10th MindBrainBody Symposium 2023

March 14-17, 2023

Berlin & Virtual in the framework of the International Brain Awareness Week

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10th MindBrainBody Symposium 2023
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10th MindBrainBody Symposium

We are pleased to welcome you to the 10th MindBrainBody Symposium (MBB Symposium 2023), which will take place in Berlin and virtual from 14 to 17 March 2023 during the International Brain Awareness Week. We are looking forward to welcoming especially young scientists, i.e. postdocs, PhD students and students from the fields of cognitive and social neuroscience, cognitive psychiatry and neurology, psychology and behavioural sciences. The symposium programme includes keynote lectures, workshops, applicant presentations, poster sessions with a poster prize and the MBB Young Scientist Award.

MBB Poster Prize

The best evaluated poster among the 134 submitted posters will be awarded the MBB Poster Prize. In previous years, the MBB Poster Prizes were awarded to Katie Groves (University of Essex) in 2016, Lise Hobeika (Sorbonne Universités), Toni Muffel (MPICBSLeipzig) in 2017, Friederike Irmen (Berlin School of Mind and Brain), Monika Graumann (Freie Universität) in 2018 and Lina Skora (University of Sussex) in 2019; Angeliki Charalampaki (Department of Psychology, HU; Mind&Brain, HU; BCCN; Berlin) & Artur Czeszumski (University of Osnabrück, Vrije Universiteit Amsterdam) in 2021; Polina Arbuzova (Berlin School of Mind and Brain, Humboldt-Universität zu Berlin) & Pablo Nicolas Fernandez Larrosa (IFIBYNE, UBA-CONICET, Buenos Aires) in 2022; and special Prize awarded to Christoph Bamberg (School of Psychology, The University of Auckland), Sidney Carls-Diamante & Alice Laciny (Universitaet Konstanz, Konstanz), Marika Constant (Humboldt-Universität zu Berlin), and Elenor Morgenroth Elenor Morgenroth (Ecole Polytechnique Federale, Lausanne) in 2022.

MBB Young Scientist Award

Applicants could submit a MindBrainBody project idea that can be carried out in a period of 3 to 6 months to be considered for the MBB Young Scientist Award. The winner of the MBB Young Scientist Award will be offered the opportunity of a funded research stay at the MindBrainBody Institute in Berlin or at the Department of Neurology at the Max Planck Institute for Human Cognitive and Brain Sciences. Collaborative projects with a home institution are also highly encouraged. Previous winners were Paweł Motyka (University of Warsaw) and Pietro Sarasso (University of Turin) in 2016; Birgit Nierula (Institut d'investigacions Biomèdiques August Pi i Sunyer) in 2017; Dorottya Lantos (Goldsmiths, University of London) & Marina Kliuchko (Aarhus University) in 2018; Alejandro Galvez-Pol (University College London) in 2019; & Mohammad Rostami (Tarbiat Modares University), Emma Louise Michalski (Umeå University), & Lina Skora (University of Sussex) in 2020; Tahnée Engelen (Ecole Normale Supérieure, Paris) & David Haslacher (Charité - Universitätsmedizin Berlin) in 2021; Aleksandra Herman (Nencki Institute of Experimental Biology, Warsaw), Irena Arslanova (University of London) and Shelby Bachman (University of Southern California, Los Angeles) in 2022Supérieure, Paris) & David Haslacher (Charité – Universitätsmedizin Berlin) in 2021; Aleksandra Herman (Nencki Institute of Experimental Biology, Warsaw), Irena Arslanova (Royal Holloway, University of London), & Shelby Bachman (University of Southern California) in 2022.

10th MindBrainBody Symposium
March 14-17, 2023
Program

Venue: Kaiserin-Friedrich-Haus, Robert-Koch-Platz 7, 10115 Berlin, Germany / Virtual

Tuesday, March 14, 2023	
15:00 – 16:00	**Registration**
16:00 – 17:15	**Keynote Public Lecture & Discussion**
	Anil K. Seth (University of Sussex; Canadian Institute for Advanced Research)
	From beast machines to dreamachines
	Chair: *Arno Villringer (MindBrainBody; MPI CBS Leipzig)*
17:15 – 18:30	**Panel 1: Presentations by 5 Participants**
	Jonas Karolis Degutis (MPI CBS Leipzig) *Neural encoding and dynamics of visual working memory during distraction*
	Juanli Zhang (MPI CBS Leipzig) *Electrophysiological biomarkers of healthy aging and Parkinson's disease progression*
	Piotr Litwin (Jagiellonian University) *Homeostatic relevance modulates access to visual awareness*
	André Hechler (Technical University of Munich) *Quantifying the brain-wide metabolic effects of predictive processing*
	Genji Kawakita (Imperial College London) *Is my "red" your "red"?: Unsupervised alignment of qualia structures via optimal transport*
	Chairs: *Alina Studenova & Nadine Herzog (MindBrainBody; MPI CBS Leipzig)*
	Reception
19:00 – 19:45	**Poster Session A (Foyer)**
	Posters Nr. A1-A28
19:45 – 20:30	**Poster Session B (Foyer)**
	Posters Nr. B1-B28

Time zone: GMT+1 (Berlin)

Wednesday, March 15, 2023	
09:00 – 09:30	Anil K. Seth | Discussion only
09:30 – 10:30	**Keynote Lecture 1**
	Frederike Petzschner (Brown University)
	On the physiological basis of reward and punishment ***Chair:*** *Michael Gaebler (MindBrainBody; MPI CBS Leipzig)*
10:30 – 10:50	**Coffee Break**
10:50 – 12:20	**Panel 2: Presentations by 6 Participants**
	Corinna Schulz (Tübingen Center for Mental Health, University of Tübingen) *Ghrelin amplifies hedonic drive and food reward signaling in binge eating disorder*
	Alireza Nia (Auckland Bioengineering Institute, Auckland) *Practical considerations in deploying hybrid fNIRS-EEG system on frontal lobe: an emotion recognition case study*
	Bonnie O'Malley (MPI CBS Leipzig) *How do mindfulness-based trainings reduce physiological stress? Assessing changes in attention and acceptance traits and their role in cortisol reduction*
	Lara Puhlmann (Leibniz Institute for Resilience Research, Mainz) *Introducing a structured online video interview to assess digital biomarkers of psychologial distress*
	Monika Malon (Institute of Psychology, Polish Academy of Sciences, Warsaw) *Is loneliness linked to prosociality? A meta-analysis of 36 studies with 43,508 participants*
	Leah Banellis (CFIN, Aarhus University, Aarhus.) *Body-Wandering: Investigating the Subjective and Physiological Fingerprints of Interoceptive Mind-wandering*
	Chairs: *Carina Forster, Felix Klotzsche & Lioba Enk (MindBrainBody; MPI CBS Leipzig)*
12:20 – 13:15	**Lunch Break**

13:15 – 14:30	**Sponsor Workshops A**
	Sophie Ankner (Brain Products / MES Forschungssyteme GmbH) *The Brain in Motion – Neuroscientific Imaging Methods* **Alex Dimov** (Biopac Systems Inc.) *High density multimodal fNIRS Application: from Virtual Reality to Real-World* **Eshwar Ghumare** (ANT Neuro) *Quick high-density EEG measurements with the advances in eego™ solutions* *Chairs:* *Marta Gerosa & Antonin Fourcade (MindBrainBody; MPI CBS Leipzig)*
14:35 – 15:35	**Keynote Lecture 2**
	Stephanie R. Jones (Brown University) *Interpreting the mechanisms and meaning of brain rhythms in somatosensation using the Human Neocortical Neurosolver (HNN) modeling software* *Chair:* *Vadim Nikulin (MindBrainBody; MPI CBS Leipzig)*
	Coffee Break
15:40– 16:25	**Poster Session C (Foyer)**
	Posters Nr. C1-C28
16:25 – 17:10	**Poster Session D (Foyer)**
	Posters Nr. D1-D28
17:15 – 18:15	**Keynote Lecture 3**
	Matthew Larkum (Humboldt Universität zu Berlin) *The Dendritic Integration Theory of Consciousness* *Chair:* *Tilman Stephani (MindBrainBody; MPI CBS Leipzig)*
	Social Gathering (Optional)

	Thursday, March 16, 2023
09:00 – 09:30	Matthew Larkum	Discussion only
09:30 – 10:30	**Keynote Lecture 4**
	György Buzsáki (New York University)
	Ways to Think About the Brain: Emergence of cognition from action ***Chair:*** *Arno Villringer (MindBrainBody; MPI CBS Leipzig)*
10:30 – 10:50	**Coffee Break**
10:50 – 11:35	**Methodological Focus 1**
	Micah Allen (Institute of Clinical Medicine, Aarhus University) *A Psychophysical Approach to Quantifing Respiratory and Cardiac Interoception* ***Chair:*** *Paul Steinfath (MindBrainBody; MPI CBS Leipzig)*
11:35 – 12:20	**Methodological Focus 2**
	Felix Biessmann (BHT Berlin) *Trust and Explanations in Machine Learning* ***Chair:*** *Michael Gaebler (MindBrainBody; MPI CBS Leipzig)*
12:20 – 13:20	**Lunch Break**
13:20 – 14:15	**Sponsor Workshops B**
	Felix Toepfer (NIRx) *fNIRS hyperscanning, a live demonstration*
	Artur Czeszumski (Mentalab) *Unlocking the Secrets of the Brain: The Power of Mobile EEG Devices*
	Chairs: *Alina Studenova & Nikolai Kapralov (MindBrainBody; MPI CBS Leipzig)*
14:15 – 14:35	**Coffee Break**

14:35 – 15:50	**Panel 3: Presentations by 5 Participants**
	Yulia Revina (MPI CBS Leipzig) *Expectations about pain location do not improve pain discrimination performance*
	Alejandro Galvez-Pol (University of the Balearic Islands, Palma de Mallorca) *People actively adjust the gaining of tactile data based on how their heartbeats alters their perceptual sensitivity*
	Suvi Karjalainen (University of Jyväskylä) *Neural activity is modulated by spontaneous and volitionally controlled breathing*
	Fivos Iliopoulos (MPI CBS Leipzig) *Fundamental Unconscious Modulators of Somatosensory Perception*
	Sofija Perovic (Istituto Italiano di Tecnologia, Sapienza University of Rome) *Does the Vertex Potential reflect the activation of the extralemniscal system?*
	Chairs: *Eleni Panagoulas & Tilman Stephani (MindBrainBody; MPI CBS Leipzig)*
15:50 – 16:00	**Closing Remarks & Award Distribution**
	Arno Villringer (MindBrainBody; MPI CBS Leipzig)
17:00 – 17:30	György Buzsáki │Discussion only
17:30 – 18:00	Frederike Petzschner │ Discussion only

	Friday, March 17, 2023	
	Only VIRTUAL poster sessions	
10:30 - 11:30	**Poster Session A	Virtual**	
	Posters Nr. A1-A27 & V1-V6	
11:30 – 12:30	**Poster Session B	Virtual**	
	Posters Nr. B1-B28 & V7-V12	
12:30 – 13:30	Break	
13:30 – 14:30	**Poster Session C	Virtual**	
	Posters Nr. C1-C28 & V13-V18	
14:30 – 15:30	**Poster Session D	Virtual**	
	Posters Nr. D1-D28 & V19-V23	

Keynote Lecture Abstracts

Public Keynote Lecture:　　　Anil K. Seth

Sackler Centre for Consciousness Science, School of Engineering and Informatics, University of Sussex, Brighton, UK
Co-Director, Canadian Institute for Advanced Research, Program on Brain, Mind, and Consciousness
Advanced Investigator, European Research Council

From beast machines to dreamachines

Consciousness remains one of the central mysteries in science and philosophy. In this talk, I will illustrate how the framework of predictive processing can help bridge from mechanism to phenomenology in the science of consciousness – addressing not the 'hard problem', but the 'real problem'. I will first show how conscious experiences of the world around us can be understood in terms of perceptual predictions, developing an approach some are calling 'computational (neuro)phenomenology'. I'll then explore how the experience of being an embodied self can be understood in terms of control-oriented predictive (allostatic) regulation of the interior of the body. This implies a deep connection between mind and life: Contrary to the old doctrine of Descartes, we are conscious *because* we are beast machines. I'll finish by describing a recent art-science collaboration – the dreamachine – which involves mass stroboscopically-induced visual hallucinations and a large-scale online survey of 'perceptual diversity' – The Perception Census.

Keynote Lecture 1: Frederike Petzschner

Brown University

On the physiological basis of reward and punishment

The role of rewards and punishments in shaping motivated behavior is critical and has been the subject of extensive investigation in the field of psychology and neuroscience. Traditionally, we have focused on how organisms learn about rewards by acquiring information from external stimuli, but have neglected a more fundamental question: What makes these signals rewarding or punishing in the first place? Here, I will argue that most external signals are rewarding or punishing because they predict internal events that provide benefits to the organism. Specifically, I will discuss how relevant physiological variables the brain optimizes for, so called "primary rewards and punishments" (such as energy utilization in the case of food rewards, maintenance of physiological integrity in the case of injury) could shape learning and behavior and provide us new insight for the treatments of psychosomatic disorders and chronic pain.

Keynote Lecture 2: Stephanie R. Jones

Brown University

Interpreting the mechanisms and meaning of brain rhythms in somatosensation using the Human Neocortical Neurosolver (HNN) modeling software

Human Neocortical Neurosolver (HNN) is a user-friendly neural modeling tool designed to help researchers and clinicians interpret the cell and circuit mechanisms generating electro- and magneto-encephalography EEG/MEG (https://hnn.brown.edu, Neymotin et al., eLife 2020). A unique feature of HNN's model is that it accounts for the biophysics generating EEG/MEG signals, with enough detail to connect to microcircuit level dynamics that can be studied in animals. I will give an overview of the development and use of this tool and describe its application to uncover the mechanism and meaning of low frequency brain rhythms in somatosensation. Our studies showed somatosensory rhythms in 15-29Hz beta band can be manipulated with attention and with mind-body meditative practices, and that beta expression influences tactile perception. Further analysis showed that in non-averaged data beta rhythms occur as transient high-power "events". HNN modeling led to a new theory on the circuit origin of these beta events and suggested beta causally impacts perception through layer specific recruitment of cortical inhibition, with support from invasive recordings in mice in non-human primates. I will also briefly describe other HNN applications that show HNN is a powerful translational tool to link mechanism to meaning of human EEG/MEG signals.

Keynote Lecture 3: Matthew Larkum

Humboldt Universität zu Berlin; Charité – Universitätsmedizin Berlin

The Dendritic Integration Theory of Consciousness

Breakthroughs in the understanding the cellular basis of anesthesia suggest that local mechanisms are essential for explaining loss of consciousness. This in turn leads to hypotheses about the essential neurobiological components of consciousness. Here, I show how the biophysical properties of pyramidal cells allow them to act as gates that control the evolution of global activation patterns. In conscious states this cellular mechanism enables complex sustained dynamics within the thalamocortical system, during unconscious states such signal propagation is prohibited. Dendritic Integration Theory (DIT) suggests that the hallmark of conscious processing is the flexible integration of different data streams at the cellular level. This cellular integration mechanism provides the bedrock for a novel neurobiological theory of consciousness and makes specific and testable predictions.

Keynote Lecture 4: György Buzsáki

Neuroscience Institute, New York University, School of Medicine, NY

Ways to think about the brain: Emergence of cognition from action

Current neuroscience is largely fueled by an empiricist philosophy that assumes the brain's goal is to perceive, represent the world, and learn the truth. An inevitable consequence of this framework is the assumption of a decision-making homunculus wedged between our perception and actions. In contrast, I advocate that the brain's fundamental function is to induce actions and predict the consequences of those actions to support the survival and prosperity of the brain's host. Only actions can provide a second opinion about the relevance of the sensory inputs and provide meaning for and interpretation of those inputs. In this "inside-out" framework, the brain comes with a preconfigured and self-organized dynamic that constrains how it acts and views the world. In the brain's nonegalitarian organization, preexisting nonsense brain patterns become meaningful through action-based experience. I will show recent experiments that support this framework and illustrate how seemingly disparate neural computations, such as metabolic homeostasis/allostasis and memory-guided behaviors, have co-evolved at every step within the same brain circuits.

Methodological Focus Abstracts

Methodological Focus 1:   **Micah Allen**

Institute of Clinical Medicine, Aarhus University

A Psychophysical Approach to Quantifing Respiratory and Cardiac Interoception

Interoception denotes the perception, control, and metacognition of visceral homeostatic signals. While interest in interoception is on the rise, methodological issues limit our ability to quantify individual differences in interoceptive ability. Here I will present two new methods for quantifying respiratory and cardiac interoception. Healthy participants completed a cardiac interoception (n = 550) and respiratory interoception (n = 180) task, together with measures of brain activity and other cognitive and mental health phenotypes. Statistical analysis using computational Bayesian and canonical correlation approaches were used to identify links between brain, body, and behavior. Individual differences in cardiac interoception are robust, and cardiac beliefs show large decreases in precision, increased bias, and decreased metacognitive calibration. In contrast, respiratory interoception was more similar to exteroceptive control tasks. These results highlight the importance of taking a multi-modal, psychophysical approach to the quantification of interoceptive biomarkers.

Methodological Focus 2:   **Felix Biessmann**

Berliner Hochschule für Technik (BHT); Fachhochschule Beuth; Einstein Center Digital Future, Berlin

Trust and Explanations in Machine Learning

Machine Learning (ML) has become an essential part of the analysis toolkit of researchers - and of most other aspects of our lives. ML is being used as assistive technology in hospitals, courts and police stations. Thus using ML technology responsibly requires the right level of trust in ML algorithms: A young doctor should not follow ML advice blindly, just like an experienced doctor should not ignore potentially valuable advice from an algorithm that has seen more cases than any doctor ever could. In order to foster trust in ML algorithms, ML researchers have proposed methods to render ML predictions more explainable, often referred to as transparent or eXplainable Artificial Intelligence (XAI). But to what extent these explanations really help to foster trust into an AI system - or whether the trust induced by them is well calibrated - remains an open question. In this workshop we will

explore some ideas around the question: „What is a good explanation (in the context of ML) - and how can we measure it"? We will start with a very simple XAI method originally developed for brain imaging dat,a and we will then discuss how we can build on established methods from the fields of psychophysics and information theory to measure the quality of explanations in more generic settings. Some results from our empirical studies will highlight that good explanations should always factor in the human observer - and that the positive impact of explanations may vary with task, experience of a human in a task and also with the personality traits of the human observer.

Oral Presentation/Talk Abstracts

Panel 1

March 14, 2023 at 17:15-18:30 | Discussion only not foreseen

Panel 1 | Talk 1:   **Jonas Karolis Degutis**

Neural encoding and dynamics of visual working memory during distraction

Degutis J.K. [1,2], Soch J. [1,3], Weber S. [1,4], & Haynes J. [1,2,4,5]

[1] Bernstein Center for Computational Neuroscience Berlin and Berlin Center for Advanced Neuroimaging, Charité Universitätsmedizin Berlin, corporate member of the Freie Universität Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Health, Berlin
[2] Max Planck School of Cognition, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig

Introduction: Recent studies have shown that both sensory percepts and visual working memory (VWM) contents are concurrently present in the visual cortex; however, the mechanisms dissociating them are still unclear. We reanalyzed an open-access fMRI dataset where six participants performed two tasks: a delayed match-to-sample task where the delay contained either a noise, orientation, or no distractor, and a perceptual orientation localizer task. We investigated the role of two mechanisms, mixed tuning and dynamic coding, during VWM maintenance in visual areas. *Methods*: First, we assessed whether evidence exists for mixed tuning in perceptual and memory representation encoding. Cross-generalization would indicate equivalent tuning functions between perception and memory; differences in tuning, despite maintained information, would indicate mixed tuning. We calculated tuning functions for perception and no-distractor VWM and identified two subpopulations per region: generalizable and mixed voxels, where tuning was correlated or not, respectively. We then used support vector regression (SVR) to investigate the subpopulations' representational format of VWM. Second, we examined whether VWM representations are dynamic; does the VWM code change across the delay? We conducted a temporal cross-decoding analysis where we trained an SVR decoder on every timepoint and iteratively tested on all timepoints. If the decoding accuracy was lower between different timepoints than within the same timepoint, we concluded that the VWM is dynamic in nature at those timepoints. *Results:* We found evidence for a sensory and non-sensory coding of memory contents in generalizable and mixed tuning voxels, respectively, during the noise distractor and across several visual areas. Additionally, we saw more dynamic coding during the noise distractor in V1 and V2 compared to other delay conditions. *Discussion*: Our results demonstrate that visual areas can adapt to incoming sensory distractors by relying on a non-perceptual memory code and can dynamically change it across time, thus supporting a dynamic coding framework of VWM.

Panel 1 | Talk 2: Juanli Zhang

Electrophysiological biomarkers of healthy aging and Parkinson's disease progression

Zhang, J. [1], Sander, C. [2], Hensch, T. [3], Hegerl, U. [4], Schomerus, G. [3], Witte, V. [1], Curio, G. [5], Villringer, A. [1], Nikulin, V. [1]
[1] Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
[2] University of Leipzig Medical Center, Leipzig, Germany

Introduction: Previous studies have repeatedly shown that Parkinson's disease (PD) is characterized by abnormal cortical PAC (phase-amplitude coupling) between the beta band (13–30 Hz) phase and the amplitude of broadband gamma (50–150 Hz). Yet, all the previous studies have been performed with a cross-sectional design. Given that elevated PAC has also been associated with healthy aging , it is unclear yet whether this effect is quantitatively differentiable between aging and PD development. In addition, behaviorally, PD has been shown to be accompanied by impairment of interception (Ricciardi et al., 2016). An open question is whether this can be manifested in heartbeat evoked potentials (HEPs), which represents cortical processing of heartbeat information and serves as a marker for cardiac interoception. *Methods*: To answer these questions, we analyzed a longitudinal dataset based on a large cohort (N=~3000 participants) LIFE study (Leipzig Research Center for Civilization Diseases). The participants had two visits which took place on average 6.5 years apart. In total, we identified a group of six participants (PD group) who were healthy at the first visit (t0=0, age of 72.5±4.37 years, 3 females) but reported having developed clinically diagnosed PD at the second visit (t1=6.5 years later, age of 79±4.28 years). The healthy control (HC) group includes 22 healthy elderly subjects who were age and gender matched. Using multichannel resting-state EEG measurement (20 minutes, 31-channel cap with 1 ECG channel), we computed the modulation index (MI) to quantify the strength of PAC. *Results:* We found that in the t1 condition, the subjects in both HC and PD groups showed more pronounced beta-gamma PAC at the motor cortex (C3 and C4) in comparison to the t0 condition which was confirmed statistically with Wilcoxon signed-rank test (p=0.027 for HC and p=0.0156 for PD). Compared to HC, there was a trend for PD group to have greater increase in PAC (but not statistically confirmed, p=0.15). In addition, our data showed PD development is accompanied by an attenuation of HEPs in centro-parietal regions over the time window of 290-362ms after R peak (cluster based permutation test, p=0.025) while there was no difference in HC over the same period. *Discussion*: Our results thus first confirm that both healthy aging and development of PD are associated with an elevation of PAC in motor-related regions, but this data does not provide evidence for a quantitative differentiation between these two processes. More patients should be added to access the genuine trend. Besides, an attenuation of HEPs indicates an impairment of cardiac interoception in PD whereas it is not observed in healthy aging. This in turn implies an importance of including non-motor domain biomarkers for the differentiation between healthy aging and PD progression.

Panel 1 | Talk 3:   Piotr Litwin

Homeostatic relevance modulates access to visual awareness

Litwin, P. [1, 2], Gayet S. [3], Motyka P., [4]
[1] Jagiellonian University, Cracow
[2] University of Warsaw, Warsaw

Introduction: Fear and disgust constitute two negative homeostatic emotions motivating avoidance behavior, which seem to exert opposite influences on perceptual processing. Threatening stimuli entertain preferential access to conscious awareness, while disgusting cues have been associated with perceptual suppression effects. We hypothesized that these effects are grounded in distinct physiological activation patterns specifying whether emotion entails the need for immediate regulatory behavior (fear) or not (disgust). Therefore, directional effects of enhanced arousal should be opposite in the case of fear-related preference and disgust-related suppression. *Methods*: We devised two breaking continuous flash suppression studies using novel methodological setups to isolate our effects of interest from potential confounds. Using adaptive staircase algorithms with trial durations as stimulus intensities, we examined performance for threatening and disgusting stimuli at individually determined thresholds. We analyzed performance in two 2AFC tasks (localization and discrimination) to determine which stage of information processing is affected. Skin conductance response to aversive stimuli was measured during the conditioning phase as an indicator of arousal. *Results:* The first experiment confirmed our hypotheses that fear-conditioned stimuli are detected and discriminated better than neutral stimuli. Mean standardized skin conductance response was positively correlated with the magnitude of conditioning-related perceptual preference, indicating that fear-related effects were grounded in underlying arousal. On the other hand, the second experiment yielded results contrasting with our initial hypotheses. Instead of expected perceptual suppression, we found an increased performance for disgust-conditioned stimuli, also correlating with underlying arousal, although the effects were weaker and less robust as compared to fear. *Discussion*: During my presentation, I will discuss three possible non-exclusive explanations of our effects: 1) There is a perceptual preference for disgusting stimuli, related to attentional processing, 2) Preferential processing of homeostatically relevant stimuli is dominantly driven by arousal, 3) Disgust conditioning has heterogeneous effects and co-elicits other emotions, such as fear.

Panel 1 | Talk 4:   André Hechler

Quantifying the brain-wide metabolic effects of predictive processing

André Hechler [1,2], Floris de Lange [3], Valentin Riedl [1,2]
[1] Neuroradiology Department, Klinikum rechts der Isar der TU München
[2] Graduate School for Systemic Neurosciences, LMU München

Introduction: The brains' ability to predict sensory input and infer its sources guides a wide range of cognitive processes. While predictive processing clearly optimizes informational aspects of perception and decision making, a biologically realistic implementation must take the energetic limits of brain metabolism into account. Interestingly, theoretical and empirical studies suggest that minimizing the mismatch between internally generated predictions and bottom-up input also minimizes energetic cost. However, the relationship between conventional imaging techniques like BOLD and EEG and metabolic processes is complex, indirect, and difficult to obtain on a systems level. *Methods*: To address this methodological shortcoming, we here apply a novel multiparametric MR method that quantifies the cerebral metabolic rate of oxygen on a voxel level during visual stimulation using a statistical learning paradigm. *Results:* We show that oxygen use is affected throughout the whole brain, extending beyond local peaks of activity in functionally specialized regions. Furthermore, interindividual variability in prediction error cost scales with subjective confidence regarding learning performance. The resulting metabolic differences exceed five percent and whole-brain level - an effect magnitude usually observed only locally or between different tasks. *Discussion*: In summary, our quantitative MR method shows that valid predictions are central to the brain wide energy balance as large amounts of resources are allocated to process deviations. Finally, the explanatory power of confidence ratings shows that energy expenditure can be derived from metacognitive judgements that fit within a Bayesian framework.

Is my "red" your "red"?: Unsupervised alignment of qualia structures via optimal transport

Kawakita, G. [1,2], Zeleznikow-Johnston, A. [3,4], Tsuchiya, N [3,4,5,6], Oizumi, M. [2]
[1] Department of Bioengineering, Imperial College London, London
[2] Graduate School of Arts and Science, The University of Tokyo, Tokyo

Introduction: A fundamental question in the study of consciousness is "To what extent are sensory experiences equivalent between individuals?" One promising approach is to intersubjectively compare the similarity relationships of sensory experiences, named "qualia structures". An issue with existing methods is the assumption that sensory experiences evoked by the same stimuli must be matched across participants, precluding the possibility that "my red" might be "your blue". *Methods*: To address this limitation, we present a novel method for assessing the degree of similarity between qualia structures without assuming any correspondence between experiences across individuals. Our approach, based on Gromov-Wasserstein optimal transport, aligns subjective experiences in a purely unsupervised manner, using only their subjective relationships. *Results:* As a proof of concept, we applied our method to a large-scale dataset of color dissimilarity judgments on 93 colors collected from 488 participants. We found that qualia structures colors can be aligned across different groups of participants solely based on the subjective relationships between experiences. *Discussion*: While we focused only on color similarities, our method has the potential to be applied to a wide range of subjective experiences and different modalities. Our approach offers a novel and powerful tool for quantitatively exploring various aspects of subjective experiences and advancing our understanding of consciousness.

Oral Presentation/Talk Abstracts
Panel 2

March 15, 2023 at 10:50-12:20 | Discussion only not foreseen

Panel 2 | Talk 1:   Corinna Schulz

Ghrelin amplifies hedonic drive and food reward signaling in binge eating disorder

Schulz, C. [1], Schwab, J. [1], Wentz, D.J. [1], Neuser, M.P. [1], Hallschmid, M. [2,3], Svaldi, J. [4], & Kroemer, N.B. [1,5]
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Introduction: Ghrelin is the only circulating orexigenic hormone to modulate reward processing via direct and indirect effects, including vagal afferent projections. Yet, it remains unclear how ghrelin contributes to the pathophysiology of binge eating (BE). **Methods**: In 65 BMI-matched (MBMI = 31.5 ± 6.98 kg/m2) women with varying symptoms of BE (no BE, subsyndromal BE disorder (sub-BED), BE disorder (BED)) concentrations of acyl (AG) and des-acyl ghrelin (DG) were assessed before (fasting) and after a standardized breakfast. Participants also performed a food bidding fMRI task ~60 min after the meal. **Results:** First, we observed group differences in postprandial ghrelin concentrations: participants with BED (vs no BE) showed attenuated meal-induced decreases in DG ($p = .047$), and both BED and sub-BED showed altered meal-related changes in early AG and late DG ($p = .030$, $p = .002$). Second, in contrast to preclinical findings, ghrelin did not boost the effort for food, but higher levels of DG made effort more strongly dependent on liking ratings ($p = .002$). Third, in line with a role of ghrelin in modulating vagal afferent signals, higher fasting levels of AG were associated with greater food-cue reactivity in the nucleus of the solitary tract (NTS; pSVC = .025) across groups. Participants with BED (vs no BE) showed elevated food-cue reactivity in the NTS (pSVC = .025). **Discussion**: We conclude that ghrelin amplifies the hedonic drive to pursue preferred food, while dysregulation in meal-induced reductions in ghrelin is associated with an elevated risk for BE. Furthermore, our results shed light on the role of vagal afferent signals in amplifying food reward signals. Ultimately, this may improve treatments for pathological eating by targeting the gut-brain axis.

Practical considerations in deploying hybrid fNIRS-EEG system on frontal lobe: an emotion recognition case study

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Introduction: EEG excels in providing temporal information, while fNIRS is ideal for locating the activation source. We investigated the complementary nature of fNIRS and EEG in the frontal lobe for emotion recognition. We distil the main lessons learnt and guidelines for future deployment of hybrid fNIRS-EEG systems. *Methods*: Using affective video-, sound-, and music-stimuli, three studies were conducted with 30 participants in each. While wearing fNIRS and EEG probes, participants rated their feelings in response to the stimuli on the dimensional model of emotions over 24 trials/study. A total of 16 electrodes were placed on the participants' frontal lobe, including the prefrontal cortex(PFC), Broca's area, and supplementary motor cortex, while eight fNIRS optodes were placed only on the PFC. Both temporal and spectral features from both modalities were extracted. A binary classification of affective states was performed using a subject-dependent approach for each type of emotional content. *Results:* Single-trial classification results showed comparable accuracy between the two modalities, and the hybrid system. For example, valence state during music-listening was correctly detected with accuracy of 64% (EEG-alone), 67% (fNIRS-alone), and 69% (hybrid system). There was no significant difference. A similar trend was observed for sound-stimuli and video-stimuli across the three affective states. *Discussion*: We did not observe complementarity between EEG and fNIRS. This may be due to the majority of the distinguishing features for the classification model coming from the information collected in the PFC. This could show: (i) fNIRS is as good as EEG in providing information on emotions from the frontal lobe, (ii) HCI studies can benefit greatly from the use of fNIRS optodes over wet EEG electrodes due to time-saving and convenience, (iii) Considering the information provided by fNIRS on PFC, EEG electrodes could be used on other lobes of the brain to possibly provide complimentary information.

How do mindfulness-based trainings reduce physiological stress? Assessing changes in attention and acceptance traits and their role in cortisol reduction

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Introduction: Mindfulness-based interventions have become a popular means to reduce stress. However, the mechanisms driving observed stress reduction remain understudied. Prior research aiming to pinpoint these specific mechanisms has benefitted from dissecting mental training interventions into distinct training modules containing different types of mental practices. This had led to the development of the Monitor and Acceptance Theory. This asserts that during mindfulness training, attentional and interoceptive capacities are first developed which may lead to emotional agitation and symptom exacerbation as monitoring is learned. However, through the secondary cultivation of acceptance and acceptance related capacities individuals learn how to manage these affective states, and thus stress reduction occurs. *Methods*: In the context of a longitudinal mindfulness training study, the ReSource project, healthy participants underwent three 3-month mental training modules targeting either attentional (Presence module), socio-affective (Affect module) or socio-cognitive skills (Perspective module). We tracked the development in a range of mental capacities relating to either monitoring or acceptance and related changes in these mental capacities to participants' stress-reactive cortisol levels following standardized psychosocial stress induction. *Results:* We found that monitoring and acceptance capacities modulated stress sensitivity. However, this was dependent on the type of training undergone. In those who trained presence, cultivation of attention based capacities was associated with higher stress sensitivity, however the reverse effect was found for those who trained in the Affect of Perspective modules. Trend level effects were observed for acceptance related capacities. *Discussion*: Our results corroborate the requirement of attention/monitoring to fully access the supporting emotional capacities to build stress resilience. Moreover, cultivating acceptance is a benefactor in lowering cortisol stress reactivity. Together, the current study Overall, mental training relies on the co-development of several interacting processes to successfully attenuate stress.

Introducing a structured online video interview to assess digital biomarkers of psychologial distress

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Introduction: To capture mind-body interactions in psychiatric disorder development, personalized approaches integrate psycho-physiological phenotyping with continuous measurement of subjective wellbeing. Longitudinal designs often rely on questionnaire-based measures, which are fast and affordable to assess, but limited by their linearity and self-report biases. We developed and tested a new structured online video-interview to identify 'digital biomarkers' (DBMs) of mental health for objective, scalable and sensitive symptom quantification. *Methods*: During the interview, participants respond to questions on potential symptoms of psychological distress and their experience of recent and upcoming emotional events by recording short video of themselves. Potential digital biomarker features are extracted from the videos using open-source algorithms. For a preliminary proof-of-concept analysis, we evaluated features of facial emotional expressivity (e.g., happy expression), facial movement (e.g., nose wrinkling) and vocal acoustics (e.g., pitch) for their overlap with self-reported mental wellbeing, assessed via the general health questionnaire (GHQ-28). Data was collected at study baseline of the EU-funded dynamic modelling of resilience intervention study (DynaMINT) until about half of the target inclusion rate was reached (data pull date: 17.10.2022). *Results:* Complete data was available from N=94 participants aged 18-27 screened for psychiatric diagnosis. Total GHQ scores ranged from 7 to 63, demonstrating meaningful variance. Based on literature research, a subset of 13 facial and 16 audio features were preselected for the present analysis. Happy, surprised, sad and angry facial expressions were all negatively associated with GHQ scores. No individual acoustic feature significantly related to GHQ scores. *Discussion*: Reduced general facial expressivity in a structured online interview could be an objective indicator of psychological distress symptoms. In future steps, we will examine convergence of specific interview questions with symptom subclusters including somatic complaints and anxiety/insomnia. We will also examine associations with endocrine, neurobiological and task-based measures to assess whether DBMs show improved overlap compared to questionnaire-based scales.

Is loneliness linked to prosociality? A meta-analysis of 36 studies with 43,508 participants.

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Introduction: The Evolutionary Theory of Loneliness (ETL) posits that loneliness may motivate individuals to approach others, but at the same time increase focus on self-preservation and safety, resulting in egocentric behavior, negative social expectations, decreased trust or increased social threat monitoring. Since the empirical evidence for the link between loneliness and prosociality is far from conclusive, the current meta-analysis aims to estimate the strength of this relationship and explore factors impacting it. *Methods*: A systematic search of PsycINFO, PubMed and Scopus was conducted in line with PRISMA 2020 guidelines to identify studies investigating the link between loneliness and prosociality. Only peer-reviewed studies using quantitative methods were included into the final sample (k=36; n=43,508; 52.78% females, mean age=25.16). Random effects models and meta-regressions employing age, sex ratio and type of the sample (WEIRD vs non-WEIRD) as meta-regressors were included in the analysis. While the main analyses were performed for the whole sample of the studies, secondary analyses were conducted separately for studies using either behavioral, declarative or observer-rating measures of prosociality. *Results:* We have found a significant albeit weak negative correlation between loneliness and prosociality [r=0.118, 95% CI: (-0.179, -0.057), p<0.001], which was stable among different types of prosociality measures. Only sex ratio was found to be a significant predictor of the strength of link between loneliness and prosociality, with stronger effects found in the samples with higher male ratio. *Discussion*: Our results support the hypothesis posited by ETL as a negative association between loneliness and prosociality has been found. However, this effect explains only a small amount of the prosociality variance, thus suggesting that other factors associated with social functioning, such as social status or social cognitive bias, should be further investigated.

Body-Wandering: Investigating the Subjective and Physiological Fingerprints of Interoceptive Mind-wandering.

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Introduction: The human mind spends much of its time, and metabolic energy, idling. During these idle states, substantive inter-individual differences in the contents of spontaneous thought, or mind-wandering, arise. Previous research has demonstrated robust patterns in the contents of mind-wandering, which are replicable across cultural contexts. However, most studies have focused on cognitive contents such as the temporal, affective, or social nature of spontaneous thought. As such, less is known about the degree to which self-generated cognition may index interoceptive feelings such as the sensation of breathing, the heartbeat, or gastro-intestinal sensations. *Methods*: To investigate this embodied axis of mind-wandering (i.e., 'body-wandering'), we expanded the multi-dimensional experience sampling approach to index interoceptive and somatic sensations in a sample of 500 healthy participants, acquired after resting state functional imaging with concurrent cardiac and respiratory recordings. Furthermore, participants completed psychophysical interoception tasks across cardiac and respiratory domains. *Results:* Through exploratory factor analysis, we found that body-related feelings are clustered primarily with the affective dimension of thoughts, such that increased interoception-oriented thoughts are generally associated with more negative and less positive thoughts. We further found that while interoceptive thoughts were overall less intense in self-reported frequency than typical cognitive dimensions, that respiratory sensations specifically dominated the body-related axis in magnitude and were associated with more temporally extended thoughts. Analysing concurrent physiological signals, we found that affective and personhood-related thoughts are associated with individual differences in autonomic arousal. In contrast, breathing was associated with broad aspects of mind wandering. Finally, canonical correlational analysis revealed specific patterns of brain connectivity associated with embodied aspects of mind wandering. *Discussion*: These results shed light on the embodied and affective nature of the idling mind, particularly within the (dis)-embodied context of lying at rest in the MRI scanner. Results indicate potential physiological confounds with specific patterns of thoughts during resting state fMRI.

Oral Presentation/Talk Abstracts
Panel 3

Panel 3 | Talk 1:   Yulia Revina

Expectations about pain location do not improve pain discrimination performance

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Introduction: In any sensory domain, there is a necessity for an interplay between top-down and bottom-up processing due to the noisy sensory world, i.e. for efficiently interpreting input, prior knowledge and sensory information should ideally be combined. In the domain of pain, prior knowledge – in the form of expectations – has been shown to strongly influence the perceived intensity of pain. It is yet unknown however, whether expectations can also facilitate perceptual discrimination between different pain stimuli. *Methods*: We tested to what extent expectations about the probability of receiving a painful stimulus in a specific location on the body can facilitate pain discrimination performance in that location. We modified a paradigm from vision science, which found that presenting an informative cue about the upcoming stimulus can improve performance on a perceptual discrimination task (Kok et al. 2012, 2014). We presented participants with 1 of 2 visual cues on each trial, signifying that either the left or the right arm was more likely to receive painful stimuli (75% validity). Participants then received 2 temporally simultaneous – but spatially non-overlapping – painful heat stimuli on the forearm and judged which of the two stimuli was more painful. *Results:* We successfully induced expectations regarding pain location, as measured by participants' reports of the experienced expectation ratio and by increased pupil dilation after unexpected location pain. Yet, there was no significant difference in task performance – psychometric function slope and reaction times – in pain intensity spatial discrimination for the expected vs unexpected location. *Discussion*: Our results suggest that knowing the upcoming location of impending pain does not help with discriminating intensities of adjacent painful heat stimuli. Further research should investigate whether expectations about stimulus features, rather than stimulus location per se can improve perceptual discrimination performance.

People actively adjust the gaining of tactile data based on how their heartbeats alters their perceptual sensitivity

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Introduction: Perception varies as a function of phasic bodily changes such as heartbeats. For instance, our tactile sensitivity varies during the two phases of our heartbeat: relative to diastole, people are less perceptive to being touched during systole (when the heart ejects blood). These findings have been key to advancing the field. Yet, it is also true that sensing of most kinds is an active process; we rarely leave our hands still and wait passively to be touched. Here we asked: does the cardiac cycle modulate active touch sensing? *Methods*: We recorded the electrocardiograms of 46 subjects while they actively performed a tactile grating orientation task. They were free to start, hold, and end sensing the gratings (i.e., touch) when they felt like it. There were seven difficulty levels according to the gratings' widths, plus, a control movement condition with a flat stimulus. We tested whether our subjects preferentially touched in a specific phase of the cardiac cycle, and the resulting changes in accuracy and time spent touching the gratings *Results:* The subjects did not start touching in a specific cardiac phase, and their accuracy was similar during both cardiac phases. However, the duration of their touch did vary as a function of the cardiac phase in which they initiated it. Touches initiated in the systole phase were held for longer periods of time than touches initiated in diastole. This effect was most pronounced when elongating the duration of the touches to sense the most difficult gratings. Conversely, the duration of touches in the control condition did not vary as a function of the phase in which these were initiated *Discussion*: People actively adjust how they acquire sensory information based on how their phasic bodily changes alter their senses. In this case, by elongating their touches to counteract cardiac-related attenuation on somatosensory perception

Neural activity is modulated by spontaneous and volitionally controlled breathing

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Introduction: Breathing is a cyclic bodily rhythm consisting of active inspiration and passive expiration. Although mainly in autonomic control, breathing can also be volitionally controlled. Recent animal and human studies have provided evidence regarding respiration-brain coupling, but less is known on how breathing modulates the state of the body and brain. In this study we examined how respiratory, cardiac, and neural measures differ between spontaneous and volitionally controlled breathing. Furthermore, we investigated how neural activity is modulated across the phases of breathing. **Methods**: Magnetoencephalography (MEG), electrocardiography and respiration data were recorded from 40 participants. MEG recordings consisted of four conditions: spontaneous breathing with eyes closed, spontaneous breathing with eyes open, deep breathing, and square breathing. Respiratory and cardiac measures as well as sensor-level power spectral density of the MEG signals were calculated for each breathing condition. Fitting oscillations and one over f algorithm was used to extract periodic and aperiodic components of the power spectra. Moreover, to investigate the spatial distribution of neural activity during different phases of spontaneous and deep breathing source reconstruction was applied. *Results:* Statistically significant differences in respiratory rate, heart rate, and heart rate variability were observed between spontaneous and volitionally controlled breathing. Moreover, periodic and aperiodic components of the sensor-level power spectra differed between breathing conditions. Source-level cluster-based permutation test results indicated that alpha power (8-13 Hz) decreased during inspiration and increased during expiration in the time windows from 0 to 2000 ms with respect to the inspiration and expiration onset in comparison with the baseline time window of -500 to 0 ms. The effects were observed in sensorimotor and parietal areas during spontaneous and deep breathing. **Discussion**: These results suggest that both the breathing technique and phases of breathing modulate neural activity. However, further research is needed to establish the possible behavioural and clinical implications of respiration-brain coupling.

Panel 3 | Talk 4:   Fivos Iliopoulos

Fundamental Unconscious Modulators of Somatosensory Perception

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Introduction: Perception of the same stimulus can vary greatly from trial to trial. Numerous studies show that "near-threshold stimuli" are sometimes consciously perceived and sometimes not. Here, we investigate fundamental non-conscious factors underlying this profound variability in somatosensory perception. *Methods*: Three studies were conducted to examine the effects of extrinsic and intrinsic presumed non-conscious modulators on somatosensory perception. In the first study, the effect of subliminal noise on peripheral somatosensory perception was investigated using behavioral methods. In the second study, the effect of different forms of pulsed subliminal stimulation on brain rhythms and somatosensory perception was examined using behavioral and EEG methods. In the third study, the influence of interoceptive signaling, specifically from the heart, on somatosensory perception was examined. *Results:* In the first study, it was found that non-felt peripheral noise can actually improve perception of weak somatosensory stimuli, likely due to stochastic resonance effects. In the second study, results showed that trains of subliminal stimuli inhibit subsequent somatosensory detection, but with decreased Mu rhythm in contrast to previous findings for single pulses. These results suggest that central rhythms mediate the perceptual modulation of peripheral subliminal stimuli, but the relationship is more complex than previously assumed. In the third study, it was found that somatosensory perception was better during diastole than during systole and detection performance declined as the amplitude of the Heart-Evoked Potential (HEP) increased. *Discussion*: The results of these studies suggest that peripheral noise, subliminal pulsed stimulation, and interoceptive signaling significantly modulate somatosensory perception in different ways. Subliminal external noise can surprisingly enhance stimuli perception while the relationship between central rhythms and peripheral subliminal stimuli is more complex than previously assumed. Additionally, our findings show that detection performance declines as the amplitude of the HEP increases, suggesting that HEP may be a marker of the relative balance between interoception and exteroception.

Does the Vertex Potential reflect the activation of the extralemniscal system?

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Introduction: Sudden changes in the sensory environment elicit a transient, large and widespread biphasic negative-positive deflection in the ongoing electroencephalogram: the Vertex Potential (VP). The VP has been traditionally interpreted as a result of modality-specific lemniscal sensory processing. However, VP shares a number of properties with the extralemniscal system, which conveys low-fidelity information from multiple sensory modalities, produces global arousal modulating other brain systems and processes through its diffused thalamic and cortical targets. We therefore propose that the VP reflects the cortical consequence of extralemniscal processing. Should this be the case, VP should similarly influence various brain processes such as somatosensory processing and motor output. *Methods*: We explored whether and how early somatosensory processing (probed by recording somatosensory evoked potentials [SEPs] elicited by high-frequency median nerve stimulation) is modulated by concomitant VPs elicited by isolated auditory stimuli, in healthy human participants. We grouped single-trial SEPs as a function of the phase of the VP waveform, and thereby provided a dynamic evaluation of the VP-dependent modulation of early somatosensory processing. *Results:* The N20 component, which represents the arrival of the first thalamocortical volley, was unaffected by the VP phase. In contrast, the amplitude of the P45 component, which reflects later intracortical processing, was reduced during the negative and enhanced during the positive VP wave. Crucially, these effects were enhanced when the SEPs were grouped accounting for the latency variability of single-trial VPs, demonstrating that the modulation is truly consequent to the VP and not some other concomitant process triggered by the auditory stimulus. *Discussion*: These results indicate that the VP exerts a strong phase-dependent modulation of lemniscal somatosensory processing. Together with the observation of similar effects on the corticospinal drive and motor output, these finding provide strong evidence that the VP reflects activation of the extralemniscal system.

Sponsor Workshops A

Sponsor Workshops A | 1:   Sophie Ankner

Brain Products / MES Forschungssyteme GmbH

The Brain in Motion – Neuroscientific Imaging Methods

During the recent years there has been a switch in the design and implementation of brain imaging studies (conducted with modalities particularly EEG and fNIRS): Previously their application fields have been namely restricted mostly to laboratory environment because of the size, weight, and sensitivity of the utilized system. Yet, since more and more (neuro)scientists wished to explore brain functions under naturalistic / real-life conditions, in which subjects can freely move around and interact with the environment, there was and still is an increasing demand for mobile neuroimaging systems. Fortunately, thanks to the ongoing technological development, we can now design ultra compact, artefact (motion or environmental noise) resistant, and wireless brain imaging tools. During the MindBrainBody Symposium we are more than happy to present our state-of-the art wireless EEG and fNIRS solutions for your mobile as well as lab studies: Including gel-based/salt-water-based EEG (BrainProducts LiveAmp), high-density EEG (CGX mobile), dry EEG (CGX Quick), and mobile fNIRS (NIRx NIRSport 2).

Sponsor Workshops A | 2:   Alex Dimov

BIopac,Systems Inc.

High density multimodal fNIRS Application: from Virtual Reality to Real-World

Parallel to the increasing use of fNIRS in research, Virtual Reality is now used in an ever growing number of labs. We will present a mobile, high-density fNIRS system which integrates with VR, and also with additional measures such as EEG (natively built into the system) and peripheral physiological signals. We will demonstrate how all these tools are integrated and synchronized in order to provide a user friendly experience for researchers. We will also show how this integrated solution can be used in the real world, from simple lab tasks to experiments in the field. In addition, the fNIRS solution presented features a unique high-density design that makes it easier to deal with hair and have a high-level of comfort for participants.

Sponsor Workshops A | 3:   Eshwar Ghumare

ANT Neuro

Quick high-density EEG measurements with the advances in eego™ solutions

High-density electroencephalography (EEG) is a powerful tool for studying neuronal brain dynamics with high temporal and spatial resolution, and it has shown a lot of promise in neurology and neuroscientific research. However, some challenges limit its use in clinical and research settings, such as longer setup and subject preparation times. Solutions to these challenges must be made available. This presentation will discuss our most recent high-density EEG innovations, eego™ hub, which is a fully integrated system, as well as our well-known high density EEG package, eego™ mylab. We will also discuss, different applications and how you can combine it with saline-based waveguard™ nets which gives you access to a full system providing high-quality research-grade EEG data with quick setup and subject preparation time.

Sponsor Workshops B

Sponsor Workshops B | 1:   Felix Toepfer

NIRx

fNIRS hyperscanning, a live demonstration

Interoception denotes the perception, control, and metacognition of visceral homeostatic signals. While interest in interoception is on the rise, methodological issues limit our ability to quantify individual differences in interoceptive ability. Here I will present two new methods for quantifying respiratory and cardiac interoception. Healthy participants completed a cardiac interoception (n = 550) and respiratory

Sponsor Workshops B | 2:   Artur Czeszumski

Mentalab

Unlocking the Secrets of the Brain: The Power of Mobile EEG Devices

Mentalab makes mobile EEG and ExG solutions designed to measure and monitor brain and other physiological biosignals at high precision. One of Mentalab's strenghts is the mobility and design of their EXG system: Mentalab Explore is the most compact system on the market, easy and convenient, and applicable to a wide range of users in healthcare, research, and beyond. Mentalab products combine high-precision sensors with portable, user-friendly, and accessible designs for researchers and other users. Mentalab is a cost-effective and accessible way to collect EEG / EXG and movement data. Mentalab has developed various software applications to acquire and stream biosignals in real time. Despite being a relatively young company, Mentalab has already made significant strides in mobile biosignal technology. The company has been recognized with several awards and has partnerships with various organizations, including hospitals and universities. Overall, Mentalab's innovative products offer a better solution for those looking to monitor human brain activity and other biosignal data in a convenient and accessible way.

Poster Session A

March 14 at 19:00-19:45 | Virtual March 17 at 10:30-11:30

Poster #	Presenter (s)	Poster Title
A01	Andrea Hiott	A hippocampal case for Waymaking: reframing memory and navigation alleviates traditional mind/body dichotomies
A02	Cyril Costines	Exploring Altered States of Consciousness: A Pilot Study of Phenomenomics Using Citizen Science
A03	Aleksandra Piejka	Social cognitive and parasympathetic correlates of loneliness in everyday life
A04	Alireza & Vanessa Nia & Vanessa Tang	Practical considerations in deploying hybrid fNIRS-EEG system on frontal lobe: An emotion recognition case study
A05	Withdrawn	Withdrawn
A06	Anika Theresa Löwe	Neural networks mimic human insight
A07	Valerio Placidi	You don't deserve my honesty! The way individuals obtain their social status influences moral behaviour towards them
A08	Maria Azanova	Heart-brain interactions in feedback processing? Consider pseudotrials first
A09	Markus Tünte	The Relationship between Automatic Imitation, Interoception, and Coupling with the Cardiac Cycle
A10	Till Nikolaus von Heiseler	Punishment is neither sufficient to secure existing social order nor to explain the evolution of human cooperativeness
A11	Jonas Weisser & H.D. Lee & J. Zegrer	Solving the Adaptive Valley Problem of Cultural Group Selection
A12	Paula Salamone	Feeling yourself when your self is altered in Schizophrenia
A13	Michael Aristodemou	Working memory fluctuations across multiple timescales
A14	Mahdiehsadat Mirmohammad	Exploring Neural Networks in Emotional Processing and Cognitive Control in Mood Disorders: An EEG Study of the Default Mode and Frontoparietal Networks
A15	Mathis Lamarre	Attention weights accurately predict language representations in the brain
A16	Valeria Becattini	Emotional Body Maps of Self-Detachment in Depersonalisation and Meditation
A17	Jellina Prinsen	Cardiac autonomic imbalance is manifested across the brain-heart axis in children with ASD: Insights from effective connectivity modelling
A18	Angeliki Charalampaki	Metacognition of agency: an EEG study
A19	Tal Geffen	Functional connectivity gradients and thought-patterns in schizophrenia - negative symptoms
A20	Hendrik-Jan De Vuyst & Javier Soriano	Development of a novel EEG-based neurofeedback protocol based on alpha-theta cross-frequency interactions in the context of stress regulation: A protocol presentation
A21	Julia Folz	Feeling your emotions in my body? The role of interoception and facial mimicry in emotion processing
A22	Alkistis Saramandi	Can I Feel my Heartbeat and Hunger? An Exploration of Interoceptive Belief Updating in Anorexia Nervosa
A23	Reinoud Kaldewaij	The backbone of the self? Differential spinal cord activity during self-other-object touch
A24	Magdalena Sabat	What is arousal? - An automated analysis of a corpus of 48.000 scientific articles and neuroimaging meta-analysi
A25	Norman Forschack	Attentional capture is modulated by stimulus saliency in visual search as evidenced by event-related potentials and alpha oscillations
A26	Antonin Fourcade & Francesca Malandrone	Minimally invasive and continuous rating of affective experience in immersive Virtual Reality
A27	Felix Klotzsche & Ammara Nasim	Stereoscopic vision and emotional face processing: insights from a combined EEG and virtual reality study

Poster Abstracts

Poster Session A

March 14, 2023 at 19:00-19:45 | Virtual March 17, 2023 at 10:30-11:30

Poster: **A01**   **Andrea Hiott**

A hippocampal case for Waymaking: reframing memory and navigation alleviates traditional mind/body dichotomies

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Introduction: The past hundred years of research relative to the hippocampal formation illuminates a new approach to understanding cognition, one that allows us to understand remembering, acquiring knowledge, and navigating as nested behaviors of a continuous process. This paper defines this process as Waymaking, offering evidence that cognition and navigation arise and evolve as ways of making way through an encounter. This framing alleviates traditional problems of dualism and subject/object dichotomy: Recent work relative to the hippocampal formation may provide a model towards approaching the study of mind and body continuously. *Methods*: Citing evidence from the tradition of hippocampal studies relative to memory, navigation, and knowledge acquisition—from Milner to Tollman; Nadal & O'Keefe to the Mosers—we trace a gradual shift away from traditional philosophical dichotomies of knowledge/action, mind/body, and subject/object and demonstrate the opening of a scaled approach using matrix-like stratification whereby words like mind, body, thought, and action nest together in a continuous multi-dimensional process. We demonstrate this by reviewing and reframing current research demonstrating memory, navigation, and knowledge acquisition as scales of agential waymaking. *Results:* This review shows that gradually, over the past century, hippocampal research has uncovered the means for reframing cognition as continuous with the navigational process. Reframing this research clarifies this paradigm and illuminates connections in research across traditional dividing lines around representation, behavior, and part/whole mereology. *Discussion*: This rearranges current questions relative to mind and body, suggesting we might better understand mental disease and physical disease not as different phenomena but as nested levels in a common process. Doing this alleviates traditional dichotomies and releases unused potentials in past and present research—i.e., confirming that whether one is making a physical change or a mental change, one is tweaking the same process.

Exploring Altered States of Consciousness: A Pilot Study of Phenomenomics Using Citizen Science

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Introduction: An important task of empirical consciousness research is the identification of invariant structures of conscious experience, also called basic dimensions of consciousness. The study of altered states of consciousness (ASC) induced by mind-modifying techniques (CMT) may be particularly fruitful in this context. The variability of these ASCs should allow us to uncover invariant, etiology-independent phenomenological patterns and identify the fundamental dimensions of consciousness to map the so-called phenomenal state space (PSS). We refer to this approach as "phenomenomics": the systematic study of the PSS. *Methods*: As part of the Phenomenomics project, a pilot study was conducted in October 2022 in collaboration with Citizen Science specialists El Gato y La Cvaya (Argentina). Data were collected from participants on their altered experiences induced by four CMTs: alcohol, cannabis, MDMA, and psilocybin. As a quantitative measure, a 22-item version of the 11-ASC questionnaire was used, supplemented by open-ended reports. *Results:* Approximately 10,000 responses were collected over a 5-day period, demonstrating distinct phenomenological patterns for alcohol, cannabis, MDMA, and psilocybin, including their dose-dependent modulation. Most pronounced with alcohol and cannabis was a sense of impaired control and cognition, with alcohol additionally eliciting a sense of unity and cannabis insight. MDMA and psilocybin induced a sense of bliss, insight, and unity, with psilocybin further associated with altered perceptual meaning, complex imagery, and elemental imagery. *Discussion*: In this pilot study, the psychometric properties of a 22-item version of the 11-ASC questionnaire were examined using citizen science crowdsourcing methods. The results were consistent with meta-analytic findings on drug-induced phenomenology and dose-response relationships reported in conventional laboratory studies. This demonstrates the feasibility, cost-effectiveness, and informational value of citizen science in developing a data-driven, formalized, phenomenology-based, and CMT-independent taxonomy of ASCs that is highly relevant to both neuroscience and clinical research.

Poster: **A03**   **Aleksandra Piejka**

Social cognitive and parasympathetic correlates of loneliness in everyday life

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Introduction: Recent decades brought an increased interest in investigating multidirectional associations between subjective states, physical health, and social functioning. One of the major research topics linking all these levels of analysis is loneliness, which was repeatedly found to be a significant risk factor for psychiatric disorders, cognitive impairments, and cardiovascular diseases. While a plethora of research provided evidence for deleterious consequences of perceived social isolation, the exact mechanisms underlying its associations with psychopathology and poor physiological outcomes are still not fully understood. The presented study aimed at examining those in a real-life context. *Methods*: 105 participants divided into groups of lonely (LI) and non-lonely individuals (NLI) were recruited to participate in a laboratory session and a week-long experience sampling study including physiological passive monitoring of heart activity. In the laboratory, they completed a set of tasks measuring various aspects of social cognition. The experience sampling included multiple daily assessments of one's feelings, reports on activities, company types, and appraisals of one's current situation. *Results:* In their daily life, LI experienced more negative and less positive affect, and declared less positive and more negative appraisals of both their company and being alone. In line with our previous findings, the effect of group on negative appraisals of one's company was mediated by social cognitive biases, but not objective social cognitive capacity. Moreover, we found that of all emotions assessed daily, only loneliness and abandonment were negatively related to heart rate variability, a marker of parasympathetic activity. *Discussion*: The demonstrated effects of loneliness on perceived social threat corroborate previous evidence for hypervigilance in lonely individuals and provide insights into the potential cognitive mechanism which could be targeted in future interventions. Moreover, the negative relationship between daily loneliness and parasympathetic activity highlights the potential pathways linking daily experiences with both physiological and psychological dysregulation.

Poster: **A04**   **Vanessa Tang & Alireza Nia**

Practical considerations in deploying hybrid fNIRS-EEG system on frontal lobe: an emotion recognition case study

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Introduction: EEG excels in providing temporal information, while fNIRS is ideal for locating the activation source. We investigated the complementary nature of fNIRS and EEG in the frontal lobe for emotion recognition. We distil the main lessons learnt and guidelines for future deployment of hybrid fNIRS-EEG systems. *Methods*: Using affective video-, sound-, and music-stimuli, three studies were conducted with 30 participants in each. While wearing fNIRS and EEG probes, participants rated their feelings in response to the stimuli on the dimensional model of emotions over 24 trials/study. A total of 16 electrodes were placed on the participants' frontal lobe, including the prefrontal cortex(PFC), Broca's area, and supplementary motor cortex, while eight fNIRS optodes were placed only on the PFC. Both temporal and spectral features from both modalities were extracted. A binary classification of affective states was performed using a subject-dependent approach for each type of emotional content. *Results:* Single-trial classification results showed comparable accuracy between the two modalities, and the hybrid system. For example, valence state during music-listening was correctly detected with accuracy of 64% (EEG-alone), 67% (fNIRS-alone), and 69% (hybrid system). There was no significant difference. A similar trend was observed for sound-stimuli and video-stimuli across the three affective states. *Discussion*: We did not observe complementarity between EEG and fNIRS. This may be due to the majority of the distinguishing features for the classification model coming from the information collected in the PFC. This could show: (i) fNIRS is as good as EEG in providing information on emotions from the frontal lobe, (ii) HCI studies can benefit greatly from the use of fNIRS optodes over wet EEG electrodes due to time-saving and convenience, (iii) Considering the information provided by fNIRS on PFC, EEG electrodes could be used on other lobes of the brain to possibly provide complimentary information.

Poster: **A05**   **Poster Withdrawn**

Poster: **A06**   **Anika Theresa Löwe**

Neural networks mimic human insight

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Introduction: Insights, or aha-moments, are a remarkable phenomenon in human cognition, where humans sometimes show sudden but large improvements in task performance. Previous research has shown that insights are characterised by a number of unique features that include abrupt behavioural changes, an extended but variable period of impasse that precedes the insight and selectivity to a few subjects, while for others an insight never arises. They are further regarded as a major source of creativity and scientific discovery and are accompanied by a powerful subjective experience. Based on their unique characteristics, insights are thought to reflect a distinct learning process that only appears in the highest of animals. *Methods*: We tested this idea by comparing learning dynamics in humans and neural networks trained with standard gradient descent in a perceptual decision task that entailed a hidden regularity, which could be discovered through insight. *Results:* We show that neural networks with regularised gate modulation closely mimicked human insight characteristics. Analyses of neural network learning dynamics revealed that insight crucially depended on noise, and was preceded by `silent knowledge' that is initially suppressed by (attentional) gating and regularisation. *Discussion*: Our results suggest that behavioural signatures of insight can naturally arise in gradual learning systems, where they reflect the combined influences of noise, attentional gating and regularisation. While present-day machines clearly do not have the capacity to have aha-moments due to their lack of meta-cognitive awareness, our results show that the remarkable behavioural signatures of insights by themselves do not necessitate a dedicated process. This raises the possibility that sudden behavioural changes which occur even during gradual learning could in turn lead to the subjective effects that accompany insights in humans.

Poster: **A07**   **Valerio Placidi**

You don't deserve my honesty! The way individuals obtain their social status influences moral behaviour towards them

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Introduction: Previous research indicates that multiple personal and contextual variables can influence an individual's propensity to lie to someone else to obtain a reward. Nevertheless, the role of social status is underexplored. Building on recent models indicating that high social status can be acquired by displaying either dominance, competence or virtue, we designed a study aimed at investigating whether the tendency to lie to someone is influenced by our previous knowledge of his/her status in a small group and by the strategy they used to gain such status. *Methods*: In a pilot study, 48 Italian participants (26 females) completed the Temptation to Lie Card Game (TLCG), an economic interactive paradigm that in each trial offers the participants the choice to tell the truth or to lie to an opponent. Depending on the trial, the decision to lie can lead the participant to obtain a monetary reward for themselves (self-gain) or for the other (other-gain). Participants were led to believe that they were playing with people who previously obtained high, middle or low status (manipulated within-subjects) by displaying either dominance, competence or virtue (between-subjects) in a group. *Results:* Results indicate that participants produced significantly more self-gain (egoistic) lies toward dominant high status players compared to virtuous or competent ones. Moreover, participants produced a significantly higher number of other-gain (altruistic) lies toward virtuous high status compared to virtuous low status individuals *Discussion*: This suggests that both a target's social status and the way they used to obtain it can indeed influence moral decision making. More specifically, people seem to lie more to individuals who obtained high social status through dominance, compared to those who obtained it through competence or virtue. Our results were used to generate and preregister a set of hypotheses that will be tested in a larger study.

Heart-brain interactions in feedback processing? Consider pseudotrials first

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Introduction: Cardiac activity influences perception and emotion processing (Al et al., 2021; Critchley & Garfinkel, 2017). We aimed to extend these observations and study the association between the activity of the heart and the neural processing of performance feedback. ***Methods***: To do this, we simultaneously recorded electroencephalogram and electrocardiogram in 37 participants while they performed a probabilistic learning task. We used computational modeling to extract prediction errors and mixed linear models to investigate the effects at a single-trial level. ***Results:*** While initially, we observed significant effects of the heart cycle phase on amplitudes of feedback-related negativity and P300 in sensor and source spaces, we were able to show that these effects were mostly artifactual. We achieved this by developing an approach that combines pseudotrials (Wainio-Theberge et al., 2021) with the behavioral data analysis. Using this framework, we also showed that an association between a change in heart rate and neural responses to feedback was genuine: after controlling for pseudotrials and confounding behavioral variables, heart slowing was significantly positively associated with peak-to-peak amplitudes of FRN and P300. Moreover, the change in the heart rate significantly mediated the effects of absolute prediction error on P300. ***Discussion***: As a result, we not only contribute to the growing heart-brain literature by providing additional evidence for their interaction in decision-making, but crucially, we also highlight the importance of additional controls on the basis of the pseudotrial approach. These critical observations apply to any evoked-response research based on a comparison of conditions in which the underlying distributions of heartbeats might differ.

Poster: **A09**   **Markus Tünte**

The Relationship between Automatic Imitation, Interoception, and Coupling with the Cardiac Cycle

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Introduction: Interoceptive accuracy, the ability to perceive internal bodily signals such as the heartbeat, has been found to be related to the tendency to automatically imitate others hand movements. *Methods*: The present study aimed to replicate previous results of a correlation between automatic imitation and interoceptive accuracy. Going beyond, we manipulated the presentation of stimuli in the automatic imitation paradigm to be coupled with the heartbeat so that stimuli could appear either during systole or diastole (250/550ms after the R-peak). We used a well-established finger-lifting paradigm to measure automatic imitation and a range of interoception measures – a Heartbeat Counting Task, Heartbeat Detection Task, as well as the Interoceptive Accuracy and Attention Scales. *Results:* We fail to replicate previous results showing a relationship between automatic imitation and interoceptive accuracy ($R = .024$, $p = .854$, $N = 62$). Further, we also did not find a predicted relationship between performance in the automatic imitation paradigm and other indexes of interoceptive accuracy as well as coupling with the heartbeat. However, in an exploratory analysis we find that performance on the automatic imitation task was related to confidence ratings in a heartbeat counting task ($R = -.270$, $p = .035$, $N = 62$). *Discussion*: Our results suggest that confidence in perceiving interoceptive signals may have a greater impact on automatic imitation scores than interoceptive accuracy.

Punishment is neither sufficient to secure existing social order nor to explain the evolution of human cooperativeness

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Introduction: Human cooperation is considered a puzzle in a Darwinian world. In the past decades, experimental evidence has shown that people punish unfair behavior even at their own cost. Also, modeling has demonstrated how coordinated punishment of defectors sustains cooperation. Moreover, it was suggested that prosocial human emotions are an adaptation to punishment In this paper, we will show that punishment is neither enough to secure social order nor to explain the evolution of human cooperativeness. *Methods*: (a) In our model, we introduce two selective pressures: punishment in the form of negative fitness points and the costs of altruistic cooperation. (b) We also found empirical evidence that punishment is rare in small-scale societies. *Results:* We learned that punishment can only stabilize social norms on a minimal level but is unable to increase the level of cooperation. Thus, punishment cannot produce a positive selective pressure for complex traits to evolve. *Discussion*: Punishment is unable to explain human cooperation, in which "doing just enough" is not sufficient for the success of the cooperation. It also cannot explain self-sacrifice and behavior that leads to economical, scientific, or technological extraordinary innovations. We suggest that the key to understanding the stability and evolution of human prosociality is better explained as an adaptation to a reputation economy. This economy is in place when past actions of agents affect their social status. This requires that the information about the actions of agents is spread through a population and that said information is then transformed into an image that influences the agent's reputation and thereby their social status.

Solving the Adaptive Valley Problem of Cultural Group Selection

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Introduction: The high degree of prosocial behaviour in humans is seen as a puzzle from an evolutionary standpoint. Cultural Group Selection (CGS) as put forth by Boyd and Richerson makes an important contribution towards solving this puzzle. However, its explanatory power is limited as it requires crossing an adaptive valley and only encompasses roughly the last 200,000 years. *Methods*: Through a critical discussion of CGS, an explanatory weakness is emphasised that the authors are already aware of. Whilst arguing that the authors explanation is insufficient, an alternative is put forth in the form of von Heiseler's Backchannel Hypothesis (BCH), capitalising on the same principle CGS is built on, namely equilibrium selection – an integration of intra- and inter-group selection making group selection consistent with the inclusive fitness approach of standard evolutionary theory. *Results:* Equilibrium selection requires stable and heritable differences between groups. CGS proposes cumulative culture to create this difference. However, this requires crossing an adaptive valley, as prerequisite traits such as social learning, overimitation, and theory of mind are not explained by CGS. In contrast, the BCH proposes reproductive isolation to create stable and heritable differences between groups. It explains how given only the behavioural traits of chimpanzees (as a proxy for our common ancestor) as prerequisite, an evolutionary system can arise that puts selective pressure on prosocial behaviour through social selection in the form of female choice. The Backchannel allows group beneficial (=prosocial) behaviour of an individual to be translated into its reproductive success. *Discussion*: It is argued that the BCH is not only consistent with the core principle of CGS, but that it can solve the adaptive valley problem and extend to encompass roughly the last 6 million years of our ancestor's evolution.

Feeling yourself when your self is altered in Schizophrenia

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Introduction: The current criteria and diagnosis, of psychiatric conditions is based on symptoms rather than biological mechanisms. Science is trying to move forward towards a mechanism-based classification, which would likely improve patient care and treatment. It has been suggested that people with schizophrenia (SZ) may have altered interoceptive mechanisms and self-other distinction. ***Methods***: In order to assess these mechanisms in SZ we designed a study including behavioral, electrophysiological and neuroimaging tasks. An easy way to study bodily self-perception is to compare self-touch with touch from others: both provide comparable stimulation of the skin, but the brain must be able to distinguish between the two types of touch. Interoception is tested using a heartbeat detection task and questionnaires. ***Results:*** Preliminary results show some alterations in interoceptive dimensions and self domains (measured behaviorally and with SEP) with respect to neurotypical volunteers. ***Discussion***: A disturbance of these processes can have far-reaching consequences for the establishment of an adequate bodily self-perception which may lead also to alterations in allostasis and in higher order cognitive domains. This study may increase our understanding of self-perception and body awareness in SZ. In the long run, the results may enable the development of new treatment strategies.

Poster: **A13**   **Michael Aristodemou**

Working memory fluctuations across multiple timescales

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Introduction: Every year millions of children are placed into different developmental programs based on their performance on intelligence tests that are administered on a single occasion. The aim of this mode of stratification is to provide the best support for each child or to impartially distribute opportunities (e.g. selective schools). This practice hides a strong and potentially problematic assumption about cognitive performance—its stability over time. Contemporary evidence shows that children's cognitive performance fluctuates across multiple timescales, forming an understudied source of individual differences. Neglecting differences in fluctuations endangers the validity of cognitive assessment and reflects a lack of appreciation for children's neurodiversity. *Methods*: We aim to progress our understanding of cognitive fluctuations across two timescales: trial-to-trial and day-to-day. We assessed these fluctuations in a domain that has been shown to be central to the structure of intelligence and viewed as the main determinant of fluid intelligence—working memory. We analysed data from 4,098 children that completed 36 days of working memory training. We used a multi-model approach which includes Bayesian hierarchical modeling to assess the substantive importance of these two temporal domains of fluctuations, their interrelation, and their association to performance in mathematics assessments. *Results:* First, we found that day-to-day variability does not explain substantial variance in children's cognitive performance. This is in contrast to findings in existing literature and can be attributed to the addition of a feature of cognitive performance that has been previously unmodelled. Second, we found that fluctuations from trial-to-trial reflect a substantial source of individual differences in working memory performance. Third, we found that differences in trial-to-trial variability predict mathematics performance further speaking to the importance of fluctuations for cognitive assessment. *Discussion*: We discuss mechanisms underlying trial-to-trial fluctuations, e.g., fluctuations in neural spiking activity, and how research into fluctuations can be used to improve cognitive assessment and interventions.

Poster: **A14**   **Mahdiehsadat Mirmohammad**

Exploring Neural Networks in Emotional Processing and Cognitive Control in Mood Disorders: An EEG Study of the Default Mode and Frontoparietal Networks

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Introduction: Mood disorders are associated with impaired cognitive control to inhibit rumination and regulate emotional processing. The present study aimed to investigate the neural networks' role cognitive control during emotional processing in mood disorders by examining the EEG frequency power differences in the default mode network (DMN) and frontoparietal network (FPN) on emotional Go/Nogo task. The DMN and FPN have been associated with self-focused thinking and attentional control, respectively. ***Methods***: This study utilized convenience sampling to recruit participants in mood disorder group from Atieh neuroscience clinic, and a control group was identified through advertisement. Participants underwent an emotional Go/Nogo task while their EEG activity was recorded. The task consisted of presenting participants with positive, negative, and neutral stimuli, requiring them to respond to a target stimulus (Go trials) or inhibit their response to a non-target stimulus (Nogo trials). The EEG data was analyzed to examine the power differences in frequency bands in the DMN and FPN during the task. ***Results:*** The results of the study revealed that individuals with mood disorders displayed significant EEG frequency power differences in the DMN and FPN during the emotional Go/Nogo task. Specifically, there were increased power band in the DMN during the nogo trials and increased power in the FPN during the go trials in response to emotional stimuli. These findings suggest that the DMN may play a role in the inhibition of negative emotional stimuli, while the FPN may be involved in the enhancement of attentive control in emotional processing. ***Discussion***: The study provides insights into the neural networks contributing in emotional regulation and cognitive control in mood disorders and the relationship with rumination. The findings suggest that targeting the DMN and FPN through neuromodulation techniques may be a promising approach for improving emotional regulation and cognitive control in individuals with mood disorders.

Poster: **A15**   **Mathis Lamarre**

Attention weights accurately predict language representations in the brain

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Introduction: During language comprehension, humans extract meaning of individual words and integrate the meaning from nearby words to form contextual representations. Previous work showed where lexical and contextual semantic information are represented across the cerebral cortex. These studies used word embeddings, vector representations that can reflect the lexical or contextual semantics of text, to model brain representations of semantic information. To study where in the brain information related to context integration is represented we use attention weights, vectors that reflect the process of context integration in state-of-the-art Transformer language models (LMs). We used voxelwise encoding models to determine where these attention weights predict brain responses. *Methods*: We analyzed functional magnetic resonance imaging (fMRI) recordings of participants reading English language narratives. We used voxelwise encoding models, where features extracted from the linguistic stimulus are used to predict the evoked brain response. We provided the narrative text as input to a Transformer LMs ("BERT") and extracted their corresponding attention weights. We then measured how well attention weights can predict recorded brain responses in each voxel. Finally, we compared the predictions of the attention weights with those of lexical and contextual word embeddings. *Results:* We find that attention weights accurately predict brain responses in much of the frontal and temporal cortices. Several of these areas have previously been associated with language processing, such as the high-level auditory cortex, the superior temporal sulcus or Broca's area. Attention weights better predict brain responses than lexical embeddings in most of these areas, and outperform contextual embeddings in portions of these areas. *Discussion*: Our results suggest that the attention mechanism carries information that is reflected in brain representations. Moreover, we indicate cortical areas in which context integration may occur. Regarding artificial LMs, we show that linguistic information can be found in the attention weights.

Emotional Body Maps of Self-Detachment in Depersonalisation and Meditation

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Introduction: This study explores how emotions are experienced by long-term meditators (Vipassana community) (LTM) versus people with Depersonalisation (DP). DP is the experience of feeling detached from one's self, body, and emotions. Strikingly, both LTM and DP report feelings of detachment from one's self and body. Yet, while DP people experience this disconnectedness as deeply distressing, LTM people typically experience it as positively valenced. In order to better understand self-detachment in DP and LTM, our study explores for the first time how emotions are experienced in the body. *Methods*: 120 participants: DP (n=40); LTM (n=40), meditating at least 3 hours/week for at least 2 years practising the body scan meditation; healthy controls non-meditators (HC) (n=40). We will use the well validated emBODY task to examine how DP vs LTM vs HC differ in their emotion bodily maps. The emBODY task is a seminal instrument, consisting of a computer-based topographical self-report tool for monitoring emotion-triggered bodily sensations. Additional questionnaires related to time perception, interoceptive awareness, mindfulness abilities, emotional regulation, self-compassion and narcissistic traits will be administered. *Results:* We expect lower activation in body maps of DP participants across emotions, compared to LTM and HC. Also, we expect higher activation in body maps of LTM participants across emotions, compared to DP and HC. We also expect lower activation of body maps for positive emotions in DP participants compared to HC and LTM; while higher activation for positive emotions in LTM vs HC and DP. *Discussion*: This study looks at how we experience emotions when we feel disconnected from our bodies. We anticipate lower activations in body maps in people experiencing self-detachment in DP vs LTM and HC. This comparison will allow us to better understand the relationship between self-detachment and bodily perception, with potential implications for therapy interventions.

Cardiac autonomic imbalance is manifested across the brain-heart axis in children with ASD: Insights from effective connectivity modelling

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Introduction: Increased parasympathetic output at the level of the heart, often denoted as cardiac vagal tone, is increasingly considered as a marker of mental health and homeostasis. In children with ASD, for whom extremely high prevalence rates of anxiety and stress are noted, lower cardiac vagal tone is often reported. In adults, cardiac vagal tone has also been shown to covary with changes in connectivity between brain regions of the central autonomic network (CAN), demonstrating a functional neuro-cardiac integration. The contribution of the CAN network to reduced parasympathetic tone at the level of the heart in ASD remains however undetermined. *Methods*: We investigated cardiac vagal tone during rest, as well as concurrent associations with intrinsic CAN connectivity, in 59 children with ASD (8-12 y/o; boys and girls) compared to 39 age- and IQ-matched typically developing (TD) children during resting state fMRI scanning. Cardiac vagal tone was captured by the high-frequency component of the heart rate variability signal (HF-HRV; child-specific frequency band: 0.24-1.04 Hz). Effective connectivity between key brain regions of the CAN (amygdala, dorsomedial prefrontal cortex, anterior cingulate) was assessed via spectral Dynamic Causal Modelling (spDCM). *Results:* At the level of the group, similar HF-HRV was noted in children with and without ASD, yet lower cardiac vagal tone was found in children with more severe ASD symptomatology. The effective connectivity analyses demonstrated increased excitatory bottom-up connections from the amygdala to other CAN regions in ASD children. Furthermore, the spDCM analysis showed that with increasing HF-HRV, the overly excitatory amygdala outflow was tempered by an inhibitory connection from the dorsomedial prefrontal cortex in these children. *Discussion*: These findings provide evidence for a functionally integrative brain-heart system that can be addressed as a marker of disrupted homeostasis in ASD children.

Metacognition of agency: an EEG study

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Introduction: Empirical studies often probe the sense of agency (SoA) by manipulating visual representations of either a movement or its consequences on the environment. While these two may be valid means to manipulate the SoA, they may also do so in very different ways. They are, however, often implicitly assumed to be equivalent, but this has not been shown. To assess whether these manipulations are indeed equivalent, we used an experimental design that allows for comparisons of the precision of agency representations in different conditions, using behavioural and electrophysiological data (EEG). ***Methods***: On each trial, participants make two consecutive movements. For only one of the movements, we manipulate either a visual representation of the movement itself or of the consequences of the movement on the external world. We then study how different manipulations affect metacognitive representations of the SoA devoid of response biases in subjective measures, which are often present in typical agency tasks. Namely, participants first discriminate which of the two movements they felt more control over, and then rate their confidence in their own decision. *Results:* We find that when trial difficulty within each condition is tightly controlled, there is no difference in the precision of the metacognitive representations of the SoA. We will also examine, using EEG, whether there are differences between these two conditions at the neural level. To do so we split the EEG signal in segments time-locked to i) movement initiation, ii) outcome realisation, iii) discrimination decision, iv) confidence rating and we then compare the signal between the two conditions using linear mixed effect models. *Discussion*: This project aims to help explain the differences between the disparate results existing in the literature on SoA, and lay some theoretical grounds and a more precise methodological approach with which to move forwards in the field.

Poster: **A19**   **Tal Geffen**

Functional connectivity gradients and thought-patterns in schizophrenia - negative symptoms

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Introduction: Ongoing thought-patterns and their association with macroscale neural connectivity patterns known as "gradients" have been investigated in healthy populations. In our study, we characterized thought-patterns and connectivity gradients in patients with schizophrenia (SZP) with predominantly negative symptoms and compared them to healthy controls (HC). *Methods*: The study used a 9.8-minute resting state fMRI scan followed by Multi-Dimensional Experience Sampling to describe the thoughts during the scan, of 77 SZP and 66 HC matched for age and sex. We extracted six thought-pattern components (TPs) using Principal Component Analysis (PCA) and created cortical connectivity gradients via BrainSpace toolbox. The six TPs and the first three gradients (constructed from cortical parcels, each associated with one of Yeo's seven networks) were compared between SZP and HC, controlling for age, motion, and gender. Results were corrected for False Discovery Rate (FDR). *Results:* SZP showed significantly lower values compared to controls in TP1 (more episodic social thought in HC) and TP6 (more abstract spontaneous thought in HC). TP2, which captures intrusive and negative thoughts, had significantly higher scores in SZP [$t(141) = 3.53$, $p = .00$]. In Gradient 1 (G1), differences were mainly from the DMN, visual, somatomotor, and attentional networks. SZP presented a more segregated pattern from the rest of the networks [all $pFDR \leq .02$, $t(138) \leq -3.5$]. In G2, significant differences between groups were mainly in the DMN, visual, and somatomotor networks, indicating a shorter gradient for SZP. *Discussion*: Our findings showed that TPs and brain organization differed between HC and SZP using gradient analyses in SZ for the first time. A pattern of DMN segregation from the rest of the networks, including the visual network, was seen among SZP. Attentional networks in SZP resembled more the visual network and had less similarity with DMN in G1; this fits findings from SZ studies with a focus on salience network-DMN connectivity.

Javier Soriano

Development of a novel EEG-based neurofeedback protocol based on alpha-theta cross-frequency interactions in the context of stress regulation: A protocol presentation

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Introduction: During neurofeedback training, real-time electroencephalographic signals are presented to individuals to promote self-regulation. Through cross-frequency phase coupling/decoupling, neural rhythms interact with each other and enable information integration and cognitive processing. The numerical ratio between the peak frequencies of two rhythms is essential for cross-frequency phase coupling/decoupling. More specifically, two oscillator frequencies with a harmonic ratio ($f2 = f1/2$) allow cross-frequency coupling, whereas a non-harmonic ratio ($f2 = f1/g$; where g is the irrational golden mean = 1.618), precludes coupling. According to recent research, non-harmonicity and harmonicity between alpha and theta reflect a meditative and active cognitive processing state, respectively. Here, we propose a novel neurofeedback protocol aimed at training alpha-theta harmonicity and non-harmonicity. *Methods*: Twenty-seven meditation-naïve individuals will attend a single-session training during which auditory feedback will repeatedly be provided upon reaching harmonic ($f2 = f1/2$) or non-harmonic ratios ($f2 = f1/g$) between alpha and theta (6 trials of 2 minute trainings per condition). Further, a sham control condition will be included. During training, participants will be asked to sit comfortably, close their eyes, and listen to the feedback sound while focussing their attention on a grounding point. The ability of the participants to engage in focused attention, together with their subjective feelings of stress and fatigue, will be evaluated throughout the trials via experience sampling. In this single-session neurofeedback training, the trainability of each parameter (harmonicity/non-harmonicity) will be assessed across trials. Based thereon, conclusions will be made regarding the feasibility of the implementation of future multiple-session neurofeedback trainings. *Results: Discussion*:

Poster: **A21**　　　　**Julia Folz**

Feeling your emotions in my body? The role of interoception and facial mimicry in emotion processing

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Introduction: Physiological changes are not only byproducts of emotional experiences. Seminal emotion theories suggest that internal sensations can also be integrated in emotion processing via afferent pathways, i.e. interoception. Research has shown that interoceptive processes are indeed linked to the subjective experience of one's own emotions, and that this link is stronger for individuals with higher interoceptive abilities. However, whether interoceptive input is also informative for interpreting embodied emotional states of others, and whether individuals with higher interoceptive abilities have an advantage in emotion recognition, is still unclear. *Methods*: In an online study (N = 100), participants completed an emotion recognition task and filled in questionnaires on interoceptive accuracy and body awareness. An independent sample (N = 64/100, data collection in progress) was then tested in the lab with the same emotion recognition task and questionnaires. In addition, we also measured facial muscle activity during the emotion recognition task to assess facial mimicry and estimated cardiac interoceptive accuracy and awareness with a heartbeat discrimination task. *Results:* Preliminary behavioral analyses of both studies revealed that, while emotion recognition accuracy was not affected by any self-report on interoception, higher self-reported body awareness was related to higher confidence in the recognition of sad expressions. People with higher body awareness further perceived other's emotional experiences as more intense, but less so for expressions of happiness. Higher self-reported interoceptive accuracy was associated with lower intensity ratings of others' angry expressions and higher intensity ratings of others' neutral expressions. *Discussion*: For highly salient and well-recognized expressions such as happiness or anger, the experience of others' emotions might depend less on interoceptive processes, and thereby result in a less pronounced relationship with self-reported interoceptive abilities. Information from the body might, however, be specifically integrated and lead to stronger (mis-)attributions of others' emotional experiences if expressions are more difficult to judge.

Can I Feel my Heartbeat and Hunger? An Exploration of Interoceptive Belief Updating in Anorexia Nervosa

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Introduction: High mortality in Anorexia Nervosa (AN) could be partly explained by difficulties in higher-order abilities, e.g., metacognition (the ability to monitor and update one's own cognition) and belief updating. Studies have shown a link between belief updating and beliefs relating to oneself and evaluation of experiences and performance (hereafter referred to as self-efficacy beliefs), and prognosis. In AN, poor self-efficacy has been linked to higher relapse rates and increased drive for thinness. Yet, to our knowledge the way in which patients update self-efficacy beliefs about everyday symptoms and behaviours remains unclear. Hence, we examined how aspects of metacognition are related to impairments in interoception (sensing of the physiological state of the body), by assessing beliefs about one's perceptual abilities in two modalities (cardiac and gastric) and across dimensions. *Methods*: We considered both retrospective and prospective aspects of interoceptive metacognition, such as beliefs about one's interoceptive accuracy in a specific task, to examine how individuals with and weight-restored from AN versus controls update their prospective beliefs about their ability to detect heartbeats after engaging in a heartbeat counting task (HCT) and receiving feedback about their HCT performance. It is unclear whether effects observed in cardiac interoception translate across other interoceptive modalities. Given that the gastric system is directly linked to AN symptoms, in a second experiment, participants provided fullness estimates before and after water ingestion. *Results:* Results suggested that AN patients held more firmly on the beliefs they had before the HCT and updated their beliefs at a lower rate in comparison to controls, despite similar performances, and gave greater fullness ratings than controls. *Discussion*: We draw comparisons between the two interoceptive modalities and despite methodological limitations, our findings highlight the importance of studying belief updating processes in AN to better understand its effects on facets of the disorder, treatment adherence and prognosis.

The backbone of the self? Differential spinal cord activity during self-other-object touch

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Introduction: Touch is crucial for identifying the physical border between our own body and the outside world, and hence plays an important role in our sense of self and social interactions. The distinct experiences of 'being touched' and 'touching oneself' are reflected in primary sensory brain areas, but also regions associated with social cognition and interoception. Early evidence suggests that self-vs-other touch is already differentially processed at the level of the spinal cord, but the exact mechanisms are not yet understood. *Methods*: During simultaneous functional MRI of the brain and spinal cord, participants touched their own left forearm (i), touched an object (ii), or were touched on their left forearm by an experimenter (iii). Touching consisted of slow and gentle stroking movements typical for real-life social touch. Two different fields of view for the spinal cord were investigated: cervical level 5-7 (sample 1) and cervical level 4.5-6.5 (sample 2). *Results:* Brain activation patterns for self/other/object-touch replicated previous findings. In sample 1, two clusters of differential activation in the spinal cord for self/other/object-touch reflected sensory and motor processing of the touching hand. In sample 2, an additional spinal cord activation cluster reflected attenuated processing for self- vs. other touch on the left forearm. *Discussion*: During self/other/object-touch, the spinal cord showed activation differences related to efferent right-hand motor signalling and afferent right-hand and left-forearm sensory signalling. Importantly, processing of self-produced touch on the forearm appeared to be attenuated compared to social touch from others. This indicates that self-vs-other-touch is already differentially processed at the level of the spinal cord. In the next step, we will investigate whether this effect is mediated by top-down modulation and which brain areas might be driving this effect.

Poster: **A24**   **Magdalena Sabat**

What is arousal? - An automated analysis of a corpus of 48.000 scientific articles and neuroimaging meta-analysi

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Introduction: What is arousal? For some, it is a loosely defined notion referring to a brain-body state, often considered uni-dimensional. For others, because arousal refers to many distinct bodily manifestations and is supported by pharmacologically distinct pathways, arousal should not be considered a singular construct. While some authors have attempted at bringing attention to the problems and limitations of the notion of arousal, the term has been and is still widely used. Proper systematization of the concept would require pondering over tens of thousands of individual uses. *Methods*: Here, we use modern natural language processing tools to computationally synthesize arousal-related literature. Using automatic term extraction and word embedding we recover semantic clusters within a data set of ~48.000 abstracts. Subsequently, we conduct a neuroimaging meta-analysis of 442 studies to test whether there are regions common to arousal across all semantic clusters we describe. *Results:* We find that the arousal literature is organized in seven semantic communities: cognition, emotion, physiology, stress disorders, sex, sleep and sleep disorders. We validate the existence of those communities by showing that each community has a distinctive profile of the prevalence of neuromodulators- and measurement-related terms. Finally, we find that most communities share a subset of regions of the anterior insula. *Discussion*: Although the definition of arousal is vague, it is recognized as one of the fundamental aspects of neurological and psychological functioning. Here we show that despite the heterogeneity of the fields where the term arousal is used, a common neural substrate emerges in the anterior insula. Combining existing knowledge about this structure and the fields where the term arousal is used, we highlight a convergence between the notion of arousal and salience: indeed to determine what is "relevant" for the organism (salience) external inputs needs to be related to current state (arousal).

Poster: **A25**   **Norman Forschack**

Attentional capture is modulated by stimulus saliency in visual search as evidenced by event-related potentials and alpha oscillations

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Introduction: Whether a salient distractor produces behavioral costs depends on the particular stimulus configurations. It is debated whether relative distractor saliency affects capture and how this is reflected electrophysiologically. This study used a typical four-item search display to investigate top-down control over attentional capture in an additional singleton paradigm. By manipulating target and distractor color and shape, stimulus saliency relative to the remaining items was systematically varied. *Methods*: Using electroencephalography (EEG), one group of participants discriminated the side of a dot within a salient orange target (ST group) presented with green circles (fillers) and a green diamond distractor. A second group discriminated the side of the dot within a green diamond target presented with green circle fillers and a salient orange square distractor (SD group). *Results:* Results showed faster reaction times and a shorter latency of the N2pc component in the event-related potential (ERP) to the more salient targets in the ST group. Both salient and less salient distractors elicited Pd components of equal amplitude. Behaviorally, no task interference was observed with the less salient distractor, indicating the prevention of attentional capture. However, reaction times were slower in the presence of the salient distractor, which conflicts with the hypothesis that the Pd reflects proactive distractor suppression. Contrary to recent proposals that elicitation of the Pd requires competitive interactions with a target, we found a greater Pd amplitude when the distractor was presented alone. Alpha-band amplitudes decreased during target processing (event-related desynchronization), but no significant amplitude enhancement was observed at electrodes contralateral to distractors regardless of their saliency. *Discussion*: The results demonstrate independent neural mechanisms for target and distractor processing and support the view that top-down guidance of attention can be offset (counteracted) by relative stimulus saliency

Malandrone, Francesca

Minimally invasive and continuous rating of affective experience in immersive Virtual Reality

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Introduction: Subjective experience is crucial in affective states (AS), but common summary ratings (SR) after stimuli may not sufficiently capture AS changes over time. Continuous assessment during dynamic stimulation can provide a better understanding of affective phenomena. Therefore, self-report tools are needed to measure AS during VR experiences; however, a potential challenge is that ratings may alter the experience. The present study aims to (1) investigate if and how continuous rating (CR) and SR are associated and (2) determine the best rating method (RM) to continuously rate participants' AS in VR in real time. To this end, we compared (1) trial-by-trial SR and CR, and (2) different RMs of CR to identify the least invasive/distracting. We hypothesized that (1) CR were associated with SR and (2) the proprioceptive RM was the least invasive. *Methods*: Twelve participants underwent a 1-hour VR experiment in which they experienced 4 blocks of trials: 3 different RMs and a baseline (without CR) condition. They were shown four 1-minute 360° videos and rated their AS twice (CR and SR) during each trial. Participants also used different RMs (modified Affect Grid, vibrations, and thumb feeling on the VR controller's touchpad) to indicate their position in the arousal-valence space. Data were analyzed using linear regression, analysis of variance (ANOVA), and post-hoc t-tests. *Results:* The preferred rated RM was Visual. We found (1) that SR was most correlated with CR mean and least correlated with CR min; (2) no significant RM effect on invasiveness. We observed significant differences between Visual, Tactile, Proprioceptive and Baseline conditions. There were no significant differences between Visual, Tactile, Proprioceptive SR and baseline. *Discussion*: Preliminary results suggest that (1) SR was strongly associated with the mean CR; (2) the different RMs were not distracting, and Visual was preferred. Future studies should use longer stimuli with more affective variability.

Ammara Nasim

Stereoscopic vision and emotional face processing: insights from a combined EEG and virtual reality study

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Introduction: Stereopsis is a powerful mechanism of the visual system for perceiving spatial depth. The availability of stereoscopic information might therefore influence how human observers process facial expressions, which includes interpreting spatial configurations of relevant landmarks (e.g., eyebrows) in the three-dimensional structure of a face. Here, we combined immersive Virtual Reality (VR) technology with EEG and multivariate decoding to compare the neurophysiological responses to stereoscopic and monoscopic presentations of emotional facial expressions. *Methods*: The stimulus set comprised renderings of three computer-generated faces with different expressions (neutral, happy, angry, surprised) which were displayed as frontal portraits using an HTC Vive Pro Eye VR headset. N = 34 healthy, young participants indicated in 720 trials the expressions of the faces. To investigate the role of stereopsis, the face stimuli were displayed either in a 2D plane (monoscopic viewing condition) or as stereoscopic 3D model. We trained and cross-validated time-resolved linear classifiers to predict the expression as well as the viewing condition from the time-locked EEG signal. *Results:* In both viewing conditions, participants recognized all emotions with high accuracy. Starting around 150 ms after stimulus onset, the expressions could be decoded from the EEG. Binary classification of expression pairs (e.g., angry-vs-neutral or happy-vs-surprised) yielded distinctive decoding time-courses. However, there was no significant difference in decoding performance between mono- and stereoscopic trials although the stereoscopic vs. monoscopic viewing condition itself, could also be decoded from the EEG with a similar time-course as decoding the (task-irrelevant) identity of the displayed face . *Discussion*: Our findings indicate that although there are differences in EEG responses to stereo- and monoscopically presented faces, this does not interact with the ability to decode the faces' expressions from neural activity. Therefore, the representation of facial expressions—at least when viewed from a fixed perspective—does not seem to rely strongly on stereoscopic information.

Poster Session B

March 14, 2023 at 19:45-20:30 | Virtual March 17, 2023 at 11:30-12:30

Poster #	Presenter (s)	Poster Title
B01	Angelika Bracher	Peer-Cooperation and Cardiophysiological Correlates in Youth with Maltreatment Experience
B02	Katharina Kühne	The SNARC effect relies on an allocentric frame of reference
B03	Fabian Kiepe	Self-Initiation Enhances Perceptual Processing of Auditory Stimuli in an Online Experiment
B04	Marina Bobou	Interventions for interoception in mental health disorders: A systematic review of randomised-controlled trials
B05	Julia Schaefer	Reactivation of Sequential Head Direction Memory Traces in Humans
B06	Agata Patyczek & Elias Reinwarth	Linking macroscale resting-state functional connectivity to acute and chronic stress
B07	Merve Kutlu	Identifying sequential memory reactivation during sleep in humans
B08	Gesche Vigh	Perception and Report of Visuomotor Delay Changes in a Virtual Reality Setting
B09	Nils Kraus	Affective States and Traits and Their Influence on Perceptual Stability During Binocular Rivalry
B10	Lisa-Marie G Pohle	Expectation effects on repetition suppression in nociception
B11	Marta Gerosa	Cognitive reappraisal of food craving and emotions: a coordinate-based meta-analysis of fMRI studies
B12	Kristin Kaduk	Non-invasive vagus nerve stimulation decreases high-frequency heart rate variability after a caloric load
B13	Richard Somervail	Phenomenology and functional significance of the Vertex Potential
B14	Guido Caccialupi	Parametric Working Memory Coding during Motor Preparation
B15	Aishwarya Bhonsle	Decrease in perceptual suppression correlates with increased heart rate
B16	Alice Dabbagh	Reliability of task-based fMRI in the dorsal horn of the human spinal cord
B17	Clara Schüler	Connectome Based Predictive Modeling of Joint Attention in Infancy
B18	Miro Grundei	A multimodal cortical network of sensory expectation violations revealed by fMRI
B19	Alexandra John	Thalamocortical structural connectivity and microstructural covariance
B20	Zoya Mooraj	Metamemory in Younger and Older Adults: Neurocognitive Processes Underlying Age Differences in Confidence Computation
B21	Anne Aerts	Trust is not needed for language evolution to begin
B22	Maik Mylius	Meditation and Body Awareness: Lower prestimulus alpha activity in meditators modulates response bias in somatosensory signal detection task
B23	Christopher Gundlach	Global attentional selection of visual features is not mirrored in a selective modulation of posterior alpha-band activity
B24	Tal Nahari	Can you control you gaze? The strong effect of familiarity on eye gaze behavior
B25	Sara Wesolek	Content representation of tactile mental imagery in primary somatosensory cortex
B26	Carina Forster	Neural correlates of stimulus expectations in somatosensory perceptual decision making
B27	Tim Paul Steinfath	Pre-Stimulus Heartbeat Evoked Potentials predict P300 and reaction time in an auditory Oddball Task: real effect or artifact?
B28	Irena Arslanova	The heart as a subjective pacemaker: how experienced time expands and contracts within each heartbeat

Poster Session B

March 14, 2023 at 19:45-20:30 | Virtual March 17, 2023 at 11:30-12:30

Poster: **B01** **Angelika Bracher**

Peer-Cooperation and Cardiophysiological Correlates in Youth with Maltreatment Experience

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Introduction: Behavioral research has yielded conflicting evidence of hyper- and hypo-cooperative strategies among children exposed maltreatment. Building on this research, we seek to investigate potential psychophysiological mechanisms through which maltreatment affects cooperative behavior. Since high-frequency HRV (hf-HRV) is a known correlate of self-regulation and positive social engagement, it qualifies as a candidate to elucidate such biological mechanisms. We aim to investigate hf-HRV and cooperative behavior in youth with and without maltreatment experience. We hypothesize that the maltreatment sample will show hyper-cooperation coupled with reduced hf-HRV compared to the non-maltreatment sample. *Methods*: We collected data from 380 participants (ages 10-23, M=16.9). Maltreatment exposure was assessed using a multi-source informant coding system. Maltreated (n=105) and non-maltreated groups (n=275) did not differ in sex (X2= 2.64; p=0.10) or age (t=0.01; p=0.99). To assess cooperative behavior, participants played the Pizzagame, a child-appropriate computerized public goods game (PGG). The game alternates between cooperative, selfish and divergent peer-cooperation conditions. During the task, we measured heart rate to calculate local power, a short-term estimate of hf-HRV. *Results:* 2x3 mixed-model ANOVA revealed significant effects of PGG condition (F=343.84; p>0.001; np2=0.48) and interaction effect of group with PGG condition, albeit with a small effect size (F=3.49; p=0.03; np2=0.009). Follow-up tests showed that this effect is driven by group differences in the selfish condition. Since we are still preprocessing heart rate data, we cannot present any hf-HRV results to this moment. However, when the final data set is complete, we will run 2x3 mixed-model ANOVA to test for differences in hf-HRV between groups and PGG conditions. *Discussion*: This study indicates that maltreated youth are prone to hyper-cooperation when faced with selfish peers. Thus, youth with maltreatment experience are more vulnerable to exploitation in social situations. Furthermore, this study will investigate hf-HRV as a psychophysiological mechanism through which maltreatment affects hyper-cooperation.

Poster: **B02**   **Katharina Kühne**

The SNARC effect relies on an allocentric frame of reference

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Introduction: According to the mental number line (MNL) hypothesis, small numbers are represented on the left and large numbers on the right. Participants react faster to small numbers with their left hand and to large numbers with their right hand (spatial-numerical association of response codes (SNARC) effect). Our study investigated the reference frame the SNARC effect relies on. If it is body-centered (egocentric), then it will reliably emerge regardless of the spatial relation between the participant's body and the numerical referents, whereas if it is world-centered (allocentric), it will be smaller if an individual's body is misaligned relative to those. *Methods*: Twenty-eight participants (M_{age} = 23 years, SD_{age} = 5) took part in the experiment. First, participants placed cards with numbers 1 to 9 on a pinboard, from left to right. Then they performed speeded parity judgments on an iPad in two conditions. First, they sat, facing the pinboard, and decided whether the number on the screen was even or odd, by pressing either the left or the right button. During a break, they read the numbers from the pinboard out loud. In the second condition, participants repeated the parity judgment task with their backs to the pinboard. Again, they read the numbers out loud during the break. *Results:* In both conditions, we found a reliable SNARC effect, reflected in faster reaction times to small numbers with the left hand, and to large numbers with the right hand. In the second block, however, the effect was weaker (β = 5.27 vs. β = 2.96). *Discussion*: These preliminary results suggest that the SNARC effect has an allocentric frame of reference. With the MNL behind the back, the effect was smaller because the external numerical referent was not salient. Further research manipulating bodily position in space, e. g., by walking, is needed.

Self-Initiation Enhances Perceptual Processing of Auditory Stimuli in an Online Experiment

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Introduction: Understanding how the brain incorporates sensory and motor information will enable better theory building on human perception and behavior. Recent empirical work suggests that sensory attenuation (SA) - the observation that self-generated sensory input is often perceived as less intense than externally generated sensory input - provides a window into predictive processing of the sensory and cognitive apparatus, and thus may allow to study the core mechanisms of human functioning. *Methods*: In this study, we aimed to estimate the magnitude and variability of SA in an online sample using PsychLab Online and the web experiment builder Lab.Js. Participants (N = 230) compared the volume of two consecutive tones in a two-alternative forced choice task. Perceptual processing was manipulated by motor behavior (active versus passive), identity prediction (i.e., the congruency of pre-learned cue-sound combinations; congruent versus incongruent), and a fixed sound offset (to account for effects of attentional differences between the passive and active condition, 50ms versus 0ms). *Results:* Contrary to our prediction, we observed enhanced perceptual processing, instead of attenuation, for self-initiated auditory sensory input. Further, our results imply an impact of multiple factors (i.e. sound offset and according multisensory influences, stimulus volume, stimulus order) on the processing of motor and non-motor-based predictive information - and may point to according shifts in attention, leading to a perceptual bias. *Discussion*: Finally, we discuss current challenges in running behavioral studies online and provide technical, as well as practical recommendations.

Interventions for interoception in mental health disorders: A systematic review of randomised-controlled trials

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† These authors contributed equally.

Introduction: Disturbed interoception (i.e., the sensing, awareness, and regulation of internal body signals) has been found across several mental disorders, leading to the development of interoception-based interventions (IBIs). ***Methods***: Searching PubMed and PsycINFO, we conducted the first systematic review of randomised-controlled trials (RCTs) investigating the efficacy of behavioural IBIs at improving interoception and target symptoms of mental disorders in comparison to a non-interoception-based control condition (pre-registration at PROSPERO: CRD42021297993). ***Results:*** RCTs demonstrating IBIs to be more efficacious at improving interoception compared to control conditions. The most promising results were found for post-traumatic stress disorder, irritable bowel syndrome, fibromyalgia and substance use disorders. Regarding symptom improvement, the evidence was inconclusive. The IBIs were heterogenous in their approach to improving interoception. The quality of RCTs was moderate to good. ***Discussion***: In conclusion, IBIs are potentially efficacious at improving interoception for some mental disorders. In terms of symptom reduction, the evidence is less promising. Future research on the efficacy of IBIs is needed.

Reactivation of Sequential Head Direction Memory Traces in Humans

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Introduction: Episodic memory and navigation both operate along the dimensions of time and space. An increasing number of studies aims at examining these processes with study designs that incorporate time and space into sequences of events. They have shown that on a neuronal level, the reactivation of previously encoded sequential memories accompanies their retrieval. In humans, testing the reactivation of sequential spatial memories has been mostly done in virtual reality neuroimaging experiments, lacking information from self-motion cues, an indispensable part of the real-world navigation experience. The present study sets out to incorporate real-world movements in a sequence memory paradigm. *Methods*: Participants learned 24 unique sequences of four distinct images from four categories, that were subsequently presented on monitors positioned at different angles around them. Participants associated each image with a specific head direction (HD) by turning their head to the corresponding monitor. Each sequence was followed by a short-term memory test including covertly retrieving the full sequence and performing the correct head rotation sequence. To assess episodic memory, the same retrieval steps were performed for all previously learned sequences after a distractor task. Throughout the experiment, EEG, head motion tracking and eye tracking data were recorded simultaneously. *Results:* By applying linear discriminant analyses to the EEG data, we were able to decode image categories while participants performed the sequential head movements during both the short-term as well as the episodic memory test. Supervised and transfer learning will be used to identify the reactivation of sequences in both memory tasks, targeting image categories as well as HD information. *Discussion*: The combination of HDs with images provides the possibility to investigate how distinct features of a sequential memory trace are reactivated during retrieval. Ultimately, our results will contribute to the understanding of how real-world navigation and memory processes work together on a neuronal level.

Poster: **B06**   **Agata Patyczek & Elias Reinwarth**

Linking macroscale resting-state functional connectivity to acute and chronic stress

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Introduction: Stress exposure leads to an intricate psychophysiological response. Acute or short-term stress adapts brain function and physiological systems to an ever-changing environment. Yet, when stress becomes chronic, cognitive or physiological impairments may unfold. Previous research on stress showed changes within single regions and inter-regional connectivity. Yet, research on how stress might influence large-scale whole-brain reconfigurations is still scarce. *Methods*: We used rs-fMRI data to investigate macroscale functional connectivity and its link to acute and chronic stress on a whole-brain & network level. We used two datasets: NECOS dataset (n = 67 males, stress group = 34) and the LEMON dataset (n= 142, female = 43) which included the Trier Social Stress Task and Trier Inventory of Chronic Stress (TICS) respectively. We used a data-driven approach which extracts low dimensional axes of whole-brain connectivity (gradients). On the network-level, we focused on the Default Mode Network (DMN), Executive Control Network (ECN), and Salience Network (SN). *Results:* Our preliminary findings suggest that on a whole brain and network level, chronic stress did not show a significant effect on macroscale cortical organisation. Yet, the relative positions of cortical regions within gradients changed significantly for acute stress, specifically for the left insula (SN) and the right vPFC (DMN). The network analysis showed a significant change of functional connectivity patterns between the DMN and ECN, as well as the DMN and the SN. *Discussion*: Incorporating both whole-brain and network-level analysis of acute stress, the results hint at the potential role of the left insula and the right vPFC as potential drivers of change of functional connectivity on the network-level. One reason for the absence of significant change in chronic stress may be that the participants were strictly screened for mental health and thus not representative of the general population. Overall, our findings provide new evidence for alterations in network hierarchy in acute stress.

Identifying sequential memory reactivation during sleep in humans

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Introduction: Sleep is assumed to benefit memory consolidation by reactivating previous experiences. Animal models support this claim by demonstrating that sequences of prior learned spatial trajectories are replayed during sleep. However, research into human memory reactivation during sleep usually lacks the combination of sequential and spatial features. *Methods*: In this study, we aim to close this gap by implementing a sequential spatial-learning paradigm during wake and using targeted memory reactivation (TMR) to trigger the reactivation of sequential memories during non-rapid eye movement sleep (NREM) in humans. Participants were instructed to learn 24 distinct sequences. A sequence consisted of four unique images that were linked to specific real-world head directions (HD). The link between image and HD was implemented by presenting each image on one of four monitors positioned at different angles around the participant. Each sequence was preceded by a unique sound serving as a reminder cue during subsequent retrieval and TMR. Memory performance was tested before and after a night of sleep, as well as 24 hours after the morning retrieval. During NREM sleep, participants were presented with half of the previously learned sounds to trigger reactivation of the associated sequences. EEG was recorded during the whole experiment. *Results:* We hypothesized that memories for complete sequences would be reactivated during NREM sleep. We demonstrate that TMR benefits memory performance: after sleep, cued sequences were remembered better than uncued ones. Multivariate EEG analyses revealed that both the HD and image-category of the first element in a sequence can be reliably decoded after the onset of TMR cues. *Discussion*: Building on these initial findings, we will use advanced multivariate decoding approaches to identify the reactivation of complete sequences. By enriching sequences of learned material with real-world spatial contexts, this study aims to provide novel insights into characterizing sequential reactivation during NREM sleep in humans.

Poster: **B08**   **Gesche Vigh**

Perception and Report of Visuomotor Delay Changes in a Virtual Reality Setting

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Introduction: In this behavioural study, we asked whether the processing of visuomotor delay changes, depend not only on the size of the delay change but also on the initial delay. *Methods*: We used a data glove to measure participants' movements in a virtual reality setting. Thus, participants were able to control a virtual hand, which showed their real hand movement – either synchronous or with some temporal delay. The visuomotor delay changed repeatedly and unpredictably in a roving oddball fashion (between 0ms and 700ms) with the magnitude of changes ranging from +/-100ms to +/-400ms. Participants performed continuous, simple grasping movements, aligning the rhythm of the movement with the rhythmic oscillation of a target sound. Crucially, participants were instructed to indicate a perceived delay change by the press of a button. Thus, we expected our participants to correctly indicate a delay change more often for larger than for smaller delay changes. Furthermore, in accordance with the Weber-Fechner law, we expect participants to notice more changes, independently of the magnitude of the change, for smaller initial delays. *Results:* A preliminary behavioural analysis (N=30) showed that correct button presses as compared to actual delay changes, were significantly higher for larger delays (F=11.19, p<.001). However, contrary to our expectations, correct button presses, were significantly lower for smaller initial delays (F= 5.07, p<.001). Furthermore, an interaction effect of initial delay and delay change could be found (F= 2.79, p<.001). *Discussion*: These preliminary results indicate that the Weber-Fechner law does not guide perception of small delays, in a virtual reality setting. Instead, we propose that delay perception for small initial delays depends on the embodiment with the virtual hand. Due to visuomotor interference, participants are more distracted by the virtual hand, the closer it resembles their own hands movement.

Affective States and Traits and Their Influence on Perceptual Stability During Binocular Rivalry

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Introduction: Affective states and traits have been associated with different measures of perceptual stability during binocular rivalry. Diverging approaches to measuring perceptual stability as well as to examination of the role of affective variables (baseline affective state vs. mood induction; clinical vs. sub-clinical expressions of affective traits) have contributed to an inconclusive pattern of findings. *Methods*: Here, we studied the influence of affective traits (depressiveness and trait anxiety) and states (positive, negative and neutral; manipulated with a musical mood induction paradigm) on different measures of perceptual stability (dominance ratios and phase durations) during binocular rivalry. Healthy participants (N=50) reported alternations in a biased perception condition, during which one stimulus was more likely to be perceived than its counterpart (upright vs. tilted face), and in a control condition, in which both stimuli (Gabors of different orientations) were equally likely to be perceived. *Results:* Baseline positive state affect significantly predicted longer phase durations during neutral viewing conditions, whereas affective traits did not yield any such effect. Furthermore, in an exploratory analysis, induced negative affect attenuated stimulus related bias in predominance ratios. Overall, we found a strong correlation between both measures of perceptual stability (phase durations and dominance ratios). *Discussion*: Our findings question the distinction between different measures of perceptual stability during binocular rivalry and highlight the role of affective states in its formation. They are in line with previous findings pointing towards a higher reliance on perceptual priors when affective valence is positive.

Expectation effects on repetition suppression in nociception

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Introduction: Repetition suppression (RS), the reduced neural response to a repeated presentation of a stimulus, can be explained with predictive coding models, which propose that repetitions are expected and therefore elicit smaller error responses. While studies in the visual and auditory domain support such models, in nociception evidence remains inconclusive. *Methods*: To assess expectation effects on RS in nociception, we adapted an established paradigm from the auditory domain. Participants (N = 36) received short CO_2 laser stimuli (125 ms), which could be repeated after 1s or not. We explicitly varied the frequency of repetitions per block to render them expected or unexpected. We acquired EEG, skin conductance and pupillometry data. Eye movement and muscle artefacts in the EEG data were corrected via ICA and trials with remaining artefacts discarded. Peak amplitudes were extracted from the average waveforms to calculate RS magnitude. Time-frequency representations were obtained by fast-Fourier transformation in a sliding window. *Results:* We confirmed that participants formed the desired expectations and that stimuli were rated as painful and elicited robust physiological responses. We observed a clear RS of the laser-evoked vertex potential (N2P2), which however was not modified by the induced expectations (RS of 18% for expected vs. 19% for unexpected repetitions). Stimuli induced an oscillatory desynchronization in low frequency bands and a gamma band synchronization, the latter also showing RS. *Discussion*: Our observation of RS not being modulated by expectations does not support predictive coding explanations for RS in nociception. Our thorough cleaning approach supports the cortical origin of the observed gamma band synchronization, but comes with discarding large portions of our trials and thus reducing the available signal-to-noise ratio (SNR). In ongoing work we are evaluating more sensitive artefact correction methods, which might then allow the investigation of prediction (error) related patterns in the time-frequency domain.

Cognitive reappraisal of food craving and emotions: a coordinate-based meta-analysis of fMRI studies

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Introduction: Growing evidence supports the effectiveness of cognitive reappraisal in down-regulating food desire. Still, the neural bases of food craving down-regulation via cognitive reappraisal, and their degree of overlap versus specificity compared with emotion down-regulation, remain unclear. *Methods*: We addressed this gap through activation likelihood estimation (ALE) meta-analyses of neuroimaging studies on the neural bases of (a) food craving down-regulation, and (b) emotion down-regulation, alongside conjunction and subtraction analyses among the resulting maps. Exploratory meta-analyses on activations related to (c) food viewing compared to active regulation, and (d) up-regulation of food craving have also been performed. *Results:* Food and emotion down-regulation via cognitive reappraisal consistently engaged overlapping activations in dorsolateral and ventrolateral prefrontal, posterior parietal, pre-supplementary motor, and lateral posterior temporal cortex, mainly in the left hemisphere. Nevertheless, food craving down-regulation was distinctively associated with activations in the right anterior/posterior insula and left inferior frontal gyrus. In the exploratory meta-analyses, food craving compared to active regulation reliably recruited the primary gustatory and somatosensory cortices, as well as the left fusiform gyrus, which are associated with heightened food-related sensory processing. Regarding the up-regulation of food craving, preliminary evidence in support of a left fronto-insular involvement emerged. *Discussion*: Overall, the distinctive involvement of the right anterior/posterior insula and left inferior frontal gyrus suggests that food craving down-regulation entails a more extensive integration of interoceptive information about bodily states and greater inhibitory control over the appetitive urge towards food, compared to emotion down-regulation. This is suggestive of unique interoceptive and motivational components elicited by food craving reappraisal, underpinned by distinctive patterns of fronto-insular activity. Altogether, the present results might inform theoretical models of food craving regulation and prompt novel therapeutic interventions for obesity and eating disorders, by targeting the contribution of insular and fronto-parietal regions to interoceptive awareness and cognitive control, respectively.

Poster: **B12**   **Kristin Kaduk**

Non-invasive vagus nerve stimulation decreases high-frequency heart rate variability after a caloric load

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Introduction: The vagus nerve plays a crucial role in balancing the body's physiological functions, including the cardiovascular system. Previous research using transcutaneous auricular vagus nerve stimulation (taVNS) in humans has shown mixed results, which might be due to differences in control conditions, or study protocols. Furthermore, most taVNS studies stimulate only the left auricular branch leading to a bias in the literature. *Methods*: To address these limitations and better understand the effect of taVNS on heart rate variability (HRV), we conducted a study using a randomized cross-over design. The study included 36 participants (18 female) and involved four sessions per person. In each session, an electrocardiogram was recorded during baseline, followed by stimulating either the left or right ear (taVNS or sham stimulation at the earlobe) before and after consuming a milkshake (~400 kcal), which served as a challenge for the autonomic system. *Results:* Before administering the milkshake, neither left nor right taVNS altered heart rate or HRV. After the milkshake, heart rate and HRV (SDRR, LF/HF ratio) increased and the high-frequency power decreased. Notably, after this challenge of the autonomic system, we observed a taVNS-induced decrease in high-frequency power (HF, a measure of cardiac vagal activity) after both left and right taVNS. In contrast to theorized side-specific effects on heart rate, we observed no significant differences between the left and right taVNS. *Discussion*: Our study supports earlier findings that the LF/HF ratio increases after a caloric load due to a decrease in high-frequency power (indicating vagal activity). Notably, taVNS amplifies the decrease in high-frequency power, suggesting that taVNS-induced changes in parasympathetic activity become only evident in high-frequency heart rate variability after challenge.

Poster: **B13**   **Richard Somervail**

Phenomenology and functional significance of the Vertex Potential

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Introduction: Living in rapidly changing and potentially dangerous environments has shaped animal brains toward high sensitivity to sudden sensory events - often signaling threats or affordances requiring swift motor reactions. Unsurprisingly, such events elicit one of the largest electrocortical responses recordable from the scalp of several animals: the widespread Vertex Potential (VP). While often assumed to reflect sensory-specific processing, we have shown that the VP instead largely reflects supramodal neural activity, sensitive to the behavioural-relevance of the eliciting stimulus. Specifically the VP amplitude is determined by the magnitude of sensory changes, rather than their absolute intensity, and this sensitivity is conserved across sensory modalities and species. Additionally highly similar VPs are elicited regardless of the direction of this sensory change (i.e. increases or decreases of sensory intensity). All together, these results suggest that, rather than reflecting the canonical "lemniscal" sensory processing in primary sensory regions, the VP instead reflects a supramodal, widespread activation of cortex mediated by the non-specific "extralemniscal" projections from non-specific thalamic nuclei (and associated subcortical structures, such as the locus coeruleus and reticular activating system). We hypothesise that the negative-positive sequence of waves composing the VP reflects a process similar to the cortical up and down states observed during slow-wave sleep, presumably to set the cortex into a more reactive state, allowing the organism to better prepare swift motor reactions. *Methods*: We present novel electrophysiological data from monkeys and mice to test these ideas, using simultaneous surface and invasive recordings of cortex, and sudden sensory stimuli of several modalities. *Results: Discussion*:

Poster: **B14**   **Guido Caccialupi**

Parametric Working Memory Coding during Motor Preparation

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Introduction: Performing an action requires to form a mental representation of an action plan, before actually executing it. However, until today, it remains an open question what the relevant neural correlates of such mental representations are. Here, we used a retro-cue delayed-response paradigm to test which brain regions contribute to the preparation of grip-force. *Methods*: During fMRI scanning, participants performed a hand squeezing task, where in each trial one of four levels of compression strength had to be prepared, but was only executed after a 9 second delay period upon a go-cue. We used multivoxel pattern analysis in a searchlight approach to test through the brain, from which regions the type of prepared action could be read out. More specifically, we tested with support vector regression which brain regions exhibited multivariate parametric WM codes of grip-force preparation during the delay period. *Results:* We found a network comprised of motor areas (lPMd, rPMd, lPMv and SMA), parietal areas (lSPL, rSPL, lPoG), the left region of the posterior-insula (lPI) and the left frontal-pole (lFRP) to parametrically code the four types of motor preparations during the delay period. During action execution the highest decoding accuracy was found in M1 and lPoG. *Discussion*: Our results extend the current literature on action planning by showing a distributed network, beyond the PMC, to contribute to the preparation of action execution. Interpreted in the light of the active inference framework the involvement of the PMC, SMA, SPL, PoG and lPI can be viewed to represent proximal goals: the predicted proprioceptive and somatosensory outcomes of the hand-compression. This work is foundational for future investigations to the temporal evolution of action plans and their translation into action execution.

Poster: **B15**   **Aishwarya Bhonsle**

Decrease in perceptual suppression correlates with increased heart rate

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Introduction: Conscious perception is not only shaped by external stimuli but is also influenced by intrinsic signals arriving from the body, such as cardiac signals. Yet, the physiological mechanism by which cardiac activity affects neural activity and ensuing perception remains poorly understood. We aimed to probe the causal relationship between visual perception, cardiac and neural activity by combining a perceptual suppression task with an autonomic challenge. *Methods*: Twenty-nine subjects reported subjective target visibility in a bistable flash suppression task while at rest or while cycling using a desk ergometer at two different resistance levels. ECG and EEG data were collected and correlated with perceptual suppression rates. *Results:* Cycling resulted in an average heart rate increase of 15% during low resistance cycling and 44% during high resistance cycling. Compared to rest, alpha power (9-13 Hz) was reduced during the cycling challenge. Importantly, we found a significant decrease in perceptual suppression rates during cycling compared to rest, with a 14% decrease during low resistance cycling and a 12% decrease during high resistance cycling. *Discussion*: Our findings indicate a relationship between cardiac activity and conscious visual perception. Since cycling did not change perceptual performance in catch trials with physical target removal, this result cannot be attributed to reduced perceptual performance. Whether these autonomic challenge-induced perceptual effects are caused by changes in general arousal and accompanying changes in neural excitability or can be attributed to the neural processing of cardiac signals remains to be seen.

Reliability of task-based fMRI in the dorsal horn of the human spinal cord

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Introduction: Pain research in humans has mostly focused on the brain, even though the spinal cord is an initial processing site within the nociceptive pathway of the central nervous system and a key target of descending modulation. The application of functional magnetic resonance imaging (fMRI) to the human spinal cord is still a relatively young field of research and faces many challenges. Here we aimed to probe the limitations of task-based spinal fMRI by investigating the reliability of spinal cord BOLD responses to identical nociceptive stimulation across two consecutive days. *Methods*: In two fMRI sessions, 40 participants received painful heat stimuli on their left forearm. 3T fMRI data were acquired using a z-shimmed gradient-echo EPI sequence. Data were motion-corrected, high-pass filtered and denoised during first-level model estimation. Group-level analyses were carried out in a standardized space using multiple comparison correction via voxel-wise permutation testing. Test-retest reliability was quantified using the intraclass correlation coefficient (ICC). *Results:* At the group level, we observed spatially specific BOLD responses at the expected location, but no spatial overlap in response patterns across days. While autonomic indicators of pain processing showed good-to-excellent reliability, both beta-estimates and z-scores of task-related BOLD responses showed poor reliability across days in an anatomical mask of the target region. However, using a slightly extended mask including the draining veins improved reliability. *Discussion*: Heat pain stimuli as short as 1s are able to evoke a robust BOLD response in the ipsilateral dorsal horn in spinal cord segment C6, in line with previous studies that used more powerful stimulation parameters. However, on an individual level BOLD response patterns varied strongly within participants, resulting in poor reliability. Improvements in spatial normalization methods may help to improve reliability. Future research should investigate to what extent draining veins distort spatial specificity in spinal fMRI.

Poster: **B17**   **Clara Schüler**

Connectome Based Predictive Modeling of Joint Attention in Infancy

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Introduction: A developmental milestone important for human communication and cognition is achieved by around 9 months when infants begin to orient their own attention with that of another person towards an object, referred to as joint attention (JA). Brain network interactions supporting JA emergence are mostly unknown. Here, we are using data from the Baby Connectome Project in a data-driven approach to examine the brain-behavior relationships underlying the development of JA between 8 and 15 months of age. *Methods*: We used resting-state fMRI and behavioral data of a JA task from 144 subjects (79 female). For image pre-processing, the infant specific pipeline niBabies and the CONN toolbox were used. Connectome based predictive modeling (CPM) was used to train a model to predict JA scores from resting state connectivity. This model was then applied to a test dataset. Correlation between predicted and observed scores delivered the model's prediction performance. *Results:* The predictive model obtained from training data (n=97, Spearman rho=.41, p-value=.011, controlled for multiple comparisons with permutation testing) significantly predicted behavioral JA scores in our test set (n=47, Spearman rho=.33, p-value=.024). The highest number of connections are within the somatomotor network (SM) followed by connections within the visual network (VIS), between the SM and the default mode network (DMN) and connections between the VIS and ventral attention network (VAN). *Discussion*: Associated with the development of joint attention, we find interactions within the SM and VIS, possibly reflecting the role of these networks in the more domain general processes of gaze shifting and head turning. We further find interactions between the SM and DMN and between the VIS and VAN which may reflect their role in the selection, processing and integration of sensory information. The DMN is also involved in later-developing Theory of Mind of which JA has been proposed to be a precursor.

Poster: **B18**   **Miro Grundei**

A multimodal cortical network of sensory expectation violations revealed by fMRI

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Introduction: Our brains are constantly subjected to a multi-modal stream of sensory inputs. Mismatch responses (MMRs), classically recorded with EEG, have provided valuable insights into the brain's processing of statistical regularities and the generation of corresponding sensory predictions. Only few studies allow direct comparisons of MMR between modalities. Here, we used a tri-modal version of the roving stimulus paradigm in fMRI to localize different components of MMRs and cross-modal predictive interactions. *Methods*: During fMRI scanning, participants were simultaneously presented with auditory, somatosensory and visual stimulation, each alternating between two intensity levels (low/high). Across modalities, stimulus sequences were generated with a probability for intensity change of p=0.175 while across all stimuli, intensities were equiprobable. Additionally, we included cross-modal regularities, i.e. stimulus transitions in one modality were more/less likely if the stimulus intensities in the two other modalities were both low/high (congruent), or were incongruent. In GLM analyses we investigated classic MMRs, their associated PPI connectivity modulation and modulation by the number of preceding standards. Additionally, we tested for the effects of cross-modal prediction violation. *Results:* We show modality-specific MMR activations in (secondary) sensory cortices, and further replicate activations in a modality independent fronto-parietal network, comprised of IFG, SMA/ACC and TPJ. Within this network we found that connectivity was modulated differentially by deviant versus standard responses. In all three modalities we found parametric deviant modulation by the number of preceding standards in sensory regions. Finally, we identified activation related to cross-modal prediction violation in an extended mismatch network, most pronounced in bilateral IPS. *Discussion*: Discussion Our study dissects modality-specific MMR responses in sensory cortices and modality independent components in the fronto-parietal mismatch network across modalities. Our findings allow to argue for overarching principles of perceptual inference and indicate sensitivity of MMRs to cross-modal predictive interactions in transition probability learning which should be further investigated.

Poster: **B19**   **Alexandra John**

Thalamocortical structural connectivity and microstructural covariance

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Introduction: The thalamus is a highly heterogeneous structure with its sub-regions extensively connected to cortical and subcortical regions. Here, we studied the link between thalamocortical structural connectivity, intra-thalamic microstructure, and thalamocortical microstructural covariance. ***Methods***: We used diffusion-weighted and quantitative T1 (qT1) MRI from the MICA-MICs dataset (N=50, age 29.54±5.62y). Probabilistic tractography from thalamic seed voxels to 100 ipsilateral cortical parcels was computed. Following, we derived two main axes of thalamocortical structural connectivity using diffusion map embedding. To contextualize with intra-thalamic microstructural features, the thalamic axes were correlated with a core-matrix gene-expression map, and intra-thalamic qT1 as a proxy for myelin, while correcting for spatial autocorrelation. Next, we extracted qT1 values of thalamic voxels, and qT1 profiles for cortical parcels sampled perpendicular to the cortical surface. Last, depth-specific thalamocortical structural covariance was generated by correlating thalamic and cortical qT1 measures to study the relationship between thalamocortical structural connectivity and microstructural similarity. ***Results:*** The principal gradient (G1) of thalamocortical structural connectivity reflected a medial to lateral-central transitional axis, while the secondary gradient (G2) stretched between the medial-anterior and medial-posterior thalamic pole, and the anterior-laterally to central-medially thalamus. Projected onto the cortex, G1 revealed a paralimbic-to-somatosensory axis, while G2 dissociates posterior-to-anterior regions. G2 was correlated with the distribution of core-matrix cells in the left thalamus (Pearson's r=0.57, pSA=0.03). We further found G1 correlated with intra-thalamic qT1-intensity (L: r=-0.49, pSA=0.026; R: r=-0.54, pSA=0.008). For G1, structural covariance correlated negatively with the inferior-anterior cortex regions and positively with superior-posterior regions. Moreover, the association between G1 and thalamocortical structural covariance varied across cortical depths. ***Discussion***: We characterized variations of thalamocortical connectivity patterns across the thalamus and showed its links to intra-thalamic microstructural and cellular variations. Further, we demonstrated that thalamocortical structural connectivity is linked to structural covariance in a depth-varying manner.

Metamemory in Younger and Older Adults: Neurocognitive Processes Underlying Age Differences in Confidence Computation

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Introduction: There is conflicting evidence regarding differences in metamemory abilities between younger and older adults, with some showing age-related declines, and others not. To shed light on this question, we examined age differences in the neurocognitive processes governing the construction of trial-by-trial confidence judgements. *Methods*: Younger (N=29) and older (N=36) adults carried out an associative recognition memory task in the MRI scanner, providing confidence judgements after each memory decision. Metacognitive efficiency was quantified with the m-ratio (meta-d'/d'). Hierarchical mixed effects analyses on trial-by-trial confidence ratings were carried out to investigate if accuracy, response time (RT) and confidence on the previous trial would predict the current confidence judgement, and whether these factors are differentially influential for older and younger adults. fMRI data was analyzed for 1) confidence judgements vs. an active control condition and 2) high-confidence vs. low-confidence to investigate age differences in neural activation for these conditions. *Results:* There was no difference in metamemory efficiency between younger and older adults. However, only older adults showed evidence of a confidence leak, whereby past-trial confidence positively influenced current-trial confidence. Younger adults, but not older, preferentially recruited the putamen for confidence trials. Older adults also exhibited less pronounced low-confidence-related upregulation of activity in the bilateral insula, right inferior frontal gyrus and right thalamus relative to younger adults. Individual differences in the confidence leak were related to the extent of upregulation in these areas during low confidence. *Discussion*: Taken together, these results suggest less dynamic modulation of neural activity in older adults related to metamemory, especially when reporting on the level of subjective confidence. The failure to upregulate activation associated with low confidence may lead to a greater susceptibility to potentially misleading cues such as past confidence.

Poster: **B21**   **Anne Aerts**

Trust is not needed for language evolution to begin

Aerts, A. [1,4], Shaman, K. [2], Preston-Kendal, D. [3], Droppa, C. [2], Eberhardt, F. [5], Pflug, M. [2], Maaser, A. [3], Fabbroni, C. [2], Uhlich, V.C. [2], & von Heisler, T.N. [1]

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Introduction: According to Dor, Knight, and Lewis, almost all researchers agree that an unprecedented level of collective cooperation and trust was needed before the evolution of language could even begin. The reason for this is that linguistic communication requires trust since it is typically not backed up by direct evidence. This paper aims to show that this dominant assumption is unnecessary. *Methods*: The investigation into language evolution should not begin with the traditional assumptions about language, but rather with the use of contemporary evolutionary theory to inform us how language should be conceptualized to be evolutionarily explainable. One well-supported view is the function-first approach, where a new function is initially fulfilled by a behavioral shift that exploits an already existing structure. We apply the function-first approach to the evolution of language by suggesting that the proper evolutionary function of language is to convey propositions, especially about displaced actions. There are two mutually exclusive and jointly exhaustive classes of signs: natural and non-natural signs. In a world without non-natural signs (such as mimetic or conventional symbols), only natural signs (if anything) can refer to a displaced action. *Results:* The function-first approach predicts that language evolved from the display behavior of natural signs. An example of such referential displacement can be found in the display of objects that imply a past action of the communicator, e.g., communicating a past kill by displaying the hunted animal as a trophy. Such use of natural signs could be reproductively beneficial for an individual by enhancing their attractiveness to potential partners for cooperation or mating. *Discussion*: This proposal has the potential to solve both major problems of language evolution—the problem of graduality of the emergence of syntax and the bootstrapping problem of language and cooperativeness/trust.

Poster: **B22**   **Maik Mylius**

Meditation and Body Awareness: Lower prestimulus alpha activity in meditators modulates response bias in somatosensory signal detection task

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Introduction: Mindfulness is believed to alter mechanisms of body awareness and changes in interoception have been suggested as potential mechanisms for its salutary effect. However, findings relating mindfulness to measures of body awareness are scarce. We have compared somatosensory accuracy of 31 meditators with 33 readers in a widely used somatosensory signal detection task (SSDT). Our main hypothesis was that meditators show increased accuracy within the SSDT indicating higher somatosensory accuracy, simultaneously expecting neural correlates of increased selective alpha modulation over the somatosensory cortex in meditators, measured through EEG. *Methods*: Participants were asked to detect a near-threshold tactile sensation. This has been combined with a non-informative light in 50% of the cases to create illusory touch sensations. Associations between prestimulus alpha and responses were analysed on a trial-by-trial basis. *Results:* Against our expectation, we did not find an increase in sensitivity in meditators, instead a lower decision criterion was found. We found the expected decrease in contralateral somatosensory prestimulus alpha power in meditators. Interestingly, decreases in prestimulus alpha activity were also found more generally over the brain. Trial-by-trial analysis revealed a negative relationship between prestimulus alpha activity and report of touch. *Discussion*: The negative relationship between lower alpha activity and report of touch provides a potential mechanism for the increase in response rate in meditators. Higher alpha modulation in meditators may have caused lower prestimulus alpha activity which increased the probability of reporting touch within the SSDT. This study indicates that meditation practice alters body awareness as indicated by modulated prestimulus alpha activity, thereby potentially decreasing the filter function over the somatosensory cortex.

Poster: **B23**   **Christopher Gundlach**

Global attentional selection of visual features is not mirrored in a selective modulation of posterior alpha-band activity

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Introduction: Visually attending to a single feature, such as the color red, leads to globally enhanced gain of neural processing linked to the representation of the attended feature. Alpha-band modulations are hypothesized to be a marker (and even a mechanism) of attention. Previous work linked the attentional selection of feature dimensions, i.e. motion over color to selective cortical modulation of alpha-band activity. We examined whether alpha-band dynamics are linked to sustained Feature- Based-Attentional (FBA) selection of single features (red over blue) within a single dimension (color). *Methods*: For this purpose, we used an attentional shifting paradigm and centrally presented flickering blue and orange random dot kinematograms (RDKs) of which one color had to be attended to detect brief episodes of coherent motion of the cued color. Additional task-irrelevant blue and orange RDKs were on the left and right side in the periphery. Steady-state visual evoked potentials (SSVEPs) and alpha-band activity associated with these task-irrelevant RDKs were analyzed to quantify FBA modulation. *Results:* Participants selectively responded to movements of the attended but not the unattended color. SSVEP results overall replicated previous findings: relative to a pre-cue baseline, SSVEP amplitudes for RDKs of the globally attended color were increased centrally and in the periphery. For the unattended color amplitudes decreased for central RDKs but not RDKs in the periphery. Crucially, there were no differences in alpha-band amplitude modulations recorded contralateral to the peripheral RDKs of the attended and unattended color. *Discussion*: SSVEP data and behavior are well in line with the global selection of the target color, as predicted by the feature similarity gain model. Yet, FBA is not mirrored by a selective modulation of alpha-band activity and alpha-band modulations seem thus not to index the selective and sustained global selection of attended over unattended feature values within the same feature dimension.

Poster: **B24**   **Tal Nahari**

Can you control you gaze? The strong effect of familiarity on eye gaze behavior

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Introduction: Through a series of studies, we provide a new framework for an interplay between memory and eye movements, across different tasks and diverse types of stimuli. Throughout these studies, we see distinct eye movement patterns to familiar and unfamiliar items, both learned and personally familiar. ***Methods***: ***Results:*** Importantly, we see these patterns even when participants are fully aware of the scanning strategy they should employ (i.e, to look at all stimuli equally and for the same amount of time), and have an incentive to do so. Moreover, our results indicate that some elements of eye movements are easier to control when the observer is aware of the expected scanning characteristics (such as seriality of gaze), and that these elements depend on the task at hand. ***Discussion***: These findings imply that familiarity is a fast-developing construct that draws visual attention, even when people are aware of the expected scanning characteristics and try to control their gaze behavior.

Poster: **B25**   **Sara Wesolek**

Content representation of tactile mental imagery in primary somatosensory cortex

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Introduction: In tactile perception cortical processing of sensory information in primary somatosensory cortex (SI) is driven by external sensory stimulation, while tactile mental imagery was in contrast shown to involve an internal activation of SI. Here, we investigate if this recruitment of sensory regions also reflects content-specific activation, i.e. if the activation in SI is specific to the mental content participants imagined. ***Methods***: To this end, healthy volunteers (n=27) either perceived or imagined three types of vibrotactile stimuli during fMRI data acquisition, supplemented with an attention control condition. ***Results:*** Independent of the content, in tactile mental imagery conditions as well as in the attention control condition, we found activation of fronto-parietal regions, which are well described as the task-positive network. Also, we replicated previous findings of activation in the SI subregion BA2 during tactile imagery. While the imagery of the three different stimuli (mental content) did not reveal univariate activation differences, we were able to decode the imagined stimulus type using multivariate pattern classification, most consistently within the hierarchically highest subregion BA2. This area furthermore showed an activation difference between imagery and attention, which correlated with the participants' self-rated ability to imagine tactile stimulation. ***Discussion***: Together, these findings promote that mental tactile imagery involves the recruitment of content-specific activation patterns in sensory cortices, namely in SI.

Poster: **B26**   **Carina Forster**

Neural correlates of stimulus expectations in somatosensory perceptual decision making

Forster, C. [1,2], Grund, M. [1], Panagoulas, E. [1,3], Al, E. [1], Stephani T. [1], Nikulin, V.V. [1], & Villringer, A. [1,2,3]

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Introduction: According to Bayesian integration, what we perceive is a combination of sensory evidence and prior beliefs. A prior belief can be based on information about the probability of a stimulus occuring in a given situation. Expectations about the probability of a sensory stimulus should therefore alter perception of a weak stimulus. It is unknown how, where and when this top-down influence of stimulus expectations is processed in the human brain. *Methods*: Here, we address whether stimulus expectations bias somatosensory perception and confidence, and how this is reflected in brain activity measured with 64-channel EEG. 43 female and male, healthy human adults received near-threshold electrical stimulation on their left index finger in 360 out of 720 trials. Participants reported stimulus presence or absence, and binary decision confidence with a button press. Stimulus expectations were manipulated in a within-subject design. Each miniblock contained either three near-threshold trials (25%; low expectation) or nine near-threshold trials (75%; high expectation). Probability cues matched the actual probability of stimulus presence. *Results:* Analysis based on Signal detection theory , indicated that participants used a more conservative threshold to report a stimulus in the low stimulus probability condition, while there was no significant difference in sensitivity. Reaction times were faster and confidence was higher in hits in blocks with a high stimulus probability. Analysis of prestimulus power replicated the well-known excitability effect of lower alpha and beta power for detected stimuli. Contrasting low and high probability conditions showed higher beta power in the low probability condition in right centro-parietal electrodes. *Discussion*: We show for the first time in the somatosensory system that informative cues of lower stimulus probability increase the subjective threshold to report a weak stimulus. While we replicated the well-established finding of higher excitability indexed by lower alpha power before detected stimuli, preliminary results suggest that not alpha but beta power encodes top-down expectations about stimulus probability.

Poster: **B27** **Tim Paul Steinfath**

Pre-Stimulus Heartbeat Evoked Potentials predict P300 and reaction time in an auditory Oddball Task: real effect or artifact?

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Introduction: Introduction: Heartbeat evoked potentials (HEPs) refer to the brain's response to one's own heartbeat and they are thought to reflect the brain's ability to monitor and regulate cardiovascular function. Previous research has shown that HEPs play an important role in cognitive and emotional processing. Since HEP amplitudes are significantly higher during interoceptive than exteroceptive attention, it has been hypothesized that changes in HEP amplitude represent an attentional shift from external task-relevant to internal interoceptive stimuli. In this framework, we aimed to investigate whether electrophysiological activity and task performance in an auditory Novelty-Oddball-Task relate to HEP amplitudes in the pre-stimulus time window. *Methods*: Methods. We analyze a large dataset of EEG recordings acquired in the LIFE-adult-study (N= 1825, 60 - 82 years). The subjects performed a 15min Auditory Oddball task. On the single-trial level, event-related responses were calculated and sorted according to high and low P300 amplitude. In addition, trials were sorted based on reaction time (RT). We identified HEPs in the pre-stimulus time window and calculated their amplitude with respect to high/low P300 amplitude and RT. *Results:* Results. We were able to replicate a previously observed inverse relationship between task evoked ERP and HEP amplitude, with higher HEPs being followed by lower ERPs (and slower RT). However, control analyses point to the spurious nature of the observed association. Several strategies were applied to circumvent this problem and investigate the genuine HEP to ERP relationship. *Discussion*: Discussion. While we cannot rule out the possibility that pre-stimulus HEPs are related to task-evoked ERPs in auditory oddball tasks, we present alternative explanations that account for the observed effects. Our results underscore the importance of appropriate control analyses in HEP and ERP research.

Poster: **B28**   **Irena Arslanova**

The heart as a subjective pacemaker: how experienced time expands and contracts within each heartbeat

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Introduction: The brain keeps constant track of time as accurate timing is crucial for survival. However, our experience of time passage does not mirror the physically elapsed time. For example, positive experiences pass quicker than negative ones. Thus, the brain contracts and expands experienced time like an accordion. Current models suggest that perceived duration is encoded from temporally evolving neural dynamics. Yet, all neural dynamics ensue at the backdrop of interoceptive rhythms within the body, like the beating of the heart. *Methods*: We asked participants categorise the duration (200-400ms) of emotionally neutral visual shape or auditory tone (Experiment 1) or an image displaying happy or fearful facial expressions (Experiment 2) as short or long. Stimuli were time-locked to systole, when the heart contracts, or to diastole, when the heart relaxes. *Results:* When participants judged the duration of emotionally neural stimuli, systole led to temporal contraction, while diastole led to temporal expansion. Such cardiac-led distortions were further modulated by the arousal ratings of the perceived facial expressions (Experiment 2). At low arousal, systole contracted while diastole expanded time, but as arousal increased, this cardiac-led time distortion disappeared. *Discussion*: Thus, experienced time contracts and expands within each heartbeat – a balance that is disrupted under heightened arousal.

Poster Session C

March 15, 2023 at 15:40-16:25 | Virtual March 17, 2023 at 13:30-14:30

Poster #	Presenter (s)	Poster Title
C01	Jonas Jänig	Tracking Depth-Selective Visual Attention using SSVEP
C02	Tilman Stephani	Cortical excitability shapes somatosensory perception with spatiotemporally structured Dynamics
C03	Sarah Wellan	Neural correlates of anhedonia during pleasant touch
A05	Jessica Gemignani	The reproducibility of infant fNIRS studies: a meta-analytic approach
C05	Pawel Motyka	Investigating the effects of cardiac activity on perceived distance to threatening objects in VR
C06	Jona Förster	EEG correlates of conscious somatosensory perception in a tactile temporal discrimination task
C07	Cecilia Vezzani	Effects of transcutaneous vagus nerve stimulation on gastric rhythm during caloric load
C08	Gajos Katarzyna & Monika Malon	Is loneliness linked to prosociality? A meta-analysis of 36 studies with 43,508 participants
C09	Adrienn Réka Németh	Studying the connection between spatial navigation and mentalization in children by using virtual reality
C10	Felix Quirmbach	Neuronal correlates of visuomotor expectation generation and violation in a virtual reality based hand movement task
C11	Thorge Haupt	Onset tracking of neural activity, a step towards understanding the brain beyond the lab
C12	Gabriel Hassan	Reactivity changes in the occipital cortex of blind subjects revealed by the combination of transcranial magnetic stimulation and electroencephalography
C13	Gianluca Gaglioti	Investigating the impact of cortical lesions on brain complexity in silico
C14	Mikołaj Szulczewski	Transcutaneus auricular Vagus Nerve Stimulation (taVNS) combined with slow breathing as an intervention for people with experience of war and symptoms of PTSD - rationale and the study design
C15	Clara Isakowitsch	How Augmented Reality Beauty Filters Can Affect Self-perception
C16	Ioanan Amaya	Altered thalamocortical connectivity induced by flicker light stimulation
C17	Tomasz Michalik	How culture shapes the mind? Eye tracking study on perception of medieval Nubian paintings by Sudanese and Western people
C18	Marek Nemecek	Bringing the colour constancy illusion to the fMRI scanner
C19	Javier de Echegaray	The role of semantic and emotional content in visual cortex processing
C20	Tiina Parviainen	Dynamic Variation of IAPF is Linked With Interoceptive Sensitivity and Approach Motivation
C21	Barbora Wolf	Is confidence a form of internal reward? A Pavlovian conditioning study
C22	Alexandrina Vasilichi	Affective expectations are modulated by the interplay between visceral signals and uncertainty of the sensory environment
C23	Nikolai Kapralov	Multiverse Analysis of Longitudinal Changes in Sensorimotor Functional Connectivity during Brain-Computer Interface Training
C24	Anastasia Asmolova	Multi-muscle TMS mapping investigation of motor cortex reorganization during finger individuation training
C25	Alina Studenova	On the relevance of alpha-rhythm modulation to the generation of readiness potential
C26	Josefin Röbbig	Habitual emotion regulation is represented in functional connectivity of cortico-limbic networks in healthy younger and older adults
C27	Xiuhui Chen	Altered Resting-state Functional Connectivity in Central Post Stroke Pain
C28	Carolina Villegas Martinez	Development and Validation of the Parental Interoception Questionnaire (PIQ)

Poster Session C

Poster: **C01**   **Jonas Jänig**

Tracking Depth-Selective Visual Attention using SSVEP

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Introduction: Visual attention can be directed to visual features such as color, orientation or spatial frequency. Active deployment of visual attention can be tracked by presenting differently colored random dot clouds (RDK) that flicker at different below-flicker-fusion frequencies. These RDKs induce frequency-specific steady-state visual evoked potentials (SSVEP) in EEG recordings. Usually the SSVEP amplitude of the to-be-attended RDK is enhanced after attentional deployment while the to-be-ignored RDKs' amplitude loses signal energy. With the SSVEP technique, previous studies greatly informed our understanding of the neural processes underlying attentional mechanisms but were restricted to plain two-dimensional stimulus arrangements. Our goal was to explore attentional deployment for the visual feature of spatial depth. *Methods*: Participants observed two white RDKs in different spatial depths that were flickering at different frequencies. The three-dimensional simulation used a stereoscopic viewing setup including a projector with a beam-polarizing shutter and polarized glasses. Participants were cued to attend to the RDK that was further away or closer to them and performed a visual detection task while ignoring the other RDK. SSVEP recordings were analyzed to quantify topographical and temporal dynamics during attentional deployment. *Results:* A behavioral pilot study confirmed that attention is guided by the cued feature rather than frequency information of the RDKs. SSVEP spectra of the first 16 recorded participants showed amplitudes at the evoked flicker as well as intermodulation frequencies. Furthermore, attended SSVEPs had quantitatively higher voltage amplitudes than unattended SSVEPs. *Discussion*: The results show that SSVEPs are measurable by using our novel approach combining flickering RDKs and stereoscopic three-dimensional viewing. There is a clear trend for a modulatory effect of spatial depth based attention similar to the known effects of spatial and feature-based attention. Interestingly, the pronounced amplitude at the intermodulation frequency suggests that, at some point, both flickers are processed as one percept in the visual cortex.

Poster: **C02**   **Tilman Stephani**

Cortical excitability shapes somatosensory perception with spatiotemporally structured Dynamics

Stephani, T. [1,2], Hodapp, A. [3], Jamshidi Idaji, M. [4], Nierula, B. [5], Eippert, F. [5], Villringer, A. [1,6,7], & Nikulin, V.V. [1]

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Introduction: Brain responses vary considerably from moment to moment, even to identical sensory stimuli. This has been attributed to changes of instantaneous neuronal states reflecting the system's excitability. Yet the spatiotemporal organization of these dynamics and their influence on perception remain poorly understood. In the current work, we characterized excitability fluctuations of the human primary somatosensory cortex in a series of three somatosensory stimulation paradigms from a temporal, spatial, and functional perspective. *Methods*: Employing electroencephalography (EEG), we examined the interplay of two markers of cortical excitability, pre-stimulus oscillatory activity in the alpha band (8-13 Hz) and thalamo-cortical excitatory post-synaptic potentials (EPSP) inferred from short-latency somatosensory evoked potentials (SEP), as well as their association with perceived stimulus intensity. Furthermore, we characterized the temporal structure and the spatial specificity of these dynamics on a single-trial basis using scaling analysis and source reconstruction of hand- and foot-related SEPs. *Results:* Pre-stimulus alpha oscillations influenced initial cortical SEPs, which were in turn associated with changes of the perceived stimulus intensity. Furthermore, these fluctuations of cortical excitability, reflected both in oscillations and SEPs, followed a temporal power law, indicating the existence of long-range temporal dependencies. Comparing these dynamics between spatially distinct somatosensory regions (i.e., foot and hand areas), we observed a somatotopic organization of the relation between ongoing neuronal states and stimulus-evoked responses. *Discussion*: Our findings demonstrate that already at initial cortical processing instantaneous neural excitability modulates how intense a stimulus is perceived. Despite these cortical dynamics representing topologically confined effects, they also seem to be embedded in global system activity that is organized in a scale-free manner, as indicated by the observed long-range temporal dependencies. This may reflect a delicate balance between robustness and flexibility of neural responses to sensory stimuli, enabling the brain to adaptively change the neural encoding of even low-level features, such as the stimulus´ intensity.

Poster: **C03**   **Sarah Wellan**

Neural correlates of anhedonia during pleasant touch

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Introduction: Anhedonia, i.e., the reduction or loss of interest or pleasure, is a severe symptom of many psychiatric disorders but can also be found in the general population. Research indicates that a dysfunction of any component of the reward process, for instance reward anticipation, consummation, or reward learning, could lead to subjectively reported anhedonia. During fMRI, consummatory pleasure is often assessed using monetary rewards. Here, we aim to examine the neural correlates of anhedonia during pleasant touch. *Methods*: Seventy young healthy adults (aged 18-30), varying in trait anhedonia, completed an established affective touch paradigm during fMRI. After each of the 36 trials of visuo-tactile stimulation, participants subjectively rated the pleasantness of their experience. Anhedonia levels were assessed with established trait and state scales. We analyzed the neural activation related to positive and negative valence with two parametric modulators based on the individual subjective ratings. The positive valence modulator was selected to assess correlations with state and trait anhedonia scales. *Results:* On a whole-brain corrected level (pFWE < .05), we found significant peak activations related to state anhedonia in the ventro-medial prefrontal cortex (vmPFC) and the right inferior parietal lobe (IPL) area PFt. *Discussion*: Our results indicate that in participants with high levels of state anhedonia activation in the vmPFC is more strongly tied to the subjective ratings of each trial, while activation in the IPL follows the subjective ratings of pleasure to a lesser extent. Thus, a complex picture of neural correlates of anhedonia during pleasant touch arises.

Poster: **C04**   **Jessica Gemignani**

The reproducibility of infant fNIRS studies: a meta-analytic approach

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Introduction: As the volume of fNIRS research has grown, especially in developmental cognitive neuroscience , so has the concern for the reproducibility of findings. Meta-analytic approaches are powerful tool to assess the robustness of empirical findings but have been so far been little applied to fNIRS data. In this work we describe a framework to aggregate across findings to reveal the robustness of the effect of rule learning in infants in the left temporal lobe and to investigate its sources of variability. *Methods*: We aggregated 19 fNIRS studies conducted in four different laboratories, testing brain responses of infants to repetition- and diversity-based linguistic rules. The sample included 355 newborns, 104 6-month-olds, 13 7-month-olds and 15 9-month-olds. We computed effect sizes for brain responses to repetition-based rules vs. baseline (R vs 0), diversity-based rules vs. baseline (N vs 0) and repetition- vs. diversity-based rules (R vs N). The average magnitude of brain responses was compared to their between-subject variation to obtain meta-analytic effect sizes, and to their inter-trial variation to obtain infant-level effect sizes. Then we explored how effects are moderated by Laboratory, Age and RuleType. *Results:* The magnitude of the effect was 0.27 (95% CI= [0.144, 0.398], $p<0.001$) for the R vs 0 comparison, 0.18 (95% CI= [0.03, 0.33], $p<0.05$) for N vs 0 and 0.08 (95% CI= [-0.06, 0.22], ns) for R vs N. No analysis revealed an effect of Lab. Age was a significant moderator: responses to repetitions were larger in 6-month-olds than in newborns, then decreased for 7-to-9-month-olds. *Discussion*: Our meta-analysis revealed no variability in infants' responses to repetition- and diversity-based rules attributable to Laboratory, indicating that effects were robust and reproducible. Further, we found differential developmental trajectories for the two types of rules.

Poster: **C05**   **Pawel Motyka**

Investigating the effects of cardiac activity on perceived distance to threatening objects in VR

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Introduction: Prior studies suggest that fear-evoking objects are perceived as physically closer than neutral ones, potentially to facilitate adaptive responses in the face of danger. In addition, the processing of threat-related signals is selectively enhanced during cardiac systole. We here investigated whether the perceived distance to threatening objects varies with cardiac phase and depends on the subjective feelings of fear. ***Methods***: We designed an immersive virtual reality-based study in which threatening and non-threatening animals (2 x 4 items) were briefly displayed (100 ms) at varying distances (1.5–5.5 m) from young healthy observers, while their ECGs were recorded (n = 41). The participants' task was to point to the positions at which the animals had been seen (resulting in a total of ~29k trials). ***Results:*** The pre-registered analysis indicated that perceived distances to neither threatening nor non-threatening animals differed significantly between cardiac phases. There was also no evidence for an association between subjective fear and perceived proximity to threatening animals. In an exploratory analysis we found that perceived distance to all animals decreased with increasing levels of trait anxiety. ***Discussion***: In contrast with previous studies which used less naturalistic experimental conditions and verbal or declarative distance measures, we did not find supporting evidence for a reduction in the subjectively perceived distance to threatening objects. Moreover, our findings add to the existing evidence suggesting that the cardiac phase-related variation in threat processing might not generalize across different paradigms.

Poster: **C06**   **Jona Förster**

EEG correlates of conscious somatosensory perception in a tactile temporal discrimination task

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Introduction: While conscious somatosensory perception has frequently been investigated using detection tasks, studies of more complex aspects, such as discrimination or identification of stimuli, are relatively scarce. Here, we investigated the conscious experience of pulse pairs in a tactile temporal discrimination paradigm and its correlates in the post-stimulus period of the EEG signal. *Methods*: EEG was recorded continuously, while participants (n=34) received pairs of brief electrical pulses with variable inter-stimulus intervals to the left median nerve and a simultaneous visual cue indicating either "one" or "two" pulses. In order to control for confounding processes such as motor responses, participants did not directly report their experience, but indicated whether they experienced a match or a mismatch between their tactile experience and the visual cue with saccades. We analyzed participants' EEG data with classical ERPs, linear deconvolution, and multivariate decoding, focusing on modulation of post-stimulus activity by the experience of (mis-)perceiving one vs. two pulses. *Results:* The ERP analysis revealed a contralateral frontal difference around 140 ms between "felt as one" and "felt as two" trials. The deconvolution analysis showed a strong effect in electrodes over bilateral primary somatosensory cortices. Multivariate decoding confirmed that information about tactile experience was reliably present in contralateral parietal electrodes from ~250 ms post-stimulus onward. *Discussion*: Our ERP finding suggests that the N140 component, known to index conscious detection of tactile stimuli, may play a role in tactile temporal discrimination as well. The bilateral effect seen in the deconvolution hints at cross-hemispheric S1 communication as an important factor in this task. Our multivariate analysis establishes that the experience of feeling one vs. two pulses is represented in contralateral parietal electrodes in a stable fashion over time.

Effects of transcutaneous vagus nerve stimulation on gastric rhythm during caloric load

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Introduction: The vagus nerve plays a fundamental role in the communication between the gut and the brain. Previous studies have shown that vagal afferent stimulation alters gastric myoelectric activity and gastric motility. Moreover, transcutaneous auricular vagus nerve stimulation (taVNS) increases stomach-brain coupling which may alter interoception. However, it is not known whether taVNS leads to discernable effects on gastric myoelectric activity depending on metabolic state and side of the stimulation (left vs. right ear). To this end, we assessed whether taVNS modulated changes in gastric frequency and power before and after a milkshake (~400 kcal). *Methods*: We conducted a randomized cross-over study on 37 healthy individuals administering right and left taVNS (vs. sham) before and after caloric intake (4 sessions). Gastric motility indexes (frequency, amplitude) were assessed through electrogastrography (EGG) and processed with a recently published best-practice pipeline. Each session was divided into 3 phases: baseline (without stimulation), stimulation, and caloric intake (during stimulation). To capture changes in metabolic state, we collected ratings of hunger and satiety every 30 min. *Results:* Consistent with the previous research, the caloric load was followed by a short drop in gastric frequency and an increase in power (in 26/37 participants). Load-induced increases in the frequency band with the highest power were qualitatively consistent across sessions, but the magnitude of increases was variable within participants. About 10 min after the load-induced power increase, we observed a plateau during taVNS sessions while power increased further during sham sessions. Load-induced changes were comparable for left and right taVNS. *Discussion*: Across participants, the caloric load led to a robust increase in power. In line with previous finding suggesting altered motility, taVNS reduced the load-induced increase in power, regardless of the side of the stimulation, which may help define the role of vagal afferent stimulation on digestion.

Poster: **C08**   **Gajos Katarzyna & Monika Malon**

Is loneliness linked to prosociality? A meta-analysis of 36 studies with 43,508 participants

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Introduction: The Evolutionary Theory of Loneliness (ETL) posits that loneliness may motivate individuals to approach others, but at the same time increase focus on self-preservation and safety, resulting in egocentric behavior, negative social expectations, decreased trust or increased social threat monitoring. Since the empirical evidence for the link between loneliness and prosociality is far from conclusive, the current meta-analysis aims to estimate the strength of this relationship and explore factors impacting it. *Methods*: A systematic search of PsycINFO, PubMed and Scopus was conducted in line with PRISMA 2020 guidelines to identify studies investigating the link between loneliness and prosociality. Only peer-reviewed studies using quantitative methods were included into the final sample (k=36; n=43,508; 52.78% females, mean age=25.16). Random effects models and meta-regressions employing age, sex ratio and type of the sample (WEIRD vs non-WEIRD) as meta-regressors were included in the analysis. While the main analyses were performed for the whole sample of the studies, secondary analyses were conducted separately for studies using either behavioral, declarative or observer-rating measures of prosociality. *Results:* We have found a significant albeit weak negative correlation between loneliness and prosociality [r=0.118, 95% CI: (-0.179, -0.057), p<0.001], which was stable among different types of prosociality measures. Only sex ratio was found to be a significant predictor of the strength of link between loneliness and prosociality, with stronger effects found in the samples with higher male ratio. *Discussion*: Our results support the hypothesis posited by ETL as a negative association between loneliness and prosociality has been found. However, this effect explains only a small amount of the prosociality variance, thus suggesting that other factors associated with social functioning, such as social status or social cognitive bias, should be further investigated.

Studying the connection between spatial navigation and mentalization in children by using virtual reality

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Introduction: Spatial navigation relies on multiple cognitive skills and it shows a stereotypical development profile from early childhood to adult age. With regards to the point of reference, we distinguish between egocentric and allocentric reference frames. Some researchers claim that children are born with allocentric representations, but at a certain age, they prefer egocentric representations. The legacy of Piaget's work suggests that the viewpoint-independent strategy requires the maturation of spatial cognition. Some researchers claim that the „Theory of Mind" and perspective-taking are independent from each other. The other approach posited a relationship between the two abilities. Interestingly, the emergence of the "Theory of Mind" and the ability to switch to allocentric spatial reference frames has similar developmental milestones between the third and the fifth year. We hypothesized a correlation between spatial perspective-taking and the cognitive operations required by mentalization in the development. *Methods*: We implemented a game for tablets in which the player has to locate and collect lost space aliens who landed on Earth. The sample included 26 preschoolers (mean age: 55,8 months). There were 5 different camera setups. These setups included a 1st person view, a 3rd person view, and a bird-eye view. The view control modes were two kinds: egocentric and allocentric. We also measured the Theory of mind with a digitalized Sally-Anne test. *Results:* Children who solve the Sally-Anne task can navigate better in the ground-level allocentric orientation viewpoint than the rest of the children. In contrast, there is no difference between the 2 mentalization groups concerning the egocentric navigation on the ground level. *Discussion*: Based on the results, the ability to use a coordinate system attached to the environment instead of the person's own body may help to understand the dependency of the source of information on spatial positions. This understanding may be supported the mentalization ability.

Poster: **C10**   **Felix Quirmbach**

Neuronal correlates of visuomotor expectation generation and violation in a virtual reality based hand movement task

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Introduction: Along certain theories of cortical processing, the brain generates predictions about sensory consequences of planned actions; e.g. which visual feedback of its body position it will receive when executing a specific movement. Here, we examined neuronal correlates of predictions of visual movement consequences, if those prediction could be induced similarly for congruent and incongruent visuomotor mappings; and whether the effects of their violation depend on the certainty of prediction. ***Methods***: Our event-related fMRI experiment induced visuomotor expectations, then either met or violated them. Participants performed a VR-based task, executing open-or-close hand movements (measured via data glove, translated to a virtual hand (VH) model) when shown a "Go" signal. During a preparation phase before each movement, cue color instructed participants to expect congruent or incongruent VH movement (expectations about visual action consequences were orthogonal to visuomotor congruence). Visual expectations were induced with varying degree of certainty, as cue shape could indicate the direction of the following VH movement (open/close), or leave it ambiguous. In 25% of trials, VH movement direction did not match the cue, inducing expectation violation. ***Results:*** Contrasting activation after presenting directional > ambiguous cues showed significantly ($p < 0.05$, FWEcluster) increased activation in the bilateral supplementary motor area, lateral occipital cortex, and the left superior parietal lobule. Contrasting incorrectly with correctly cued VH behavior (expectation violation) showed significantly increased activation in areas related to error detection, e.g. the medial frontal cortex and the bilateral anterior insulae. ***Discussion***: Preliminary results suggest that visuomotor control regions and visual associative (motion) areas form predictions about visual action consequences with varying certainty. Activity in these areas increased during movement preparation when a specific prediction could be made which VH movement would accompany action vs when this prediction was ambivalent. Violations of those predictions were detected by a similar error network as identified in previous work.

Poster: **C11**   **Thorge Haupt**

Onset tracking of neural activity, a step towards understanding the brain beyond the lab

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Introduction: One challenge of monitoring auditory neural activity in daily life is the extraction optimal features that can be derived from the environment and reveal interpretable insights into the dynamic brain response. In this study, we propose sound onsets of acoustic transients, as an easily obtained feature for potential usage in beyond the lab recordings. *Methods*: We re-analysed an existing dataset where participants performed a 3D Tetris task while listening to a realistic soundscape of a surgery room. We extracted a multitude of relevant acoustic features and trained the temporal response functions (TRF). The performance of the derived neural model was compared on a held-out testing set. Using variance partitioning, model explainability was compared by determining the shared and unique variance of each feature of interest. Additionally, we compared labeled vs unlabeled onset, as marker information is not readily available during beyond the lab recordings. At last, we use event density estimation of the soundscape to derive neural models representing periods of high and low acoustic event density, simulating real-world acoustic dynamics. *Results:* The results show that unsupervised detected onsets from continuous sound streams can be used to derive plausible neural models, that in terms of model predictions are comparable to state-of-the-art features. Training models based on experimental markers compared to unspecific onsets requires an order of magnitude more training trials to obtain a similar model prediction performance. At last, we show that during periods of increased acoustic event density, a reduction in the N1 can be observed. *Discussion*: We demonstrate automatically detected onsets based on acoustic transients as a promising feature to be derived when moving beyond the lab to monitor sound processing in daily life. The sparse representation fulfills both practical constraints and provides sufficient stimulus information to detect neural changes in response to changes in the environment.

Poster: **C12**   **Gabriel Hassan**

Reactivity changes in the occipital cortex of blind subjects revealed by the combination of transcranial magnetic stimulation and electroencephalography

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Introduction: The visual cortex of individuals who lack sight, especially since birth, can be activated by various external inputs, spanning from different modalities and across cognitive tasks. While this functional adaptation suggests modifications in the electrophysiological characteristics of the occipital area, its functional significance remains unclear. *Methods*: To investigate these changes in brain reactivity, we recorded the electroencephalographic (EEG) responses to transcranial magnetic stimulation (TMS) in 7 blind (1 congenital and 6 late) and 10 sighted subjects by perturbing the left occipital cortex as target site and the left premotor cortex as control site. Additionally, we registered spontaneous EEG activity during eyes closed and open conditions and visually evoked potentials (VEPs). *Results:* As expected, VEPs were absent in all blind subjects, and EEG alpha power was significantly ($P<0.05$) reduced in blind as compared to sighted subjects during the eyes-closed condition. When stimulating the left occipital cortex, TMS-evoked potentials (TEPs) were significantly faster in blind than in sighted subjects ($P<0.05$), as assessed by the time lag between the first two positive components elicited by TMS. Conversely, premotor responses were comparable between sighted and blind subjects. *Discussion*: These preliminary results show that TMS-EEG uniquely allows for a direct investigation of the electrophysiological features of the occipital cortex in blind subjects. Despite the small sample size, the results were consistent. Interestingly, the morphological and frequency features of occipital TEPs in blind subjects strongly resemble the ones evoked by stimulation of more anterior cortices, suggesting a significant reorganization of the area after permanent visual deprivation, even in late-blind. However, heterogeneous etiologies and blindness onsets prevent us from drawing conclusive functional interpretations. Nonetheless, this work might contribute to understanding whether the neurophysiological features of the occipital cortex of blind subjects could be ascribed to a functional reorganization of the area, which would potentially participate in sensory-specific and higher-order functions.

Poster: **C13**   **Gianluca Gaglioti**

Investigating the impact of cortical lesions on brain complexity in silico

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Introduction: From a theoretical perspective, an efficient brain information processing can be characterized in terms of an optimal balance between functional integration and functional differentiation. This balance, also called brain complexity, is likely altered following brain injuries. Several works have recently used the Perturbational Complexity Index (PCI) to quantify brain complexity in humans, but only few have used this index in computational models. In fact, whole-brain simulations allow us to investigate the consequences of focal brain injury on brain complexity and to explore the mechanisms that sustain it. *Methods*: Here we used a perturbational approach to quantify the complexity of the deterministic component of the response to stimulation using The Virtual Brain (TVB) platform and tested the effect of different cortical lesions, exploring some possible pathophysiological mechanisms of brain injury, on the spatiotemporal complexity of the evoked responses, quantified with PCI. We used a large-scale connectome and each node was modelled with a neural mass describing the interaction of excitatory and inhibitory neurons. We analysed the response to stimulation in terms of the instantaneous firing rate (IFR) of each node. Next, we extracted a binary spatiotemporal matrix of significant post-stimulus IFR relative to baseline and measured PCI by applying the Lempel-Ziv algorithm to the matrix. *Results:* Consistent with empirical work on focal brain injury, we found that lesions impacted the evoked responses to stimulation (e.g., by reducing stimulus-related oscillations), particularly over the affected hemisphere. Importantly, we found a reduction in the spatiotemporal complexity of the response, as measured by PCI, in most lesions. *Discussion*: These results highlight the possibility of exploiting computational models to explore the impact of brain injury on complexity, and open further perspectives for investigating the network underpinnings that sustain brain complexity as well as the precise mechanisms for its recovery following brain injury.

Poster: **C14**   **Mikołaj Szulczewski**

Transcutaneus auricular Vagus Nerve Stimulation (taVNS) combined with slow breathing as an intervention for people with experience of war and symptoms of PTSD - rationale and the study design

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Introduction: During wartime, the number of people exposed to the traumatic experience of war and forced migration is very high, making typical methods of psychotherapeutic help non-scalable and unfeasible to implement for all those in need. The present study will test the feasibility and effectiveness of a hybrid behavioral and neurostimulation intervention targeting activity of the vagus nerve using transcutaneus auricular Vagus Nerve Stimulation (taVNS) combined with slow breathing (six breaths per minute - 0.1 Hz). This method may improve symptoms of trauma-related emotional disorders because both of these interventions have been shown to have beneficial effects on emotional functioning. Furthermore, this method (specifically slow breathing) may also correct the dysregulation in autonomic activity characterized by decreased parasympathetic and increased sympathetic activity that is observed in this clinical population. *Methods*: The study will be a prospective pragmatic pre-post observational study. The interventional part of the study will last four weeks with dosage of 20 minutes of taVNS with slow breathing twice a day. Two laboratory measurements of resting cardiovascular activity will be conducted before and after the study. The study will test the effects of this method in a group of 20 woman who have experienced war in Ukraine and are experiencing symptoms of post-traumatic stress disorder (Posttraumatic Stress Disorder Checklist for DSM-5). The effect of this intervention on depressive and anxiety symptoms will also be examined (The Hopkins Symptom Checklist-25). Additionally, the intensity of somatic symptoms (the somatization scale of Symptom Checklist-90-Revised) and sleep problems (Insomnia Severity Index) will be measured. Furthermore, resting autonomic balance in the control of the cardiovascular system will be measured with electrocardiography (heart rate and analysis of heart rate variability), impedance cardiography to test whether the intervention induces a sustained increase in parasympathetic activity and a decrease in sympathetic activity in this group.

Poster: **C15**   **Clara Isakowitsch**

How Augmented Reality Beauty Filters Can Affect Self-perception

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Introduction: Augmented reality is used on social media with filters that can be applied to the user's face. These filters detect and transform facial features by overlaying digital masks on moving faces that conform the face to current beauty ideals. Prior to the development of ARB filters selfies could only be enhanced by retroactive photo editing. However, ARB filters adapt to facial features in real time, resulting in a unique digital beautifying process. The embodied experience of virtually altering one's face can create confusion in people about their real bodies and lead to a kind of body dysmorphia. Negative effects on user's mental health could be observed. This qualitative study explores how the use of ARB filters impacts people's perceptions of themselves. *Methods*: The study is based on online interviews that were conducted with eight individuals. Convenience sampling was used for recruiting the participants. The interviews were conducted over Zoom and comprised two parts. First participants looked at their static enhanced selfie, then they interacted with their augmented beautified self while moving. Interview questions covered three dimensions: emotional experience, self-perception and selfie-behaviour. *Results:* The majority of participants stated that moving with the filter affected them more than looking at the static enhanced selfie. The results were analysed within the frameworks of Extended Mind Theory (EMT) and Enactivism. Following EMT, the ARB filters could serve as visualisation aids for the mental image of the ideal self. The augmented self seems real because it is not static, but reflects people's movements. The AR beauty application and the self interact and therefore become a coupled system. *Discussion*: Overall this research adds to existing literature exploring the impact of beauty filters on users' self-perception and body image. AR facilitates a digital beautification process that could potentially have a greater impact on people's self-perception than retroactive photo editing.

Altered thalamocortical connectivity induced by flicker light stimulation

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Introduction: Perceptual disturbances, such as visual hallucinations, occur similarly during various psychopathologies (e.g., Charles Bonnet Syndrome, migraine aura), hinting toward a shared underlying mechanism. However, the specific neural mechanisms remain unclear up to today. Experimental induction methods of visual hallucinations (e.g., psychedelic substances, flicker light stimulation (FLS)) indicate a link to altered thalamocortical interactions. Here, we use FLS to induce visual hallucinations and test for thalamocortical dysconnectivity patterns of thalamic subregions. *Methods*: During resting-state fMRI recording, N=24 participants were exposed to constant light, 3Hz and 10Hz FLS in three eight-minute runs. After each run, participants rated their visual experience with ASC-R questionnaire items. We used the AAL3 parcellation of thalamic subfields and visual cortical regions to calculate temporal correlations in a ROI-to-ROI analysis. These correlations were used as functional connectivity measure to test for effects of FLS on interactions between thalamus and upstream visual areas. Additionally, we tested for correlations of connectivity changes with intensity scores of visual hallucinations. *Results:* We found that 3Hz and 10Hz FLS increased coupling between LGN, mediodorsal and ventrolateral thalamic nuclei with early visual cortices (e.g., cuneus). Further, FLS frequency modulated thalamocortical connectivity with higher visual areas (i.e., occipital gyri), where connectivity strength positively correlated with the intensity of visual effects. *Discussion*: Our results support that changes in thalamocortical connectivity crucially underlies altered perceptual processing. Specifically, thalamocortical hyperconnectivity with visual regions positively correlates with hallucination intensity. Our work extends previous research by identifying a differential pattern of thalamic subregion connectivity induced by FLS, which catalyses progress to establish the functional role of thalamocortical dysconnectivity in perceptual disturbances. While the LGN relays visual input, mediodorsal nuclei are association nuclei facilitating cortico-cortical communication and ventrolateral nuclei seem to play a role in synaesthesia. Together, it suggests that altered thalamocortical connectivity with first-order and association thalamic nuclei may contribute to visual hallucinations.

Poster: **C17**   **Tomasz Michalik**

How culture shapes the mind? Eye tracking study on perception of medieval Nubian paintings by Sudanese and Western people

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Introduction: In the last 700 years, the culture in Sudan has changed dramatically. In contrast to the currently dominant Islamic culture in Sudan, in the Middle Ages Christian kingdoms existed in the northern and central parts of this country. The remains of them are, among others, churches and monasteries in which paintings depicting biblical figures and rulers have been preserved. Due to historical changes (spread of Islam in Sudan) medieval heritage can be differently perceived by local people (mostly connected to Islam and belonging to collectivist culture) and western tourists (mostly connected to Christianity and belonging to individualistic culture). *Methods*: The main objective of the project was to investigate how culture affects the perception of archaeological heritage. The research was carried out in medieval Monastery on Kom H in Old Dongola archaeological site in Sudan. During the study Sudanese (n= 55) and Western (n=19) visitors equipped with eye-tracker visited two rooms containing medieval paintings. After a visit an interview on understanding of medieval paintings was conducted. *Results:* Results indicate that there are (1) differences in the recognition of emotions in some paintings between people from different cultures, (2) that allocation of attention in some cases resulting from culturally grounded aesthetic preferences and knowledge from everyday life, (3) that there is more relational way of looking at paintings by representatives of collectives cultures in comparison to people from individualistic cultures and (4) that there is the importance of the state of preservation of paintings when assessing their beauty. *Discussion*: The study was important in understanding the needs of visitors from different social and cultural groups. Presented explorative research partially confirmed relations between culture background and ways of looking at paintings as well as importance of cultural knowledge (stage of familiarity with Christianity) on understanding and interpretation of paintings.

Poster: **C18**   **Marek Nemecek**

Bringing the colour constancy illusion to the fMRI scanner

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Introduction: Colour constancy refers to the phenomenon whereby observers are able to identify colours as stable across illumination changes and which can lead to perceptual illusions of apparent colour. However, how colour constancy is realised in the brain and at which level of the processing stream representations of apparent colours arise is unknown. To this aim, the present study employs a combination of fMRI and multivariate pattern analysis on novel visual stimuli containing either apparent ("illusory") or colorimetric ("real") colours. Here, we report on the initial phase of data analysis with two goals: 1) establish the strength of the perceived colour illusion of our fMRI-optimised stimuli; 2) demonstrate accurate decoding of real colours *Methods*: We designed a novel set of apparent colour stimuli optimised for fMRI with a large illusion surface area. Participants (N=33) were asked to report their illusory colour percept in a colour matching task. In the main experiment, participants were presented with real colours, as indicated in the colour matching task, illusory colours and a number of control conditions. *Results:* We found strong illusory colour effects for all considered colours with the strongest effects present for blue and red. Interestingly, we found positive cross-individual correlations between the illusion strength of all colours, indicating a general susceptibility towards the illusion rather than subject-specific biases to specific illusory colours. Finally, we show that the colorimetric colours of our stimuli can be decoded with high accuracy from early visual areas. *Discussion*: We introduce a novel paradigm and stimulus set to investigate colour constancy processing in the human brain. We demonstrate that colour constancy stimuli can be adapted to fMRI stimulus requirements while maintaining a strong illusion effect. Moreover, colorimetric colours could be decoded with high accuracy from early visual cortices, paving the way towards our main goal of identifying neural correlates of apparent colours.

Poster: **C19**   **Javier de Echegaray**

The role of semantic and emotional content in visual cortex processing

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Introduction: Emotional stimuli have the capacity to engage our attention in an involuntary bottom-up manner, overriding top-down control and prioritising their processing due to their high threatening or rewarding potential. Facilitated processing of these salient emotional signals would be reflected in heightened activity in visual regions, conveyed via re-entrant feedback signals from the amygdala and/or higher cortical regions. Previous evidence has shown enhanced sensory gain in the visual network during emotional exposure. Nonetheless, the relationship between the semantic effect versus the emotional content at the visual cortex remains unclear. Therefore, the present study aims to analyse the cortical response to neutral/emotional visual stimuli with and without semantic meaning in the visual cortex. *Methods*: We analysed frequency-taggled Steady-State Visual Evoked Potentials (SSVEPs) responses under a Rapid Serial Visual Presentation (RSVP) paradigm presented at 4 Hz. RSVP streams were composed by meaningless images followed by intact neutral or emotional complex scenes taken from the International Affective Picture System (IAPS). Keeping constant the low level features of stimuli, meaningless images consisted on scrambled versions of the same IAPS pictures. *Results:* Analysis of SSVEP responses revealed higher SSVEP amplitudes for intact IAPS scenes compared to their scrambled versions. Moreover, our results show greater SSVEP amplitudes for emotional compared to neutral streams across intact IAPS scenes, regardless of the valence. *Discussion*: Our results suggest that differences in the priority processing of emotionally relevant elements do not depend (solely) on low-level properties of the images, such as colour, but on their semantic content. Furthermore, the absence of significant differences in SSVEP amplitudes during emotional stimulation with respect to valence category (Pleasant vs. Unpleasant) suggests that the enhanced sensory gain would be driven by the difference in arousal.

Dynamic variation of IAPF linked with interoceptive sensitivity and approach motivation

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Introduction: Alpha oscillations show individual stability in frequency (individual alpha peak frequency, IAPF) which, however, modulates due to cognitive demands. Interestingly, IAPF has been linked also to variance in perceptual sampling and integration. IAPF may thus influence the way brain reacts to external (or internal) information flow. Earlier studies have linked IAPF mainly with cognitive functions, but it may also underlie our characteristic tendency to respond to 'social demands', mediated via exteroceptive or interoceptive sensations. We studied the link between MEG determined IAPF and the approach-avoidance motivation, as estimated by BIS/BAS scale. ***Methods***: We determined, in 50 young adults, the IAPF during exteroceptive vs. interoceptive task and examined also the link between IAPF and interoceptive sensitivity (IS). We used 48 x 20 s blocks with sounds either in synchrony (half of the blocks) or not with individually determined heartbeat. The sounds in each block were either all the same (half of the blocks) or with single deviant sounds. The MEG tasks were SOUND discrimination (deviant/no deviant, 24 blocks), HEART beat discrimination (heart-sound synch/not synch, 24 blocks) and REST (eyes closed and open). ***Results:*** Higher behavioral approach was associated with larger IAF difference in SOUND vs. REST (EC). Moreover, better performance in HEART task (IS) was associated with larger IAF difference in SOUND vs. HEART. ***Discussion***: Stronger task-related reactivity of IAPF may link with higher approach motivation and flexible engagement in processing external vs. internal information. In general, the dynamics of IAPF may be relevant for better understanding the individual differences not only in cognitive functions, but also in psychological experience.

Poster: **C21** **Barbora Wolf**

Is confidence a form of internal reward? A Pavlovian conditioning study

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Introduction: The feeling of subjective confidence, the sense of certainty in one's actions and perceptions is not only cognitive in nature but also has an affective dimension: it feels pleasing and rewarding to be confident. Indeed, neuroimaging and neurophysiological studies have implicated the mesolimbic reward network in the processing of confidence. These findings gave rise to the hypothesis that the feeling of confidence leads to self-generated reinforcement signals similar to those induced by external rewards. The present study tests this hypothesis by investigating whether confidence can lead to Pavlovian conditioning. *Methods*: Sixtythree healthy participants completed a novel confidence-based conditioning paradigm comprising a baseline, acquisition and extinction phase. To induce confidence-based conditioning in the acquisition phase, we used a random dot motion task with two coherence levels, eliciting the experience of low and high subjective confidence, respectively. To assess conditioning, we measured physiological signals (skin conductance, heart rate, pupil dilation) and behavioural pleasantness ratings about the sounds. *Results:* In line with our hypothesis, we found a strong behavioural conditioning effect in the acquisition phase. As known from Pavlovian conditioning with primary reinforcers, this conditioning effect levelled off in the extinction phase. Surprisingly, being unaware about the CS-US connection did not reduce the effect. Initial analyses at the physiological level show that skin conductance responses increased for high-confidence (CS+) relative to low-confidence (CS-) sounds, as likewise known from classic appetitive Pavlovian conditioning. *Discussion*: Our results show that the feeling of confidence is associated with a form of internal reward that transfers to previously neutral stimuli. We suggest that this phenomenon constitutes a form of confidence-based Pavlovian conditioning. Our results support the more general hypothesis that internal confidence constitutes a reinforcement-like learning signal which might be leveraged in instances of learning without external feedback.

Affective expectations are modulated by the interplay between visceral signals and uncertainty of the sensory environment

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Introduction: There is a growing consensus in perception science that expectations shape how we see the world and monitor our feelings. In particular, the numerous theories now emphasize an important role for interoceptive inferences in shaping our exteroceptive perceptual consciousness, yet little evidence exists for this. Here, using a novel perceptual learning task, we analysed how cyclic fluctuations in the visceral signal from the cardiac domain influence affective perceptual inferences in a face discrimination task. *Methods*: 245 participants completed the Confidence Weighting Task (CWT), a novel perceptual and affective reversal learning task, while physiological signals (i.e. electrocardiogram, respiration) were recorded. This design enabled us to manipulate both the sensory uncertainty or precision of stimuli, and the expected precision of prior expectations. We tested whether sensory uncertainty, affective valence, and expectation influences a range of exploratory behaviour, such as confidence, reaction time, choice, and accuracy. We also tested if CWT decision-making and learning correlates with the cardiac cycle. *Results:* We found evidence that the cardiac dynamics over the entire trial encode sensory uncertainty, and affective valence. Furthermore, we identified effects of these behavioural indices on confidence, choice, reaction time, and accuracy. In the next step, we plan to conduct these analyses on the extra dataset, as well as incorporate the visceral signal from the respiratory domain for both datasets. *Discussion*: Overall, these results show that there is a top-down modulation, whereby the visceral signals are adapting to the perceived characteristics of the sensory environment, as well as a bottom-up modulation, whereby the phase of the visceral signals cycles influence perceptual and metacognitive biases. Perceptual consciousness in the affective domain is modulated by this delicate balance.

Poster: **C23**   **Nikolai Kapralov**

Multiverse Analysis of Longitudinal Changes in Sensorimotor Functional Connectivity during Brain-Computer Interface Training

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Introduction: Sensorimotor brain-computer interface (BCI) is a system that decodes imaginary movements from the recorded activity of the user's brain and provides commands to external devices such as prostheses. On average, around 20% of individuals are unable to learn to control the device, and the mechanisms of successful BCI training are not clear yet. Signal-to-noise ratio (SNR) of the mu rhythm and functional connectivity between sensorimotor areas were previously shown to predict BCI performance. In the current work, we aimed to validate the relationship between SNR, connectivity, and accuracy of BCI control and investigate their longitudinal changes in a dataset with multiple sessions of BCI training. *Methods*: We used publicly available EEG recordings of 62 participants that performed 7-11 sessions of a cursor control task based on the imaginary movements of their hands. We considered 24 combinations of methods for inverse modeling and extraction of time courses of activity in sensorimotor areas of both hemispheres. Then, we applied multiverse analysis in order to assess robustness of effects with respect to selection of the pipeline. Within each pipeline, we used lagged coherence to estimate connectivity between sensorimotor areas. *Results:* We observed a positive effect of SNR on accuracy and connectivity, which was significant for all considered pipelines. At the same time, effects of connectivity on accuracy and changes in connectivity over time were significant for less than 25% of pipelines after controlling for changes in SNR. *Discussion*: Our results suggest that SNR is a primary factor of the observed variability in performance, while effects of connectivity are less robust across different pipelines. This in turn may indicate that changes in neuronal connectivity within the sensorimotor system are not the main factor defining learning in BCI.

Poster: **C24**   **Anastasia Asmolova**

Multi-muscle TMS mapping investigation of motor cortex reorganization during finger individuation training

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Introduction: Navigated transcranial magnetic stimulation (nTMS) is a powerful method for non-invasive cortical mapping. Recently we have demonstrated reliability of multi-muscle nTMS motor mapping in healthy volunteers in a test-retest study. As motor learning is known to alter muscle cortical representations (MCRs), here we aimed to investigate MCR reorganization after training of individual finger movements. *Methods*: 27 healthy right-handed male volunteers underwent two nTMS mapping sessions separated by ten sessions of finger-independence training. During nTMS mapping we recorded EMG from abductor pollicis brevis (APB) and abductor digiti minimi (ADM), first dorsal interosseous, extensor digitorum communis and biceps brachii. Within the 10 sessions of EMG-based biofeedback training participants learned to abduct thumb keeping their little finger still and vice versa. We measured the amplitude of the maximum voluntary contraction (MVC) of the trained muscles (APB, ADM) and hand dexterity using 9-hole peg test (9HPT). *Results:* Time of the 9HPT performance significantly decreased (t = 4.93, p = 0.001), while the amplitudes of APB and ADM MVC did not change significantly. At the group level changes in the MCR parameters were not significant, showing an increase trend (APB MCR area increased from 6.17 to 6.81 cm2, ADM - from 5.22 to 5.92 cm2). Yet at the individual level APB MCR area significantly increased in 7 participants and decreased in 4; ADM MCR area increased in 5 - decreased in 4; the APB-ADM MCRs' overlap increased in 1 - decreased in 2. *Discussion*: The finger independence training significantly increased hand dexterity, but not hand strength – this finding being in line with the previous studies showing that hand strength and dexterity are not associated directly. While previous studies with muscle immobilization showed a decrease in the overlap between MCRs, we observed a tendency for the increase in MCRs and their overlaps, suggesting that voluntary muscle relaxation reflects an active neurophysiological mechanism distinct from the simple muscle immobilization.

Poster: **C25**   **Alina Studenova**

On the relevance of alpha-rhythm modulation to the generation of readiness potential

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Introduction: The readiness potential (RP) was discovered more than 50 years ago, but it was Libet who introduced it to objective research on subjective agency. Although Libet's experiments were criticised for their design, the time interval between the onset of RP and the awareness of an intention was sufficient to spark debates about free will. Such temporal relationship between the two events was taken as a demonstration that the decision to move is formed in the brain before such decision is formed consciously. An alternative account for the explanation of RP is that it may represent an artefact of averaging, which implies that readiness-potential-like events may happen even in periods without voluntary actions. However, a recent study failed to find such events, possibly due to a low signal-to-noise ratio. One solution could be to perform a search in other frequency ranges where the signal has better quality. Along with RP, movement preparation is accompanied by changes in alpha rhythm, i.e., it's amplitude decreases progressively toward the movement execution. We hypothesise that RP is at least partially generated by alpha rhythm via the baseline-shift mechanism *Methods*: We analysed EEG recordings of 32 participants who performed self-paced movements in a classical Libet's paradigm. RP was obtained by averaging all epochs, and the alpha amplitude envelope was computed from each epoch via the Hilbert transform. *Results:* We show that the temporal dynamics are similar for RP and alpha rhythm amplitude, i.e., the negative RP corresponds to the decrease in oscillations' amplitude. Moreover, there is a spatial similarity between the neuronal sources generating RP and oscillatory dynamics, where both processes are particularly pronounced over the central-frontal regions of the cortex. *Discussion*: We suggest that demonstrating the link between RP and alpha rhythm will improve the conditions for searching for readiness-potential-like events in continuous data.

Poster: **C26**   **Josefin Röbbig**

Habitual emotion regulation is represented in functional connectivity of cortico-limbic networks in healthy younger and older adults

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Introduction: The capacity to regulate emotions is vital for mental and cardiovascular health. Here we test whether two forms of habitual emotion regulation, namely cognitive reappraisal and suppression, are represented in cortico-limbic networks using resting-state functional magnetic resonance imaging (rs-fMRI). Previous studies have shown that rs-fMRI allows to identify intrinsic synchronization of functionally coupled neural networks which can serve as a biomarker of personality. *Methods*: 136 young and 58 older healthy adults completed the Emotion Regulation Questionnaire (ERQ) and underwent a 15 min resting-state fMRI acquisition. We defined the left and right amygdala as seed regions and investigated their whole-brain functional connectivity, including habitual reappraisal or habitual suppression, respectively and age as covariates. Thresholds were $p < .05$ on cluster level (FWE corrected). *Results:* Correlation analysis of rs-fMRI data and habitual suppression revealed positive associations of cortico-limbic networks, that is, stronger functional connectivity of the bilateral amygdala and cognitive control areas (mPFC) as well as a positive association with right amygdala-nucleus accumbens connectivity. Both functional connectivity patterns showed an interaction with age, that is, in contrast to younger adults, older adults showed a stronger functional connectivity with higher habitual suppression use. *Discussion*: Our results indicate intrinsic synchronization of key nodes of the emotion regulation network (based on online emotion regulation fMRI studies) in relation to self-reported habitual suppression use. Most interestingly, our results indicate life-span developmental differences of this association, showing stronger cortico-limbic connectivity with age.

Poster: **C27**   **Xiuhui Chen**

Altered Resting-state Functional Connectivity in Central Post Stroke Pain

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Introduction: Central post stroke pain (CPSP) is a common consequence of somatosensory stroke, typically occurring within 3-6 months after the stroke. CPSP is refractory to therapy and affect patients' quality of life. We conducted a prospective longitudinal study in which we recruited somatosensory stroke patients in the acute phase and performed detailed clinical, behavioral, and MRI assessments. *Methods*: 77 stroke patients were recruited at Charité – Universitätsmedizin Berlin. Resting-state fMRI were performed before the pain (day2-10 days post-stroke) and after the pain (>60 days post-stroke). In total 61 patients were included in the analysis, 18 CPSP and 43 non-pain somatosensory stroke (NPSS). For the seed-based connectivity analysis, seeds were chosen from the pain network. For the connectivity gradients, we constructed affinity matrices and decomposed them using principal component analysis. The first gradient was included in the regression analysis. *Results:* (1)In the cross-sectional analysis before the pain, CPSP group showed stronger functional connectivity between the contralesional pars triangularis and opercularis in the inferior frontal gyrus. When the pain had occurred, CPSP group showed lower functional connectivity between the ipsilesional superior parietal lobule and putamen. There was a significant group by time interaction showing that pain patients have lower functional connectivity between the ipsilesional superior parietal lobule and putamen. (2) In the cross-sectional analysis on gradient 1, 8 parcels before the pain and 14 parcels after the pain are close to somatosensory and pain. In the longitudinal analysis on gradient 1, 7 parcels which are close to somatosensory, show a group by time interaction. The post-hoc test showed that in the pain group 6 parcels are close to somatosensory. *Discussion*: This analysis shows for the first time that functional connectivity of multiple brain areas differs between CPSP and NPSS patients. The changes in connectivity before pain development could help predict who will develop pain after stroke.

Poster: **C28**   **Carolina Villegas Martinez**

Development and Validation of the Parental Interoception Questionnaire (PIQ)

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Introduction: Parents' responses to their child's mental states are relevant for healthy development. However, less emphasis has been made on the child's body states and signals. Neuroscientific and psychological theory suggests that interoception is especially relevant and the parent-child relationship encourages the development of interoceptive and self-regulating abilities. To provide empirical evidence, a measure of parental interoception is needed, thus, our aim was to develop and validate a questionnaire that measures parents' confidence in their ability to detect and regulate their child's internal bodily signals and states. ***Methods***: There were three phases: 1) item development and content validity assessment (mixed methods), 2 & 3) evaluating reliability and construct validity (quantitative methods). Items were generated after a review of relevant constructs and existing measures. Expert ratings (relevance and clarity) and a field test (relatedness and importance) were used for content validity evaluation. Item reduction and factor analyses were carried out on a first sample. The questionnaire was administered to a new sample, with other standardized questionnaires, to assess construct validity. A re-test was made ~30 days after to evaluate test-retest reliability. Analyses for the last phase of the study are underway. ***Results:*** The first draft consisted of 72 items and 10 subscales. Expert ratings were low (CVR<0.62) for 30 items, qualitative feedback revealed the themes: subscale definitions, jargon, adding examples. Field tests showed overall high scores for relatedness (8.32/10) and importance (8.62/10). After modifications, 49 items and 9 subscales were left. After recruiting the first sample, item reduction and exploratory factor analyses suggested a 5-factor structure (TLI=0.831, RMSEA=0.094, BIC=-224.6) and a final number of 20 items. Confirmatory factor analysis showed a good fit (CFI=0.924, TLI=0.91, RMSEA=0.055). ***Discussion***: Though analyses are ongoing, and considering the limitations of self-report measures, we hope the questionnaire becomes a useful tool for future research on parental interoception.

Poster Session D

March 15, 2023 at 16:25-17:10 | Virtual March 17, 2023 at 14:30-15:30

Poster #	Presenter (s)	Poster Title
D01	Anna-Thekla Jäger	Decreased Self-Similarity of the rsfMRI BOLD Signal reflects Motor Sequence Learning Up to Two Weeks following Training
D02	Anna Fischer	Emotion regulation choice and flexibility in daily life
D03	Malthe Brændholt	The respiratory cycle modulates cross-modal decision computations
D04	Sandra Stojić	Intentional Binding Paradigm in a Social Context
D05	Nadine Herzog	Taq1A polymorphism is associated with worse working memory updating in high-BMI individuals
D06	Renzo Comolatti	Transcranial vs intracranial stimulation: similarities and differences explored by hd-EEG recordings
D07	Fabian Renz	Representation learning facilitates different levels of generalization
D08	Yonghao Chen	Real or fake? Decoding realness levels of stylized face images with EEG
D09	Thomas Schreiner	Respiration shapes sleep-oscillations and memory reactivation in humans
D10	Xiongbo Wu	Investigating the interaction between microsaccades and electrophysiology to understand their joint impact on visual perception in humans
D11	Laura Kaltwasser	The self in face identity processing with fast periodic visual stimulation
D12	Andrey Zhdanov, Ilya Zakharov, Andrey Zhdanov & Pshonkovskaya Polina	Brain sex prediction from EEG data using tree-based algorithms
D13	Genji Kawakita	Is my "red" your "red"?: Unsupervised alignment of qualia structures via optimal transport
D14	Yulia Revina	Expectations about pain location do not improve pain discrimination performance
D15	Suvi Karjalainen	Neural activity is modulated by spontaneous and volitionally controlled breathing
D16	Marko Dimitrovski	Heart evoked responses in the anterior cingulate can explain the effects of trait anxiety on decision-making under uncertainty
D17	Olgierd Borowiecki	Operationalization of planning based on Tower Tasks applied to clinical population – a meta-analysis.
D18	Delia Della Porta	Top-down attentional modulation does not affect the development of secondary hyperalgesia: an experimental investigation.
D19	Aoife Fitzpatrick	Investigating the role of peripersonal space representation in contact-related action across human and non-human primates
D20	Hannah Dalnim Lee & Jonas Weisser	Solving the Adaptive Valley Problem of Cultural Group Selection
D21	Venkatesh Subramani	Structure-Function decoupling of electrophysiological brain activity during video-watching
D22	Corinna Schulz	Ghrelin amplifies hedonic drive and food reward signaling in binge eating disorder
D24	Giulio Gabrieli	Recordings of SEPs from spinal regions: a systematic review
D25	Sarah Meissner	Through the eye to the brain: Modulating arousal via pupil-based neurofeedback
D26	Lioba Enk	Impact of nasal breathing on somatosensory detection: experimental design and pilot results
D27	Marta Gerosa	The influence of cardiorespiratory phase locking and heart-brain interactions on the sense of agency – a project idea
D28	David López Martos	Linguistic selection alteration in Huntington's Disease: ecological oral language production reveals evidence through lexical diversity algorithms

Poster Session D

Poster: **D01**   **Anna-Thekla Jäger**

Decreased Self-Similarity of the rsfMRI BOLD Signal reflects Motor Sequence Learning Up to Two Weeks following Training

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Introduction: Recent research in functional magnetic resonance imaging (fMRI) shows that scale-free properties of brain signals can meaningfully reflect human brain activity in health and disease. Here, we sought to examine whether changes in scale-free temporal dynamics within resting-state fMRI (rsfMRI) data are reflective of functional neuroplasticity following sequence-specific motor sequence learning (MSL). *Methods*: Using the Hurst Exponent (HE), we estimated voxel-wise scale-free functional dynamics and assessed changes over 5 consecutive days of MSL, followed by a retention scan (12 days later). The experimental group learned a complex visuomotor sequence while a complementary control group performed tightly matched motor movements. *Results:* Using the Hurst Exponent (HE), we estimated voxel-wise scale-free functional dynamics and assessed changes over 5 consecutive days of MSL, followed by a retention scan (12 days later). The experimental group learned a complex visuomotor sequence while a complementary control group performed tightly matched motor movements. *Discussion*: Our study presents new evidence of HE's relevance for functional plasticity and suggests that the sequence-specific cortical subset of regions may continue to represent a functional signature of learning after a period of inactivity reflected by unchanging HE levels following learning.

Emotion regulation choice and flexibility in daily life

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Introduction: How we regulate our emotions is essential for our well-being and social relationships. Emotion regulation (ER) is a highly complex, adaptive, and dynamic process and thus difficult to assess under restricted conditions in controlled laboratory studies. It has also been suggested that not the use of specific 'adaptive' ER strategies, but greater ER flexibility is related to increased adaptation to the environment and better mental health. We are especially interested in how health and well-being are reflected in ER choice considering situational and emotional factors, and how ER flexibility influences health and well-being. *Methods*: We implemented an experience sampling study using a smartphone application. 100 participants were asked randomly five times per day for two to four weeks if an emotional situation occurred and if so to complete a series of questions. These characterized the situation, its context, ER motivation, as well as used ER strategies and perceived ER success. Self-reports on well-being and health were collected separately. Multilevel modelling with day and subject as random effect factors is used to analyze the data. Additionally, we calculate a flexibility index to capture the high complexity and dynamics of the ER process and to investigate its role for the ER outcome. *Results:* Data analysis is ongoing. Descriptive results show an average response rate of 82.6 % of which 32.8 % represented encountered emotional situations by the participants. Pro-hedonic regulation represented the main motivation, followed by performance-related, social, and epistemic goals. *Discussion*: This study serves as a pilot project to gain better inside in what predicts ER choice in daily life and how this relates to health and well-being. We expect to identify key ER predictors, as well as well-being benefits of flexibly adapting ER strategies to differing situational demands. Moreover, we expect our results to differ from more traditional, controlled laboratory studies.

Poster: **D03**   **Malthe Brændholt**

The respiratory cycle modulates cross-modal decision computations

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Introduction: Respiratory rhythms not only play a critical role in homeostatic survival, but also modulate other, non-interoceptive perceptual and affective processes in the brain. In particular, recent evidence from human and rodent models suggests that both neural and behavioral oscillations are modulated by respiratory phase, i.e. the inspiratory-expiratory cycle. Thus far no mechanism based account of respiratory modulated behavior has emerged. Recent theoretical proposals have suggested that these rhythms may alter behavior by shaping neural excitability and neural gain control, two interlinked mechanisms which control evidence accumulation processes. Other studies have found the coupling effect to be particularly dependent on the respiratory phase at which responses are made rather than phases at stimulus presentation, suggesting an effect on motor rather than perceptual processes. ***Methods***: We conducted a psychophysical experiment probing breath-behavior coupling in 42 human participants using visual dot motion and face emotion stimuli. To investigate what aspect of the decision process was modulated by the respiratory phase we fitted a hierarchical bayesian drift diffusion model. ***Results:*** By comparing inspiratory versus expiratory states, we found that responses made during the inspiratory state were faster across both tasks ($p<0.001$ and $p=0.003$). Using a hierarchical computational modeling approach, we show that this effect is driven by a cross-domain enhancement of the non-decision time (95 % highest density interval of posterior distribution not overlapping zero), a latent parameter of the model related to early perceptual processes and motor preparation and execution. ***Discussion***: Here we present the first computational investigation of the respiratory phase on perceptual decision-making . The results seem to conflict with recent proposals that respiratory rhythms modulate neural gain but support the hypothesis of a cross-modal effect driven by a coupling between respiration and the motor system and are the first to demonstrate evidence for a computational mechanism underlying respiratory-behavior coupling.

Poster: **D04**   **Sandra Stojić**

Intentional Binding Paradigm in a Social Context

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Introduction: The sense of agency (SoA), or subjective experience of governing one's own actions, can be implicitly assessed through the intentional binding paradigm, where the compression of a time interval between the volitional action and outcome serves as a quantitative measure. *Methods*: In the present study, we investigated whether the SoA can be modified in a postdictive model of binding paradigm by incorporating social and non-social cues as auditory outcomes, potentially interpreted as cues conveying the piece of relevant information. Healthy participants (N= 80) were required to temporally estimate the onset of the auditory effects in three different conditions: when the sensory event was caused by the participant themself ("self"); another social agent ("other"); or an inanimate source ("nature"). *Results:* The statistical analysis revealed that the estimation error between physical and perceived sound onset, the outcome shift, was the greatest in the operant "self "condition (p < .001), replicating the robust effect between the voluntary executed versus the passively observed conditions ("other" and "nature"). The temporal estimates were shifted earlier in women (p < .05) as compared to men in all the experimental conditions. Despite the effects of social and non-social sounds did not manifest in the low-level parameters of the binding paradigm and its perceptual shifts, the reflective parameters, i.e., ratings of the auditory outcomes on valence (p < .001) and arousal (p < .001) scales were estimated as the highest for the "self "condition. Both arousal and valence estimates were higher for the category of social sounds than nonsocial. *Discussion*: The results of the present study confirm the robust intentional binding effect; however, the study offers a first-time inspection of sex differences and a novel approach to inspecting the social aspect of the discussed phenomenon.

Taq1A polymorphism is associated with worse working memory updating in high-BMI individuals

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Introduction: The working memory gating process has been hypothesized to be neurochemically rooted in fronto-striatal dopamine neurotransmission. Two single nucleotide polymorphisms associated with elevated prefrontal dopamine levels (Catechol - O - Methyl Transferase, COMT; rs4680) and reduced receptor density in the striatum (Taq1A, rs1800497) have been studied extensively in the context of working memory functioning. It remains unclear, however, if and how these two SNPs interactively influence working memory gating specifically. *Methods*: In this study, we aim to fill this gap by combining genotype and working memory gating data from 3 separate studies, thus generating a fairly big sample size. We further probe the influence of BMI on these interactions, as elevated BMI has been associated with compromised dopamine signaling. *Results:* Results show that specifically updating of working memory representations seems to be compromised in high BMI individuals, only if they carry the A-allele of the Taq1A gene. COMT did not have an influence on this relationship, however. *Discussion*: Our results are in line with the resource-modulation hypothesis, which posits that genetic effects (on cognition) are larger when resources are limited.

Poster: **D06**   **Renzo Comolatti**

Transcranial vs intracranial stimulation: similarities and differences explored by hd-EEG recordings

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Introduction: Transcranial Magnetic Stimulation (TMS) and intracranial single-pulse electrical stimulation (SPES) have both been used to assess reactivity and connectivity, as well as to induce and suppress cognitive, perceptual and behavioral phenomena in the human brain. However, the similarities and differences between these two perturbational techniques and their respective neural effects haven't been systematically compared. Here, we address this issue by comparing for the first time the effects of TMS and SPES on the same scale, that is at the level of hd-EEG scalp evoked potentials. *Methods*: The dataset consisted of TMS evoked potentials (n=20) recorded from healthy patients and SPES evoked potentials (n=20) recorded from drug-resistant epileptic patients, in both wakefulness and NREM sleep, registered using simultaneous intracerebral EEG and high-density scalp EEG. *Results:* We find that both TMS and SPES induce cortical responses that can be large-amplitude, long lasting and characterized by complex spatiotemporal patterns that vary consistently across wakefulness and sleep. Nonetheless, we find significant differences in their inter-trial variability, time-frequency content and spatiotemporal dynamics. Whereas SPES is more likely to induce larger and slower evoked responses, with increased suppression of high-frequencies, TMS evokes smaller and faster responses that are spatiotemporally more diverse. *Discussion*: On one hand, the consistent changes found between wakefulness and NREM sleep in both TMS and SPES, indicate that these state-dependent differences are due to intrinsic neurophysiological properties rather than specific to a brain stimulation technique. On the other hand, the differences found between TMS and SPES responses could be potentially accounted for by differences in the electrical field generated and the ensuing neuronal inhibition/excitation induced by each technique.

Representation learning facilitates different levels of generalization

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Introduction: Cognitive maps represent relational structures and are taken to be important for generalization and optimal decision making in spatial as well as non-spatial domains. While many studies have investigated the benefits of cognitive maps, how these maps are learned from experience has remained less clear. *Methods*: We introduce a new graph-structured sequence task to better understand how cognitive maps are learned. Participants observed sequences of episodes followed by a reward, thereby learning about the underlying transition structure and fluctuating reward contingencies. Importantly, the task structure allowed participants to generalize value from some episode sequences to others, and generalizability was either signaled by episode similarity or had to be inferred more indirectly. *Results:* Behavioral data demonstrated participants` ability to learn about signaled and unsignaled generalizability with different speed and adapt flexibly to changes in reward structure, indicating that the formation of cognitive maps partially relies on exploiting observable similarities across episodes. *Discussion*: We hypothesize that a possible neural mechanism involved in learning cognitve maps as described here is experience replay. According to this idea, replay goes beyond the application of preexisting structural knowledge, and takes an active role in establishing task-state representations by combining experienced sequences in novel ways that shape subsequent neural representations and generalization behavior.

Poster: **D08**   **Yonghao Chen**

Real or fake? Decoding realness levels of stylized face images with EEG

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Introduction: With the development of computer-generated graphics, virtual humans, especially virtual human faces play an increasing role in various new interactive applications such as VR/AR devices. A major challenge in creating such avatars is the generation of faces at a high level of realism. However, the so-called uncanny valley effect may cause people to perceive highly human-like faces as eerie. Although many studies have approached the uncanny valley effect through behavioral assessments of the subjectively perceived realness of computer-generated faces, the neurocognitive understanding still remains elusive. *Methods*: In this study, we utilized an existing electroencephalography (EEG) dataset of a steady-state visual evoked potential (SSVEP) paradigm recorded as a neural response from participants that were presented with human face images of a range of different stylization levels. *Results:* We found a nonlinear relationship between SSVEP amplitudes and the level of stylization. That is, the most stylized cartoon images and the real images evoked stronger responses than images with medium stylization. Additionally, we found that the realness level can be decoded from EEG data using a classification algorithm based on task-related component analysis (TRCA) using short EEG segments. This classifier could distinguish even between the close-by stylization levels of high similarity. We discuss possible confounding effects in the context of EEG responses to artificially generated faces, such as the size of the stimulus face's eye, which arguably represents a critical factor during face recognition. *Discussion*: This study provides a basis for future research and benchmarking of real-time detection of face realness regarding three aspects: SSVEP-based modulation effects of stylized images, efficient classification methods, and low-level stimulus confounders that need to be controlled.

Respiration shapes sleep-oscillations and memory reactivation in humans

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Introduction: Contemporary models propose that sleep's critical contribution to memory consolidation relies on an intricate interplay of neuronal rhythms in the sleeping brain (i.e., cortical slow oscillations (SOs), thalamic sleep spindles). However, identifying the mechanisms that orchestrate these rhythms has remained a major challenge in cognitive neuroscience. Here, we tested whether respiration, which has been shown to impact neuronal rhythms and cognition during wake, paces memory consolidation by clocking sleep-related oscillations and their interplay. *Methods*: Twenty participants (age: 20.75 ± 0.35; 17 female) took part in two experimental sessions. In both sessions they performed an episodic learning task (i.e., associating verbs with images of objects or scenes), with memory performance being assessed before and after taking a nap. Scalp EEG and respiration were recorded throughout the experiment (note that parts of the data have already been published (Schreiner et al., 2021)). *Results:* Locking sleep EEG to inhalation peaks revealed a strong clustering of oscillatory activity in the SO-spindle range by respiration (as evidenced by time-frequency-analyses and the modulation index). Follow-up analyses indicated that respiration specifically regulated the emergence of SOs, spindles as well as coupled SO_spindle complexes. The strength of respiration-SO_spindle coupling was tightly linked to the emergence of memory reactivation during SO_spindles. *Discussion*: Respiration has recently taken centre stage as a potential pacemaker for neuronal oscillations and cognition during wake. Here, we show that respiration reliably modulates the cardinal NREM sleep-related oscillations, namely SOs and sleep spindles. Intriguingly, the strength of the respiration – SO_spindle coupling predicted the amount of memory reactivation across participants, highlighting its functional significance for consolidation. Our results identify a novel pacemaker for memory consolidation in humans and pave the way for future research on brain-body interactions during sleep.

Poster: **D10**   **Xiongbo Wu**

Investigating the interaction between microsaccades and electrophysiology to understand their joint impact on visual perception in humans

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Introduction: Humans are visual animals and predominantly explore the environment through eye movements. By making large saccades, humans move their fovea to increase acuity while fixating. However, even when fixating, the eyes never remain completely still. Among such fixational eye movements, microsaccades have been indicated to play an important role for visual attention and perception. Here, we ask whether and how microsaccades modulate the neural correlates of visual perception and, consequentially, perception performance in humans. *Methods*: The current study simultaneously records scalp EEG and eye tracking while participants perform a near-threshold visual detection task. Participants are instructed to detect the orientation of a brief, masked visual target stimulus. The task is embedded in a (2-up-1-down) staircase procedure, such that the time interval between target and mask is adapted to the participant's individual detection threshold. The analyses focus on the pre-stimulus interval, when participants fixate prior to the appearance of a target. Pre-stimulus phase alignment, time-locked to microsaccades, and phase bifurcation in the presence versus absence of microsaccades, as well as their joint impact on detection performance are the main metrics of interest. *Results:* We expect to observe phase alignment of pre-stimulus low frequency brain oscillations, locked to the onset of microsaccades, in line with previous findings reporting phase alignment locked to the onset of large saccades. Phase bifurcation is expected to vary with the occurrence of microsaccades. More specifically, we expect the timing of microsaccades, relative to the target presentation, to impact phase-bifurcation and, consequentially, detection performance. *Discussion*: Miniature and large eye movements are assumed to rely on common neural circuits and to have a similar impact on visual perception. We speculate that microsaccades modulate brain activity, akin to large saccades and that it is the covariation of microsaccades and neural activity prior to a near-threshold visual target that precisely predicts the behavioural outcome.

Poster: **D11**   **Laura Kaltwasser**

The self in face identity processing with fast periodic visual stimulation

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Introduction: Substantial behavioral evidence suggests that self-related processes are different from those of others. Evidence that self-face recognition is dissociable from general face recognition has important implications for social cognition and face cognition. The former requiring self-other distinction during social interaction such as for example in empathy. The latter suggesting that there are different cognitive modules involved in structural encoding compared to identity or familiarity related processes. ***Methods***: In this study, we investigate whether one's own face is processed differently than the one of a familiar other (good same gender friend) in a paradigm of fast periodic visual stimulation (FPVS). In FPVS tasks, a face is presented repetitively at a specific flickering rate and typically elicits a continuous oscillatory brain response, steady-state visual evoked potentials (SSVEP). ***Results:*** Results suggest independent self-effects in SSVEPs starting prior to mean reaction time. ***Discussion***: The findings will be discussed in the light of the somatic marker hypothesis and recent accounts of duplex models of the self in affective and cognitive neuroscience.

Poster: **D12**   **Andrey Zhdanov, Ilya Zakharov, Andrey Zhdanov & Pshonkovskaya Polina**

Brain sex prediction from EEG data using tree-based algorithms

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Introduction: Current research on sex-related electrical signatures of the brain shows that some of these features are more common in women and others are more common in men. Overall, sex-related brain variance is better described as a continuous rather than a binary variable (Eliot et al., 2021). The brain-sex phenotype may act as a biomarker to mark certain mental health disorders (Phillips et al., 2019). In the present study, we investigated the accuracy of brain-sex prediction by utilizing machine learning algorithms. Also, we examined what would be considered the most important features for brain-sex prediction. *Methods*: We used resting state EEG data from a recently published TD-Brain dataset (van Dijk et al., 2022) to calculate more than 4000 different EEG features for brain-sex prediction. An initial dataset consisted of 1,274 patients (620 females), aged 38.67 ± 19.21 (range 5–88) years, with a total of 1,346 EEG sessions. We used EEGLIB (L. Cabañero-Gomez, 2017) and Neural_PY (O'Toole and Boylan, 2017) packages to calculate features from 2 min EEG recordings with eyes-opened and eyes-closed conditions. We used the LightGBM package to analyze the accuracy of brain sex prediction. LightGBM is a gradient boosting framework that uses tree-based learning algorithms. *Results:* Our results indicate ROC AUC of the 5-fold cross-validation model = 0.808, with the balanced accuracy = 0.737. The feature importance analysis shows that the most important features are related to cross-electrode connectivity in fronto-central areas of the brain. *Discussion*: Our results are in line with the Zhang et al. (2018) study, where 87% prediction accuracy was achieved from fMRI data with functional connectivity features within the default mode, fronto-parietal and sensorimotor networks contributed most to the brain-sex prediction. The potential utility of the EEG brain-sex phenotype as a possible biomarker for various diseases is a matter of future research.

Poster: **D13**   **Genji Kawakita**

Is my "red" your "red"?: Unsupervised alignment of qualia structures via optimal transport

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Introduction: A fundamental question in the study of consciousness is "To what extent are sensory experiences equivalent between individuals?" One promising approach is to intersubjectively compare the similarity relationships of sensory experiences, named "qualia structures". An issue with existing methods is the assumption that sensory experiences evoked by the same stimuli must be matched across participants, precluding the possibility that "my red" might be "your blue". *Methods*: To address this limitation, we present a novel method for assessing the degree of similarity between qualia structures without assuming any correspondence between experiences across individuals. Our approach, based on Gromov-Wasserstein optimal transport, aligns subjective experiences in a purely unsupervised manner, using only their subjective relationships. *Results:* As a proof of concept, we applied our method to a large-scale dataset of color dissimilarity judgments on 93 colors collected from 488 participants. We found that qualia structures colors can be aligned across different groups of participants solely based on the subjective relationships between experiences. *Discussion*: While we focused only on color similarities, our method has the potential to be applied to a wide range of subjective experiences and different modalities. Our approach offers a novel and powerful tool for quantitatively exploring various aspects of subjective experiences and advancing our understanding of consciousness.

Poster: **D14**   **Yulia Revina**

Expectations about pain location do not improve pain discrimination performance

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Introduction: In any sensory domain, there is a necessity for an interplay between top-down and bottom-up processing due to the noisy sensory world, i.e. for efficiently interpreting input, prior knowledge and sensory information should ideally be combined. In the domain of pain, prior knowledge – in the form of expectations – has been shown to strongly influence the perceived intensity of pain. It is yet unknown however, whether expectations can also facilitate perceptual discrimination between different pain stimuli. *Methods*: We tested to what extent expectations about the probability of receiving a painful stimulus in a specific location on the body can facilitate pain discrimination performance in that location. We modified a paradigm from vision science, which found that presenting an informative cue about the upcoming stimulus can improve performance on a perceptual discrimination task (Kok et al. 2012, 2014). We presented participants with 1 of 2 visual cues on each trial, signifying that either the left or the right arm was more likely to receive painful stimuli (75% validity). Participants then received 2 temporally simultaneous – but spatially non-overlapping – painful heat stimuli on the forearm and judged which of the two stimuli was more painful. *Results:* We successfully induced expectations regarding pain location, as measured by participants' reports of the experienced expectation ratio and by increased pupil dilation after unexpected location pain. Yet, there was no significant difference in task performance – psychometric function slope and reaction times – in pain intensity spatial discrimination for the expected vs unexpected location. *Discussion*: Our results suggest that knowing the upcoming location of impending pain does not help with discriminating intensities of adjacent painful heat stimuli. Further research should investigate whether expectations about stimulus features, rather than stimulus location per se can improve perceptual discrimination performance.

Poster: **D15**   **Suvi Karjalainen**

Neural activity is modulated by spontaneous and volitionally controlled breathing

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Introduction: Breathing is a cyclic bodily rhythm consisting of active inspiration and passive expiration. Although mainly in autonomic control, breathing can also be volitionally controlled. Recent animal and human studies have provided evidence regarding respiration-brain coupling, but less is known on how breathing modulates the state of the body and brain. In this study we examined how respiratory, cardiac, and neural measures differ between spontaneous and volitionally controlled breathing. Furthermore, we investigated how neural activity is modulated across the phases of breathing. *Methods*: Magnetoencephalography (MEG), electrocardiography and respiration data were recorded from 40 participants. MEG recordings consisted of four conditions: spontaneous breathing with eyes closed, spontaneous breathing with eyes open, deep breathing, and square breathing. Respiratory and cardiac measures as well as sensor-level power spectral density of the MEG signals were calculated for each breathing condition. Fitting oscillations and one over f algorithm was used to extract periodic and aperiodic components of the power spectra. Moreover, to investigate the spatial distribution of neural activity during different phases of spontaneous and deep breathing source reconstruction was applied. *Results:* Statistically significant differences in respiratory rate, heart rate, and heart rate variability were observed between spontaneous and volitionally controlled breathing. Moreover, periodic and aperiodic components of the sensor-level power spectra differed between breathing conditions. Source-level cluster-based permutation test results indicated that alpha power (8-13 Hz) decreased during inspiration and increased during expiration in the time windows from 0 to 2000 ms with respect to the inspiration and expiration onset in comparison with the baseline time window of -500 to 0 ms. The effects were observed in sensorimotor and parietal areas during spontaneous and deep breathing. *Discussion*: These results suggest that both the breathing technique and phases of breathing modulate neural activity. However, further research is needed to establish the possible behavioural and clinical implications of respiration-brain coupling.

Poster: **D16**   **Marko Dimitrovski**

Heart evoked responses in the anterior cingulate can explain the effects of trait anxiety on decision-making under uncertainty

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Introduction: Anxiety is often marked by heightened anticipation of negative outcomes and altered experience of internal bodily signals, which may impair learning. The Anterior Cingulate Cortex (ACC) is considered to integrate interoceptive signals with emotional and cognitive processing, while also playing a role in both the experience of anxiety and in decision-making. Here, we aim to identify whether alterations in interoceptive processing in anxiety can explain biases in decision-making in a volatile environment through changes in ACC activity. *Methods*: Thirty healthy participants were pre-screened into groups of high and low trait anxiety (HTA; LTA). Participants performed a volatile probabilistic binary reward-based task while undergoing magnetoencephalography (MEG) and electrocardiography (ECG) recording. We employed a hierarchical Bayesian computational model to evaluate how trait anxiety impacts learning and decision-making under uncertainty. To measure interoceptive processing, we extracted Heart Evoked Responses (HERs) by synchronizing source-reconstructed MEG activity with the T-wave preceding the outcome event. We statistically contrasted the pre-outcome HER in the ACC between HTA and LTA individuals. Next, we conducted Bayesian linear mixed models (BLMM) to assess the association between HER values and stimulus-outcome contingency prediction strength trial-by-trial, along with the effect of anxiety on this association. *Results:* HTA individuals showed impaired learning compared to LTA individuals primarily by overestimating environment volatility. Additionally, the HTA group had a significantly higher HER amplitude in the left caudate ACC during outcome expectation than the LTA group. This effect was specific to the ACC and the HER, as we did not find a general anxiety-related change in neural activity before the outcome. Our BLMM analysis suggests that the trial-by-trial relationship between the ACC-HER and the strength of predictions is modulated by anxiety *Discussion*: Our results suggest that the ACC-HER may be a useful neural marker to track the effects of trait anxiety on decision-making under uncertainty.

Poster: **D17**   **Olgierd Borowiecki**

Operationalization of planning based on Tower Tasks applied to clinical population – a meta-analysis.

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Introduction: Research in clinical psychology involve administrating tasks categorised as representative of either cognitive or sensorimotor skills. One of the leading means for testing the former are Tower Tasks (TT). However, plurality of versions of TT and difficulties in operationalisation of planning and counterfactual thinking makes using TT problematic. *Methods*: This work summarises a meta-analysis performed on research papers reporting the results of studies conducted on neurodegenerative patients with usage of the TT. The articles were categorised with regards to characteristics of dysfunctions of the patients and version of the TT. *Results:* Based on this categorisation, two crucial observations have been made. Firstly, plurality of solving strategies implies that TT does not always test recursive problem solving and planning. Secondly, differences in the structure of the problem imply that puzzles which require an equal number of movements to solve vary in difficulty. *Discussion*: This analysis shows that planning is inconsistently defined across the literature. Thus, the necessity of interdisciplinary operationalisation of planning is stressed. Such operationalisation should include theoretical insights from structuring problem space, abductive reasoning, and genetic epistemology, as well as neuroscientific findings related to model-based reinforcement learning, cognitive maps and graphs in the medial temporal lobe, and activity of the default mode network.

Poster: **D18**   **Delia Della Porta**

Top-down attentional modulation does not affect the development of secondary hyperalgesia: an experimental investigation.

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Introduction: According to the neurocognitive model of attention to pain, when the attentional resources invested in a task unrelated to pain are high, limited cognitive resources can be directed toward pain. This is supported by experimental studies showing that distracting people from acute pain, leads to experiencing less pain. Theoretical work has suggested that this phenomenon may present a top-down modulatory mechanism for chronic pain as well. However, conclusive empirical evidence is lacking. To step forward to this matter, we used a double-blind, between-subjects study design to investigate whether performing a tailored, demanding, and engaging working memory task unrelated to pain (high-load) vs a task that did not require mental effort to be performed (low-load), could lead to lower development of secondary hyperalgesia–a common symptom in chronic pain patients. *Methods*: Eighty-five healthy volunteers, randomly assigned to one of the two conditions, performed a working memory task with a different cognitive load (high vs low) while secondary hyperalgesia was induced on their non-dominant forearm using high-frequency stimulation (HFS). To assess the development of secondary hyperalgesia, sensitivity to mechanical stimuli was measured three times: T0, for baseline, 20(T1) and 40(T2) minutes after the procedure. *Results:* In line with recent findings, our results show no significant difference in the development of secondary hyperalgesia between the high-load vs the low-load group, neither in terms of intensity of mechanical sensitivity or in terms of spatial extent. *Discussion*: This may suggest that a top-down modulation through attention might not be sufficient to affect the development of secondary hyperalgesia.

Investigating the role of peripersonal space representation in contact-related action across human and non-human primates

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Introduction: Sensory events occurring close to the body have particular behavioural relevance. Perhaps unsurprisingly, these events elicit enhanced behavioural or neurophysiological responses. Such "peripersonal space" (PPS) responses, traditionally interpreted as reflecting the position of the stimulus in egocentric coordinates, may in fact play a role in creating or avoiding contact with objects near the body. Here we provide a comprehensive characterisation of PPS responses across humans and non-human primates (NHP), with the aim of facilitating the assessment of their role in contact-related actions. *Methods*: We recorded high-density EEG in humans and intracranial neuronal signals in NHPs during the same task. Visual and tactile stimuli were presented along a mediolateral axis centred on the right hand (distance from the hand: ±24, ±12, 0cm [visual]; 0cm [tactile]). Crucially, eye and hand positions were manipulated to disentangle eye- versus hand-centered encoding. Both scalp and intracortical local field potentials were analysed in the frequency domain by computing power spectral densities. *Results:* Preliminary results (24 humans, 1 NHP) revealed gaze-independent coding of stimulus position across species. In humans, alpha, beta, and gamma band power in posterior, lateralized regions was modulated by stimulus position. A qualitatively comparable positional coding was observed in NHP ventral premotor cortex. Further, hand position affected alpha and beta power in left-lateralised frontal and posterior electrodes, though this effect was rather independent of stimulus distance. Additional computational modelling analyses assess whether these responses represent action intention. Results indicate that, as well as reflecting the distance between the stimulus and an effector, the neurophysiological correlates of PPS representation reflect the biomechanical properties of potential contact-actions. *Discussion*: These results support the notion that the role off PPS responses extends beyond representing the position of a stimulus in egocentric coordinates, but also reflects the value of actions which create or avoid contact with the body.

Solving the Adaptive Valley Problem of Cultural Group Selection

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Introduction: The high degree of prosocial behaviour in humans is seen as a puzzle from an evolutionary standpoint. Cultural Group Selection (CGS) as put forth by Boyd and Richerson makes an important contribution towards solving this puzzle. However, its explanatory power is limited as it requires crossing an adaptive valley and only encompasses roughly the last 200,000 years. ***Methods***: Through a critical discussion of CGS, an explanatory weakness is emphasised that the authors are already aware of. Whilst arguing that the authors explanation is insufficient, an alternative is put forth in the form of von Heiseler's Backchannel Hypothesis (BCH), capitalising on the same principle CGS is built on, namely equilibrium selection – an integration of intra- and inter-group selection making group selection consistent with the inclusive fitness approach of standard evolutionary theory. ***Results:*** Equilibrium selection requires stable and heritable differences between groups. CGS proposes cumulative culture to create this difference. However, this requires crossing an adaptive valley, as prerequisite traits such as social learning, overimitation, and theory of mind are not explained by CGS. In contrast, the BCH proposes reproductive isolation to create stable and heritable differences between groups. It explains how given only the behavioural traits of chimpanzees (as a proxy for our common ancestor) as prerequisite, an evolutionary system can arise that puts selective pressure on prosocial behaviour through social selection in the form of female choice. The Backchannel allows group beneficial (=prosocial) behaviour of an individual to be translated into its reproductive success. ***Discussion***: It is argued that the BCH is not only consistent with the core principle of CGS, but that it can solve the adaptive valley problem and extend to encompass roughly the last 6 million years of our ancestor's evolution.

Structure-Function decoupling of electrophysiological brain activity during video-watching

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Introduction: The relationship between brain structure and brain activity has previously been investigated by comparing functional connectivity at rest and anatomical connectivity. Naturalistic stimuli enable the study of brain activity dynamics in a more ecological setting. Here, we investigate and quantify structure-function relationship using Structure-Decoupling Index (SDI) during short periods of time corresponding to highly correlated EEG brain activity across subjects (n = 25) watching the same movie *Methods*: We analyze preprocessed EEG video-watching data (170s). We localize electrical sources using eLORETA with a Boundary Element Method as forward model, and parcellate using HCP-MMP atlas. Then, we compute the envelope of the cortical activity using Hilbert transform in four frequency bands and our analysis focuses in the α band (8-13 Hz). We compute Inter-Subject Correlation (ISC) of the EEG cortical signal across subjects using Correlated Component Analysis, and identify 30 time-periods (Strong ISC "events") with significantly higher ISC than a null model. In particular, we compare the structure-function relationship between Strong ISC (500 ms) and the preceding 200 ms of baseline. *Results:* We compute SDI for both the baseline and strong ISC periods, and test it against a null model based on spectral randomization of the graph. We report the SDI patterns during baseline as well as the difference between SDI during strong ISC events and baseline. We report how many subjects exhibit significant coupling or decoupling of brain activity for varying amounts of events. *Discussion*: The cortical activity in the α band of most subjects is consistently coupled during baseline in brain areas including core regions of the DMN such as the ACC and vmPFC, similar to previous work, while, during Strong ISC events, it is more decoupled for 10 subjects and 7 events in primary visual areas, as well as two core regions of the DMN: ventromedial prefrontal cortex and the parahippocampal gyri.

Poster: **D22**   **Corinna Schulz**

Ghrelin amplifies hedonic drive and food reward signaling in binge eating disorder

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Introduction: Ghrelin is the only circulating orexigenic hormone to modulate reward processing via direct and indirect effects, including vagal afferent projections. Yet, it remains unclear how ghrelin contributes to the pathophysiology of binge eating (BE). *Methods*: In 65 BMI-matched (MBMI = 31.5 ± 6.98 kg/m2) women with varying symptoms of BE (no BE, subsyndromal BE disorder (sub-BED), BE disorder (BED)) concentrations of acyl (AG) and des-acyl ghrelin (DG) were assessed before (fasting) and after a standardized breakfast. Participants also performed a food bidding fMRI task ~60 min after the meal. *Results:* First, we observed group differences in postprandial ghrelin concentrations: participants with BED (vs no BE) showed attenuated meal-induced decreases in DG ($p = .047$), and both BED and sub-BED showed altered meal-related changes in early AG and late DG ($p = .030$, $p = .002$). Second, in contrast to preclinical findings, ghrelin did not boost the effort for food, but higher levels of DG made effort more strongly dependent on liking ratings ($p = .002$). Third, in line with a role of ghrelin in modulating vagal afferent signals, higher fasting levels of AG were associated with greater food-cue reactivity in the nucleus of the solitary tract (NTS; $pSVC = .025$) across groups. Participants with BED (vs no BE) showed elevated food-cue reactivity in the NTS ($pSVC = .025$). *Discussion*: We conclude that ghrelin amplifies the hedonic drive to pursue preferred food, while dysregulation in meal-induced reductions in ghrelin is associated with an elevated risk for BE. Furthermore, our results shed light on the role of vagal afferent signals in amplifying food reward signals. Ultimately, this may improve treatments for pathological eating by targeting the gut-brain axis.

Poster: **D23**   **Withdrawn**

Poster: **D24**   **Giulio Gabrieli**

Recordings of SEPs from spinal regions: a systematic review

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Introduction: Somatosensory Evoked Potential (SEP) are used to verify the functional integrity of somatosensory afferent pathways in humans. Despite the fact that near-field scalp recordings of SEP have been reported to be less affected by movements' artifacts and muscles' activity, scalp recording does not provide adequate spatial resolution to identify the possible damages to the afferent pathway: specifically, they have extremely low sensitivity to probe spinal cord function. While MRI-based neuroimaging techniques can be used to overcome the spatial limitations of scalp EEG recordings, several technical challenges pose a limit to their applicability. Recording SEPs from the spinal cord should, at least in theory, overcome the limits of scalp SEPs recordings. However, published results lack consistency, consequent to the multitude of different recording techniques , stimulation sites, electrode locations used. *Methods*: We conducted a systematic review of the available literature about non-invasive recordings of electrical activity of the human spinal cord. *Results:* We investigated 14 different features of spinal SEPs literature: investigated populations (4 features), experimental paradigms (5 features), recordings (4 features), and analysis (2 features). Results support the lacks of consistency across published works. *Discussion*: We provide recommendations for future spinal SEPs recording studies, and report normative values of published works, and discuss clinical applications of SEPs recordings for the verification of functional integrity of the spinal cord.

Poster: **D25**   **Sarah Meissner**

Through the eye to the brain: Modulating arousal via pupil-based neurofeedback

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Introduction: The locus coeruleus (LC) is the principal source of noradrenaline in the brain and is one of the key regulators of the brain's arousal level. Additionally, it modulates cardiovascular function via projections to the brainstem and spinal cord. Interestingly, there is ample evidence for a link between LC activity and non-luminance dependent pupil size changes. Building on this evidence, we investigated whether changes in pupil size (i) can be volitionally induced via pupil-based neurofeedback (pupil-NF) training and are linked to changes in (ii) LC activity and (iii) cardiovascular parameters. *Methods*: In experiment I, 54 healthy volunteers (19-47 years) received 3 days of pupil-NF training to learn to volitionally up- and downregulate pupil size. 28 control participants (19-40 years) received the same amount of training and instructions on mental strategies but no veridical pupil-NF. To explore the link between pupil size changes and LC activity, 25 pupil-NF participants underwent follow-up sessions combining pupil-NF with 3T functional magnetic resonance imaging (fMRI) and pulse oximetry to measure BOLD responses and cardiovascular parameters. In a replication experiment, 23 participants (21-41 years) completed a slightly adapted pupil-NF training with simultaneous electrocardiography (ECG) recordings. *Results:* Participants of the pupil-NF group were able to successfully self-regulate their pupil size. Such self-regulation was significantly reduced in control participants. fMRI and ECG analyses revealed that pupil self-regulation was linked to systematic activity changes in the LC and other arousal-regulating centers in the brainstem, and to changes in cardiovascular measures: we found higher BOLD responses and heart rate during blocks of volitional pupil size up- than downregulation. Heart rate variability, in contrast, was higher during pupil size down- than upregulation. *Discussion*: We provide evidence that pupil-NF makes the brain's arousal system accessible to volitional control, a finding that has tremendous potential for translation to behavioral and clinical applications across various domains.

Poster: **D26**   **Lioba Enk**

Impact of nasal breathing on somatosensory detection: experimental design and pilot results

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Introduction: Recent accounts suggest respiration is used to actively adapt neural excitability to contextual demands to thereby improve sensory information sampling. A cardinal role has been attributed to the rhythmic stimulation of olfactory structures - by anatomy specific and phase-locked to nasal breathing. The entrainment of faster neural oscillations is thought to propagate from thereon. With this behavioural pilot we investigate the impact of nasal (vs. oral) respiration on somatosensory perception. Secondly, we aim to assess cardiorespiratory effects on perceptual sensitivity given the intertwinement of both bodily functions and previous findings of cardiac phase shifts in sensitivity favouring diastole. *Methods*: Twenty-one non-clinical adults participated in a somatosensory yes/no detection task under nose and mouth breathing (4 consecutive blocks per condition, order counterbalanced). Always under nose breathing and prior to each block, a near-threshold assessment was done to select in-block intensities. In each trial, participants indicated whether they felt a weak electrical stimulus delivered to their left index finger. Throughout the experiment, cardiac and respiratory signals were recorded (respiration belt, ECG, pulse oximetry). Nose clips and mouth tapes were used for experimental control of breathing. *Results:* Hit rates were lower than priorly estimated which necessitated exclusion of six participants. A within-person comparison of perceptual sensitivity between both breathing routes yielded a small effect in favour for nasal respiration. There was no evidence for a shift in response criterion. Across the respiratory cycle and in both conditions, mean hit rate and perceptual sensitivity were significantly decreased during a phase attributable to early inspiration. However, participants reported having breathed less freely in mouth than nose blocks. *Discussion*: We propose changes to the design regarding block length and order, the use of an adaptive staircase procedure within blocks, and a refinement of breathing control. Given their incorporation, we suggest repeating the experiment in a bigger sample incorporating EEG.

Poster: **D27**   **Marta Gerosa**

The influence of cardiorespiratory phase locking and heart-brain interactions on the sense of agency – a project idea

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Introduction: Sense of agency, the experience of controlling one's own actions and their effects, is thought to arise from the successful integration of predicted and observed sensory outcomes of intentional action, encompassing both the body and the environment. Recently, voluntary action initiation has been found to be entrained by cardiorespiratory fluctuations, which may provide optimal, predictable windows for action or perception. Whether and how this coupling between voluntary action and cardiorespiratory signals influences the emergence of sense of agency is still unclear. In my doctoral project, I will investigate the behavioural relevance of the link between cardiorespiratory signalling, voluntary action initiation and sense of agency, as well as the neurophysiological markers of the underlying heart-brain interactions. *Methods*: In two complementary experiments, participants will be administered a modified version of the intentional binding task, which quantifies sense of agency as the degree of subjective temporal compression between a voluntary action and its sensory outcomes. The task will include separate blocks for baseline and experimental conditions, following either active movement (voluntary button press) or passive movement (involuntary, externally-imposed button press). Measures of action binding (i.e., the temporal attraction of action toward its outcome), tone binding (i.e., the attraction of consequent tone toward action) and total intentional binding will be extracted. Meanwhile, cardiac and respiratory measures will be recorded during the task, with the addition of electroencephalography in Experiment 2. The plan is to test the effects of cardio-respiratory phase-locking of voluntary action on sense of agency, as well as to investigate the neurophysiological proxies for the assessment of this interaction, mainly the auditory-evoked N1 component and heartbeat-evoked potentials (HEPs). *Results:* The coupling of voluntary actions with specific phases of the cardiorespiratory cycles, alongside the amplitude of HEPs preceding movement onset, is expected to modulate intentional binding, as a marker of sense of agency. *Discussion*:

Linguistic selection alteration in Huntington's Disease: ecological oral language production reveals evidence through lexical diversity algorithms

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Introduction: Huntington's disease (HD) is a neurodegenerative disease that presents motor, cognitive, and psychiatric alterations. Language is affected from pre-manifest stages, revealing that cognitive decline precedes clinical onset. Morphological and syntactic operations have been reported to be altered in these patients due to sub-cortical damage at the striatum affecting the verbal executive network. However, other linguistic aspects tapping this function have not been addressed. Particularly, it remains unknown whether alterations in selection processes appear in a transversal mode in the linguistic domain, and not just as isolated grammatical deficits. The aim of this study was to evaluate a lexical selection deficit in HD gene carriers. *Methods*: Using a story-telling task, we tested spontaneous speech in a sample of 33 HD gene carriers (17 Manifest, 16 Pre-Manifest) matched in age, gender, and educational background with 33 healthy controls. Computational linguistics methods were deployed to compute lexical diversity by grammatical categories. Lexical diversity was assessed among groups by means of ANOVAs, and for the subset of HD as predictor of disease burden clinical scores through multiple linear regression. *Results:* HD gene carriers showed a decline in lexical diversity when compared to the control sample over the entire corpus of language production ($p = 0.032$). While manifest HD patients revealed a minor diversity in adjectives ($p = {<}0.001$) and verbs ($p = 0.005$), but a higher diversity for prepositions ($p = 0.044$), Pre-Manifest HD patients revealed a minor diversity in adjectives ($p = 0.025$) but a higher diversity for interjections ($p = 0.021$). Lexical diversity significantly predicted disease burden of HD gene carriers (95 % CI= -1.676, -0.009). *Discussion*: These results revealed how lexical diversity delineates the linguistic profile in HD from the Pre-Manifest stage, reflecting how striatal damage and disease progression alters language organization in terms of a transversal alteration of the linguistic selection processes.

Virtual Posters Only

Virtual Poster Session A | March 17, 2023 at 10:30-11:30

Poster #	Presenter (s)	Poster Title
V01	Karen Simonyan	Positive effects of Teucrium polium on rat brain cholinergic network deficits caused by amyloid β
V02	Friederike Charlotte Hechler	Phonetic Accommodation in Autism
V03	Rory Bufacchi	Egocentric value maps of the near-body environment: from Reinforcement Learning to neural responses
V04	Jessica L. Hazelton	Investigating interoception and emotion in left- vs right-predominant anterior temporal lobe degeneration
V05	Ruijie Li	Holistic Bursting Cells Store Long-term Memory in Auditory Cortex
V06	Kirti Saluja	Age associated reduction in cortical representation of cardiac signals

Virtual Poster Session B | March 17, 2023 at 11:30-12:30

Poster #	Presenter (s)	Poster Title
V07	Mst. Maleka Pervin	Attitudes Towards Evidence-Based Practice and Usage of Evidence-based Practices for Children and Adolescents with Autism Spectrum Disorder: A Comparison of Mental Health Professionals in Bangladesh and Germany
V08	Esra Zeynep Düdükcü & Halil Aziz Velioğlu	Modeling the Physiopathology of Capgras Syndrome A Virtual Lesion Study
V09	Tuğçe Nur Akar & Esra Zeynep Düdükcü	Examination of the Relationship of Prospective Memory with Executive Functions and Attention by EEG
V10	Lilit Darbinyan	Effects of L-Thyroxine on rat hippocampal neurons
V11	Margarita Danielyan	Studying the biochemical status of various tissues in rats on a model of Parkinson's disease under the influence of melanin
V12	Melinda A. Jeglinski-Mende	Negation has a size! Number magnitude corresponds with set-size in linguistic negation

Virtual Poster Session C | March 17, 2023 at 13:30-14:30

Poster #	Presenter (s)	Poster Title
V13	Cinthia Sayuri Misaka	The effects of learning Japanese by a Brazilian person with aphasia
V14	Sonia Montemurro	The Relationship Between Aperiodic Activity Of Resting-State EEG and Cognitive Performance is Modulated by Education In Aging
V15	Silvia Canino	Inner and outer bodily information processing: evidence in adolescence
V16	Magdalena Gippert	Motor Imagery of Linked Movements Enhances Motor Adaptation
V17	Cemre Baykan	Influences of temporal order in temporal reproduction
V18	Ekaterina Ivanina	EmoEye Project: deep learning-based approach to commercial eye-tracking data analysis

Virtual Poster Session D | March 17, 2023 at 14:30-15:30

Poster #	Presenter (s)	Poster Title
V19	Elizaveta Ivanova	The origin of symbolic numerical knowledge in preschool children - a longitudinal study (research plan)
V20	Lin Yu	Perturbation of Initial and Final Action Goals during the Preparation of Grasp-to-Rotate Movement: An ERP study
V21	Yalcin Ceyda	Investigation of Metamemory Judgments During Eyewitness Testimony
V22	Anabela Pereira	Mind, brain, body & environment interaction: the emotionally embedded cognition hypothesis
V23	L. S. Merritt Millman	Altered interoceptive sensibility with intact interoceptive accuracy and awareness in functional neurological disorder

Poster Session Virtual Only

Virtual Poster Session A | March 17, 2023 at 10:30-11:30

Poster: **V01**   **Karen Simonyan**

Positive effects of Teucrium polium on rat brain cholinergic network deficits caused by amyloid β

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Introduction: Several pathogenic pathways are associated with the progression of Alzheimer's disease (AD), including synaptic failure in the cholinergic networks. Teucrium polium has been recognized as a promising candidate for drug development against AD and related disorders. However, the key role of amyloid β (25-35) in the rat basal forebrain cholinergic circuit and the protective effect of Teucrium polium against amyloid β (25-35)-induced disruption of synaptic plasticity remain poorly understood. *Methods*: In the present study, using in vivo extracellular single-unit recordings, we studied the preventive efficacy of hydroponic Teucrium polium on amyloid β (25-35)-induced aberrant neuronal activity in the hippocampus and basolateral amygdala in response to high-frequency stimulation (HFS) of the cholinergic nucleus basalis magnocellularis (NBM) in rats. After 12 weeks, intracerebroventricular injection of amyloid β (25-35) results in a predominance of inhibition during HFS and post-stimulus time, and an abnormal evoked spike activity. *Results:* Teucrium polium treatment ameliorates the expression and balance of excitatory and inhibitory responses in the hippocampus and basolateral amygdala. These results confirm the ability of Teucrium polium to promote synaptic cholinergic neurotransmission, which is an essential preventive strategy for cholinergic disorders. Thus, Teucrium polium reduced amyloid β (25-35)-induced short-term synaptic plasticity alterations in the NBM – hippocampus – basolateral amygdala circuit through facilitation of neurotransmission and modulation of network plasticity. *Discussion*: This work was supported by the Enterprise Incubator Foundation, Faculty Research Funding Program, 2022.

Poster: **V02**   **Friederike Charlotte Hechler**

Phonetic Accommodation in Autism

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Introduction: In social interaction, individuals with Autism Spectrum Condition (ASC) may face severe problems with perception, social cognition, and motor behaviour. A phenomenon of daily communication that requires a complex combination of exactly these three skills is phonetic accommodation. This is a common subconscious imitation of the interlocutor's speech during verbal interaction. Phonetic accommodation is not well understood yet. Some researchers consider the systematic change of phonetic categories to be an automatic behaviour that improves social interactions (e.g. as a carry-over effect of motor simulation). Others assume it to be non-automatic and related to the manipulation of social distance between speakers. Given that ASC symptoms are, despite strong heterogeneity, related to the three skills necessary for phonetic accommodation, looking at this phenomenon in autistic individuals is a way to test different theories on phonetic accommodation. Vice versa, phonetic accommodation might help us better understand what contributes to social difficulties experienced by autistic individuals. *Methods*: Accordingly, this project explores the extent to which verbal autistic individuals engage in phonetic accommodation in a non-social setting. We hypothesise that the perceived quality of social interaction in ASC is affected by a lack in phonetic accommodation, which might be caused by atypical sensory processing and impaired or delayed motor skill. To test this hypothesis, we will elicit behavioural data in a cue-distractor paradigm and an AXB similarity test. *Results:* Data collection is still ongoing. The results will be discussed in the conference presentation. *Discussion*: We expect that verbal autistic individuals, compared to neurotypical controls, accommodate less to an acoustic distractor in the cue-distractor paradigm and, in the AXB test, perceive the respective differences in phonetic details in speech of other speakers to a lesser extent or more slowly.

Poster: **V03**   **Rory Bufacchi**

Egocentric value maps of the near-body environment: from Reinforcement Learning to neural responses

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Introduction: ody-part centric responsefields are pervasive: they are observed in single neurons, fMRI, EEG, and multiple behavioural measures. This prevalenceacross scales and measures makes them excellent candidates for studying systems-level neuroscience. Nonetheless,they remain poorly understood becausewe lack a unifyingformal explanation oftheir origins and role in wider brain function. Here, we provide such explanation. *Methods*: We use reinforcement learning to analytically explain the existence of body-part centric receptive fields, also known as peripersonal field. We then simulate multiple experimental findingsconsidered foundational inthe peripersonal space literature. *Results:* Peripersonal fieldsnaturally arise fromtwo simple and plausible assumptions about living agents: 1) theyexperience reward when they contact objects in the environment, and 2)theyact to maximise reward. These simple assumptions are enough to explain empirical findings on stimulus kinematics, tool use, valence, and network-architecture. *Discussion*: Our explanationprovides further insight. First, it offers multiple empirically testable predictions. Second, it offers a formaldescription of the notion that the world-agent state is encoded in parieto-premotor cortices, using motor primitives: peripersonal fieldsprovide building blocks that together createa short-term model of the world near the agent in terms of its future states;a successor representation. This short-term,close-range egocentric peripersonal mapis analogous to the long-term, long-range allocentric spatial map of place and grid cells, which underlielocomotion and navigation to reach distant objects. Together, these allocentric and egocentric mapsallow efficient interactions with a changing environment across multiplespatial and temporal scales.

Poster: **V04**   **Jessica L. Hazelton**

Investigating interoception and emotion in left- vs right-predominant anterior temporal lobe degeneration

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Introduction: The hemispheric contributions toward interoception, the perception of internal bodily cues, and emotion recognition remains unclear. Semantic dementia cases with either left-dominant (i.e., left-SD) or right-dominant (i.e., right-SD) anterior temporal lobe atrophy experience emotion recognition difficulties, however, little is known about interoception in these syndromes. Here, we hypothesised that right-SD would show worse interoception and emotion recognition due to right-dominant atrophy. *Methods*: Thirty-five participants (8 left-SD; 6 right-SD; 21 controls) completed a monitoring task. Participants pressed a button when they: (1) felt their heartbeat, without pulse measurement (Interoception); or (2) heard a recorded heartbeat (Exteroception-control). Simultaneous ECG was recorded. Accuracy was calculated by comparing the event frequency (i.e., heartbeat or sound) to response frequency. Emotion recognition was assessed via the Facial Affect Selection Task. Voxel-based morphometry analyses identified neural correlates of interoception and emotion recognition. *Results:* Right-SD showed worse interoception than controls and left-SD (both p's<.001). Both patient groups showed worse emotion recognition than controls (right-SD: p<.001; left-SD: p=.018), and right-SD showed worse emotion recognition than left-SD (p=.003). Regression analyses revealed that worse emotion recognition was predicted by right-SD (p=.002), left-SD (p=.005), and impaired interoception (p=.004). Interoception and emotion were associated with the integrity of right-lateralised structures including the insula, temporal pole, thalamus, superior temporal gyrus, and hippocampus. *Discussion*: Our study provides the first evidence for impaired interoception in right-SD, suggesting that impaired emotion recognition in this syndrome is driven by inaccurate internal monitoring. Further we identified a common neurobiological basis for interoception and emotion in the right hemisphere.

Poster: **V05**   **Ruijie Li**

Holistic Bursting Cells Store Long-term Memory in Auditory Cortex

Li, R. [1,2], Huang, J. [3], Liang, S. [3], Liang, S. [1], Wang, M. [3], Liao, X. [3], Lyu, J. [4], Zhou, Z. [4], Jin, W. [1,5], Chen, H. [5], Holder, D. [6], Liu, H. [2], Zhang, J. [1], Li, M. [4], Tang, Y. [4], Remy, S. [6], Pakan, J. M.P.[7], Chen, X. [1], & Jia, H. [2,4,6,8]

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Introduction: The sensory neocortex has been since long suggested to be a substrate for long-term memory storage, yet which exact cells store long-term memories remained neither known nor visible over a century. *Methods*: combination of day-by-day two-photon Ca2+ imaging and targeted single-cell loose-patch recording in a non-fear auditory associative learning paradigm *Results:* We reveal sparsely distributed neurons in layer 2/3 of auditory cortex emerged step-wise from quiescence into bursting mode, which then invariably expressed a holistic information of the learned composite sounds, referred to as holistic bursting (HB) cells. *Discussion*: Notably, it was not shuffled populations but the same sparse HB cells that causally embodied the behavioral relevance of the learned composite sounds, pinpointing HB cells as long-term memory storage in the sensory neocortex.

Age associated reduction in cortical representation of cardiac signals

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Introduction: Our brain constantly receives signals from the internal body and environment [1]. One of the key functions of the brain is to maintain homeostasis by processing the visceral signals even in the resting state, which is termed as interoception. For instance, the heartbeat signal triggers a heart evoked response at the cortical level that influences a variety of psychological and cognitive functions. Since aging is associated with cardiac dysfunction and changes in the properties of brain rhythms, the fall-out on heart-brain dynamics becomes an area of detailed scientific inquiry. *Methods*: We used data from Cambridge Centre for Aging and Neuroscience (Cam-CAN) repository of participants aged between 18-88 including simultaneous MEG and ECG recording acquired during resting state. ECG time series was used as a temporal trigger to epoch ICA corrected MEG time series 200ms prior to R peak and 800ms post the R peak, further averaged to obtain heart evoked potential (HEP). *Results:* : In categorial analysis of HEP, we observed a significant (Wilcoxon Rank Sum Test $p < 0.001$) deflection in the peak-to-peak amplitude in the range of 200-320 millisecond post R peak showing a more negative deflection in amplitude for young adults (18-40 years) as compared to the older adults (57-87 years). In topographical analysis, activated cluster was obtained over only left temporal sensors for young adults and left temporal and right parietal sensors for older adults whereas deactivated cluster was obtained over right tempo-occipital sensors for all the age groups. *Discussion*: The decline in the HEP is believed to be related to a decrease in interoceptive accuracy which is the ability to sense and perceive internal bodily signals. With aging, this ability may decline leading to a decrease in HEP and resulting in slower reaction times and poor task performance. HEP can act as a potential biomarker to study heart-brain interaction that govern several important daily functions.

Poster: **V07**   **Mst. Maleka PERVIN**

Attitudes Towards Evidence-Based Practice and Usage of Evidence-based Practices for Children and Adolescents with Autism Spectrum Disorder: A Comparison of Mental Health Professionals in Bangladesh and Germany

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Introduction: The dissemination and implementation of evidence-based practices (EBPs) to ensure a high quality of mental health services for children with autism spectrum disorder (ASD) is a critical concern worldwide. Research examining factors facilitating the implementation of EBPs found that providers' attitudes are an important factor. The present study examined cross-cultural differences in attitudes towards EBP, in the number and types of EBPs used, and in the relations between demographic variables, attitudes, and EBPs between mental health professionals providing treatment to children and adolescents with ASD in Bangladesh and Germany. *Methods*: We decided to use purposeful sampling. Two-hundred-ninety-two professionals who worked in a clinical setting responded to the survey and fulfilled the inclusion criteria (101 in Bangladesh, 191 in Germany). *Results:* Reported use of different EBPs was higher in Germany than in Bangladesh. Measurement invariance across countries could be established for four of nine subscales of the Evidence-Based Practice Attitude Scale. Comparative analyses showed that professionals in both countries were open to using EBPs, but German practitioners were more likely to use EBPs when they appealed to them. By contrast, Bangladeshi professionals claimed to be more likely to adopt an EBP when required and to be more willing to learn EBPs to enhance job security. The relationship between caseload and attitudes varied between countries. *Discussion*: This is the first study that directly compared the attitudes towards EBPs and the usage of different EBPs in a HIC (Germany) and a LMIC (Bangladesh). It also represents one of the first endeavours to explore factors that may influence professionals' attitudes towards EBP in both countries. The findings highlight the importance to consider country-specific factors when implementing EBPs. Directions for conducting international comparison studies on mental health professionals' attitudes towards EBP including methodological considerations are discussed.

Modeling the Physiopathology of Capgras Syndrome A Virtual Lesion Study

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Introduction: Capgras Syndrome (CS) is a delusion that appears with the beliefs of a person's relatives, such as spouse, parents, or sibling, who have been replaced by another very similar "imposter". It is thought that emotional component of face recognition and/or hypothesis evaluation defects cause delusions in CS *Methods*: In this study, electro neurophysiological responses that occur when neurophysiological processes thought to cause CS are triggered by a virtual lesion in the healthy subjects. Occipital area for the emotional face component was inhibited in the first session by continuous theta burst stimulation (cTBS). Then ventromedial prefrontal cortex (vmPFC), which is accepted as the hypothesis evaluation and reality monitoring region, was inhibited in the second session. Fifteen healthy young adults were included in the study. Familiar, famous and unfamiliar face stimuli were presented before and after the virtual lesion. *Results:* After occipital inhibition in the delta band, the power spectrum was significantly reduced in familiar faces in the frontal and frontocentral regions. In vmPFC inhibition, a decrease in delta power was observed in the frontal regions and an increase in the parietal and parietal occipital regions. Theta band power decreased in the frontal region at familiar face stimulus after inhibition of both regions. *Discussion*: It is thought that delta frequency power changes in CS can be followed as a biomarker for the risky groups' progression of delusional belief. The reason for being relatives of the object of the delusion in CS was associated with the vmPFC dysfunction in reality monitoring, instead of emotional face dysfunction. It was also shown that unlike the two-factor theory, delusional formation can only be triggered by the first factor.

Examination of the Relationship of Prospective Memory with Executive Functions and Attention by EEG

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Introduction: The ability to remember, make, and execute one's future intentions in a way that activates them at the appropriate time is called prospective memory (PM). PM is basically divided into two time-based and event-based, depending on which variable the recall takes place. Event-based PM is when a person remembers to perform a delayed intention when triggered by an environmental stimulus. Event-based PM cues are divided tow subcategories depending on the use of controlled attention processes as focus or out-of-focus event-based PM. It is assumed that out-of-focus ON tasks require more cognition of attention processes. *Methods*: The Stroop Color-Word test is a widely accepted criterion in the examination of selective attention. This study, it was aimed to examine the relationship between PM and attention in healthy adults while solving PM out-of-focus cue stimuli tasks. A total of 19 young adult participants' behavioral and electro neurophysiological data were collected. Event-related potential analyzes were performed for the centro-parietal, parietal, and occipital regions. *Results:* It was shown that the amplitudes of the N100 and P100 potentials associated with early attention were affected by the PM out-of-focus cue in the occipital regions. It was observed that parietal positivity revealed significant activation of the cue stimulus in the centro-parietal and parietal regions than other stimuli. Parietal positivity findings were found to be consistent with the previous studies. *Discussion*: PM was directly related to attention. The PM cue was associated with selective attention instead of complex attention.

Poster: **V10** **Lilit Darbinyan**

Effects of L-Thyroxine on rat hippocampal neurons

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Introduction: Thyroid hormones are essential for appropriate brain development and function. These alterations have also been observed in animal models as adult rats, in which hypothyroidism is associated with deterioration of their memory and learning capacity and impairment of long-term potentiation. In rodents, thyroid hormones play an important role in thermogenesis of brown fat, allowing them to adapt to cold temperatures. ***Methods***: ***Results:*** We hypothesized thyroidectomized rats will have abnormal hippocampal neuronal activity and treatment with thyroxine (T4) will normalize electrical activity. Body temperatures were significantly lower in the thyroidectomized group compared to T4-treated group. ***Discussion***: Thyroid hormone supplementation directly affected the hippocampus and showed protective effects.

Poster: **V11**   **Margarita Danielyan**

Studying the biochemical status of various tissues in rats on a model of Parkinson's disease under the influence of melanin

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Introduction: The main cause of Parkinson's disease (PD) is the destruction and death of neurons that produce the neurotransmitter dopamine. Oxidative stress resulting from an imbalance in oxidant and antioxidant status is believed to play an important role in dopaminergic neurotoxicity. In the present study, bacterial melanin (BM) was used, which has a high biological activity and a biostimulating effect. The aim of the study was to determine the quantitative and qualitative changes in the total fractions of associates from membranes (cell membranes and intracellular membranes) of rat tissues in rotenone-induced PD and under BM exposure. *Methods*: In control rats, PD was induced by unilateral intracerebral administration of 12 µg rotenone, followed by 6 mg/ml BM. From rats tissues (brain, lung and small intestine) of the observed groups the isolation, purification of the isoforms of new thermostable superoxide (O_2^-)-producing associates between NADPH-containing lipoprotein (NLP) and NADPH oxidase-Nox (NLP-Nox) were carried out *Results:* The optical absorption spectral characteristics, specific amounts, stationary concentration of the produced O_2^-, the content of NADPH in the composition of observed associates were determined. In comparison with the indices of the control group, the optical absorption spectra of the isoforms of NLP-Nox in the PD and in the influence BM in the visible and UV regions did not differ. On the other hand, in comparison with the indices of the control group, the specific content of the total fractions of the isoforms of NLP-Nox associate from PD groups was higher, especially in the small intestine. This change may be a new mechanism for rotenone-induced PD. *Discussion*: The antioxidant bacterial melanin was shown to have a regulating effect on the membrane formations in the brain, lung, and small intestine by inhibiting the release of new membrane-bound thermostable formations (NLP-Nox associates) from these membranes while also regulating the stationary concentration of produced O_2^-. The work was supported by the Science Committee of RA, in the frames of the research project № 21T-1F282.

Poster: **V12**   **Melinda A. Jeglinski-Mende**

Negation has a size! Number magnitude corresponds with set-size in linguistic negation

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Introduction: While some studies have found that in linguistic negation processing the actual state of affairs is presented directly, other results favor a two-step account. This is potentially influenced by contextual factors as set-size and availability of antonyms (i.e., short as antonym of tall). In number processing, set-effects have been found, i.e., the perceived number magnitude depends on the set. Further, there is evidence that congruent size and number magnitude elicit processing advantages. We aim to assess congruity effects of set-size and number magnitude in linguistic negation. We expect a processing-advantage of large numbers over small numbers in a larger stimuli-set and vice versa in a smaller set, reflecting a magnitude congruency effect across domains. *Methods*: Data of 78 participants were analyzed in a speeded picture verification task: Negated statements in German (e.g., Die Zahl ist nicht rot; "the number is not red") were followed by a number. Participants were asked to press the spacebar if the utterance correctly described the number. Response times were recorded. Numbers were categorized into small (1,2) and large (8,9). We calculated compatibility scores separately for the small (2 different colors) and the large set (8 different colors). *Results:* Results showed processing advantages reflected by compatibility effects in the expected direction: smaller number were processed faster in the small stimuli-set and larger numbers in the context of the larger stimuli-set, but only in negated statements. *Discussion*: We showed that participants perceived the set-size in linguistic negation reflected by a congruity effect with number magnitude. This supports previous claims that size congruity effects are perceived across domains. Moreover, the results are in accordance with the view that direct inferences toward the actual state of affairs are possible in negation processing depending on the set size.

Poster: **V13**   **Cinthia Sayuri Misaka**

The effects of learning Japanese by a Brazilian person with aphasia

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Introduction: Introduction: learning a foreign language can be a challenging activity for persons with aphasia since this task requires a variety of complex linguistic and cognitive processes. Therefore, this study aimed at analyzing the effects of learning Japanese, by a Brazilian participant with aphasia named GF., in his L1. *Methods*: Methods: we conducted a qualitative and longitudinal study case based on linguistic analysis of discourse in aphasia. The 18 years-old participant was Brazilian, he suffered brain injury and presented a verbal aphasia (Freud, 1891/2014). GF spoke Brazilian Portuguese as L1 and he had no previous knowledge of Japanese. The Japanese activities were designed for this study considering the specific needs brought by the aphasic condition. Since our goal was to understand the effects of learning a new language on an aphasic L1, we also had interactional activities in Portuguese to analyze his L1. *Results:* Results: the data was categorized into: a) strategies used to accomplish the tasks; b) language reorganization. For (a), we observed that the participant used his L1 to help him learn Japanese. When he faced difficulties in accessing the L1, he used alternative ways to overcome them (visual or kinesthetic information). For (b), we noticed differences in his writing and speaking abilities in Portuguese. At the end, he showed autonomy in writing and his hesitations seemed to be results of epilinguistic processes. In addition, GF presented a more spontaneous speech and elaborated syntactic structures. *Discussion*: Discussion: the results indicated that GF challenged himself by using different ways of intellectual reasoning (visual memory, metalinguistic and epilinguistic processes). Consequently, he found alternative ways to overcome the difficulties by using non-verbal systems (i.e. gestures, visual or kinesthetic information). Also, he seemed to reorganize his own native language, showing spontaneity in his interactions, an elaborated syntactic structure and autonomy in writing in Portuguese.

Poster: **V14**   **Sonia Montemurro**

THE RELATIONSHIP BETWEEN APERIODIC ACTIVITY OF RESTING-STATE EEG AND COGNITIVE PERFORMANCE IS MODULATED BY EDUCATION IN AGING

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Introduction: Aging influences the oscillatory (periodic) brain activity in the alpha band (8-12 Hz), as measured in resting state EEG (rsEEG). Studies using standard Fourier methods report that older adults have significantly lower alpha frequency and power relative to younger adults. Interestingly, the aperiodic component of the rsEEG signal (i.e., exponent), is related with aging: as age increases, the aperiodic slope flattens, possibly reflecting age-related changes in excitatory/inhibitory balance. The aperiodic component in alpha rsEEG correlates with cognitive performance. However, it is not clear whether education, well known for its modulatory role on cognitive performance, also influences the relationship between aperiodic activity and performance. *Methods*: Data on N=179 healthy subjects from the LEMON dataset were analyzed. Available information about education was expressed in two levels: high (N=123 young adults, Y_H; N=24 older adults, O_H) and low (N=32 older adults, O_L). Analyses were made only on rsEEG eyes closed signal, reconstructed in the occipital area. Signal was decomposed with the specparam/FOOOF approach, to obtain both periodic and aperiodic components and to investigate their relationship with cognitive scores. We included test scores of tasks assessing Processing Speed (i.e., alertness and attention) and Memory (i.e., working and delayed). *Results:* Both O_H and O_L showed lower scores on all cognitive tasks and on aperiodic activity compared to Y_H. The O_H group had significantly better working memory compared to O_L. In the regression analysis, the Processing Speed tasks in the O_H group showed a significant interaction between education and the aperiodic component. *Discussion*: The lower the exponent, the faster O_H performed in cognitive tasks. Education, which contributes to compensatory processes, may help to explain the relationship between aperiodic activity and cognitive efficiency in older adults.

Poster: **V15**   **Silvia Canino**

Inner and outer bodily information processing: evidence in adolescence

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Introduction: Given the impact of bodily information processing on physical and mental health, there is a growing interest in the topic. Despite this appreciation, the developmental trajectory of inner and outer bodily information processing across the lifespan remains under-researched, particularly during adolescence. This study aims to fill this gap by exploring the development during adolescence of different interoceptive dimensions, that is, interoceptive accuracy (IAcc), sensibility (IS) and awareness (IAw), and action- (i.e., body schema, BS) and nonaction-oriented (i.e., visuo-spatial body map, VSBM) body representations (BR). ***Methods***: Fifty-five adolescents (12-14 yrs) and forty-seven young adults (20-34 yrs) completed a heartbeat tracking task probing IAcc and IAw, two IS questionnaires (Self-Awareness Questionnaire, and Multidimensional Assessment of Interoceptive Awareness), and a computerized battery consisting of action- and nonaction-oriented BR tasks. ***Results:*** Adolescents were as accurate as young adults in counting their heartbeats (IAcc). However, they showed less metacognitive awareness of their interoceptive ability (IAw) and scored significantly different from young adults on IS questionnaires. Also, the correlational analysis showed a lack of significant associations between the different interoceptive dimensions (IAcc, IAw, IS). Concerning the action- and nonaction-oriented BR, adolescents were slower than young adults in performing mental rotation of body parts (BS) and less accurate in locating body parts (VSBM). ***Discussion***: The adolescents' performance on objective behavioral measures probing different kinds of bodily information suggests an adult-like pattern of performance in processing interoceptive information (IAcc) but not in representing sensorimotor (BS) and visuo-spatial (VSBM) bodily information. As already proved in studies on adults, current results indicate that the three interoceptive dimensions (IAcc, IAw, IS) are independent, and their maturation follows different trajectories during adolescence. These findings may be helpful in clinical settings to better understand the atypical development of bodily information processing during adolescence and how it may be associated with health problems.

Poster: **V16**   **Magdalena Gippert**

Motor Imagery of Linked Movements Enhances Motor Adaptation

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Introduction: Most movements in daily life do not occur in isolation but are embedded within a motor sequence. Linked movements like this have been shown to influence the execution of prior and following motor elements. If a reach is linked to a prior movement of the same arm, kinematic characteristics of that prior movement can even facilitate motor adaptation during reaches, while other cues (e.g., static visual) do not allow this. We investigated whether the facilitative effect of linked movements could also be achieved not only through real movements but also via kinesthetic motor imagery of prior movements. An additional aim of the project was to identify neuronal correlates of motor imagery predicting motor learning. *Methods*: We measured motor learning by 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. Movement kinematics (exoskeleton robot) and EEG (64 electrodes) of 60 participants were recorded to investigate the underlying neural mechanisms involved in the motor learning process. *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. In addition, our initial results indicate that post-imagery synchronization of alpha and beta oscillations can serve as indicator of successful motor adaptation. *Discussion*: 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 both real and imagined movements can be represented together to enhance motor performance.

Poster: **V17**   **Cemre Baykan**

Influences of temporal order in temporal reproduction

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Introduction: Despite the outstanding role of complex temporal sequences, such as a flow of speech or a sample of music, in our everyday lives, the way we acquire or reproduce those patterns is still susceptible to many perceptual biases. Here we examined how the temporal order affects the temporal reproduction. *Methods*: We used a temporal reproduction task in which participants (n = 15) reproduced either decelerating, accelerating or random auditory sequences with finger taps. *Results:* Despite the sample sequences having the same mean and variance, our results showed that the pattern mean reproduction and its precision depended on the sequence structure. The mean reproduced interval was assimilated by the first interval of the sequence, with the lowest for the decelerating and the highest for the accelerating sequence. Moreover, the central tendency bias (i.e., assimilation of the reproductions to the group mean) was dependent on the volatility of the sequence. Using Bayesian integration between the ensemble mean of the sequence and individual durations and assuming the perceptual uncertainty depending on the sequential structure and position, we were able to predict the behavioral results. *Discussion*: We conclude that the temporal order of a sequence plays a critical role in temporal pattern reproduction, with a higher weight of the first interval in the mean reproduction and the volatility of the sequence contributing to the perceptual uncertainty of individual intervals and the central tendency bias.

Poster: **V18**   **Ekaterina Ivanina**

EmoEye Project: deep learning-based approach to commercial eye-tracking data analysis

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Introduction: Detection of emotion is one of the core elements of Affective Computing and is often used both in scientific and commercial settings. Responding to the demand for AI analytics from our own business demands and the latest trends we collected the largest (by our estimations) multimodal psychophysiological database and developed a Deep Learning approach to affect recognition. *Methods*: Eye-tracking, galvanic skin response (GSR) and heart-rate variability data were collected from 200 (27.46±11.45 years) subjects while they were viewing 316 pictures, balanced by Arousal and Valency metrics, from Open Affective Standardized Image Set (OASIS) and evaluating them with Self-Assessment Manekin (SAM) 7-point form. Data was cleared of artifacts, segmented and fed to the model. *Results:* Final neural network consisted of Convolutional (CNN) and Long Short-term memory (LSTM) network layers using three types of data - scanpaths, GSR and HR signal data values and images viewed by the participants - as an input. We were able to achieve an accuracy of 87% for valence and 78% for arousal. *Discussion*: We present an EmoEye Project as one of the few entrepreneurial Affective Computing ventures, based on psychophysiology and eye-tracking compared to widely-used Facial Recognition approach, which often provides rather speculative results. EmoEye neural network has already been successfully applied in commercial research. We are currently developing EmoEye-based solutions for other types of emotional content (e.g., articles, videos).

Poster: **V19**   **Elizaveta Ivanova**

The origin of symbolic numerical knowledge in preschool children - a longitudinal study (research plan)

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Introduction: Cardinality principle (CP) is the ability to use counting to determine the numerical quantity of any set. Children who have not yet acquired the principle cannot decide on quantity for more than 4 objects and are referred to as subset knowers (as compared to CP-knowers). Today, not much is known about brain changes chaperoning acquisition of cardinality principle, despite its immense influence on further mathematical learning. Based on the existent literature, we hypothesised that CP-knowers will reveal higher left parietal activation related to the semantic processing of number words, higher bilateral parietal functional connectivity that links number words to their discrete quantity, and higher bilateral frontal activation related to supportive executive functions as compared to subset-knowers.
Methods: In this longitudinal study we are measuring brain responses with fNIRS during two tasks: the numerical adaptation task and numerical incongruence task. During year one, we are collecting data from 150 children aged 3 years old, 40 of whom are CP-knowers, while the rest are subset-knowers. In the next two years we will track only subset-knowers (meaning approx. 30 children after 12 months of initial assessment, and 10 children after 24 months).
Results: We will apply repeated measures ANOVA 2 (subset-knowers vs CP-knowers) by 2 (deviant non- number word vs deviant number word) in 4 ROI: right/left parietal/frontal cortex, as well as conduct contrast analysis, functional connectivity, and multivariate pattern analysis. *Discussion*: The study will reveal neural changes when acquiring the cardinality principle, and how these changes differ when the principle is acquired later than expected. Theoretically, this can be discussed in terms of forwarding theories about the origin of symbolic knowledge in early development. Practically, it can help identify future risk factors for late CP-knowers.

Perturbation of Initial and Final Action Goals during the Preparation of Grasp-to-Rotate Movement: An ERP study

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Introduction: For most prehensile movements, action goals are not restricted to reaching or grasping an object (the initial goal) but, more importantly, manipulating the object for a subsequent task (the final goal). Coordinating the initial and final action goals during motor planning has been studied. However, the (functional) roles of the goals in motor re-planning are still not fully understood. In this study, event-related potentials (ERPs) were used to investigate motor re-planning in response to an unexpected change in the initial or final action goals. ***Methods***: To address this issue, we modified the "S1-S2" paradigm and introduced an unexpected perturbation in either the initial or final goals for a quarter of trials. Twenty-six right-handed participants (Mean age = 25.08, SD = 3.60, 16 females) were asked to perform a grasp-to-rotation task in which initial (how to grip) or final (target position) goals were perturbed unexpectedly. In the goal-perturbed trials, participants had to re-plan their prepared movements to adapt to the unexpected changes in either initial or final goals. ERPs were used to investigate the processes associated with motor re-planning (inhibition and implementation). ***Results:*** Behaviorally, we found that longer re-planning time was needed when initial goals were perturbed, as compared when final goals were perturbed (t25 = 4.65; p < 0.001). Neurophysiologically, we found no significant amplitude difference in the mid-line P2, N2, and P3 components between the initial- and final-perturbed conditions. However, initial-perturbed trials elicited a more positive centro-parietal slow-wave potential than final-perturbed trials in the time window 500 – 700 ms after the perturbation onset (all ts > 2.79; all ps < 0.05). ***Discussion***: These results suggest motor re-planning with a perturbed initial goal is more cognitively demanding than with a perturbed final goal. The increased efforts seem to be engaged in implementing a new motor plan instead of inhibiting the pre-planned movements.

Poster: **V21**   **Yalcin Ceyda**

Investigation of Metamemory Judgments During Eyewitness Testimony

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Introduction: The relationships between metamemory judgments and eyewitness memory (EM) is unknown. In this study, we investigated the effects of the emotional content of the witnessed event on different metamemory judgments and accuracy, namely feeling-of-knowing (FOK) and judgment-of-learning (JOL). ***Methods***: It is an ongoing study. Seventy-five healthy university students participated (46 females, Mage = 21.89). The task consisted of four consecutive phases. First, participants were instructed to watch ten neutrals and ten negative (robbery, traffic accident) videos. Second, participants gave JOL judgments (Can you remember the details in this video?). Third, participants were instructed to answer five questions for each video and evaluated their confidence level (Yes: confident, No: not confident, or FOK: I don't remember the answer, but I can remember it in the future). Lastly, participants completed a recognition test for the questions they gave FOK responses. ***Results:*** Only JOL and FOK phases were analyzed for this paper. JOL and FOK judgments and accuracy (Gamma correlation) scores were analyzed using repeated measure ANOVA. FOK accuracy regarding negative videos (M = 0.40) was significantly higher than the neutral (M=0.08) ($p < 0.05$). On the other hand, JOL judgments were significantly lower for negative videos (M=3.90) than neutral (M=4.16, $p < 0.001$). Although JOL accuracy and FOK judgments for negative videos were higher than the neutral, these differences were insignificant. ***Discussion***: Our initial results showed that metamemory judgments and accuracy during EM were affected by the emotional content of the event. Participants gave higher FOK judgments and were more accurate for negative events. Although participants might tend to think they will remember fewer details of negative event (JOL judgments), they were more accurate for negative events than neutral. We concluded that metamemory judgments should also be examined during eyewitness testimony. *This project was supported by TÜBITAK (ID #1919B012203023)

Poster: **V22**   **Anabela Pereira**

Mind, brain, body & environment interaction: the emotionally embedded cognition hypothesis

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Introduction: To think of emotions in the scope of a situated mind-body interaction is to consider if and how a person's emotional processing embeds that context/environment. This question has gained relevance within the COVID-19 pandemic with the strong development of digital interactions, both in private and public sectors of economic activity, as well as in people's homes and daily life (work, leisure, relationships), accelerating the transition to the new digital economy-based societies. However, how exactly is the emotionally embedded response (to a specific environment) capable of constraining cognition and behaviour, and what factors can be related to it (e.g., age, gender, personality, features/objects from the environment)? *Methods*: To test our Emotionally Embedded Cognition Hypothesis, we conducted a study in 2021 with students attending university to investigate their digitally embedded experiences, namely, how neuropsychological states, cognitive performance, and environment engagement correlate. Methods included: an assessment (N=16) of biometrics associated with cognitive control and emotional response (heart rate [bpm] and heart rate variability/captured through PPG signals); the Stroop Test (measuring cognitive interference and accuracy in the task); neuropsychological scales (the Maslach Burnout Inventory Students Survey/MBI-SS); the Profile of Mood States/POMS), and a questionnaire on environment characteristics perceptions (light, sounds, objects), to which participants responded after attending digital classes (vs presential). *Results:* We concluded that the MBI-SS scale did not correlate with the other variables (results showed that none of the participants had a burnout state of mind). Regarding moods, depression/melancholy could predict the Stroop results, and confusion/disorientation could predict heart rate variability during the task. And environmental engagement could predict the Stroop effect (cognitive interference) and the heart rate variability during the task. *Discussion*: These results suggest that environment-related-bodily-activity is essential to understanding mind-brain-body interaction and emotional embedding in the digital world and its behavioral challenges.

Poster: **V23**   **L. S. Merritt Millman**

Altered interoceptive sensibility with intact interoceptive accuracy and awareness in functional neurological disorder

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Introduction: Altered interoception may be a core pathophysiological mechanism in functional neurological disorder (FND). However, there have been inconsistent findings from interoceptive accuracy paradigms, with several studies reporting no significant group differences in comparisons to controls, contrary to evidence for alterations in other interoceptive dimensions including awareness and sensibility in this population. We aimed to measure interoception across several dimensions, with the prediction that individuals with FND would show reduced accuracy, awareness, and sensibility compared to controls. ***Methods***: Individuals with FND (n=17) and healthy controls (HC, n=17) completed measures of interoceptive accuracy and awareness (modified heartbeat tracking task [HTT]) and a time estimation task (TET). Participants also completed a validated scale of interoceptive sensibility (Multidimensional Assessment of Interoceptive Awareness-2, MAIA-2). ***Results:*** FND and HC groups did not differ in interoceptive accuracy (p=1.00) or awareness (p=.99), although the FND group displayed lower scores on the "Not-Distracting" (p<.001, g=1.42) and "Trusting" (p=.005, g=1.17) subscales of the MAIA-2, relative to HCs. There was no relationship in either group between HTT and TET scores. There was a significant positive relationship between HTT accuracy and awareness in HCs (r=.61, p=.016) but not in the FND group (r=.11, p=.69). Exploratory correlations revealed a significant positive relationship between interoceptive awareness and the "Self-Regulation" subscale of the MAIA-2 in the FND group (r=.77, p=.002). ***Discussion***: Individuals with FND did not differ from HCs on interoceptive accuracy or awareness. Lower levels of "Not-Distracting" and "Trusting" seen in this FND sample replicated previous findings, suggesting that there may be a separation between trait and state interoceptive awareness in FND, reinforcing the need for interoception to be considered within a multidimensional framework. The lack of relationship between interoceptive accuracy and awareness in the FND group also implies that there may be a disconnect between actual performance and subjective confidence.

Participants MBBS 2023

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