9th MindBrainBody Symposium 2022

Poster Session A

Posters Nr. A1-A20 (Zoom Breakout Rooms)

Monday, March 16, 2022 at 18:30-19:15 (GMT+1)
Discussion Part 2 | Poster Session A & B | Tuesday, March 17, 2022 at 09:30-10:00 (GMT+1)

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A01_Candia-Rivera	Diego	Neurocardiac dynamics initiate emotional processing through parasympathetic afferents
A02_Walter	Jasmin L.	Finding landmarks – An investigation of viewing behavior during spatial navigation in VR using a graph-theoretical analysis approach
A03_Carls-Diamante	Sidney	A predictive processing/active inference account of procrastination in the context of autism spectrum disorder (ASD) ***Poster Co-Presenter:*** *Laciny, Alice*
A04_Hapsari	Fransisca Mira	Adaptive Sensorimotor Training for Amnestic Mild Cognitive Impairment Patient: A randomized and controlled study of a tablet-based sensorimotor home training
A05_Leiman	Marina	Are Developmental Learning Disorders risk factors for Neurodegenerative Diseases?
A06_Charalampaki	Angeliki	Are experimental approaches to study the Sense of Agency comparable?
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A11_Miklashevsky	Alex	Emotions at our fingertips: Grip force signatures of emotional information processing **Poster Co-Presenters:** *Kulkova, Elena & Fischer, Martin H.*
A12_Fanghella	Martina	How humans and artificial classifiers decode grasping movements through kinematic information **Poster Co-Presenter:** *D'Asaro, Fabio Aurelio*
A13_Nasim	Ammara	Decoding the neural representations of digital humans' emotional faces in stereo- versus monoscopic viewing conditions - a study plan **Poster Co-Presenter:** *Klotzsche, Felix*
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A16_Fourcade	Antonin	Linking emotional arousal to the heartbeat-evoked potential in immersive virtual reality
A17_Shaikh	Usman Jawed	Modulation of fronto-striatal connectivity by intermittent Theta Burst Stimulation (iTBS). A 18F-DesmethoxyFallypride Positron Emission Tomography (PET) study
A18_Hechler	André	Quantifying the Metabolic Cost of Prediction During Visual Processing
A19_Fernandez Larrosa	Pablo Nicolas	Complex decision-making could be facilitated by social modulation through priming
A20_Rodriguez Soriano	Javier	Cross-frequency dynamics of neural and cardiac rhythms in the context of effortful cognition and breath focus

Poster Abstracts

A01 **Poster Presenter: Candia-Rivera, Diego**

Neurocardiac dynamics initiate emotional processing through parasympathetic afferents

Candia-Rivera, D. [1], Catrambone, V. [1], Thayer, J. F. [2,3], Gentili, C. [4], & Valenza, G. [1]

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Introduction: A century-long debate on bodily states and emotions persists. While the involvement of bodily activity in emotion physiology is widely recognized, the specificity or causative role of such activity has not yet been demonstrated. We hypothesize that the peripheral neural monitoring and control of cardiovascular activity prompts and sustains brain dynamics during an emotional experience **Methods:** We investigated the functional brain-heart interplay under emotion elicitation in publicly available data from 62 healthy participants. The estimation of the bidirectional brain-heart interplay was assessed with a computational model based on synthetic data generation of EEG and ECG signals. The output of the model are time-varying coupling coefficients, for either ascending or descending interplay, between EEG bands and heartbeat's spectral estimators of sympathovagal activity. **Results:** Our findings show that parasympathetic activity plays a leading and causal role in initiating the emotional response, in which ascending modulations precede the descending modulations in the bidirectional communication measurements. Furthermore, we found the existence of a bidirectional interplay between central and peripheral neural dynamics in emotional processing, and the average ascending interplay measured during the whole trial is correlated to the reported level of arousal. **Discussion:** The observed neural dynamics showed that the heart prompts emotions, supporting causation theories of physiological feelings. Our results demonstrate that the emotional experience raise from the mutual interplay between brain and body. The brain receives afferent autonomic information, triggering a cascade of cortical activations. In turn, the brain performs directed neural control onto the heart. The observed ascending pathway of parasympathetic activity towards cortical regions suggests that emotion processing is an integration of physiological inputs in the brain, rather than an interpretation of the physiological changes.

A02 **Poster Presenter: Walter, Jasmin L.**

Finding landmarks – An investigation of viewing behavior during spatial navigation in VR using a graph-theoretical analysis approach

Walter, J. L. [1], Essmann, L. [1], König, S. U. [1], & König, P. [1,2]

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Introduction: Vision provides the most important sensory information for spatial navigation. Recent technical advances allow new options to conduct more naturalistic experiments in virtual reality (VR) while additionally gather data of the viewing behavior with eye tracking investigations. Here, we propose a method that allows one to quantify characteristics of visual behavior by using graph-theoretical measures to abstract eye tracking data recorded in a 3D virtual urban environment. **Methods:** The analysis is based on eye tracking data of 20 participants, who freely explored the virtual city Seahaven for 90 minutes with an immersive VR headset with an inbuild eye tracker. To extract what participants looked at, we defined "gaze" events, from which we created gaze graphs. On these, we applied graph-theoretical measures to reveal the underlying structure of visual attention. **Results:** Applying graph partitioning, we found that our virtual environment could be treated as one coherent city. To investigate the importance of houses in the city, we applied the node degree centrality measure. Our results revealed that 10 houses had a node degree that exceeded consistently two-sigma distance from the mean node degree of all other houses. The importance of these houses was supported by the hierarchy index, which showed a clear hierarchical structure of the gaze graphs. As these high node degree houses fulfilled several characteristics of landmarks, we named them "gaze-graph-defined landmarks". Applying the rich club coefficient, we found that these gaze-graph-defined landmarks were preferentially connected to each other and that participants spend the majority of their experiment time in areas where at least two of those houses were visible. **Discussion:** Our findings do not only provide new experimental evidence for the development of spatial knowledge, but also establish a new methodology to identify and assess the function of landmarks in spatial navigation based on eye tracking data.

A03 **Poster Presenter: Carls-Diamante, Sidney** **Co-Presenter: Laciny, Alice**

A predictive processing/active inference account of procrastination in the context of autism spectrum disorder (ASD)

Carls-Diamante, S. [1], & Laciny, A. [2]

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Introduction: A phenomenon often associated with autism spectrum disorder (ASD) is a deficit in executive function, manifestations of which include difficulty in initiating tasks. In some cases, this is accompanied by feelings of inertia and sensations that can be described as simultaneous restlessness and paralysis. Consequently, the difficulty in getting started on tasks can result in procrastination, either by simply postponing working on the task or by performing other unrelated tasks before engaging in the original one. Interestingly, however, it is also documented that once a task has been started, autistic persons may focus on it intensely and for prolonged periods of time (hyperfocus), especially when the task is interesting to them. **Methods:** This study uses the analytical methods of philosophy to develop a framework to account for the relationship between deficits in executive function, procrastination, and hyperfocus in ASD. The framework is based on the existing theories of predictive processing and active inference. **Results:** The relationship between executive function, procrastination, and hyperfocus in ASD is accounted for via a model that integrates the known and proposed causes of deficits in executive function, predictive processing/active inference theories of action selection and motor control, and the role played by interest in attention regulation and motivation. **Discussion:** The model proposes that procrastination is the outcome of inefficiency in prediction-error minimizing processes, such as differential weighting of sensory stimuli. Links to the proposed ASD model of weak central coherence (WCC), i.e., a tendency to focus on small details rather than the "big picture", as well as possible distinctions from similar phenomena known from attention deficit disorder (AD(H)D) or anxiety disorders are discussed.

A04 **Poster Presenter: Hapsari, Fransisca Mira**

Adaptive Sensorimotor Training for Amnestic Mild Cognitive Impairment Patient: A randomized and controlled study of a tablet-based sensorimotor home training

Bekrater-Bodmann, R. [1], Löffler, A. [1], Silvoni, S. [1], Frölich, L. [2], Hausner, L. [2], Desch, S. [1], Kleinböhl, D. [1], Flor, H. [1, 3], & Hapsari, F. [4]

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Introduction: One reliable early sign of dementia and Alzheimer's disease is the diagnosis of amnestic Mild Cognitive Impairment (aMCI), a stage in which preventive measures can make or break the prognosis of cognitive decline. To date, cognitive trainings demonstrated low generalization and maintenance, yielding limited positive effect to specific task which often disappears after the training is completed. **Methods:** This study presents a new approach for retaining cognitive performance in aMCI patients, that is more fundamental in nature. Our current study tested firstly whether there is a connection between sensory and memory functions. Secondly, whether a tablet-based sensorimotor training (tbSMT) was superior to control cognitive training, in terms of generalization to sensory and cognitive function improvements. As sensory cortices are less vulnerable to aging than the newer cortices, training basic sensorimotor functions might yield a more long-lasting and generalized improvement. The sensorimotor training was based on brain-plasticity and operant conditioning principles. Applying shaping, it provided reinforcement of successive approximations of desired sensorimotor outcomes. **Results:** Pearson correlations showed a strong relationship between sensory ability, as indicated by visual acuity and hearing threshold, and cognitive functions, as indicated by verbal and visual episodic memory. After 3-months of computerized training, no significant progress difference between tbSMT and control training groups was observed with factorial ANOVA. However, both groups showed sensory improvement which is largely limited to visual acuity perception. No clear-cut cognitive improvement was discovered, as only slight progress in verbal and visual episodic memory was found. **Discussion:** We provided another evidence for interconnection between sensory functions and cognitive functions in clinical population. This was one of the first studies examining multi-modality sensorimotor training to cognition. Thus, future research comparing the effectiveness of sensorimotor and cognitive training is needed, as well as integrating different approaches in training elderly with MCI.

A05 **Poster Presenter: Leiman, Marina**

Are Developmental Learning Disorders risk factors for Neurodegenerative Diseases?

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Introduction: Factors associated with early life educational performance can be related to neurodevelopment, cognitive functioning and, consequently, the risk for dementia, but have received less attention than adult biomarkers. **Methods**: A systematic review of the evidence available up to December 2021 in PubMed and Scopus was carried out. Original articles addressing both developmental LD and late-onset NDD were included. **Results:** A significant prevalence of LD was found in patients with atypical variants of Alzheimer's disease (AD). Furthermore, an association was found between primary progressive aphasia - logopenic variant and language-related LD, and also between posterior cortical atrophy and non-language-related LD. These results could be explained by the selective vulnerability hypothesis, which states that the vulnerability of a particular brain network or area could predispose both to developmental LD and late-onset NDD. **Discussion:** Developmental LDs can be considered as risk factors for late-onset NDD, especially for atypical AD variants. Given the scarcity of results and the limitations reported, a greater number of studies are required, with larger samples and, preferably, of longitudinal design in order to address this issue.

A06 **Poster Presenter: Charalampaki, Angeliki**

Are experimental approaches to study the Sense of Agency comparable?

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Introduction: The sense of agency (SoA) is the feeling of intentionally moving our body and, through it, affecting the environment. In line with this definition, studies aim to affect SoA by manipulating either a representation of a movement or the consequences of that movement on the environment. However, it is unclear whether the underlying assumption is valid, that these two kinds of manipulations equally affect the SoA. Using a novel experimental paradigm, we aim to address this question by systematically manipulating these two components: a representation of the movement itself vs its effects on the environment. Further, we employ as dependent measures estimates of metacognitive performance to compare different conditions devoid of response biases in subjective measures, which are often present in typical agency tasks. **Methods:** In a virtual game, participants throw a ball to hit a target twice on each trial. The visual feedback is congruent with what participants did in only one of the two movements and incongruent in the other: Either the movement or the outcome (ball flight trajectory) does not match what participants did. In each trial, participants select the interval in which they felt stronger SoA and rate their confidence in that decision. **Results:** We will estimate participants' metacognitive performance in each condition. We will also conduct exploratory event-related potentials (ERP) analyses to examine if the amplitude of specific ERPs (e.g. ERN and CRN) differs between conditions. **Discussion:** We hypothesize that SoA over the movement differs from SoA over the outcome both behaviourally and at the neural (EEG) level, which would suggest that these two approaches, while each valid on its own, should not be considered equivalent. Furthermore, by framing SoA within the broader framework of metacognitive monitoring, we aspire to lay some theoretical grounds and a more precise methodological approach to move forward the research on SoA.

A07 **Poster Presenter: Forster, Carina Poster Co-Presenter: Enk, Lioba**

Informative cue on stimulus frequency affects criterion in near-threshold detection

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Introduction: Sensory perception relies on stimulus properties and the context in which the stimuli are presented. Recently in the visual system, it has been shown that expectation of a weak stimulus altered the subjective threshold of reporting the stimulus (commonly known as criterion in signal detection theory). Moreover, interoceptive signals such as cardiac and respiratory rhythms influence human perception of near-threshold stimuli. However, it remains to be determined whether stimulus expectations interact with these interoceptive signals to influence sensory perception. **Methods:** Forty-two healthy adults received near-threshold electrical stimulation to their index finger whilst 62-channel EEG, ECG and respiration were recorded. In each trial, participants had to report stimulus presence and decision confidence. Stimulus expectation was manipulated in a within-subject design. Each of the 30 blocks per condition contained either three near-threshold trials (25%; low expectation) or nine near-threshold trials (75%; high expectation). Before each block of twelve trials a cue indicated whether there was a high or low chance for a stimulus. The cues (25%/75%) matched the actual probability of stimulus presence. **Results:** Participant's threshold to report a stimulus was higher in the low expectation condition while sensitivity did not differ significantly between conditions. Reaction times were shorter and confidence was higher in hits in blocks with a high stimulus probability compared to blocks with a low probability for a stimulus. Preliminary results indicate that participants are more sensitive in diastole but this effect is only present in the low expectation condition. **Discussion:** We show for the first time in the somatosensory system that informative cues of lower stimulus probability lead to an increase of subjective thresholds to report a weak stimulus. Interestingly, higher sensitivity for weak tactile stimuli can only be replicated in the low expectation condition.

A08 **Poster Presenter: Studenova, Alina**

Non-zero mean alpha oscillations are involved in P3b generation

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Introduction: The parietal P3b is by far the most widely investigated evoked response in EEG/MEG research and it is used to study general stimulus processing, attention and arousal, working memory, etc. However, the neurobiological mechanisms underlying the generation of P3b are rather poorly understood. Previous research demonstrated that P3b co-occurs with alpha-amplitude decrease triggered by a stimulus, therefore P3b origin may be due to the baseline-shift mechanism for evoked response generation (BSM). BSM posits that if neuronal oscillations have a non-zero mean, any modulation of oscillations' amplitude would result in the deflection in the frequency range of modulation. Therefore, modulation of the non-zero mean alpha oscillations co-occurs with a low-frequency wave, i.e., evoked response. In this study, we tested the BSM prerequisites for the generation of P3b. **Methods:** We analysed a large cohort of elderly individuals (N=2308, 60-82 y.o.) in a framework of assumptions relating to BSM. From the rest-state data, we extracted the baseline-shift index, a measure that determines how strong is the concordance between low-frequency time course (0.1-3 Hz) and the ongoing rhythm envelope (the alpha rhythm). From the stimulus-based data, we extracted P3b (using simple averaging) and alpha rhythm amplitude envelope (using the Hilbert transform). **Results:** We showed that predictions of BSM concurred with the P3b–alpha amplitude relation - (1) the sign of the baseline-shift index together with the direction of amplitude change determined the direction of P3b, (2) time courses of P3b and alpha envelope were correlated, (3) spatial distributions of P3b and alpha modulation were comparable. **Discussion:** Our results suggest that P3b, at least partially, is generated via BSM, and therefore is closely related to alpha oscillations. Furthermore, in a broader sense, it indicates that changes in P3b with respect to age or disease should also be interpreted in the context of oscillatory neuronal dynamics.

A09 **Poster Presenter: Vanoncini, Monica**

The Role of Mother-Infant Emotional Synchrony in Speech Processing in 9-month-old Infants

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Introduction: Interactions between mothers and their infants are characterized by regular and recurring cycles of behavior and affective expressions. These rhythmic patterns might elicit the temporal alignment of behavioral states (i.e., interpersonal synchrony), such as the matching of affective expressions. Similarly, language is rhythmic. Infants ability to perceive rhythm and their word segmentation ability predict later language outcomes. The present study aimed at investigating whether mother-infant emotional synchrony contributes to infant language development. We hypothesized that higher levels of emotional synchrony are linked to better word segmentation at 9 months of age. **Methods:** Data of twenty-six 9-month-old infants and their German-speaking mothers were included in this study. To measure emotional synchrony, we video-recorded 5 minutes of free play interactions between the mothers and their infants, which were then coded for positive, neutral and negative emotional expressions. To quantify the patterns of emotional synchrony we used Cross-Recurrence Quantification Analysis, particularly recurrence rate (i.e., RR, tendency of the dyadic system to repeat itself) and entropy (i.e., ENTR, degree of disorder characterizing the dyad). With an eye-tracking-based central fixation paradigm, we tested infants' word segmentation. During familiarization, infants heard text passages containing two target words (i.e., familiar trials). At test, infants heard familiar words and novel word trials, and infants' looking times while listening to trials were used as dependent measure. **Results:** Regression modelling revealed that ENTR, but not RR, interacted with trial type: the lower the entropy during interaction, the longer infants looked during presentation of novel compared to familiar words at test, indicating successful word segmentation performance. **Discussion:** These findings suggest that individual differences in word segmentation relate to the complexity and predictability of emotional expressions during mother-infant interactions. Our study highlights the relevance of examining the role of shared emotions in communication, specifically its dynamics, and language development.

A11 **Poster Presenter: Miklashevsky, Alex** **Poster Co-Presenters: Kulkova, Elena & Fischer, Martin H.**

Emotions at our fingertips: Grip force signatures of emotional information processing

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Introduction: The body-specificity hypothesis predicts an association between positive stimuli and the right hand and between negative stimuli and the left hand in right-handed participants. The magnitude account of emotion processing instead predicts the association of all arousing stimuli with the right hand and of neutral stimuli with the left hand. **Methods:** 26 right-handed participants were included in the study. We measured participants' initial emotional state and then presented them with happy, sad, and neutral faces. Participants' spontaneous grip force changes were bimanually recorded with millisecond resolution by using grip force sensors. Vocal responses were required only in go trials, while all trials of interest required no response at all (no-go trials). The task was to distinguish between faces vs. non-animate objects, i.e., emotional state was processed implicitly. **Results:** We found a complex interaction between participants' initial emotional state and their reactions to emotional stimuli presented during the experiment. Participants whose state before the experiment was calmer and more negative exhibited stronger grip force for emotional stimuli in both hands already at 140-180 ms after stimulus onset. At 630-760 ms, the same participants only demonstrated this effect in the left hand. Participants whose initial emotional state was positive showed stronger grip force for emotional stimuli in the right hand at 630-760 ms. **Discussion:** Our findings favor the magnitude account that predicts an association between force and arousal. We demonstrate the moderating impact of participant's initial emotional state on the processing of emotional stimuli. The body-specificity hypothesis received little support in our study. We hypothesize that horizontal valence-space associations might result from explicit lateralized responses used in previous studies.

A12 **Poster Presenter: Fanghella, Martina Poster Co-Presenter: D'Asaro, Fabio Aurelio**

How humans and artificial classifiers decode grasping movements through kinematic information

Martina Fanghella [1], Fabio Aurelio D'Asaro* [2], Maria Teresa Pascarelli [1], Guido Barchiesi [1], & Corrado Sinigaglia [1]*

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*equally contributed

Introduction: Recent models of action observation suggest that the brain relies on motor information to understand others' behaviour. However, less is known on the mechanisms underlying action recognition when motor information is ambiguous. By comparing human and algorithms performances in a grasping recognition task, this study aims to investigate the strategies underpinning movement classification when different amounts of motor information are available. **Methods:** 1.Human recognition of grasping movements 30 participants took part to an online study. They observed videos showing 10%, 20%, 30% or 40% of the kinematic, and guessed if the hand was grasping a large or a small object, by looking at the hand kinematics. 2.SVM classification on Kinematic Data We performed binary classification on kinematic data by training a Support Vector Machine (SVM). 3.Neural Network classification on Videos To perform classification on videos, we used a hybrid Machine Learning Neural Network model known as CNN-RNN. All classifications were performed on the same datasets. **Results:** Analysis of Precision and Recall in Humans and SVMs shows that recall for "small" objects is significantly greater than recall for "large" objects up to 30% of video for humans ($p < 0.005$). Then, the trend is inverted with recall for class "small" being reduced than recall for class "large" from 30% of the video onwards ($p < 0.001$). Similar results hold for precision. Conversely, we could not observe the same pattern for visual classification with Neural Network. **Discussion:** Our study shows that human performance is characterised by similar patterns compared to the classifier using only kinematic information, confirming that humans use motor information to understand others' actions, even when ambiguous. By contrast, machine learning algorithms using visual information exhibit different trends of performance, suggesting that visual analyses of the stimuli may impact only marginally on movement recognition.

A13 **Poster Presenter: Nasim, Ammara** **Poster Presenter: Klotzsche, Felix**

Decoding the neural representations of digital humans' emotional faces in stereo- versus monoscopic viewing conditions - a study plan

Nasim, A. [1,2], Hofmann, S.M. [1,3], Nikulin, V. [1], Sommer, W. [4,5,6], Villringer, A. [1,4], Gaebler, M [1,4], Klotzsche, F. [1,4,5]

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Introduction: One of the core building blocks of social communication are emotional facial expressions. Faces are complex 3D structures that the human visual system captures via stereopsis. Yet, face perception has mostly been studied with setups that do not provide stereoscopic depth information. In our study, we compare the effect of stereoscopic and monoscopic presentations of digital humans' facial expressions on the elicited neurophysiological response by combining immersive Virtual Reality (VR) technology with EEG and eye tracking. **Methods:** Healthy, young participants (N=30) perform an emotion recognition task (720 trials) with stereoscopic and monoscopic renderings of three digital humans' faces showing different emotional expressions (neutral, happy, angry, surprise). The stimuli were generated based on the Facial Action Coding System (FACS) using "FACSHuman", a validated plugin for the open-source software "makehuman". The faces are presented in a VR headset while we record EEG and eye tracking data. We use multivariate decoding (temporally resolved logistic regression) to test the extent to which different facial expressions and identities can be distinguished based on EEG data. To assess the impact of stereoscopic information, we compare the classification performance and relevant neural features in the EEG for stereoscopically and monoscopically presented faces. **Results:** Data acquisition for this study is not yet completed. We will present the experimental design as well as preliminary results of this ongoing study, demonstrating the EEG decoding approach and challenges posed by eye movement artifacts. **Discussion:** We hypothesize that stereoscopically presented emotional facial expressions lead to enriched mental representations, which manifests in higher decoding performances. This study will contribute to understanding the relevance of stereopsis for the processing of digital humans' emotional faces by the brain.

A15 **Poster Presenter: Bamberg, Christoph**

A Meta-Analysis of the Effects of Temporary Calorie Restriction on Cognitive Performance

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Introduction: Does temporary calorie restriction, such as skipping breakfast or intermittent fasting, worsen cognitive performance? Previous research investigated this question by assessing a variety of fasting interventions and cognitive tests. Bringing together these different approaches, we assess whether calorie restriction effects are dose-dependent, and whether the effect differs across cognitive domains (e.g., attention, working memory capacity). **Methods:** We searched seven electronic databases, Google Scholar and previous reviews for relevant experimental studies (PROSPERO preregistration ID: CRD42021272822). We considered experiments with a zero-calorie fasting intervention and a standardised cognitive performance measure. In total, 17,465 studies were screened; 52 were entered into the meta analysis, with 157 effect sizes and a combined sample of N=2,185. The median fasting duration was 12 hours. A three-level random-effects model was fit to the standardised mean differences in cognitive performance between the fasted and satiated condition. **Results:** Cognitive performance in the satiated condition was higher than in the fasted condition (SMD = 0.078, SE = 0.035, 95%CI = [0.009, 0.147], p = 0.026). The heterogeneity in the model was I2 = 34.08%. Adding fasting duration as a predictor, the difference in cognitive performance between the satiated and fasted condition increased for longer fasting periods (beta=0.003, SE=0.001, 95%CI=[0.001,0.005], p=0.004). Distinguishing the investigated cognitive domain in a subgroup analysis significantly reduced residual heterogeneity by 2.38% (Test of Moderators: QM(df = 7) = 14.89, p = 0.038). **Discussion:** Cognitive performance decreases in individuals who are fasted compared to when satiated. This effect is dose-dependent—it increases for longer periods of calorie restriction—and slightly differs between cognitive domains. The worse performance when fasted may be due to participants not being used to fasting. Future studies following participants over several fasting periods could help shed light on individual cognitive responses to calorie restriction.

A16 **Poster Presenter: Fourcade, Antonin**

Linking emotional arousal to the heartbeat-evoked potential in immersive virtual reality

Fourcade A. [1, 2, 3], Klotzsche, F. [1, 2], Hofmann, S. M. [1, 4], Mariola, A. [5, 6], Nikulin, V. V. [1], Villringer A. [1, 2, 3], & Gaebler M. [1, 2]

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Introduction: The heartbeat-evoked potential (HEP) is an event-related potential linked to the cortical processing of the heartbeat. It has previously been associated with emotional arousal, a fundamental dimension of affective processing: HEP amplitude over temporo-parietal electrodes has been found to be larger during high emotional arousal (HA) than during low emotional arousal (LA). In the present study we tested this association under naturalistic conditions using immersive virtual reality (VR). **Methods:** We analyzed HEPs in previously collected data: 37 young healthy participants completed a VR experience (HTC Vive), while EEG and ECG were recorded. Each participant completed the experience (two rollercoasters separated by a break) twice: once without and once with freely moving the head (randomized across participants). After each experience, subjective emotional arousal was continuously rated while viewing a 2D recording of the experience. LA and HA were defined as lower and upper tertile of the rating (1-s) bins, respectively. In a whole-head analysis, non-parametric cluster-based permutation t-tests were used to compare HEP amplitudes between HA and LA, by pooling the data from both head movement conditions. **Results:** We did not find evidence for higher HEP amplitudes during HA compared to LA over right temporo-parietal electrodes. A cluster over left frontal electrodes showed a significantly lower HEP amplitude for HA than for LA. In control analyses, we found significant effects of arousal, head movement, and their interaction on heart rate variability (HRV) but not on heart rate. In particular, HRV was higher for LA than for HA. **Discussion:** The topography of the frontal cluster might reflect the anterior pole of a dipole that also (reversely) projects to parietal electrodes. The difference in HEP amplitude could also be related to the difference in HRV. Frontal cortices have been associated with changes in heart rate, HRV, and the regulation of emotional arousal.

A17 **Poster Presenter: Shaikh, Usman Jawed**

Modulation of fronto-striatal connectivity by intermittent Theta Burst Stimulation (iTBS). A 18F-DesmethoxyFallypride Positron Emission Tomography (PET) study

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Introduction: Frontostriatal networks are neural pathways that connects frontal regions and the striatum and is involved in motor, cognitive, and behavioural processes. It has been shown that Transcranial Magnetic Stimulation (TMS) can modulate connectivity in the human brain. TMS with long stimulation protocols to the Pre Frontal Cortex (PFC) is widely used for clinical purposes such as depression treatments. The combined measurement of PET and TMS technique would help to understand better the dopaminergic activity in the fronto-striatal area. The aim of the study is to investigate the fronto-striatal connectivity by measuring the release of dopamine in the striatum in response to an excitatory intermittent theta burst stimulation (iTBS) of the Left-Dorsolateral Prefrontal Cortex (L-DLPFC). A PET measurement was performed by using the 18F-DesmethoxyFallypride (DMFP) radioligand, that is a high affinity receptor-antagonist which competes with endogenous Dopamine neurotransmitters for D2/D3 receptor binding. **Methods:** The study was conducted on 23 healthy participants, who underwent iTBS sham (control) and verum (active) stimulations on separate days. The PET scan lasted 120 mins, consisting of 4 iTBS stimulations delivered to the left-DLPFC at 30 mins interval in both sham and verum condition. Mean Binding Potential values in the sub-regions of the striatum (Nucleus Caudate and Putamen) were determined and compared between the sham and verum stimulation using analysis of variance (ANOVA). **Results:** Mean Binding Potentials shows a significant difference between sham and verum stimulations. The Sham stimulation shows the expected, baseline increasing pattern for the Binding Potentials. The verum stimulation shows reduction in Binding Potentials as the iTBS has increased the Dopamine release in the striatum. **Discussion:** Results suggest that the minimal stimulation time iTBS protocol can effectively increase Fronto-striatal connectivity. This stimulation protocol can be used as a therapeutic therapy for treating major Depression patients by presenting it in the repeated blocks of short intervals.

A18 **Poster Presenter: Hechler, André**

Quantifying the Metabolic Cost of Prediction During Visual Processing

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Introduction: Mathematical models informed by the free energy principle suggest that information processing in the human brain leads to metabolic efficiency. An underlying mechanism might be the minimization of uncertainty about sensory input via a feedback loop between internal models of the world and actual input. This is supported by MR studies showing decreased activity for sensory stimuli that validate participants' predictions. However, whether predictions themselves incur significant metabolic cost over naïve perception is still unclear. **Methods:** The traditionally used BOLD signal is only a proxy for energy consumption, providing relative measurements mainly driven by hemodynamic activity. Here, we have been acquiring data from 21 healthy subjects using novel multiparametric quantitative BOLD methods. We separately measured blood deoxygenation, cerebral blood flow and cerebral blood volume to calculate the cerebral metabolic rate of oxygen (CMRO2) on a voxel level. During a three-day training phase, participants viewed temporal object sequences while performing a cover task to ensure attention. Objects either always appeared in the same order (predictable condition) or always in a random order (unpredictable condition). We tracked the learning progress with a sequence completion test after each session. In the following MR session, we presented the experimental conditions using a block design. **Results:** After the training, participants averaged >80% correct completions of predictable sequences. To estimate the cost of prediction, we contrasted CMRO2 values of predictable versus unpredictable blocks both brain-wide and within the object selective cortex. Results show a significant increase in the predictable condition of 4.3% and 1.94% respectively (all $p<.05$). These findings are consistent across functional brain networks (Schaefer parcellation) with the smallest changes in the visual network and largest in fronto-parietal regions. **Discussion:** The quantitative evidence for a brain-wide increase in energy consumption suggests that predictive processing and metabolic efficiency are at least partly at odds.

A19 **Poster Presenter: Fernandez Larrosa, Pablo Nicolas**

Complex decision-making could be facilitated by social modulation through priming

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Introduction: Some decision-making (DM) processes require quick answers, while more complex decisions demand greater cognitive engagement. Under the hypothesis that frequent exposure to a stimulus (repetition priming) or its association with an emotional valence (emotional priming) could drive DM, online experiments were conducted. **Methods:** Cognitive experiments involved a computer task where participants had to choose a face from 4 options, each of them was associated with different frequencies (EXP#1) or with positive, negative, neutral, or mixed sentences (EXP#2). Two experimental groups were assessed: the 1st group was asked to choose a face without any specification (NST); and the 2nd one for an important task (IT). To compare results in a more ecological situation (Social Study), online social surveys were conducted during the 2019 Argentine Presidential Elections, as well as written media news were scraped to assess each candidate's mention frequency and sentiment analysis. **Results:** Results show: 1. The most repeated face was significantly more chosen in the NST group, involving significantly greater response time; 2. The faces with a positive association were significantly more chosen than others, in both groups; and 3. The effect persisted at least for 24hs. In the case of the Social Study, Familiarity(F), Trust(T), and Voting Probability(VP) were estimated for each candidate from the surveys, as well as the main means used by the participants to inform themselves about the candidates. T and F mostly explain the VP variance; in a cross-analysis between variables and for different candidates, T was found to correlate better (than F) with VP but both were significant in most analyses. Besides, F, T, and VP for each candidate correlate significantly with the frequency of mentions, the positive association, and election results. **Discussion:** These results support our hypothesis and suggest that complex decision-making susceptibility to repetition or emotional priming could depend on the relevance of the involved task.

A20 **Poster Presenter: Rodriguez Soriano, Javier**

Cross-frequency dynamics of neural and cardiac rhythms in the context of effortful cognition and breath focus

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Introduction: Pairs of neural oscillators can only phase-synchronize when their peak frequencies arrange harmonically (e.g., alpha = 10 Hz; theta= 5 Hz; ratio alpha:theta = 2:1). Transient shifts in peak frequencies of different neural oscillators seem to form the principal mechanism by which cross-frequency coupling (i.e., facilitating information integration and communication) takes place. Previous work shows that alpha and theta peak frequencies undergo shifts upon conditions of cognitive effort, breath focus and rest. Considering the growing evidence that an interplay between neural and other physiological oscillatory activity (e.g., cardiac, respiratory and gastric rhythms) also occurs in a state-dependent manner, a similar mechanism of cross-frequency relationships has been proposed to characterize brain-body interactions. **Methods** Following a systemic approach to study human oscillatory physiology, we explored cross-frequency relationships between neural and cardiac (i.e., alpha and heart rate; HR) oscillators. Electroencephalography and electrocardiography were recorded from 18 adults (mean age 23.56 ; 11 women) during three 5-min conditions of (i) rest, (ii) breath focus and (iii) a cognitively demanding arithmetic task. Then, transient frequency changes and the ratio between frequencies of the oscillator pair were computed. **Results:** The transient incidence of alpha-HR cross-frequency relationships at or around the harmonic (8:1 for alpha-HR) was significantly higher during the arithmetic task compared to rest and breath focus. On the contrary, the incidence of approximately non-harmonic relationships (harmonic ratio of 8:1 multiplied by the irrational number golden mean, 1.618; i.e., ratio of 12.94:1) was shown to be higher during breath focus compared to both rest and arithmetic task. **Discussion:** These findings, considering the dynamical interaction of body subsystems, inform of the physiological underpinnings of cognition. Specifically, the cross-frequency relationships predominant in each condition suggest that during effortful cognition there is a greater degree of coupling between neural and cardiac oscillators. Conversely, breath focus seems to be characterized by decoupling between these oscillators.