involvement of motor circuits may increase through MNS activation.

Methods: A stroke patient participated in two sessions over one week. In Session 1, the patient passively watched hand movements involving squeezing a soft and hard spring, while in Session 2, the patient replicated the movements with the assistance of a hand rehabilitation robot. EEG data were collected on the 1st, 4th, and 7th days for each session. To analyze MNS activation, power suppression in the mu and beta frequency bands was examined at electrode locations C3, C4, P3, P4, F7, and F8, which are believed to reflect MNS activation. The data were preprocessed using EEGLAB and MATLAB R2022a. Differences in mu and beta band power between days and electrodes were statistically analyzed using the Wilcoxon signed-rank test.

Results: In the first session, a significant increase in MNS suppression was observed in the mu band between the 1st and 7th days at electrode locations P3, F7, and F8 ($p<0.05$). Similarly, significant beta band suppression was found at electrode locations C3, P3, and F7 ($p<0.05$). In the second session, significant mu band activation suppression was observed in electrode locations other than P3 electrode ($p<0.05$). In the beta activation, significant suppression was found at electrode locations C4, P3, and F7 ($p<0.05$).

Conclusion: The study demonstrates increased MNS activation during active motor learning in a stroke patient. Understanding the relationship between active motor training, motor learning, and MNS may facilitate the development and optimization of personalized rehabilitation programs for stroke patients. Investigating the relationship between MNS and neuroplasticity could contribute to the development of recovery approaches.

Keywords: MNS activation, motor rehabilitation, robotic rehabilitation, EEG

PP-06

Predictive processing in the cortical network of biological motion perception

Murat Batu Tunca[1], Burcu Ayşen Ürgen[2]

[1]Interdisciplinary Program of Neuroscience, Bilkent University, Ankara, Türkiye; [2]Interdisciplinary Program of Neuroscience, Bilkent University, Ankara, Türkiye; Department of Psychology, Bilkent University, Ankara, Türkiye; Aysel Sabuncu Brain Research and National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye

Objective: Although it is known that the cortical network supporting biological motion perception includes the pSTS (posterior superior temporal sulcus), PPC (posterior parietal cortex), and IFC (inferior frontal gyrus) regions, how it is affected by expectations has not been explained yet. Existing models of biological motion perception are based solely on feedforward processing, conflicting with predictive processing models.

Methods: In the present fMRI study, participants (n=21) observed point-light biological motion displays representing the same movement on both sides of the screen. These displays, covered with noise dots, represent either a kicking or walking motion. However, one of the displays is a scrambled version of the movement. Participants' task is to determine on which side of the screen the original movement (unscrambled version) is. Before the displays, participants are given a clue about the movement (a picture of walking or kicking). Participants are aware that this clue is highly likely (75% probability, congruent condition) to predict the correct action but could also be wrong with a low probability (25% probability, incongruent condition). The experiment also includes two more conditions, one where the clue contains no information

about the movement (neutral condition) and the other where no movement is observed after the clue.

Results: MVPA analysis on the fMRI data does not show a difference between congruent and incongruent conditions. However, it is observed that the left occipital gyrus can distinguish neutral conditions from congruent conditions, and the IFG can distinguish neutral conditions from incongruent conditions. Additionally, the conducted DCM modeling indicates that incongruent conditions play a role in feedback mechanisms between pSTS-PPC and IFG-PPC, while neutral and congruent conditions do not have a role in these mechanisms.

Conclusion: Considering these findings, the current study demonstrates that created predictions and expectations are factors influencing biological motion perception. Therefore, it is evident that biological motion perception is not merely a process involving feedforward networks. The inconsistency of the presented biological motion with prior information (where bottom-up information does not align with top-down information) leads to the involvement of feedback mechanisms.

Keywords: Biological motion, prediction, visual processing

PP-07

EEG examination of cortical reactions of cognitive flexibility and eating disorder symptoms to rewarding and aversive stimuli

Zeynep Suiçmez

Department of Clinical Psychology, Cyprus International University, Hasolat, Nicosisa, TRNC

Objective: This study aims to interpret the tendency towards approach and avoidance behavior by examining left and right alpha activations in the frontal region of the brain within the scope of eating disorder (ED) symptoms and to examine the relationship between cognitive flexibility levels and eating disorder symptoms. Frontal Alpha Asymmetry (FAA) is thought to have a predictive effect on the symptoms of ED. It was aimed to compare the performances of the participants in the task of evaluating food stimuli and to examine the neurobiological dimension of eating disorder within the scope of frontal alpha asymmetry, which indicates approach-avoidance motivation.

Methods: Food images in 20 calorie categories (low calorie-high calorie) and 20 freshness categories (fresh rotten) were presented to the participants. The relationship between Cognitive Flexibility (CF) and ED was examined with the self-report scale. The sample of the study consists of a non-clinical community sample consisting of 80 participants (42 women, 38 men) aged 18–40 living in the TRNC. The research design is the within-subject design, which is one of the experimental designs, and the participants were determined by convenient sampling method. In the analysis of the data, "EEGLAB", "MATLAB" and "SPSS" programs were used.

Results: As a result, it was found that the symptoms of eating disorders and cognitive flexibility levels did not differ within the scope of sociodemographic variables. A significant difference was found between the responses to food in the freshness and calorie categories. No significant relationship was found between CF and ED. It was found that the Fp1-Fp2 asymmetry value had a predictive effect on the eating disorder total score and the restriction sub-dimension.

Conclusion: It was observed that all of the FAA values were positive and therefore alpha power was low in left frontal activation, indicating that there may be a tendency to approach stimuli.

Keywords: Feeding and eating disorders, cognitive flexibility, approach and avoidance motivation, frontal alpha asymmetry, rewarding and aversive stimuli, EEG

PP-08

Exploring the relationship between working memory performance and oscillatory activity in resting EEG of healthy adults: a preliminary study

Hazal Artuvan Korkmaz[1], Rumeysa Gülşah Özer[2], Büşra Baş[3], Yakup Yılmaz[4], Melek Elcircevi[5]

[1]Department of Physiology, Faculty of Medicine, Ankara University, Ankara, Türkiye; [2]Department of Language and Speech Therapy, Faculty of Health Sciences, Anadolu University, Eskişehir, Türkiye; [3]Department of Psychology, Faculty of Science, Middle East Tecnical University, Ankara, Türkiye; [4]Department of Psychology, Faculty of Languages and History-Geography, Ankara University, Ankara, Türkiye; [5]Department of Psychology, Faculty of Literature, Hacettepe University, Ankara, Türkiye

Objective: Working memory (WM) involves the temporary storage of information and recalling it during mental processes. The Verbal Fluency Test includes information storage and retrieval that reflects WM. There are few studies in the foreign literature and no studies in Turkish combining resting-state EEG with WM tests in healthy individuals. This preliminary study aimed to examine the relationship between WM performance and dominant frequencies in the resting-state EEG.

Methods: 12 healthy volunteers (7 females, mean age=21.66, SD=1.83) participating in the study were divided into upper and lower groups according to WM performance. Resting-state EEG was recorded for 5 minutes over 32 channels according to the 10x20 electrode system. Spectral power analysis has been performed with Fast Fourier Transform and the average power in the Alpha (7–13Hz), Beta (13–30Hz), Delta (1–3.5Hz), and Theta (3.5–7Hz) bands were elicited. Repeated-measure ANOVA has been performed and 4 frequencies*2 sites(frontal/posterior)*2 hemispheres (right/left) were within-

group factors, and WM performance (good/bad) was the between-group factor.

Results: Frequency main effect (F=9.166 p<0.05), frequency*hemisphere*group (F=5.28 p<0.05), and site*hemisphere*group (F=11.76 p<0.01) interaction effects were significant. Post-hoc tests showed that the group difference was only in the left frontal site (p<0.05).

Conclusion: WM is a function relating to activation in the prefrontal cortex, and studies have reported reduced power in various frequency bands in cases such as attention deficit and dyslexia, which affects WM. In this preliminary study, although the limitations like small sample size, a group difference was found lateralized to the left hemisphere. This was not related to a certain frequency. Findings showing that the lower group has lower mean power values than the upper group were similar to studies that reported weak left hemisphere alpha oscillation during the semantic task.

Keywords: Alpha power, working memory, resting-state EEG, verbal fluency

PP-09

Neurophysiological investigation of inhibitory processes involved in forward masking

Afife Türker[1], H. Hulusi Kafalıgönül[2]

[1]Interdisciplinary Neuroscience Program, Aysel Sabuncu Brain Research Center, Bilkent University, Ankara, Türkiye; [2]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye

Objective: Forward masking is a commonly used paradigm to investigate the temporal dynamics of visual processing. The neural correlates of this paradigm, however, are not fully understood. In particular, there is no study to our knowledge that systematically investigated the associated ERP components.

Methods: We designed two experiments using the paracontrast masking paradigm. In both experiments, EEG (Electroencephalography) activity was recorded while the participants performed a contour discrimination task. In addition to the mask-to-target onset timing (SOA), the mask-to-target (M/T) contrast ratio was manipulated in the first experiment, and the contrast polarity (same and opposite polarities) of the mask was manipulated in the second experiment.

Results: Behavioral results showed that the perceived visibility was dependent on SOA, and the mask caused strong brief-inhibition on target visibility at short SOA values. The brief-inhibition was also found to be significantly modulated by the M/T contrast ratio and polarity. The EEG analyses revealed SOA-dependent non-linear interactions between the target and mask in the P1, N1, and late components. Moreover, the M/T contrast ratio significantly modulated the interactions in the N1 component range.

Conclusion: In summary, this study points to the neurophysiological correlates of forward masking and particularly provides important insights into the ERP components associated with brief inhibition. The findings also contribute to our understanding of cortical dynamics underlying perceived visibility. This work was supported by The Scientific and Technological Research Council of Türkiye (TUBITAK Project Number. 119K368).

Keywords: Cortex, EEG, perception, temporal dynamics, visual masking

PP-10

Loss of small-worldness in psychiatric patients

Ata Akın

Department of Biomedical Engineering, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: One of the most frequently used analysis methods in brain research is functional connectivity and then analysis with graph theory metrics. The aim of this study is to identify a potential biomarker from the brain hemodynamics measured with fNIRS that can be utilized in the field of neuropsychiatry.

Methods: During the Stroop experiment, functional connectivity matrices were constructed prior to data obtained from 60 subjects (13 healthy, 21 obsessive-compulsive, and 26 schizophrenia patients) with fNIRS. Then these matrices were cleaned by PCA. Global efficiency values were calculated according to different threshold values from the remaining matrices. As a result of statistical comparisons of these values, the number of PCA components and threshold values that give the best global efficiency values were found.

Results: Global efficiency values were 0.5604±0.0285 for healthy subjects, 0.5909±0.0412 for OCD patients, and 0.6122±0.0361 for schizophrenia patients (p=0.000475). When the healthy and the patients are divided into two groups, the sensitivity of the biomarker discrimination obtained by this method from fNIRS is 63%. The specificity was 92.3%, AROC 79%, and accuracy 70%, while these values were calculated as 100%, 89.4%, 97.1%, and 91.7% when multiplied by the behavioral data of the patients (Accuracy/Response Time), respectively.

Conclusion: The results showed that psychiatric cases require more brain regions to be engaged to try to perform like the healthy ones. In this case, the global efficiency values obtained from the sick brains showed that they approached the efficiency of a random network of the same size and moved away from the small world feature.

Keywords: fNIRS, global efficiency, small world property, psychiatric patients

PP-11

Investigating empathy in neural responses of individuals with major depressive disorder during listening to negative musical stimuli

Başak Kurtişoğlu, Yunus Emre Balcı, Filiz Yönyüksel

Master's Program in Cognitive Sciences, Yeditepe University, Istanbul, Türkiye

Objective: Music is a highly rewarding stimulus for humans. Yet, Major Depressive Disorder (MDD) causes decreased activation in the reward system such as prefrontal, anterior cingulate and insular cortices which makes music less rewarding as much as any other enjoyable activity. Empathy is the ability to infer relatable affective meanings from other individuals. However, studies suggest that individuals with MDD show great activation in empathy related areas during listening music such as ventromedial prefrontal (vmPFC), medial orbitofrontal (mOFC), dorsolateral prefrontal (DLPFC), anterior cingulate cortices (ACC) and left anterior insula (left AI). Thereby, the aim of the study is to investigate whether MDD group shows activation in empathy-related areas while listening to negative musical stimuli compared to Never Depressed (ND) group.

Methods: MDD group showed significantly greater correlation in left AI than ND group to negative musical stimuli ($p<.05$). No significant results found in vmPFC, mOFC, DLPFC, ACC.

Conclusion: Given the fact that left AI is associated with empathy, the ability to infer relatable affective meanings, the ambiguity in music creates a large space for MDD group for relatable interpretation. The reason there were no significant results found in vmPFC, mOFC, DLPFC, ACC might be due to the negative effects of MDD on these regions. It is important to note that this is a plot study for understanding the relation between music and empathy.

Keywords: Empathy, major depressive disorder, music-evoked emotions

PP-13

The impact of top-down attention on action perception: an fMRI study

Aslı Eroğlu[1], Burcu Ayşen Ürgen[2]

[1]Interdisciplinary Neuroscience Program, Bilkent University, Ankara, Türkiye; Aysel Sabuncu Brain Research Center and National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye; [2]Interdisciplinary Neuroscience Program, Bilkent University, Ankara, Türkiye; Aysel Sabuncu Brain Research Center and National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye; Department of Psychology, Bilkent University, Ankara, Türkiye

Objective: Understanding others' behaviors through dynamic visual cues is essential in daily life. Action perception recruits the Action Observation Network (AON), comprising the parietal, premotor, and posterior superior temporal sulcus (pSTS). However, existing research often neglects crucial top-down influences like attention and primarily focuses on passive viewing.

Methods: To address this research gap, we conducted an fMRI study with 27 healthy volunteers. The experiment consisted of two sessions which are active and passive sessions. In the active session, participants were presented eight action videos featuring various actors, effectors, and targets, all centered on pushing action. The given tasks directed participants' attention to different aspects of the videos. The passive session involved viewing the videos without any tasks. From the passive session, we extracted pSTS, parietal, and premotor brain regions, the primary regions of interest (ROIs) for the fMRI data analysis. The active session data were examined using model-based representational similarity analysis (RSA). Implemented models included a task model, three feature models (actor, effector, and target), and a low-level visual model.

Results: Results showed significant correlations between neural patterns in each ROI and the task model. However, the low-level visual model and feature models did not show significant correlations with activation patterns in any ROIs. These findings emphasize the critical role of top-down signals in computational modeling research and highlight the substantial influence of top-down attention throughout the action observation network (AON).

Conclusion: In conclusion, our study emphasizes the vital importance of considering top-down influences in researching the neural underpinnings of visual action processing. By shedding light on the profound impact of top-down attention, our findings offer essential insights for comprehending the intricate mechanisms of action perception.

Keywords: Action perception, attention, fMRI, representational similarity analysis, task

PP-14

Neuroimaging incubation period in creative process

Yaprak Deniz Yurt[1], Naz A.G.Z. Börekçi[2], Tolga Esat Özkurt[3]

[1]Department of Industrial Design, Atılım University, Ankara, Türkiye; [2]Department of Industrial Design, Middle East Technical University, Ankara, Türkiye; [3]Medical Informatics, Informatics Institute, Middle East Technical University, Ankara, Türkiye

Objective: A break in the product design process after discovering the problem domain can increase the creativity of the ideas (Sio and Ormerod, 2009). This period, called incubation, is also seen as a stimulus for alternative ideas and a mechanism to overcome the fixation (Kirjavainen and Höltta, 2020).

However, unlike other modulators of the creative process, the incubation period seems effective in producing more creative results, but studies in the design context are lacking. This study examines the cognitive mechanisms underlying an incubation period without stimulus influence and how it differs from a normal resting period.

Methods: Adopting concurrent mixed methods, this study is based on three main data sources: Signal data recorded with electroencephalography (EEG); two questionnaires measuring the creative motivation of the participants; and sketches, which are design solutions produced by the participants with a drawing tablet. The mechanisms underlying the incubation period that is given in the middle of the design process are investigated by monitoring the participants' brain activity, who are expected to produce solutions through sketches to two design problems presented to them in a digital flow. The incubation condition is followed by the control condition, which involves a continuous design process. Twenty participants from third and fourth year students of METU Industrial Design Department were invited to participate in the study with exclusion criteria of being right-handed and not having a neurological illness. The experiments were conducted at the METU Informatics Institute Neurosignaling Laboratory.

Results: The findings include a discussion of the methodological structure of the study within the framework of design research and cognitive neuroscience as part of an ongoing doctoral dissertation.

Conclusion: The data collected in the study is framed with the aim of answering the question of the relationship between the incubation period and cognitive functions and its impact on design creativity.

Keywords: Incubation period, design creativity, cognitive neuroscience, electroensephalography, double diamond design model

PP-15

Perception of built environments and its neural modulation by the behavioral goals of the perceiver

Aysu Nur Koç[1], Burcu Ayşen Ürgen[2], Yasemin Afacan[3]

[1]Interdisciplinary Neuroscience Program, İhsan Doğramacı Bilkent University, Ankara, Türkiye; National Magnetic Resonance Research Center (UMRAM) and Aysel Sabuncu Brain Research Center, Ankara, Türkiye; [2]Interdisciplinary Neuroscience Program, İhsan Doğramacı Bilkent University, Ankara, Türkiye; National Magnetic Resonance Research Center (UMRAM) and Aysel Sabuncu Brain Research Center, Ankara, Türkiye; Department of Psychology, İhsan Doğramacı Bilkent University, Ankara, Türkiye; [3]Interdisciplinary Neuroscience Program, İhsan Doğramacı Bilkent University, Ankara, Türkiye; Department of Interior Architecture and Environmental Design, İhsan Doğramacı Bilkent University, Ankara, Türkiye

Objective: This study examines the neural activity patterns to scenes from built environment categories and their modulation by behavioral tasks, addressing several gaps in the literature with an interdisciplinary approach. We study the often-overlooked built environments where we spend most of our time, use a principled categorization method from the architecture literature, employ multiple behavioral tasks, and apply various analysis techniques.

Methods: FMRI data were collected from 23 participants (12 females) as they viewed scenes and performed two tasks. Scene categories were architectural elements and functional facilities common to all public environments. Architectural elements consisted of areas that allow us to access (entrances-exits) and circulate within (stairs, corridors, etc.) buildings. Functional facilities consisted of places that serve human needs (restrooms, eating, and seating areas). Behavioral tasks consisted of a categorization task where participants decided which of the two main categories the presented stimulus belongs, and an approach-avoidance task which aims to measure initial processing regarding a scene with subjective enter-or-not decisions. Further, we conducted a localizer session to define scene-selective regions of interest (ROIs): parahippocampal place area (PPA), retrosplenial cortex (RSC), and occipital place area (OPA).

Results: Univariate whole-brain analyses did not reveal significant differences between the tasks. Searchlight-based MVPA revealed that not tasks but categories are decoded at the whole-brain level at the lingual and parahippocampal gyri, the supplementary motor area, and the occipital cortex. Further, we performed a model-based representational similarity analysis (RSA) to examine neural modulations in the scene-selective regions. Comparing task, category, and visual similarity models to neural activity patterns in these regions, RSA demonstrated that scene-selective regions were strongly correlated with the task model only.

Conclusion: Results indicate that neural responses to built environments are modulated by scene category at the whole-brain level and task at the ROI level.

Keywords: fMRI, neuroarchitecture, scene perception

PP-16

Alteration of brain's functional connectivity during a working memory task

Elif Kurt[1], Ali Bayram[1], Tamer Demiralp[2]

[1]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [2]Hulusi Behçet Life Sciences Research Laboratory, Neuroimaging Unit, Istanbul University, Istanbul, Türkiye; Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Working memory (WM) is an important cognitive function and represents the capacity of individuals to temporarily hold, process and use information. In this study, it is aimed to examine the functional connectivity changes in the brain during a WM task by using the functional magnetic resonance imaging (fMRI) method and to contribute to the research of the functions of the intrinsic connectivity networks (ICNs).

Methods: 28 healthy volunteers participated in the study. fMRI data were recorded during the simple-reaction-time task (SRTT) and N-back task using 3T-MRI-scanner. While participants responded to all letters by pressing the button during SRTT; in 1-back, 2-back, and 3-back conditions of the N-back task, they pressed only when the letters were the same as one, two, and three previous ones. ICNs were obtained by independent component analysis. The regression of the ICN time-series with experimental conditions was evaluated with general linear model, and differences of the obtained t-values between experimental conditions were compared using repeated-measures ANOVA in SPSS.

Results: Twelve ICNs showed significant differences between task conditions ($p<0.003$). Default-mode (DMN), limbic (LN), dorsal attention (DAN), and basal ganglia (BG) networks showed significant difference between both SRTT and 1-back, and 1-back and 2-back conditions. The frontoparietal (FPN), lateral-visual (VN), and lateral-somatomotor (SMN) networks showed significant difference between 1-back and 2-back, and the ventral attention network (VAN) showed significant difference between SRTT and 1-back conditions ($p<0.003$).

Conclusion: DMN, LN, DAN, and BG progressively changed their intrinsic connectivities with progressively increasing memory load, which indicates that these networks may have central roles in WM function. While FPN, lateral VN, and SMN were not affected by low-level memory load, they changed their intrinsic connectivities when the memory load increased. The VAN changed its connectivity only at low-level memory load and didn't exhibit extra modulation as the memory load increased.

Keywords: Working memory, N-back memory task, functional magnetic resonance imaging, functional connectivity, intrinsic connectivity networks, independent component analysis

PP-17

The occipital place area contributes to object recognition utilizing spatial context information

Ulaş Ay[1], Tamer Demiralp[2]

[1]Hulusi Behçet Life Sciences Research Laboratory, Neuroimaging Unit, Istanbul University, Istanbul, Türkiye; Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [2]Hulusi Behçet Life Sciences Research Laboratory, Neuroimaging Unit, Istanbul University, Istanbul, Türkiye; Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: This study aimed to investigate the functions of object- and scene-selective cortices in the effects of spatial context on object recognition and object information on spatial context recognition.

Methods: Functional magnetic resonance imaging (fMRI) data were collected from 11 healthy participants using a localizer task and encoding and recall tasks involving two different experimental conditions. In the first of the experimental conditions, the participants were tasked with coding the context-related but degraded objects in intact scenes using contextual information; in the second condition, they performed the task of encoding the context using intact objects shown in a degraded context. In the recall stage, the participants were asked to both intact recalls the degraded objects in intact contexts and recall the contexts in which the objects they saw intact in the degraded context were present. Event-related fMRI data were analyzed with SPM12 software. Object- and scene-selective cortices were identified by analysis of the localizer task, and activations in these regions were investigated in experimental conditions.

Results: In recalling the intact forms of degraded objects presented in an intact spatial context, it was observed that the decreased activation of the parahippocampal place area (PPA) and medial place area (MPA), however, preserved the activation of the OPA. Interestingly, both object-selective cortices (lateral occipital cortex and posterior fusiform sulcus) were activated in the task of recalling the context with the help of intact objects presented in the degraded spatial context.

Conclusion: Recalling scenes encoded by object information requires activation not only of scene-selective cortices but also of object-selective cortices. On the other hand, only the OPA contributes to the intact recognition of degraded objects encoded with spatial context information. This study was supported by TUBITAK (Project No: 122S654).

Keywords: Scene perception, spatial context, object recognition, occipital place area

PP-19

Designing a visual recognition test for an experiment involving functional magnetic resonance imaging (fMRI) on patients with Alzheimer's disease

Sabiha Tezcan Aydemir, Burcu Ayşen Ürgen

Bilkent Aysel Sabuncuoğlu Brain Research Center, Ankara, Türkiye

Objective: Using visual memory tests in the screening of Alzheimer's disease patients (ADP) is crucial. Additionally, previous literature demonstrates that when the objects in visual memory tests are unexpected, patients' performance was similar with healthy individuals. Also, it is underlined that

decreased prediction error in this group is what causes memory problems according to predictive coding. In this preliminary study, we aim to develop a visual memory test that could be applied to fMRI research on ADP and comprises images illustrating both expected and unexpected action-place relationships. The main study's basis is that unexpected items will be remembered by ADP similarly to their healthy peers in a memory test.

Methods: Before drawings, we asked participants via online survey to state five actions with expected and unexpected places. Totally, 72 scenes were drawn using the data collected from 336 participants, in which 36 actions occurred in one expected and one unexpected place. A current online survey was designed after the drawings were finished to make sure that the scenes were perceived as intended. In this survey, participants were asked to identify the places and actions depicted in the illustrations, as well as their opinion of how probable it was that the action would occur in depicted places.

Results: 172 participants completed the online evaluation survey. The participants had higher education, and the mean age was 36.8 ± 11.5. Consequently, the two groups of items were seperated appereantly according to their performance probability in those places. Also, 9 products were chosen for redesign due to ambiguous perception.

Conculusion: Upon the validity-reliability phase is completed, this test with two groups of items will provide novel data in understanding the memory issues of ADP, considering the predictive coding. The reliability and interpretation of the data will be better by using this task in fMRI.

Keywords: Alzheimer's disease, visual recognition test, predictive coding, functional manyetic resonance imaging

PP-20

The effect of exercise and circadian rhythm on working memory in young adulthood

Kübra Altuntaş[1], Zehra Ülgen[2]

[1]Department of Psychology, Izmir University of Economics, Izmir, Türikye; [2]Department of Biophysics, Dokuz Eylül University, Izmir, Türkiye

Objective: Working memory (WM) is a central structure with limited storage contains maintaining, updating, and manipulating to process of information. Research shows individual, and age-related differences, and also exercise affect WM performance. In addition, circadian rhythm (CR) includes physical, biochemical, and behavioral cycles in daily routine. It can affect WM in a positive or negative way depending on how regular or irregular it is. In this research, we defined the individual's chronotype in order to find out the optimal time intervals of participants to examine the effect of exercise on WM performance in young adulthood.

Methods: All schedules (3 weeks skipping rope, 2 weeks pre and post measurements once a week) were planned based upon participants' CR (11 Neither Type; 6 Evening Type). N-Back Paradigm was applied for 5 weeks in total. A four-way mixed ANOVA was conducted to investigate the effects of chronotype (Evening Type, Neither Type) and time (base, first exercise, second exercise, third exercise, post) on participants' reaction time (RT) and accuracy rate (AR) depending on N-back conditions (0 back, 1 back, 2 back) in terms of the type of stimuli (Target, Non-target).

Results: The results showed that there was a significant interaction effect between time-N-back conditions $F(2.43, 33.96) = 12.63$, $p<.001$; and time-stimuli $F(4, 56) = 4.29$, $p<.01$ on participants' RT. Also there was a significant interaction effect between time-N-back conditions $F(8, 120) = 9.051$, $p<.001$ and stimuli-N-back condition $F(2, 30) = 8{,}105$, $p<.01$ on AR.

Conclusion: As a result of exercises performed at a person's optimal time, participant's RT and AR were different for evening and neither type. When participant's RT were decreased, AR were increased by the time. According to our results, we obtained in regular exercise enhance WM performance, when CR synchrony effect was taken into account.

Keywords: Working memory, exercise, circadian rhythm, younger adulthood

PP-21

Detection of Alzheimer's stages with transfer learning and vision transformer approach

Nergis Pervan Akman, Melike Çolak, Ali Berkol, Yahya Ekici

BITES Defense, Ankara, Türkiye

Objective: This study aims to detect the different stages of Alzheimer's disease through MRI images using transfer learning and vision transformers.

Methods: In the study, the OASIS dataset obtained for Alzheimer's research has been used. The dataset includes brain slice images of subjects aged between 18 and 96, and each subject has been subjected to 3 or 4 MRI scans in a single session. 100 subjects over the age of 60 have been added to the dataset as Alzheimer's patients. All subjects are right-handed and include individuals of both genders. Comprising the brain MR images of a total of 600 people, including healthy individuals as well as those in the very early, early, and middle stages of Alzheimer's disease, this dataset has been chosen due to its inclusion of subjects from various age, gender, and disease stage groups. In the study, 11 slices between numbers 125 and

136, which are the most voluminous and contain the hippocampus region, have been selected from the images consisting of 256 horizontal slices of the brain. The pre-trained vision transformer layer splits the image into patches, and each patch is embedded into a lower or different dimension using linear projection. Subsequently, the transformer encoder encodes the data in a more complex manner and transfers it to the multilayer perceptron layer. After this stage, the first layer added to the model, Linear, helps the model capture learnable linear relationships within the data and performs dimension adjustment. A RELU activation function has been added, and overfitting is intended to be prevented with a Dropout layer. This structure repeats twice, and the final addition of the softmax function provides the output for the Alzheimer's stage.

Results: After training the model for 12 epochs, an accuracy value of 98.33% was achieved. This result indicates that vision transformers with transfer learning are an effective method for Alzheimer's detection. The reason for the middle stage being the most misclassified class in this matrix is due to the fewer number of images in the mid-stage.

Conclusion: In this study, we achieved an accuracy score of 98.33%. The model flawlessly predicts the very early and early-stage classes, while it is prone to confuse the mid-stage and healthy classes with the early-stage. The fact that all predictions of the mid-stage are erroneous may be due to the lack of data for this class in the training set. In addition, the only incorrect prediction from 172 healthy individuals could be due to similarities in the person's MRI images between slices 125 and 136 to the early-stage. The number of mispredictions can be reduced by increasing the number of slices in future studies. This study was supported by BİTES Defense and Aerospace.

Keywords: Transfer learning, vision transformers, Alzheimer's disease, MRI images

PP-22

The effect of cathodal transcranial direct current stimulation on mood and sleepiness in patients with drug-resistant focal epilepsy

İrem Gezginci[1], Murat Aydemir[2], Aytaç Güzel[1], Mahmut Taha Özulucan[1], Candan Gürses[3], Sacit Karamürsel[2], Ezgi Tuna Erdoğan[2]

[1]Graduate School of Health Sciences, Koç University, Istanbul, Türkiye; [2]Department of Physiology, School of Medicine, Koç University Istanbul, Türkiye; [3]Department of Neurology, School of Medicine, Koç University, Istanbul, Türkiye

Objective: Epilepsy is a neurological disorder characterized by recurrent seizures. Transcranial direct current stimulation (tDCS) is a neuromodulation method used in research to suppress epileptic seizures. The aim of this research is to investigate the effects of cathodal tDCS on cognitive functions, mood and sleepiness in patients with drug-resistant epilepsy. The preliminary findings of our research are presented below.

Methods: Our research is a randomized double-blind parallel controlled clinical trial. 10 patients with drug-resistant focal epilepsy participated in the research (7 in active and 3 in sham group). Cathodal tDCS was applied for 30 minutes at 2 mA, over the seizure focus, for five consecutive days while the anode being on the contralateral deltoid muscle. In the sham stimulation, tDCS with the same electrode montage, ceased at the end of 1st minute. Patients completed The Depression Anxiety Stress-21 and Epworth Sleepiness Scales before the first tDCS and one week after the last tDCS. Changes in all test scores were evaluated between the active and sham groups using repeated measures ANOVA. Baseline scores between groups were compared with the independent sample t-test.

Results: There was a decrease in the mean scores of anxiety, stress and sleepiness at the end of the 1st week after the tDCS in both groups. However, the conducted statistical analyses did not show a significant difference between these two groups.

Conclusion: The decrease in the averages of anxiety, stress, and sleepiness scores at the end of first week in both groups can be interpreted as a change independent of active current application. Since the patient recruitment is still ongoing, more reliable results may be obtained with higher number of participants. Our findings did not demonstrate a modulatory effect of tDCS on depression, anxiety, stress and sleepiness in epilepsy patients yet.

Keywords: Transcranial direct current stimulation, neuromodulation, drug-resistant focal epilepsy

PP-23

The effect of cathodal transcranial direct current stimulation on seizure frequency in patients with drug-resistant focal epilepsy

Murat Aydemir[1], İrem Gezginci[2], Aytaç Güzel[2], Mahmut Taha Özulucan[2], Candan Gürses[3], Sacit Karamürsel[1], Ezgi Tuna Erdoğan[1]

[1]Department of Physiology, School of Medicine, Koç University, Istanbul, Türkiye; [2]Graduate School of Health Sciences, Koç University, Istanbul, Türkiye; [3]Department of Neurology, School of Medicine, Koç University, Istanbul, Türkiye

Objective: Epilepsy is a neurological disease affecting more than 50 million people worldwide. Antiepileptic drugs are the first-line treatment for epilepsy. However, seizures persist in approximately one third of patients despite appropriate treatment and patient compliance. Transcranial direct current stimulation (tDCS) is a neuromodulation method that can be used in research to suppress epileptic seizures. In this study, we

aimed to investigate the effect of cathodal tDCS on seizure frequency in patients with drug-resistant focal epilepsy. The preliminary findings of our study are presented below.

Methods: Our study is a randomized, double-blind, parallel-controlled clinical trial. We enrolled 10 adult patients with drug-resistant epilepsy (7active/3sham). Cathodal tDCS was applied at a current of 2mA for 30 minutes for 5 consecutive days on the epileptic focus location determined by EEG, MRI, and clinical correlation. The anode electrode was placed on the contralateral deltoid muscle. Patients or their caregivers were asked to keep a seizure diary for one month before and 3 months after tDCS application. In this presentation, we evaluated the results for the first month. Baseline seizure frequencies between the active and sham groups were compared using an independent sample t-test. Then, the data of the patients who completed the first month were evaluated using a repeated measures analysis of variance test.

Results: In the statistical analyses, there was no difference between the groups in baseline seizure frequencies. For both the active group (n=7) and the sham group (n=3), there were no significant differences in seizure frequencies before and one month after the tDCS.

Conclusion: Patient recruitment and monthly seizure follow-up are ongoing. More reliable results will be obtained as the number of patients in the groups increases. Since the number of patients in the groups is low, it is predicted that the statistical results we obtained supposed to change as the study continues.

Keywords: Transcranial direct current stimulation, drug resistant focal epilepsy, neuromodulation

PP-26

Effects of levodopa use on brain volumes and cognitive functions in Parkinson's disease

Rumeysa Dikici[1], Dilara Nemutlu Samur[2], Burak Yuluğ[3], Ramazan Karaca[3], Tahir Fatih Dikici[4], Seda Avnioğlu[1]

[1]Department of Anatomy Faculty of Medicine, Alanya Alaaddin Keykubat University, Antalya, Türkiye; [2]Department of Medical Pharmacology, Faculty of Medicine, Alanya Alaaddin Keykubat University, Antalya, Türkiye; [3]Department of Neurology, Faculty of Medicine, Alanya Alaaddin Keykubat University, Antalya, Türkiye; [4]Department of Therapy and Rehabilitation Vocational School of Health Services, Alanya Alaaddin Keykubat University, Antalya, Türkiye

Objective: Although levodopa is the gold standard agent used in the symptomatic treatment of Parkinson's disease (PD), it is discussed that it may adversely affect cognitive performance. In this study, it was aimed to examine the effects of levodopa use on the volumes of critical brain regions affected by Parkinson's disease and cognitive function.

Methods: The study group was formed retrospectively from Magnetic Resonance Imaging (MRI) data of PD patients who applied to Alanya Alaaddin Keykubat University Training and Research Hospital Neurology Clinic. PH patients with cognitive dysfunction were divided into two groups those using levodopa (n=13) and those not using levodopa (n=11). Healthy individuals without any neurological findings constituted the control group (n=12). Volumes of total gray matter (TGM), accumbens, amygdala, nucleus caudatus, hippocampus, pallidum, putamen, thalamus, and medial frontal cortex were analyzed with VolBrain. Results were correlated with the MMT and MOCA clinical scales.

Results: While no correlation was found between the duration of PH and the volumes of brain regions, a significant correlation was found between the ages of the participants and the volumes of TGM, accumbens, amygdala, hippocampus, and thalamus ($p<0.05$). When the intergroup differences of these regions were analyzed with ANCOVA by fixing the age criterion, hippocampus volume was found to be significantly smaller in PD patients using levodopa compared to the control group ($p=0.024$). Thalamus volume was significantly smaller in PD patients using and not using levodopa compared to the control group ($p<0.05$).

Conclusion: The positive correlation between cognitive function tests and the medial frontal cortex, amygdala, and hippocampus regions strengthens the hypothesis that these regions are affected in PD patients with cognitive dysfunction. It also shows that levodopa treatment is associated with changes in hippocampus and thalamus volumes and may have an effect on cognitive performance.

Keywords: Amygdala, cognitive dysfunction, hippocampus, levodopa, thalamus

PP-27

Calculation of hippocampus volume using volbrain (HIPS) in guitar players and non-players

Cansu Kibar, Hatice Yenigül, Özge Coşkun, Hassan Bagheri, Niyazi Acer

Department of Anatomy, Istanbul Arel University, Istanbul, Türkiye

Objective: The hippocampus is an anatomical structure located in the central nervous system as a part of the limbic system. Functionally, it has an important role in memory, direction finding and learning. There have been many neuroimaging studies examining the effects of music on the human brain. This study aims to compare total and segmental hippocampal volumes of guitar players and non-players on magnetic resonance (MR) images.

Methods: 10 people who played the guitar and 10 people who did not play the guitar (control group) were included in our study. High-resolution T1-weighted 3D Magnetization Prepared Rapid Gradient Echo (MPRAGE) images of people of similar age range were used for the volumetric analysis of the hippocampus and its subfields. Data analyzes were performed using 'Volbrain (v1.0, https://volbrain.upv.es)-HIPpocampus subfield Segmentation (HIPS)', a free online system that performs hippocampal automatic segmentation. The results were obtained as the ratio of the hippocampus and its subfields to the whole brain, along with the volumes.

Results: There was no statistically significant difference between the volume values of the hippocampus and its subfields in the guitar playing and non-playing groups ($p>0.05$). However, the ratio of total hippocampus volume to whole brain, the ratio of total volume of CA1 to whole brain, and the ratio of total volume of CA2-CA3 to whole brain were found to be minimally higher in the guitar playing group than in the non-playing group.

Conclusion: Although there was no statistically significant difference between the groups in our study, which was conducted with a mean age of 22 and a total of 20 people, we think that studies conducted in a larger population will give more precise results.

Keywords: Hippocampus, VolBrain, music, MRI

PP-28

Comparison of cerebellar volumes in professional musicians and non-musicians using magnetic resonance imaging

Özge Coşkun, Hassan Bagheri, Cansu Kibar, Hatice Yenigül, Niyazi Acer

Department of Anatomy, Faculty of Medicine, Istanbul Arel University, Istanbul, Türkiye

Objective: The cerebellum is a part of the brain that plays a role in motor coordination, sensitivity and fine motor skills. Playing the guitar requires complex finger movements, precise hand-eye coordination and manual dexterity. The aim of this study is to investigate the changes in cerebellum and cerebellar lobule volumes between professional guitarists and non-guitarists.

Methods: MR images of 10 guitarists and 10 non-guitarists (control group) were used in the study. High-resolution T1-weighted 3D Magnetization Prepared Rapid Gradient Echo (MPRAGE) images of individuals of similar age range were used for volumetric analysis of the cerebellum and its lobules. Data analysis was performed using "Volbrain (v1.0, https://volbrain.upv.es)-CERES (CEREbellum Segmentation)", a free online system that performs automatic segmentation. Results were obtained as the ratio of cerebellum and lobule volumes to total brain volume. Additionally, right and left asymmetry values were obtained and compared between groups using student t-test.

Results: The mean cerebellar volume of the guitarists were found to be an average of 144.81±12.89 cm^3; while those of the non-guitarists were 147.73±15.50 cm^3. There was no statistically significant difference between the musician and the control group, both cerebellum and its lobule volumes ($p>0.05$). However, there was a statistically significant difference in Lobule V Asymmetry, Lobule V Gray Matter Asymmetry and Cerebellum Cortical Thickness Asymmetry values between the musician and control groups ($p<0.05$).

Conclusion: According to our results, "Lobule V Asymmetry, Lobule V Gray Matter Asymmetry and Cerebellum Cortical Thickness Asymmetry" volume measurements of guitarists were found to be more asymmetric in right side than in left side in cerebellum.

Keywords: Cerebellum, VolBrain, CERES, MRI

PP-29

Nucleus accumbens, substantia innominata and hypothalamus relationship: correct localisation for deep brain stimulation

Burcu Arslan[1], Serhat Baydın[2]

[1]Term 4, Faculty of Medicine, Ondokuz Mayıs University, Samsun, Türkiye; [2]Department of Neurosurgery, Faculty of Medicine, Ondokuz Mayıs University, Samsun, Türkiye

Objective: The nucleus accumbens (NA) is known to be an important center in some psychiatric disorders such as drug-resistant depression and obsessivecompulsive disorder (OCD), anxiety and addictive behaviors. Therefore, it is the most important target for deep brain stimulation (DBS) in the treatment of these disorders. NA is in close relationship with substantia innominata, hypothalamus and nucleus caudatus. In our study, we tried to reveal the anatomical relations of these anatomical structures with each other.

Methods: Ten human cadaveric brains (20 hemispheres) were used in our study. All specimens underwent white matter dissection using the modified Klingler technique under a surgical microscope.

Results: The NA is located inferior to the head of the nucleus caudatus and extends medially. The substantia innominata is located lateral to the NA and it is impossible to separate these two structures under a microscope. However, the anterior leg of the anterior commissure is a very good landmark for the separation of these two structures. The hypothalamus is located

posterior to the NA and is completely cellularly different from the NA. The line drawn inferiorly from the most anterior point of the body of the anterior commissure medial to the hemisphere is a landmark for the distinction of these two structures.

Conclusion: Accurate electrode placement in the targeted area is critical for the most effective clinical outcome in DBS treatment. Not only surgical atlases and radiological studies but also anatomical studies are essential to determine the target area and its neighborhood. The fiber connections and neural relationships of structures such as NA, substantia innominata and hypothalamus, whose borders may be difficult to determine, should be localized anatomically correctly.

Keywords: Deep brain stimulation, nucleus accumbens, substantia innominata, hypothalamus

German-Turkish Symposium Session

Poster Session 2

(P-30—P-42)

9 September 2023, 13.00–14.00

Poster Area

PP-30

Neural alterations in mild cognitive impairment: insights from task-based word generation and resting-state fMRI

Kerem Kemik[1], Emel Ada[1], Cansu Aykaç[1], Berrin Çavuşoğlu[1], Derya Durusu Emek-Savaş[1], Görsev G. Yener[2]

[1]Dokuz Eylül University, Izmir, Türkiye; [2]İzmir Ekonomi University, Izmir, Türkiye

Objective: Mild cognitive impairment (MCI) is a transitional stage between normal aging and dementia characterized by cognitive deficits. Understanding the neural basis of MCI is crucial for early detection and intervention. This manuscript investigates the neural alterations associated with MCI using task-based and fMRI.

Methods: The study employed a word generation task to assess cognitive processes related to language, attention, and visual processing. A group of individuals with MCI and a control group underwent fMRI scanning while performing the task. Independent component analysis (ICA) was conducted to identify and analyze task-related networks.

Results: The results revealed distinct patterns of functional connectivity in the MCI group compared to the control group. During the word generation task, the MCI group exhibited decreased functional connectivity in the dorsal attention network (DAN), specifically in the right precentral gyrus, right superior frontal gyrus, and right middle frontal gyrus. Conversely, increased functional connectivity was observed in the language network, including bilateral lingual gyrus, right temporooccipital cortex, right hippocampus, and right thalamus. Furthermore, decreased functional connectivity was observed in the visual network, involving bilateral superior frontal gyrus and paracingulate gyrus. Resting-state fMRI analysis revealed increased functional connectivity in the language network of the aMCI group, particularly in bilateral thalamus and caudate nucleus.

Conclusion: These findings highlight specific neural alterations in language, attention, and visual processing networks in individuals with aMCI, providing insights into the underlying mechanisms of cognitive impairment. The observed changes in functional connectivity during both task-based and resting-state fMRI suggest disrupted network dynamics in MCI. These results contribute to the knowledge on the neural correlates of MCI and have implications for the development of targeted interventions. Early detection and intervention based on these neural markers may improve prognosis and potentially delay the progression to dementia. Further research is warranted to validate these findings and explore their clinical significance.

Keywords: Mild cognitive impairment, functional connectivity, task-based fMRI, resting-state fMRI, language network, attention network

PP-31

Neural correlates of context-dependent lightness perception

Amna Malik[1], Hüseyin Boyacı[2]

[1]Neuroscience Graduate Program, Bilkent University, Ankara, Türkiye, Aysel Sabuncu Brain Research Center & National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye; [2]Neuroscience Graduate Program, Bilkent University, Ankara, Türkiye, Aysel Sabuncu Brain Research Center & National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye, Department of Psychology, Bilkent University, Ankara, Türkiye; Department of Psychology, Justus Liebig University Giessen, Giessen, Germany

Objective: The lightness of a surface is not solely determined by the amount of light it reflects but it is also modulated by the surrounding context. Despite a long history of research, neural correlates of context dependent lightness perception remain a question of ongoing debate. The current study seeks to expand upon the existing literature by using a classical effect called simultaneous lightness induction (SLI) as stimulus where a central disk appears darker when embedded in a darker surround compared to when it is embedded in a lighter surround.

Methods: We use functional magnetic resonance imaging (fMRI) to investigate locus of processing of context-dependent lightness in visual hierarchy. During the fMRI experiment, we presented ten participants with a dynamic stimulus by modu-

lating the luminance of either achromatic surround (surround-modulation condition) or achromatic disk (disk-modulation condition) at four different frequencies ranging from 1 to 8 Hz while they perform a demanding fixation task.

Results: Behaviorally, when the surround luminance is modulated at low frequencies, participants perceive an illusory change in lightness of the disk (lightness induction). Whereas, they perceive the disk as having constant lightness at higher frequencies. Utilizing this temporal dependence of lightness induction and comparing the fMRI BOLD activity of the surround-modulation condition with that of the disk-modulation condition at different frequencies, while accounting for the effects of long-range luminance changes, we showed that activity in V1 correlates with perceived lightness. However, such a correlation was not evident in extrastriate areas, V2, V3, and V4.

Conclusion: The findings of our study provide evidence for the involvement of the primary visual cortex in processing of context-dependent lightness information.

Keywords: Simultaneous lightness induction, lightness perception, fMRI, primary visual cortex, perception

PP-32

Instant neural responses to different fat content drinks and their correlation with fat suppression caused by distraction

Sara Razzaghi Asl[1], Maria Veldhuizen[2]

[1]Department of Cognitive Science, METU University, Ankara, Türkiye; Aysel Sabuncu Brain Research Center & National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye; [2]Faculty of Medicine, Mersin University, Mersin, Türkiye

Objective: Obesity and overeating are on the rise globally. Fat intake and habitual distraction during eating are two of the many contributors. Preventing and treating obesity requires more in-depth research into the interactions between these two factors. Here, we measured immediate brain activations after drinking various fat- content drinks (low, high, and tasteless) and examined their correlations with suppression of fat perception during distraction.

Methods: Functional magnetic resonance imaging was used in 19 healthy participants (14 women and 5 men) to measure BOLD responses to low-fat and high- fat chocolate flavors and a tasteless control solution. After MRI scanning, participants performed a flavor perception task that included fat ratings during a distracting working memory task.

Results: We observed neural responses to both fat drinks relative to the tasteless mid-dorsal insula and overlying operculum, precentral gyrus, and cerebellum. We did not observe regions that showed stronger activation for high-fat drinks compared to low-fat drinks (or vice versa). We observed that greater responses in the fusiform gyrus and amygdala corresponded to less suppression of fat perception during a distraction task.

Conclusion: These results suggest that individual differences in neural sensitivity to fat perception and/or distractibility from flavor perception may indirectly contribute to risk factors for overeating.

Keywords: fMRI, flavor, fat perception, distractibility

PP-33

Cerebello-cortical and striato-cortical functional connectivity changes during implicit associative learning

Çiğdem Ulaşoğlu Yıldız[1], Kardelen Eryürek[2], Tamer Demiralp[3], Hakan Gürvit[4]

[1]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [2]Hulusi Behcet Life Sciences Research Laboratory, Neuroimaging Unit, Istanbul University, Istanbul, Türkiye; [3]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [4]Department of Neurology, Behavioral Neurology and Movement Disorders Unit, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: This study aimed to investigate the role of the subcortical structures on implicit associative learning (IAL). Functional connectivity (FC) analysis was conducted on functional magnetic resonance imaging (fMRI) data obtained from spinocereballar ataxia (SCA) patients and healthy control (HC) pariticpants during Triplet Learning Task (TLT), which relies on acquiring the associations between predictive cue and target over practice.

Methods: 15 SCA patients (8 females) and age-sex-education matched healthy participants underwent 6-block TLT twice (2 run) in 3T MRI scanner. Each predictive and random cue (red-lights) was presented for 200ms and target (green-light) events for 850ms with 250ms inter-event-interval, resulting in 2000ms duration time per trial. Seed-to-voxel connectivity analysis was performed with striatal and cerebellar seeds using the CONN toolbox. Results surviving height threshold uncorrected $p<0.001$ and cluster-level FWE-correction ($p<0.005$) were reported.

Results: 2×2×2 Repeated-Measures ANOVA as a function of reaction time (RT) indicates that HCs respond faster ($p<0.001$, $\eta^2=0.523$) and benefited from practise more than SCAs ($p=0.004$, $\eta^2=0.265$), whereas no practice effect was observed in the SCAs. GroupXConditionXPractice interaction revealed that IAL was related with increased FC in HCs between (1) bilateral putamen and middle temporal, supramarginal and angular gyri, (2) right serebellum lobule IV-V and left fusiform, inferior temporal, lateral occipital, hippocampal, parahippocampal areas, (3) left cerebellum-X and left

orbitofrontal, right lateral occipital areas, (4) vermis-VI and right supramarginal, angular gyri, superior parietal lobule, (5) vermis-VIII and primer visual areas.

Conclusion: IAL was associated with increased striato- and cerebello-cortical FCs in HCs compared to the SCA patients. Increased FC of the putamen with the structures involved in the ventral and dorsal pathways might be related with improvement in processing speed, whereas increased FC of the cerebellum mainly with the structures critical for visual long-term memory indicates that cerebellum plays important role in IAL. Supported by TUBITAK project #115S437.

Keywords: Implicit associative learning, cerebellum, striatum, functional connectivity

PP-34

Performing a time-frequency analysis of EEG data from a free viewing task in virtual reality

Debora Nolte[1], Marc Vidal De Palol[1], Ashima Keshava[1], John Madrid Carvajal[1], Anna Lisa Gert[1], Eva Marie Von Butler[1], Pelin Kömürlüoğlu[1], Peter König[2]

[1]Institute of Cognitive Science, University of Osnabrück, Osnabrück, Germany; [2]Institute of Cognitive Science, University of Osnabrück, Osnabrück, Germany, Department of Neurophysiology and Pathophysiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

Objective: Our study investigates how time-frequency analysis of EEG data can handle the imprecise timing due to a combination of different measurements with varying sampling rates. We applied Morlet wavelets with different numbers of cycles to EEG data to obtain event-related spectral perturbations (ERSPs).

Methods: Eighteen participants explored a virtual city modeling a city square while their EEG activity and eye movement data were recorded. We conducted a time- frequency analysis using Morlet wavelets on the EEG data and compared ERSPs related to fixation onset. Additionally, we performed a correlation analysis across trials for ERPs and ERSPs with different temporal shifts compared to the actual gaze onset. The Pearson correlation coefficients of the average ERPs and ERSPs to the individual trials helped us understand how sensitive these methods are to timing imprecisions.

Results: We examined the activity at the Oz channel. The spectrograms from the time-frequency analysis revealed an increase of around 0–150ms and a decrease of around 160-300ms after the stimulus onset in all subjects. The cycle number of a wavelet was reflected in the resolution in time and frequency domains. While the 1-cycle wavelet had the highest temporal resolution, the 5-cycle wavelet had the lowest temporal resolution. The correlation analysis showed that the average ERSP had a stronger correlation with individual trials compared to ERPs.

Conclusion: Our study highlighted the benefits of time-frequency analysis in capturing both time and frequency domains of the EEG data, and how different numbers of cycles in a wavelet can influence the ERSPs. Additionally, the results from the correlation analysis revealed that ERSPs are more robust and consistent than ERPs when timing precision cannot be guaranteed. This suggests that time- frequency analysis is especially useful when dealing with data collected with devices that have different sampling rates.

Keywords: Electroencephalography (EEG), event-related spectral perturbations (ERSPs), event-related potentials (ERPs), virtual reality (VR), time-frequency analysis

PP-35

Non-invasive optical brain imaging of sarcopenia disease: preliminary results

Bora Mert Şahin[1], Mahmut Esad Durmuş[2], Özgür Kara[2], Bayram Kaymak[3], Murat Kara[3], Aykut Eken[1], Süveyda Şanlı[1]

[1]TOBB University of Economics and Technology, Ankara, Türkiye; [2]Department of Internal Medicine, Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital, Ankara, Türkiye; [3]Department of Physical and Rehabilitation Medicine, School of Medicine,Hacettepe University, Ankara, Türkiye

Objective: Sarcopenia is an age-related disease characterized by skeletal muscle mass and function deterioration. Recent studies indicate that sarcopenia can be associated with an increase in the likelihood of cognitive impairment and in addition to cognitive functioning, muscle functions might be a critical factor to understand the sarcopenia compared to muscle mass. To understand these functions, we utilized Functional Near-Infrared Spectroscopy (fNIRS) to reveal neurological markers of sarcopenia by observing both motor functions of sarcopenia patients and healthy controls.

Methods: In this study, we recorded fNIRS data from 32 female participants (20 control, 12 sarcopenic) during the Hand-Grip paradigm. Optodes were positioned over Primary Motor Cortex (BA 4), Premotor and Supplementary Motor Cortex (BA 6) and Dorsolateral Prefrontal Cortex (BA 46 & BA 9). After preprocessing, mean oxy-hemoglobin concentration change (ΔHbO_2) was used as independent variable for two-way repeated measures ANOVA to analyze the group (sarcopenic, healthy controls),condition (for hand grip, grip & rest) main effect and their interactions.

Results: None of the regions showed significant group main effect ($p>0.05$). All of the regions showed significant condition

main effect ($p<0.05$). Post hoc results revealed that grip condition is greater than rest condition. Also, there was no significant interaction between group and condition ($p>0.05$).

Conclusion: As expected, there was a significant difference between rest and grip conditions. Moreover, we have seen that the control group showed greater response during grip condition. However, we did not find any significant difference between participants groups and no interactions between groups and conditions. This result is similar to the result of the study done by Trost et. al. (2023) which is the only task-based neuroimaging study carried out on sarcopenia patients, where they did not find any differences between participant groups in single task experiments. This study is supported by TUBITAK within the scope of ARDEB 1001 with the title "Identification of Neuro-Cognitive Markers of Sarcopenia Disease by Using Functional Near Infrared Spectroscopy and Artificial Intelligence Approaches" and project number 122E210.

Keywords: fNIRS, sarcopenia, neuroimaging, hand grip

PP-36

Neural response to flavor measured during a sip-and-swallow protocol with EEG

Samet Albayrak[1], Burcu Ayşen Ürgen[2], Hüseyin Yanık[3], Maria Veldhuizen[4]

[1]Cognitive Science, Middle East Technical University, Ankara, Türkiye; [2]Neuroscience, Bilkent University, Ankara, Türkiye; [3]Faculty of Engineering, Mersin University, Mersin, Türkiye; [4]Faculty of Medicine, Mersin University, Mersin, Türkiye

Objective: Brain responses to food or flavor stimuli are usually measured with functional magnetic resonance imaging (fMRI). One advantage of using electro- encephalo gram (EEG) is reduced cost and the ability to include participants with a higher BMI (compared to fMRI). In addition, because the participant is seated, EEG allows for a more naturalistic eating context. Event-related EEG studies using sip– and–swallow protocols do not exist to our awareness, but this is a critical lack, as the swallow breath contains flavor.

Methods: In each session, the participants sipped the stimulus on 50 trials upon hearing an auditory cue. A pair of EMG electrodes were connected to the submental muscles under the participants' chin and utilized for the detection of swallow moment to obtain a precise time point for the consumption event. In addition, sip size was tracked with a USB-readable scale to identify unusual or irregular sips. We have completed data collection on 15 participants (7 women, 8 men) for 4 sessions each. Ongoing data analyses are done with EEGLAB and ERPLAB on MATLAB and MNE on Python.

Results: Here we present preliminary results from a sip–and–swallow protocol with EEG, done to obtain event–related potential (ERP) changes time–locked to swallowing of a food stimulus (cacao milk).

Conclusion: In conclusion, we demonstrate that a sip-and-swallow EEG protocol is possible with limited loss of data due to movement and clear ERPs can be obtained through such a procedure.

Keywords: EEG, ERP, flavor perception, multisensory perception

PP-37

Connectivity of hippocampus and thalamus in sleep: a case study with an epilepsy patient

Sezan Mert[1], F. İrsel Tezer[2], Serap Saygı[2], Burcu Ayşen Ürgen[1]

[1]Department of Neuroscience, Bilkent University, Ankara, Türkiye; [2]Department of Neurology, Hacettepe University, Ankara, Türkiye

Objective: This study investigates the connectivity between the hippocampus and thalamus in sleep to understand the coupling between these areas.

Methods: To this end, we recorded a minute-long 12-channel stereo EEG (sEEG) data from the thalamic and hippocampal brain regions of an epilepsy patient during sleep, with six channels each in the thalamus and hippocampus, sampled at 200 Hz. As a measure of functional connectivity, we have computed the pairwise coherence of each channel from both regions. High coherence values indicate significant temporal coordination and likely synchronized functioning between two locations, while lower values suggest independent and unsynchronized neuronal activations.

Results: We considered coherence values in the delta, theta, alpha, and beta bands. These analyses showed a high coherence between the activations of the hippocampus and thalamus. Specifically, the first and second hippocampal channels located in the head or medial part of the hippocampus had the highest coherence in almost all frequency bands, especially in the delta and beta bands. Intermediate coherence values were observed between the third and fourth hippocampal channels and all thalamic channels, where its highest values were in the delta band. Lastly, the lowest coherence values were observed at the fifth and sixth channels located in the tail of the hippocampus with all thalamic channels for all frequency bands. These coherence values suggest a gradual decrease of connectivity from the head to the tail of the hippocampus. Interestingly, a significant notch at 15 Hz was present for the first four hippocampal channels paired with all thalamic channels, which may hint at unsynchronized spindle-like activations.

Conclusion: Overall, all these findings can suggest a network between the thalamus and the head of the hippocampus rather than the tail across a broad range of frequency bands and should be tested with more patients in future work to see the generalizability of the results.

Keywords: Coherence, intracranial EEG, sleep

PP-39

Multiple demand regions in cerebellum

Ayşe Betül Varol, Hasan Duymuş, Ausaf Ahmed Farooqui

National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Türkiye

Objective: It is well-known that a common set of frontal and parietal regions activates in response to diverse control demands. This set of regions has been referred to as multiple demands, task-positive, cognitive-control, attentional network. Cerebellum, a key hind-brain structure, used to be thought of as a motor-related region. Over the past two decades, its role in other aspects of cognition has gradually been uncovered. Neuroimaging studies frequently find cerebellar activations during diverse cognitive tasks. However, it is unclear if these diverse tasks activate functionally distinct regions within the cerebellum, or activate common loci, just like the case in frontal and parietal regions. Specifically, lobules VI and VII (including crus 1 and 2) are believed to have cognitive functions while lobules I to V are considered to have motor-related functions.

Methods: We investigated which parts of the cerebellum show increased activity across a diverse set of control demands and thus behave like multiple demand regions. Blind and sighted participants, a total of 31 participants (15 sighted, and 16 blind) did four different tasks that involved working memory demands, tactile decisions, time-duration judgment, and generating complex motor sequences.

Results: Demands-related motor complexity showed increased activation in both anterior as well as posterior lobes. The three non-motor cognitive demands (working memory, tactile decision, and time-duration judgment) activated a region in lobule VI of the posterior lobe that was also activated by motor complexity. Crucially, these three non-motor cognitive demands also activated a locus in the vermis of the anterior lobe that spanned lobules II-V.

Conclusion: We show specific regions of the cerebellum activate in response to a diverse set of control demands. These parts include what are accepted as cognitive parts (e.g., lobule VI), but crucially also include parts that are still thought of as purely motor (e.g., vermis of lobules II–V).

Keywords: Cerebellum, cognitive neuroscience, multiple demand regions

PP-40

Examining prefrontal oxygenation parameter in migraine classification: a machine learning approach

Fatih Emre Öztürk[1], Nilüfer Zengin[2], Begüm Kara Gülay[3], Vesile Öztürk[4], Cağdaş Güdücü[5], Neslihan Demirel[3]

[1]Data Science, Department of Statistics, Graduate School of Natural and Applied Science, Dokuz Eylül University, Izmir, Türkiye; [2]Department of Biophysics, Health Science Institute, Dokuz Eylül University, Izmir, Türkiye; [3]Department of Statistics, Faculty of Science, Dokuz Eylül University, Izmir, Türkiye; [4]Department of Neurology, Faculty of Medicine, Dokuz Eylül University, Izmir, Türkiye; [5]Department of Sleep and Conscious States; Department of Biophysics, Health Sciences Institute; Faculty of Medicine, Dokuz Eylül University, Izmir, Türkiye

Objective: Migraine headache is frequently misdiagnosed in clinical settings. Today, there is no method (blood test, cerebrospinal fluid, neuroimaging, etc.) that provides precise and accurate results in the clinical diagnosis of migraine. The main aim of the study is to be able to classify individuals into three groups: healthy controls, migraine with aura, and migraine without aura by using certain machine learning approaches.

Methods: The changes in the prefrontal oxy-hemoglobin (HbO) concentrations were measured by a 16-channel functional near-infrared spectroscopy (fNIRS) device during the Victoria Stroop task. Features were extracted by analyzing differences in HbO concentrations between different stages of the Stroop task according to the time domain. Subsequently, feature selection methods were employed to identify the most influential features in the classification process.

Results: Through the application of machine learning techniques, Support Vector Machine (SVM) algorithm achieved an accuracy of 78% based on preliminary analysis, successfully classifying healthy controls, migraine with aura, and migraine without aura.

Conclusion: This study revealed the potential role of fNIRS-based prefrontal oxygenation parameters during a cognitive task to differentiate healthy controls, migraine with aura, and migraine without aura. The findings indicated that combining prefrontal oxygenation patterns obtained through fNIRS with extracted features and machine learning techniques is effective for classifying individuals with different migraine conditions. This research may contribute to our understanding of the hemodynamic correlates of migraines and could pave the way for the development of objective diagnostic methods in the future.

Keywords: fNirs, machine learning, migraine classification, stroop task

PP-41

Amino acid-derived fullerenols as neuroimaging nanocarriers for neurodegenerative diseases: overcoming the blood-brain barrier and fluorescent tracking of Aβ fibrils

Çağdaş Devrim Son[1], Salih Özçubukçu[2], Ahmet Zübeyir Nursoy[1], Volkan Dolgun[2]

[1]Department of Biological Sciences, Middle East Technical University, Ankara, Türkiye; [2]Department of Chemistry, Middle East Technical University, Ankara, Türkiye

Objective: Fullerenol nanoparticles, developed by attaching hydroxyl groups to the initially nonpolar and water-insoluble fullerene, have demonstrated diverse applications ranging from cosmetics to medical imaging. With potential benefits for drug delivery, fullerenols can be activated with p-nitrophenyl chloroformate to incorporate functional groups, making them promising candidates as drug carriers. Despite their inherent antioxidant and neuroprotective properties, the negatively charged nature of fullerenols presents a challenge for passing through the blood-brain barrier (BBB), limiting their utility in delivering drugs to the brain.

Methods: To overcome this limitation, we designed a modified fullerenol molecule inspired by peptides used by HIV to traverse the BBB. By incorporating L-DOPA, positively charged amino acids are introduced to maintain antioxidant properties while preventing the reduction of hydroxy groups. Notably, the aromatic rings of DOPA are expected to hinder fibrilization of amyloid beta through pi-pi interactions with the peptide, effectively acting as a truncation agent. Zeta potential and NMR measurements support the synthesis of a stable and successful DOPA-fullerenol molecule. Additionally, free DOPA molecules, when not bound to Aβ, can undergo conversion to melanin via DCE (dopachrome conversion to melanin), leading to the emission of a fluorescent signal. This characteristic offers a potential means of tracking the behavior of DOPA-fullerenol in biological systems. This feature provides a powerful tool for non-invasive tracking of Aβ fibrils and disease progression in AD. Further investigations involve in vitro tests to assess cytotoxicity and cell viability before employing a BBB model to evaluate the carrier molecule's performance. These are currently being done using three different cell lines, bEND.3, HEKa, SH- SY5Y.

Results: Successful results from in vitro imaging tests will pave the way for subsequent BBB model studies, which will done along with our 122Z732 TÜBİTAK project, which inspired me to develop such model.

Keywords: Fullerenol, nanocarrier, BBB models, neurodegenerative diseases

PP-42

Glioblastoma extended to limbic system demonstrated by tractography

Sena Kıcıklar[1], Zeynep Fırat[2], Gazanfer Ekinci[2]

[1]Department of Neuroscience, Faculty of Medicine, Yeditepe University, Istanbul, Türkiye; [2]Department of Radiology, Faculty of Medicine, Yeditepe University Koşuyolu Hospital, Istanbul, Türkiye

Objective: The fibers that form the white matter of the cortex connect cortical areas to different parts of the central nervous system. The formations such as glioblastoma (GBM) can disrupt fibers. Although GBM is the most common tumor type, its spread throughout the limbic system is uncommon. This study aimed to review fiber bundles in the brain based on a patient with a high-grade glial tumor involving the limbic system but without symptoms other than mild memory impairment.

Methods: A 55-year-old patient was diagnosed with GBM by biopsy. The glioma involved the perirhinal cortex, amygdala, hippocampus and was localized to piriform cortex extending to the bilateral fornix, bilateral mammillary body, anterior cingulate gyrus, anterior commissure, genu, and rostrum of the corpus callosum. The lesion also involved the subcallosal area, corpus callosum isthmus, and splenium and extended to the opposite hemisphere. Therefore, it has affected many fibers throughout its spread, including the anterior commissure, corpus callosum, fornix, cingulum, and superior longitudinal fasciculus. The case was examined with magnetic resonance imaging (MRI) and diffusion tensor imaging (DTI). Based on the information that intact, edematous, or disrupted fibers have different patterns in the color maps, fibers that are destroyed and some of which are repelled by glioma without being completely damaged will be discussed with their individual functions.

Results: As revealed by MRI and DTI data, the glioma follows and involves a large part of the limbic system structures, including the papez circuit. While the formation deflected some fibers instead of destroying them completely, the others were severely damaged.

Conclusion: Perhaps because the deflected fibers were not destroyed, the tumor involving most of the limbic system may have caused only mild memory impairment. It appears different from glial tumors that affect only specific limbic system structures in terms of their spread following the limbic system.

Keywords: Gliablastoma, tractography, DTI