SAMBA 2017

SALZBURG MIND - BRAIN ANNUAL MEETING

13.-14.07.2017

Local organizing committee

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Catherine Tallon-Baudry
Chris Frith
Pascal Fries
Paul Sauseng

PROGRAM

TIME	13.07.	14.07.
08:30	Registration & Coffee	
09:15	Opening remarks	
09:30	Talk 1: Catherine Tallon-Baudry Visceral inputs, brain dynamics and subjectivity	Talk 6: Pascal Fries Rhythms for cognition: Communication through coherence
10:30	Coffee	Coffee
11:00	Talk 2: Christian-G. Benar Brain mapping at two scales: simultaneous recordings of MEG and intracerebral EEG	Talk 7: Tobias Donner Distinct catecholaminergic and cholinergic shaping of large-scale cortical population dynamics
12:00	Lunch	Lunch
13:30	Talk 3: Jan-Mathijs Schoffelen How (not) to study directed interactions in brain networks using MEG	Talk 8: Angelika Lingnau The organization of actions in the human brain
14:30	Short break	Short break
14:45	Talk 4: Anne-Lise Giraud The spatio-temporal geometry of speech processing	Talk 9: Rosalyn J. Moran Probing predictive models in the mind with dynamic causal modeling
15:45	Coffee & Poster Session 1	Coffee & Poster Session 2
17:00	Talk 5: Paul Sauseng Coordinating distributed cortical activity: significance of prefrontal slow(ish) brain oscillations	Talk 10: Sylvain Baillet Mechanisms & dynamical structure of brain rhythms: from rest to perception
18:00		Closing Remarks & Poster Awards
19:00		Social Event

TALKS

Talk 1: Visceral inputs, brain dynamics and subjectivity

Catherine Tallon-Baudry

Ecole Normale Supérieure Paris, France

Visceral organs such as the heart and the stomach constantly send information up to the cortex, thus potentially constraining brain dynamics. In addition, the brain might use visceral inputs to create a subject-centered reference frame, from which the first person perspective inherent to consciousness can develop. I will present recent evidence, gathered using MEG but also unit recordings and fMRI, that visceral inputs shape brain dynamics and contribute to subjective experience.

Talk 2: Brain mapping at two scales: simultaneous recordings of MEG and intracerebral EEG

Christian-G. Bénar

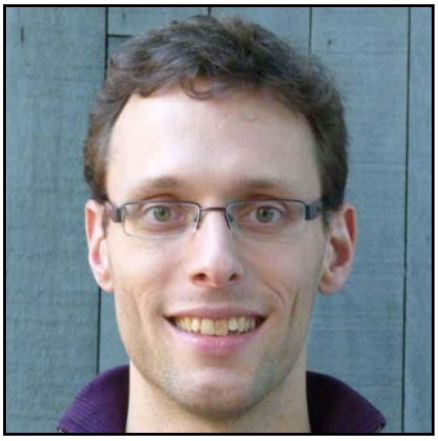
Institut de Neurosciences des Systèmes, Aix-Marseille Université, Marseille, France

Intracerebral EEG (stereotaxic EEG, SEEG), performed in patients during presurgical evaluation of epilepsy, provides a formidable opportunity for recording directly from brain structures in humans. From a neuroscientific point of view, this allows investigating brain networks at a mesoscopic scale, with high spatial precision and time-frequency sensitivity. From a methodological perspective, this provides a "ground truth" to which non-invasive results (EEG, MEG) can be compared. Several studies have thus validated non-invasive measures thanks to SEEG. This was however mostly performed on separate recordings, which is not optimal as brain activity fluctuates in time. The only way to ensure that the exact same activity is recorded at the two levels is thus to perform simultaneous recordings.
We performed simultaneous MEG-SEEG or EEG-MEG-SEEG recordings in as series of patients. I will present the technical challenges associated with such set-ups. I will show initial results on the deection of deep structures (amygdala, hippocampus) on MEG signals, as well as brain mapping application as a "meta modality" providing both a local and a global view on brain networks. Implications for computational modelling, methodological investigations and basic neuroscience will be discussed.

Talk 3: How (not) to study directed interactions in brain networks using MEG

Jan-Mathijs Schoffelen

Radboud University, Nijmegen, Netherlands



Recent years have witnessed a rapid development of advanced signal processing techniques to explore dynamic interactions between brain regions using MEG-recordings. Also, the availability of state-of-the-art tools in open source data visualization and analysis packages (e.g. AnyWave, Brainstorm, SPM, Fieldtrip) has enabled researchers in the wider community to interrogate their data with connectivity-colored glasses. This in itself is a good thing, because studying the dynamics of connectivity is the way to go if we want to explore the coordinated interplay between brain regions that underlies perception, cognition and behavior.
Yet, in order to get a good interpretation of the data, one needs to be aware of the limitations of the analysis techniques. In this talk, I will discuss my view on how directed interactions can be studied, and somewhat meaningfully interpreted. As an illustration, I will show some recent results showing frequency-specific directed interactions in the human brain network for language.

Talk 4: The spatio-temporal geometry of speech processing

Anne-Lise Giraud

University of Geneva, Switzerland

A review of a series of recent studies that critically explore different principles of neural coding in speech processing both theoretically with computational models and experimentally with MEG, fMRI and intracortical EEG recordings

Talk 5: Coordinating distributed cortical activity: significance of prefrontal slow(ish) brain oscillations

Paul Sauseng

Department of Psychology, Ludwig-Maximilian-University Munich, Germany

Depending on which kind of information needs to be retained in working memory, and dependent on what exact mental transformation this information has to undergo, different working memory sub- processes will be necessary. These sub-processes are supposed to be implemented within different cortical networks. But how are these networks coordinated? How is communication in one reinforced and coupling of another one reduced depending on the task-requirements? Here I will provide a theoretical framework and empirical data arguing that slow brain oscillations in the prefrontal cortex – and specifically their phase to which fast frequency brain activity is locked - allow a simple and efficient mechanism by which fronto-parietal brain networks can be dynamically coupled or desynchronized, and hence, working memory processes can be coordinated. Electroencephalographic and combined EEG and non-invasive brain stimulation data from healthy participants, elderly volunteers and psychiatric patients will be presented.

Talk 6: Rhythms for Cognition: Communication through Coherence

Pascal Fries

Ernst Strüngmann Institute (ESI) for Neuroscience in Cooperation with Max Planck Society, Frankfurt, Germany

I will show that free viewing induces gamma-band oscillations in early visual cortex. If the gamma rhythm in a lower visual area entrains a gamma rhythm in a higher visual area, this might establish an effective communication protocol: The lower area sends a representation of the visual stimulus rhythmically, and the higher area is most excitable precisely when this representation arrives. At other times, the higher area is inhibited, which excludes competing stimuli. I refer to this scenario as the Communication-through-Coherence (CTC) hypothesis. I will show that the gamma rhythm in awake macaque V4 modulates the gain of synaptic inputs. I will further show that constant optogenetic stimulation in anesthetized cat area 21a (homologue to V4) induces a local gamma rhythm, and that this isolated gamma is sufficient to produce similar gain modulation. These gain modulation effects would be ideal to lend enhanced effective connectivity to attended stimuli. I will show that this is indeed the case between macaque V1 and V4. When two visual stimuli induce two local gamma rhythms in V1, only the one induced by the attended stimulus entrains V4. I will then investigate how these changes in gamma synchronization between visual areas are controlled by influences from parietal cortex. I will show that posterior parietal cortex influences visual areas primarily via beta-band synchronization. I will show that generally, beta-band influences are stronger in the top-down direction, while gamma-band influences are stronger in the bottom-up direction. This holds across macaques and human subjects, and in both species it allows building a hierarchy of visual areas based on the directed influences. Finally, I will show that attentional selection occurs at a theta rhythm. When two objects are monitored simultaneously, attentional benefits alternate at 4 Hz, consistent with an 8 Hz sampling rhythm, sampling them in alternation.

Talk 7: Distinct Catecholaminergic and Cholinergic Shaping of Large-scale Cortical Population Dynamics

Tobias H. Donner

University Medical Center Hamburg-Eppendorf, Hamburg, Germany

The dopaminergic, noradrenergic, and cholinergic systems have long been implicated in the regulation of behavioral state. The brainstem centers of these neuromodulatory systems receive top-down projections from frontal cortex and send widespread projections to large parts of the brain. Despite this similar organization, influential models postulate distinct computational roles for these systems in the orchestration of cognition and behavior. Yet, direct evidence for dissociated effects on their downstream targets is missing.

I will present physiological evidence for distinct roles of catecholamines (dopamine and noradrenaline) and acetylcholine in shaping the intrinsic dynamics of large-scale cortical population activity and cognition. We manipulated the levels of these neuromodulators with selective pharmacological interventions in humans and measured the resulting changes in the temporal and spatial correlation structure of intrinsic fluctuations in MEG activity.

To this end, we compared two steady-state tasks differing in external drive: (i) blank fixation and (ii) silent counting of the alternations of perception of a continuously presented visual stimulus (3D structure-from-motion).

Catecholamines, but not acetylcholine, increased both, the rate of perceptual alternations, as well as the long-range temporal correlation structure alpha-band activity in parietal and occipital cortex. Computational modeling showed that both effects could be accounted for by a net increase in the ratio between excitation and inhibition in cortex. At the same time, catecholamines increased cortex-wide correlations in the low beta-band during task, whereas acetylcholine decreased these correlations, but during rest.

Our results reveal novel dissociations between the large-scale functional effects of key neuromodulatory systems, and set the stage for disentangling these systems' computational roles.

Talk 8: The organization of actions in the human brain

Angelika Lingnau

Royal Holloway University of London, UK
Center for Mind/ Brain Sciences, University of Trento, Italy

Being able to understand other people's actions is fundamental for social interacions. One important problem our brain needs to resolve to achieve this task is to distinguish between different actions while generalizing across the way these actions are performed. In this talk I will present a number of recent studies using multivarite pattern analysis (MVPA) and representational similarity analysis (RSA) of functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) data to identify action representations that show generalization across effectors, kinematics and objects. I will discuss the results, which highlight the importance of the lateral occipito-temporal cortex for such abstract representations, in light of the ongoing debates on the neural basis of action understanding.

Talk 9: Probing Predictive Models in the Mind with Dynamic Causal Modeling

Rosalyn J. Moran

University of Bristol, UK

Prediction and predictive codes are now ubiquitous computational viewpoints from which we may better understand neural circuit organization and signal transmission in the brain.

In this talk I will present a predictive view of changing brains, over lifespans, based on the Free Energy Principle, a theory of hierarchical empirical Bayesian inference in the brain (Friston 2013). This particular formulation of the Bayesian brain produces predictive coding schemes that have been used to inform the principles of perception, action and decision-making, accounting for how sensory information combines with our own prior beliefs about the world to shape brain activity and behavior.There are many ways that a brain could perform Bayesian inference and the hypothesized scheme under the Free Energy Principle in the perceptual domain posits a variational algorithm where posterior density estimation is recast as an optimization problem. In this guise the scheme becomes a predictive coding algorithm, with hierarchical structure and attribution of optimization dynamics to particular components of neuronal circuits.

In this talk I will present evidence from neuroimaging studies of brain circuits (using dynamic causal models) that age-related connectivity changes are commensurate with long-term Free-Energy minimization. I will present work from sensory learning, memory and decision making paradigms that show that the neurobiological implementations of prior beliefs grow stronger in older brains. I will explore how this relates to faster timescales of prediction in terms of electrophysiological correlates.

Talk 10: Mechanisms & dynamical structure of brain rhythms: from rest to perception

Sylvain Baillet

McGill University, Montreal, Canada

One broad objective in neuroscience is to comprehend the mechanisms of large-scale, oscillatory neural dynamics: how they enable functions by shaping communication in brain networks, and how the earliest detection of their alterations in disease can contribute to improved healthcare prevention and interventions. We will review how the ubiquitous polyrhythmic activity of the brain has been approached empirically so far, with underlying mechanisms that remain not understood. This hinders our comprehension of how 1) perception and behaviour emerge from brain network activity, and 2) the pathophysiological developments of brain and mental-health disorders increasingly studied as network diseases, affect large-scale neural communication. In this lecture, we will introduce how these difficult questions can benefit from a bottom-up approach: We aim to understand how basic physiological factors of neural integrity and function shape the dynamical structure of oscillatory brain rhythms, such as their interdependence across multiple frequencies through cross-frequency coupling. These phenomena represent a deep source of uncharted markers of neural excitability, activity and connectivity. I will illustrate these principles with our latest results concerning the resting brain, multimodal perception and pathophysiological markers of epilepsy and neurodegenerative syndromes.

POSTER-ABSTRACTS

1 Rhythmic neural activity and neuromodulation shape selective attention in healthy aging

Dahl, M.[1], Ilg, L.[2], Li, S.-C. [2], Passow, S.[2], Mather, M.[3], Sander, M.[2], & Werkle-Bergner M.[2]

[1] Max Planck Institute for Human Development, Center for Lifespan Psychology , Berlin, Germany
[2] Technical University Dresden, Dresden, Germany
[3] University of Southern California Davis, School of Gerontology, Davis, USA

The present study aims to provide evidence that music tempo is a crucial parameter, which controls the influence of acoustical rhythms on attentional tasks. Thereby we follow a resonance hypothesis as a potential mechanism responsible for our empirical results.

Our study consisted in three behavioral experiments, designed to identify the possible influence of musical tempo in (1) perception of a visual stimuli and the motor reaction to it, (2) influence of musical tempo on the performance of an attentional task (Color-Word Matching Stroop Task) and (3) the preference of the participants (likeness and motivation) for a specific tempo. Furthermore, we looked for possible sex differences and disparity of results obtained for women in different phases of their menstrual cycle. Our results provide clear evidence that (a) Rhythmic acoustic stimuli displayed in a specific tempo improves the performance of attentional tasks, (b) tempo preference is gender dependent and (c) there are significant performance changes during the menstrual cycle.

2 Attention & Tempo: Stroop Effect Modulation by Auditory Stimulus

Martínez Guerrero, A.[1], Le Corre, M.[2], Muñoz-Torres, Z.[3], & Müller, M.[4]

[1] Centro de Investigación Transdisciplinar en Psicología (CITPsi) - Instituto de Investigación en Ciencias Básicas y Aplicadas, Universidad Autónoma del Estado de Morelos (UAEM)
[2] Centro de Investigación Transdisciplinar en Psicología (CITPsi), Universidad Autónoma del Estado de Morelos (UAEM)
[3] Hospital General Ajusco Medio, Secretaría de Salud del Distrito Federal.
[4] Centro de Investigación en Ciencias, Universidad Autónoma del Estado de Morelos (UAEM)

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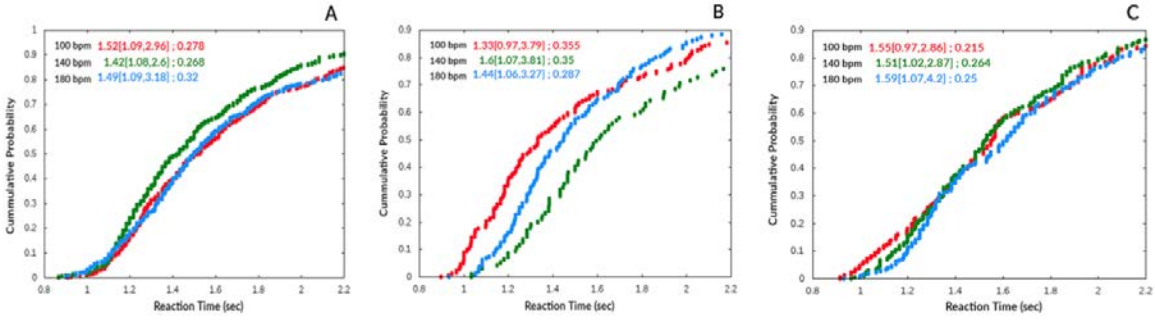

Figure 1. Cummulative probability plots for reaction times at the Color-Word Matching Stroop Task. The numbers at the top-left corner of each plot indicates: auditory condition, median [0.025 quantile, 0.975 quantile] nonparametrical skewness. A) The male group showed better reaction times (P<0.01) listening the auditory stimulus at140 bpm. B) Female group within the 3 first days of their menstrual cycle showed better results (P=0.02) with the auditory stimulus at 100 bpm. C) The results of the female group at the other menstrual phases, showed that there was no significant differences at their performance (P>0.05), when listening the different auditory stimulus.

3 Investigating the dynamic modulation of alpha activity during an auditory spatial attention task

ElShafei, H. A., Bouet, R., Bertrand, O., & Bidet-Caulet, A.

Brain Dynamics and Cognition Team, Lyon Neuroscience Research Center University of Lyon, Lyon, France

Anticipation biases our attentional set towards upcoming stimuli. This attentional mechanism has been shown to operate by enhancing neural activity in cortical regions responsible for processing the upcoming stimulus, while suppressing activity in regions responsible for processing stimuli outside of the attentional focus. The role of alpha oscillations in sustaining these attentional modulations has been well demonstrated in the visual domain (e.g. Thut et al., 2006). However, only a handful of studies (e.g. Frey et al., 2014) have succeeded to establish this role in the auditory domain.

MEG data were collected from fourteen healthy young participants performing an auditory pitch discrimination task. Anticipatory attention was manipulated by a visual cue that was either informative, i.e. indicating the target side (either left or right), or uninformative. Behaviorally, participants were significantly faster in the informative condition.

Analysis of the post-cue alpha activity at the sensor, source and virtual electrode levels demonstrated that anticipatory attention modulated alpha activity differently in the auditory and visual cortices. Preceding the onset of the auditory target, alpha power decreased in the auditory cortex. This decrease was accompanied by an increase in alpha power in the visual cortex. Furthermore, these two modulation profiles were centered around different alpha frequencies (9Hz for the auditory cortex and 13Hz for the visual cortex). Moreover, alpha activity in both cortices were modulated differently according to the type of the visual cue and behavioral performances negatively correlated with the increase of alpha power in the visual cortex.

Evidence of top-down modulation of auditory alpha has only been recently put forward. The present results corroborate this outgrowing literature and provide new insights into the dynamics of top-down modulation of alpha oscillations within the auditory and the visual cortices.

4 Oscillatory signatures of multisensory attention: An MEG study

Göschl, F.[1], Friese, U.[1,2], Daume, J.[1], König, P.[1,2], Engel, A. K.[1], & Nolte, G.[1]

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

Transient synchronization of neural oscillatory activity has been suggested to underlie the communication between remote brain areas and to address the challenge of binding stimulus features not only within but also across sensory modalities.
In the present study, we recorded the magnetoencephalogram (MEG) while human participants engaged in a visuotactile pattern-matching paradigm. To investigate the interplay of bottom-up stimulus processing and top-down demands, we manipulated the crossmodal congruence of visual and tactile patterns as well as the direction of spatial attention. Spectral power in the theta- (2-7 Hz), alpha- (7-13 Hz), beta- (13-30 Hz) and gamma-bands (60-90 Hz) was analyzed on the sensor level and projected to the cortical source level using beamforming. In anticipation of visuotactile stimulation, oscillatory power in the alpha- and beta-bands was reduced in cortical regions contralateral to the attended side, the maxima being located in visual areas, somatosensory association cortex, and supramarginal gyrus (SMG). Additional phase analysis showed beta-band synchronization between visual areas (fusiform gyrus) and somatosensory association cortex to be associated with the deployment of crossmodal attention. After stimulus onset in contrast, attentional modulation was mainly reflected in the gamma-band and located in cortical areas largely overlapping with those observed in the baseline contrasts.
Taken together, these results provide evidence for a functional role of beta-band connectivity in integrating visuotactile information, and suggest that suppression of low-frequent oscillations in task-relevant sensory cortices as well as integration areas (SMG) might serve as a mechanism of crossmodal attention and facilitate the integration of multisensory input.

5 Modulation of visual gamma oscillations by spatial attention

Magazzini, L. & Singh, K.

CUBRIC, School of Psychology, Cardiff University, Cardiff, UK

Neuronal synchronization in the gamma range (30-80 Hz) is a prominent feature of the cortical response to visual stimulation. According to theoretical proposals and empirical evidence, the modulation of gamma oscillations in visual cortex could represent a mechanism by which selective attention enhances stimulus processing. Recent studies in animals found that selective spatial attention enhanced gamma- band synchronization in high-order visual areas (V4) and increased the gamma peak frequency in V1. The existence of such mechanisms in the human visual system is yet to be fully demonstrated. In this study, we used MEG, in combination with an optimised stimulus design, to record visual gamma oscillations from human early visual cortex, while participants performed a visuospatial attention cueing task. First, we reconstructed virtual sensors in V1/V2, where gamma oscillations were strongly induced by visual stimulation alone. Second, following the results of a statistical comparison between conditions of attention, we reconstructed cortical activity also in inferior occipital-temporal regions (V4). The results indicated that gamma amplitude was modulated by spatial attention across the cortical hierarchy, both in the early visual cortex and in higher-order regions of the ventral visual pathway. In contrast, despite peak frequency was measured unambiguously using a bootstrap method, we found no evidence for an effect of attention on the gamma peak frequency. Attentional effects in V1/V2 preceded those in V4 by approximately 70 ms, consistent with a feed-forward role of gamma-band activity in propagating sensory representations across the visual cortical hierarchy. Together, these findings suggest that differences in experimental design or methodology can account for the inconsistencies in previous animal and human studies. Furthermore, our results support the hypothesis of enhanced gamma-band synchronization as an attentional mechanism in the human visual cortex.

6 Rhythms, collectivity and interpersonal synchronization of brain dynamics

Olguín, P.[1] , Ramos, J.[2], Müller, M.[1,3]

[1] Instituto de Investigación en Ciencias Básicas y Aplicadas, Universidad Autónoma del Estado de Morelos (UAEM), Cuernavaca Morelos, México
[2] Instituto de Neurociencias, Universidad de Guadalajara (UDG), Gudalajara, México
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Hyperscanning is the simultaneous registration of the electrical brain activity of two or more subjects. In the present study, we investigate possible interpersonal synchronization of male and female couples performing a coopertive task within a particular acoustic environment. The experimental setup contains three different conditions: (1) simultaneous recording of two subjects during resting state, (2) recording of couples just listening the same rhythms with different tempi (119, 140, 161 bpm) and (3) recoding of couples performing a cooperative task while listening the same rhythms with the different tempi mentioned in condition (2). In a pilot study we found a pronounced gender difference for the interpersonal synchronization, extended between zero and 25Hz (Figure 1). Furthermore, different tempi of the rhythmic acoustic stimuli imprint slightly different characteristics of the interpersonal synchronization pattern. Most surprising, the synchronization between monozygotic male twins notably more pronounced than other male couples. Although the number of participant in this pilot study was quite small, we obtained systematically the features desribed above and the results are homogeneous across groups of male and female subjects.

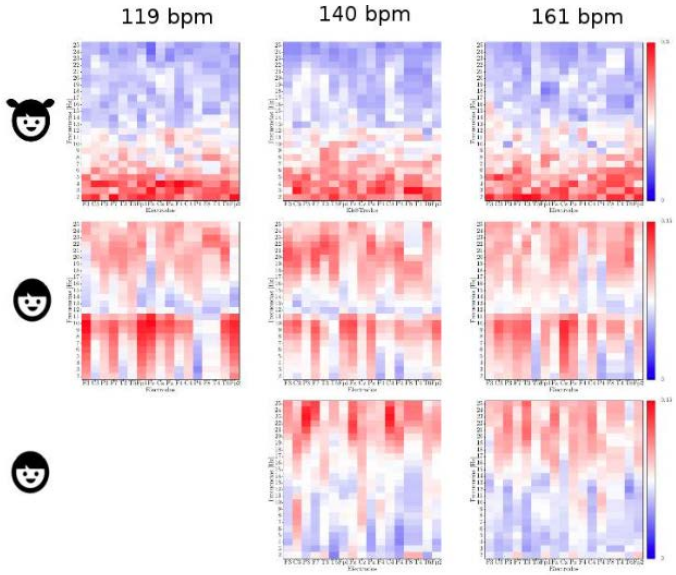

Figure 1: Shown is the Cross-Correlation (zero blue, male couple 0.15 red and female couple 0.3 red), for each pair of the same electrodes between subjects, seperately for band pass filtered data (band-width equals to 1Hz) between 1 and 25Hz. The first panel shows results for a female-couple, the midle pannel of the male twins couple and the lower panel of another male-couple.

7 Individual Alpha Frequency Relates to the Sound-Induced Flash Illusion

Keil, J. & Senkowski, D.

AG Multisensory Integration, Department of Psychiatry and Psychotherapy, Charité – Universitätsmedizin Berlin, Berlin, Germany

Ongoing neural oscillations reflect fluctuations of cortical excitability. A growing body of research has underlined the role of neural oscillations for stimulus processing. Neural oscillations in the alpha band have gained special interest in electrophysiological research on perception. Recent studies proposed the idea that neural oscillations provide temporal windows in which sensory stimuli can be perceptually integrated. This also includes multisensory integration. In the current high-density EEG-study we examined the relationship between the individual alpha frequency (IAF) and cross-modal audiovisual integration in the sound-induced flash illusion (SIFI). In 26 human volunteers we found a negative correlation between the IAF and the SIFI illusion rate. Individuals with a lower IAF showed higher audiovisual illusions. Source analysis suggested an involvement of the visual cortex, especially the calcarine sulcus, for this relationship. Our findings corroborate the notion that the IAF influences the crossmodal integration of auditory and visual stimuli in the SIFI.

8 Asymmetries in Behavioral and Neural Responses to Spectral Cues Demonstrate the Generality of Auditory Looming Bias

Baumgartner, R.[1], Reed, D. K.[2], Tóth, B.[3], Best, V.[4], Majdak, P.[1], Colburn, H. S.[2], & Shinn-Cunningham, B.[2]

[1] Acoustics Research Institute, Austrian Academy of Sciences, Vienna, Austria
[2] Department of Biomedical Engineering, Boston University, Boston, MA, USA
[3] Institute of Cognitive Neuroscience and Psychology, Hungarian Academy of Sciences, Budapest, Hungary
[4] Department of Speech, Language & Hearing Sciences, Boston University, Boston, MA, USA

Past studies of auditory looming bias showed that sources increasing in intensity are more salient than sources decreasing in intensity. Based on this, researchers argued that listeners are more sensitive to approaching sounds compared to receding sounds, reflecting an evolutionary pressure. However, these studies only manipulated overall sound intensity; therefore, it is unclear whether looming bias is a perceptual bias truly for source distance or only for changes in sound intensity. The current study answers this question by demonstrating both behavioral and neural correlates of looming bias, independent of overall sound intensity. In natural environments, the pinnae induce spectral cues that give rise to a sense of externalization; when high-frequency spectral cues are unnatural, sounds are perceived as closer to the listener. We manipulated spectral contrast in high-frequency spectral cues tailored to each subject, creating sounds of similar intensity but different naturalness. We confirmed that sounds were perceived as approaching when spectral contrast decreased, and were perceived as receding when spectral contrast increased. We then measured behavior and electroencephalography (EEG) as listeners judged the direction of sound motion. Behavioral responses showed a looming bias in that responses were more consistent for sounds perceived as approaching than for sounds perceived as receding. Neurally, looming bias was reflected in an asymmetry of event-related potentials at latencies of about 200 ms (P2). Because P2 is functionally associated with motion evaluation, our neural findings support a generality of the auditory looming bias, representing a general perceptual preference for approaching auditory objects.

9 Neurophysiological correlates of prenatal learning and early bonding

del Giudice, R.[1,2,3], Wislowska, M.[1,2], Lang, A.[1,2], Lithari, C.[2], Weisz, N.[2], Calvet, C.[4], Ott, P.[1], & Schabus, M.[1,2]

[1] Laboratory for Sleep, Cognition and Consciousness Research, Department of Psychology, University of Salzburg, Salzburg, Austria
[2] Centre for Cognitive Neuroscience Salzburg (CCNS), University of Salzburg, Salzburg, Austria
[3] Developmental Psychopathology Unit, Scientific Institute, IRCCS Eugenio Medea, Bosisio Parini, Lecco, Italy
[4] Developmental Psychology, Universität der Künste, Berlin, Germany

It is a common belief that learning begins far before birth. This conviction raises interesting questions about how and what exactly an unborn baby is able to learn. Different studies about prenatal learning rely on reports with few cases and often lack neurophysiological evidences. In the present study 35 pregnant women were asked to replay twice a day (from 34 gestational week onwards), at 80 dB, a nursery rhyme that was previously recorded with their own voice. At around week two and five after birth, newborns were presented again with the same rhyme uttered either by the mother's voice or a stranger's voice, or were presented with a completely new rhyme. During the experimental session video as well as high density EEG (129 channels), EMG, and ECG were recorded. We computed the speech envelope for the nursery rhyme, for each subject, and each stimulus condition using nine equi-spaced frequency bands (100 Hz – 10 Hz) following the method from Gross and colleagues (2013).
Using 3 seconds segments we performed time-frequency analysis of the EEG and speech signal and calculated the coherence between them. Preliminary results indicate that the coherence between the EEG and speech signal is higher in the 1-4Hz, 15-25Hz and 35-45Hz frequency ranges and can differentiate between familiar and unfamiliar stimuli only in newborns that received prenatal stimulation. We will discuss these findings in the light of brain maturation as well as its potential relation to early mother-child "bonding".

10 Promoting the perception of two and three concurrent sound objects: an event-related potential study

Kocsis, Z.[1,2], Winkler, I.[1,3], Bendixen, A.[4], & Alain, C.[5,6]

[1] Institute of Psychology and Cognitive Neuroscience, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Hungary
[2] Department of Cognitive Science, Faculty of Natural Sciences, Budapest University of Technology and Economics, Hungary
[3] Institute of Psychology, University of Szeged, Hungary
[4] Cognitive Systems Lab, Institute of Physics, Chemnitz University of Technology, Germany
[5] Rotman Research Institute, Baycrest Centre, Canada
[6] Department of Psychology, University of Toronto, Canada

The auditory environment typically comprises several simultaneously active sound sources. In contrast to the perceptual segregation of two concurrent sounds, the perception of three simultaneous sound objects has not yet been studied systematically. We conducted two experiments in which participants were presented with complex sounds containing sound segregation cues (mistuning, onset asynchrony, differences in frequency or amplitude modulation or in sound location), which were set up to promote the perceptual organization of the tonal elements into one, two, or three concurrent sounds. In Experiment 1, listeners indicated whether they heard one, two, or three concurrent sounds. In Experiment 2, participants watched a silent subtitled movie while EEG was recorded to extract the object- related negativity (ORN) component of the event-related potential. Listeners predominantly reported hearing two sounds when the segregation promoting manipulations were applied to the same tonal element. When two different tonal elements received manipulations promoting them to be heard as separate auditory objects, participants reported hearing two and three concurrent sounds objects with equal probability. The ORN was elicited in most conditions; sounds that included the amplitude- or the frequency-modulation cue generated the smallest ORN amplitudes. Manipulating two different tonal elements yielded numerically and often significantly smaller ORNs than the sum of the ORNs elicited when the same cues were applied on a single tonal element. These results suggest that ORN reflects the presence of multiple concurrent sounds, but not their number. The ORN results are compatible with the horse-race principle of combining different cues of concurrent sound segregation.

11 Cognitive effect of rhythmic auditory stimulation in Parkinson's desease: a P300 study

Lei, J., Conradi, N., Abel, C., Fisch, S., Brodski-Guerniero, A., Kell, C. A., Kasier, J., & Schmidt-Kassow, M.

Rhythmic auditory stimulation (RAS) as a nonpharmacological treatment in gait training for patients with Parkinson's disease (PD) results in gait improvements. RAS might compensate dysfunctions of the basal ganglia (BG), involved with intrinsic evaluation of temporal intervals and action initiation and continuation. In the cognitive domain, RAS containing periodically presented tones facilitates healthy participants' attention allocation to anticipated time points, indicating by better performance and larger P300 amplitudes to periodic compared to random stimuli. Additionally, auditory motor synchronization (AMS) leads to more precise temporal encoding of stimuli via embodied timing encoding9. Furthermore, passive AMS, i.e. stimuli are presented adaptively with participants' effective speed, reveals no enhancement in temporal predictability contrary to active AMS where participants actively synchronize their movements with presented stimuli. However, the cognitive effect of RAS and AMS in PD patients remains unresolved. In this study, 21 PD patients and 21 age-matched healthy controls underwent an auditory oddball task manipulating the timing (periodic/random/adaptive) and setting (pedaling/sitting still) of stimulation. Our results revealed larger P300 amplitudes to periodic than random stimuli for both groups. Patients yielded a stronger effect of temporal predictability in a later phase of P300 than controls. Interestingly, during pedaling largest P300 amplitudes were in response to RAS for patients, but to passive AMS for controls. Correlation between P300 amplitudes and AMS performance was only obtained in controls. We conclude that RAS enhanced the attentional processing, but the effect of AMS was absent in PD patients given the disruption of BG.

12 Processing of emotion-related vocal cues in self-produced and non-self produced speech

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Both emotion and speaker identity affect the way the brain processes vocal information. A recent study showed that self-other discrimination and semantic emotional valence modulate speech processing in an interactive manner (Pinheiro et al., 2016). However, it is not known whether this interaction extends to acoustical cues of emotional speech as well. To this end, we used a voice transformation tool to control infra-segmental cues related to happiness and sadness in self-produced speech and vocalizations produced by unknown others. We present here a series of behavioral experiments and an electroencephalography study that explore how self-relatedness and emotion-related acoustic cues interact during voice perception. In the behavioral experiments we tested whether manipulating the acoustic vocal cues affects the recognition rates of the self-voice and unknown voices as compared to non-manipulated voice stimuli. Additionally, we tested whether self- relatedness affected the ability to decode emotional cues from the presented speech samples. While we found no evidence that the recognition of unknown speakers was affected by the voice transformations, our results show that self-voice recognition was impaired for transformed stimuli, suggesting that the transformations affected identity recognition specifically for self-related voice stimuli. EEG data showed differential activations at the onset of the mismatch negativity for these acoustical changes on self-produced speech compared to unknown speech. Taken together, these results extend previous reports of integrated processing of self-produced speech and semantic emotions and show that the processing of emotion-related vocal cues is modulated by the identity of the speaker.

13 The time function of the entrainment of EEG signals to speech may only reflect low-level processes: evidence from similarities between neonatal and adult correlograms

Simon, J.

Newborn infants do not yet have access to sufficient statistic and semantic cues for parsing the full hierarchy of speech. Therefore, one may assume that speech entrainment in the neonate brain is predominantly driven by salient acoustic cues. In contrast, adults process the full structure of speech, as is also shown by the fact that different aspects of speech elicit different event-related electric brain responses. This leads to the assumption that adults and infants should show different EEG-speech correlograms to continuous speech. However, we found that the time course of speech entrainment was similar in the two age groups. Using a relatively long sliding window (1400 ms) led to positive correlations in lags between 400 and 1000 ms, and negative correlation between 1200 and 1800 ms. This sinus-shaped temporal function has been found when the correlation was calculated from sentence onsets and, much weaker, also from phrase starts, but it was absent when using arbitrary starting points.
These results suggest that there is a slow attunement to the energy changes representing phrase/sentence prosody, which is already functional at birth. However, this entrainment does not likely reflect the higher-level processes of speech analysis.

14 The effects of visual information on multi-speaker separation: an EEG and NIRS study

Urban, G.

The ability to attend a single speaker in a multi-speaker environment relies on processing both auditory and visual information. In the present study, we assessed the brain networks involved in facilitating speaker segregation by congruent visual information. The electroencephalogram (EEG) and near infrared spectroscopic signals (NIRS) were simultaneously recorded while in separate conditions, listeners were presented with speech from two concurrent speakers together with audio- synchronized video recording of the speakers (multimodal integration condition), non-speaking facial mimicry videos of the speakers, or phase randomized variant of the latter (control condition). Listeners (N = 24) were instructed to perform a numeral detection task on one of the speech streams as well as later answering questions about its contents. Large-scale functional connectivity between brain regions was compared between conditions. Our results suggest that multimodal integration may increase the effectiveness in speaker segregation in a multi-speaker environment.

15 Does entrained tACS modulate speech-specific BOLD responses? Evidence from combined tACS-fMRI

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Alignment between neural oscillations and speech rhythm, "entrainment", is often enhanced during speech comprehension. Nevertheless, the relation between entrainment and comprehension might merely be correlational, introduced by stimulus manipulations that simultaneously reduce speech intelligibility and remove entraining cues for neural oscillations. Only if we manipulate entrainment as a dependent variable and observe consequences for speech comprehension, can we can conclude that there is a causal relation between the two. This is possible using transcranial alternating current stimulation (tACS): tACS has been shown to impose a rhythm on neural oscillations and can thus be used to manipulate entrainment in an experimental setting.
However, based on behavioural measures alone, it is difficult to distinguish a specific modulation of speech processing and changes to low-level auditory processes (such as hearing thresholds) that would affect processing of various acoustic stimuli.
We therefore combined tACS over lateral temporal regions with fMRI responses to speech. We systematically varied the phase relation between 3.125Hz tACS and an intelligible (16-channel vocoded) or unintelligible (1-channel vocoded) rhythmic speech stimulus (Fig. 1). We thereby test whether tACS affects neural activity (reflected in the BOLD response) and can compare effects in speech-specific and auditory brain regions.
We found that, for intelligible speech, the relation between tACS phase and speech rhythm modulates the magnitude of the BOLD response in the Superior Temporal Gyrus; importantly, this modulation was significantly stronger than for unintelligible speech or during sham stimulation. Our results suggest that entrainment to speech has a specific, causal influence on neural activity in speech-responsive areas.

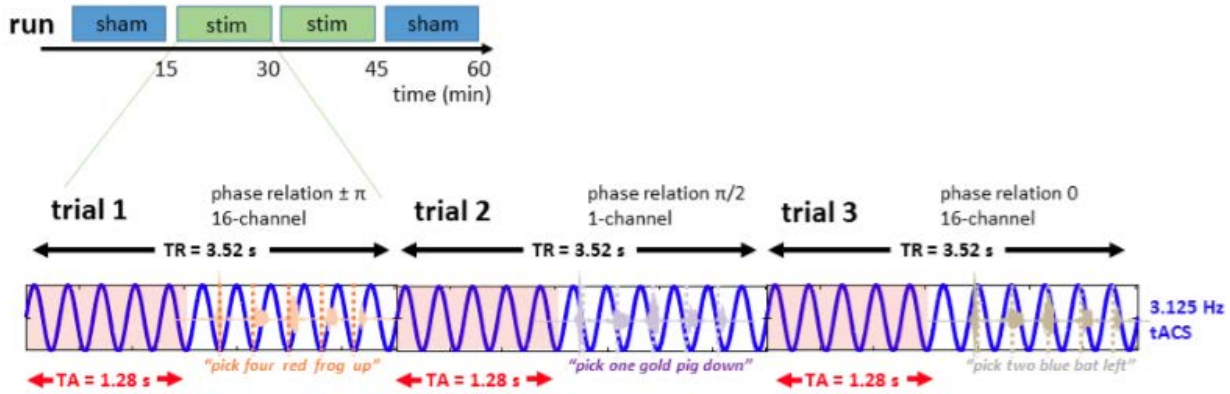

Figure 1.

16 Predictive processing is key for reading: Evaluating an information-optimization hypothesis in visual word recognition

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How do we process visual information in reading? Here we propose and implement a visual optimization algorithm that "explains away" redundant visual information as described by predictive coding. The result of this computation is a representation based on unpredicted visual features (i.e. prediction error; PE), which allows efficient higher-level processing since the PE-representation includes only word specific visual information. This hypothesis was evaluated against current visual word recognition concepts and by multiple behavioral (lexical decision tasks; N=78/54) and neuronal datasets (fMRI/EEG data from silent reading; N=39/31). Interestingly, the PE reflects orthographic familiarity, in a pure form, since PE is associated to orthographic word-characteristics (e.g. Orthographic neighborhood) without a relation to higher-level concepts (e.g. Word frequency). In the behavioral data we found a PE effect that was reflected in an increase of reaction times with PE for words and a decrease for non-words. We propose that this interaction reflects an information accumulation process related to lexical access. Drift-diffusion modeling underlines this notion since drift-rates,
indicating information accumulation, were modulated by PE and lexicality accordingly. In the neuronal data we found that bilateral-occipital brain regions (fMRI) and the N170 component (EEG) were related to the PE. Furthermore, left/medial-frontal regions and the N400 component showed an interaction of PE with word lexicality as also observed in behavior. On the basis of these results, we conclude that in reading, visual information is optimized by a prediction based on redundant visual information from words providing an optimal representation for efficient meaning extraction in reading.

17 Brain networks underlying individual differences in natural reading: A fixation-related fMRI study

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Learning to read requires the development of a highly organized brain system capable of integrating orthographic, phonological, and lexico-semantic features of written words. In the neuroimaging literature, to date, relatively artificial "reading tasks" and unnatural presentation modes are prevailing, thus limiting the validity of the findings of these studies. Therefore, a new technique - "fixation-related fMRI" - has been developed, allowing the investigation of natural reading processes via a combined analysis of eye movement and brain activation data. The present study used fixation-related fMRI in 56 healthy adults during self-paced silent sentence reading. Individual differences in reading speed were defined as words read per minute during fMRI scanning. We identified several brain regions related to reading speed (Figure 1). More fluent readers exhibited higher activation in the bilateral temporo-parietal cortex associated with phonological processing, in the bilateral middle and inferior temporal cortex associated with semantic processing, and in the bilateral occipito-parietal cortex associated with visual-attentional processing. In contrast, slower readers exhibited higher activation in the medial superior frontal cortex, the insula, and the thalamus. These regions are part of the cingulo-opercular control network associated with stable maintenance of goal-directed behavior. The present study is a first step in the identification of brain networks involved in slow and fluent reading under natural reading conditions. It adds to the knowledge gained from studies presenting isolated reading material. Furthermore, it opens new possibilities for studying individual differences in natural reading in impaired readers, for example, children with developmental dyslexia or patients with acquired reading problems.

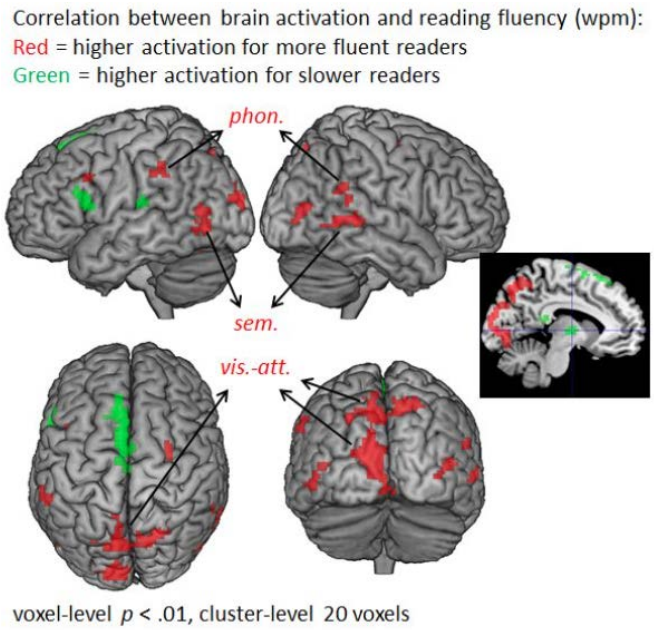

Figure 1.

18 The effects of cloze probability and semantic congruency on brain responses during natural reading

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During reading, the predictability of a word based on prior sentence context facilitates visual word recognition. Most evidence from neuroimaging – especially from functional magnetic resonance imaging (fMRI) – however, stems from studies presenting semantically legal and illegal sentences which consistently highlight contributions of the left inferior frontal gyrus during semantic processing. Contributions of the left temporal cortex are less consistently reported which is at odds with the notion of this regions' involvement in storing and retrieving lexico-semantic information. The present study investigated the effects of cloze probability and congruency on eye movements and brain responses during natural reading by means of simultaneous eye-tracking and fMRI. While manipulating the congruency of sentence final words, we also induced different levels of expectations (i.e., cloze probability). In so doing, we observed higher activation within left inferior frontal regions in response to semantic violations compared to legal continuations, whereas left middle temporal regions exhibited higher activation to high-cloze compared to low-cloze words. Moreover, left occipito-temporal regions, which have been linked to visuo-orthographic processing, exhibited an effect of congruency for high-cloze finals, indicating that prediction formation might not be limited to the lexico-semantic level, but also propagates to the orthographic level.

19 Task-related effects on visual word recognition. A MEG study

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The majority of fMRI studies investigating visual word recognition processes reported higher activation for pseudowords compared to words in the left ventral occipitotemporal cortex. Conversely, few studies reported similar levels of activation for both kinds of stimuli or even the opposite pattern. These apparently conflicting findings might have two non-mutually exclusive causes. The first possible explanation resides in task demands, the second possible cause resides in differences in stimulus presentation durations. Both these issues may affect the depth of processing. For the present experiment we used MEG to investigate task-related effects during visual word recognition. We alternatively focused participants' attention on linguistic (lexical decision task) or nonlinguistic (brightness judgment task) properties of the stimuli while keeping experimental settings constant across tasks. In the lexical decision task, event-related fields (ERFs) analysis evidenced an early lexically effect (120-140 ms) confined to left fronto-temporal sensors. Furthermore, time-frequency representation (TFR) showed higher beta desynchronization for words compared to pseudowords starting at 350 ms after stimulus onset. These findings were not evident in the brightness judgment task. In line with previous experiments, the present results evidenced task-related effects on visual word recognition.

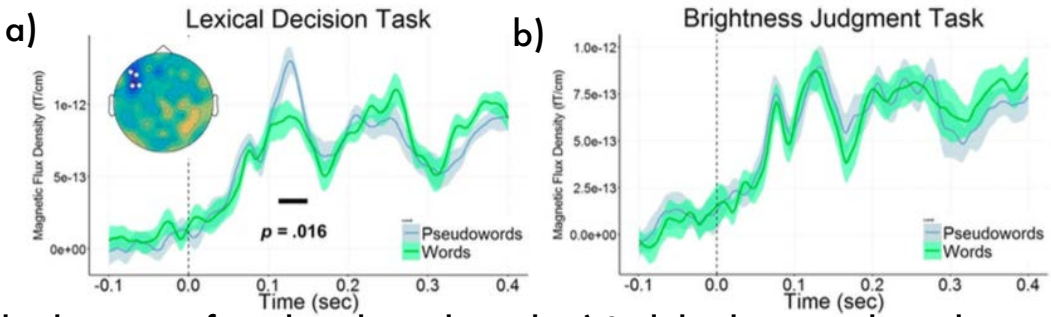

Fig. 1. Sensor-level contrasts of words and pseudowords. a) Scalp-level topography and magnetic flux density averaged over time (-0.1 to 0.4 s) in the lexical decision task. The horizontal black bar illustrates the significant cluster (p = .016). The shaded areas represent standard deviation across the cluster of sensors. b) Scalp-level topography and magnetic flux density averaged over time (-0.1 to 0.4 s) in the brightness judgment task. The shaded areas as in a)

20 Is there an electrophysiological fingerprint for cognitive control?

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Introduction: Midline frontal theta is a 3-8 Hz oscillation in humans typically recorded from the scalp by electroencephalogram (EEG) over the frontocentral electrodes (FCz). It has previously been described as being a global brain network level predictor of goal-directed behavior and cognitive control. However, little is known about the between-sessions variability of midline frontal theta-band peak frequency. This question is particularly interesting for studies aim to employ participant-specific transcranial alternating current stimulation (tACS) at a specific frequency band. Objectives: The objective of the present study was to investigate the individual and group- level variability of midline frontal theta in repeated sessions. Methods: In a double-blind, cross-over study, we investigated the evolvement of midline frontal theta by measuring 16 participants (8 males, 8 females; mean age 25.07 ± 4.45) performing a Go-NoGo probabilistic learning task in six experimental sessions, while recording EEG from 64 channels. We estimated the subject-specific peak-frequency values by using the method described by vanDriel and colleagues (2015). Results: The behavioral data showed that the participants performed equally well across the six repetitions of the task indicating only minor between-sessions variability of the performance (accuracy). Our electrophysiological results revealed that the group-level theta- band peak frequency stayed relatively unchanged throughout the experimental sessions, however we observed a decent variability at the individual level across the sessions. Conclusion: Our results indicate that midline frontal theta-band peak frequency demonstrate moderate amount of intra- and interindividual variability across the experimental sessions. We conclude that careful caution is needed when using individual-specific theta-band peak frequency estimations for calibrating the stimulation frequency in tACS studies.

21 Emotional egocentric bias in autism spectrum disorder: behavioral and neurophysiological evidence

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Empathy, the ability to feel with another person, has already been widely studied in both neurotypical as well as clinical populations, being fundamental for everyday social interactions. However, such social skill is not free from error. Since humans primarily use their own emotions and perceptions in guiding their thoughts about conspecifics, such a self- projection mechanism can lead to empathic judgements that are egocentrically biased towards one's own perspective – resulting in an emotional egocentricity bias (EEB). In this context, the ability for Self-Other Distinction (SOD) plays an essential role during empathic interactions, mainly because it avoids confusion between self and others' emotions. Since multiple studies have shown impairments regarding Theory of Mind in individuals with autism spectrum disorders (ASD), it may be possible to observe difficulties in distinguishing their own feelings from those of other individuals. By means of a virtual ball-tossing game, aimed at inducing congruent or incongruent feelings of social inclusion/exclusion between the participant and a confederate, we investigated the ability of SOD in 17 participants with autism spectrum disorders (ASD) together with 17 matched controls both on a behavioral and neurophysiological level. The results indicated a significant EEB during incongruent emotional empathic judgements. Interestingly, autistic subjects exhibited significantly more egocentric empathic judgements than controls when the degree of alexithymia was kept constant. The present study adds valuable preliminary insights to the investigation of social cognition in this population.

22 Theta-gamma cross-frequency coupling: A marker for the deepness of hypnosis?

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The neuronal dissociation hypothesis states, that hypnosis is an altered state of consciousness caused by a decoupling of brain areas, which are coupled under normal conditions. Support for this hypothesis is mainly provided by studies on pain, showing reductions in gamma coherence under hypnosis. Theta activity typically increases during hypnosis compared to control conditions in participants suggestible for hypnosis. Similar increases have been reported for gamma activity, although less consistently. A possible explanation for the inconsistency in gamma-related findings is that not gamma activity per se, but its coupling to theta is associated with hypnosis. Based on the neuronal dissociation hypothesis, we hypothesize that the strength of theta-gamma phase-amplitude coupling should decrease during the state of hypnosis in high suggestible subjects. We tested this hypothesis in two independent data sets, each consisting of groups of high and low suggestible subjects. The hypnosis consisted of a standard induction procedure, followed by suggestions to imagine a fish swimming deeper and deeper in the water. Previous results have shown that these suggestions are capable of prolonging later periods of slow-wave sleep (SWS). Preliminary results show that during the hypnosis, theta-gamma phase-amplitude coupling is present in all subjects, although to a lesser extend during hypnosis compared to the control condition in high suggestible subjects. In accordance with the predictions of the neuronal dissociation hypothesis, theta-gamma coupling might indicate deepness of hypnosis and might be related to the success of hypnotic induction and suggestions.

23 Cognitive control during audiovisual working memory engages frontotemporal theta interactions

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During working memory (WM), phase-amplitude coupling (PAC) has been suggested to serve as a mechanism to coordinate and integrate processes across frequency bands. Recent work demonstrated that sensory areas showing elevated levels of PAC during WM maintenance also exhibit enhanced phase synchronization to frontal cortex, presumably indicating top-down cognitive control over maintaining sensory areas. Here, we aimed at further investigating these processes as a function of different levels of cognitive control. By shifting attention to a second, auditory WM task, we expected to enforce enhanced cognitive control required to keep multiple sensory information in mind. We used magnetoencephalography to record neural activity of healthy human participants engaged in an audiovisual delayed-match-to-sample task. In each trial, participants were stimulated twice with a simultaneous presentation of a picture and a sound. Their task was to judge whether stimuli were the same or different within the modalities. In one condition, participants had to focus on the visual stimulus only, while in the other, responses for both stimuli were required. Sensory regions showed elevated beta and gamma as well as decreased alpha power throughout the delay periods. Differences between the conditions were apparent in enhanced frontal delta power during multisensory WM. A cluster of voxels spanning from left medial temporal lobe (MTL) to inferior frontal gyrus showed elevated theta-beta PAC in both conditions. Multisensory WM was associated with increased phase synchronization between MTL and frontal regions within the theta band and between MTL and posterior visual areas within the beta band. Our results provide insights into interactions of neuronal oscillations during multisensory WM. They suggest that frontotemporal synchronization in the theta band might reflect frontal top-down control over processes taking place in sensory areas, where enhanced theta-beta PAC and beta phase synchronization might represent processes of active multisensory WM.

24 Phase coupling between posterior EEG theta and gamma as a signature of predictive coding

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Our visual perception is strongly influenced by our expectancies about incoming sensory information. It is assumed that mental templates of expected sensory input are created that are compared to actual sensory input, which can be matching or not. In cases where such mental templates have to be held in short-term memory, such as in visual attention or search tasks, cross-frequency synchronization between theta and gamma band EEG oscillations has been proposed to serve matching processes between prediction and sensation. In this study, we investigated how matching between sensory input and mental templates from working memory is affected by the certainty about which activated template must be matched. In a visual search paradigm, we compared cross-frequency phase coupling for conditions where participants had to keep either one or multiple templates in mind for successful search. We find that memory matching appeared as a transient posterior phase-synchronization between EEG theta and gamma oscillations in an early time window after search display presentation, around 100-150 ms. Our results suggest a stronger transient phase-synchronization of theta and gamma over posterior sites contralateral to target presentation for conditions where one mental template was required than for multiple templates. This is understood in line with previous theoretical accounts, lending promising support for such transient phase coupling between posterior theta and gamma as a neuronal correlate of matching of incoming sensory information with memory contents from working memory.

25 Flexible resource allocation by theta and alpha oscillations in working memory

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Working memory (WM) consists of various cognitive processes and maintains and manipulates information no longer available in the environment. Individual processes are co-ordinated by a central monitoring component ensuring their efficient interaction. This central component is strongly linked to top-down attention processes. On cortical level, fronto-posterior interregional phase coupling of slow oscillations (in particular of the theta and alpha frequency range) has been suggested to play an important role in executive functioning and hence the top-down control of attention allocation. In addition, local synchronization especially in the alpha/theta band has been repeatedly implicated in the succesful allocation of attention and selective inhibition. However, distinct brain oscillatry mechanisms of the flexibility with which attention is allocated and information is selected or inhibited are not yet known. We designed a dual-task delayed-match-to-sample EEG experiment where participants retained visuospatial and figural information simultaneously. Most importantly, they were instructed to either prioritise the visuospatial or the figural information in alternating blocks. We found that local posterior alpha activity over areas associated with visuospatial processing can distinguish between the two conditions while elevated local frontal theta synchronisation is equally present in both. Moreover, interregional phase coupling (m:m) in the slow frequency ranges of the theta and alpha bands between frontal and posterior areas differentiates between prioritising the visuo-spatial and the figural information. We conclude that flexible voluntary attention allocation is implemented in the brain by local processes in task relevant brain regions as well as long-range interactions between frontal and posterior areas.

26 Suppression of Auditory Processing by Attentional Modulation: A Combined Otoacoustic Emission and MEG Study

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A number of previous studies have shown that focusing attention on a specific single stimulus in a complex multisensory environment is done by selecting relevant information while ignoring distracting input. Moreover, it has been demonstrated that the otoacoustic emissions (OAEs) measured during the execution of behavioral tasks can be modulated by attending or not attending the auditory sensory domain. This suggests that the cognitive and perceptual demands of a task can affect the first neural stage of auditory processing – the outer hair cells themselves. The underlying mechanism and involved neuronal levels of this attentional modulation are still a matter of debate. Here, in the center of interest is the cochlear amplifier which is known to be modulated by efferent neurons of the medial olivocochlear complex. In this study brain activity besides OAEs is measured by using magnetoencephalography (MEG) during an intermodal (visual/auditory) cueing paradigm. We found effects of selective attention for OAEs. The Power in a spectrum from 1 to 11 Hz is in general less for attend visual compared to attend auditory periods. The Power at 11 Hz was significantly higher in attend auditory vs. attend visual trials. This reflects a suppression of auditory processing as early as in the very first stage of auditory processing – in the cochlea. In conclusion, this study showed suppressed processing of auditory stimuli, when attention is focused on the visual modality, in the cochlea.

27 Age-related changes in the quality of memory representations

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Although neurocognitive aging research has yielded important insights into age-related changes in memory performance, little is known about changes of the quality of memory representations. We propose that investigating age- differences on the level of neural representations and their relation to memory performance adds a novel perspective on age-related memory decline.

Recent studies focussing mostly on young adulthood showed that stability (or self-similarity) and distinctiveness (or global similarity) of a representation are crucial for memory success. However, whereas representational self- similarity clearly benefits memory, current findings on global similarity in both the memory and aging literature are highly inconsistent, providing evidence of beneficial effects of either very distinct or very similar neural representations.

To investigate how age-related changes in neural representations impact memory performance, we examined spatiotemporal frequency patterns during memory encoding in an age-comparative EEG study. Twenty-seven young (19-25 y.) and 33 old (65-75 y.) adults studied scene-word pairs in several learning and recall cycles. We compared memory representations across item repetition (self-similarity) and across different items (global similarity) by applying representational similarity analysis. We were able to identify electrode clusters and time intervals during encoding in which the quality of frequency-based neural representations differed significantly between subsequently remembered and forgotten items in young but not in old adults.

Our preliminary findings underline the high relevance of investigating pattern stability and distinctiveness as potential representational characteristics for successful memory and how they may change during aging. In addition, it indicates that frequency may be of particular importance for representing memory-relevant information.

28 Neural correlates of mental context reinstatement supporting episodic memory retrieval

Bramão, I., Karlsson, A., & Johansson, M.

Previous work has shown that physically re-experiencing the encoding context at retrieval improves memory accessibility. The current study examined if mental reconstruction of the original encoding context would yield parallel memory benefits. Participants performed a cued-recall memory task, preceded either by a mental or by a physical context reinstatement task, and we manipulated whether the context reinstated at retrieval overlapped with the encoding context. Both behavioral and electrophysiological measures of brain activity showed strong encoding-retrieval (E-R) overlap effects, with facilitated episodic retrieval when the encoding and retrieval contexts overlapped. The electrophysiological E-R overlap effect was more sustained and involved more posterior regions when context was mentally compared with physically reinstated. Additionally, a time-frequency analysis revealed that context reinstatement engenders recollection of the target episode. However, while recollection of the target memory is readily prompted by the physical reinstatement, target recollection during mental reinstatement is delayed and depends on the gradual reconstruction of the context. Taken together, our results suggest that episodic remembering is also facilitated by mentally reinstating the encoding context; and that such benefits are supported by both shared and partially non-overlapping neural mechanisms when the encoding context is mentally reconstructed as compared with physically presented at the time of retrieval.

29 Timing of supramodal semantic representations – an MEG study

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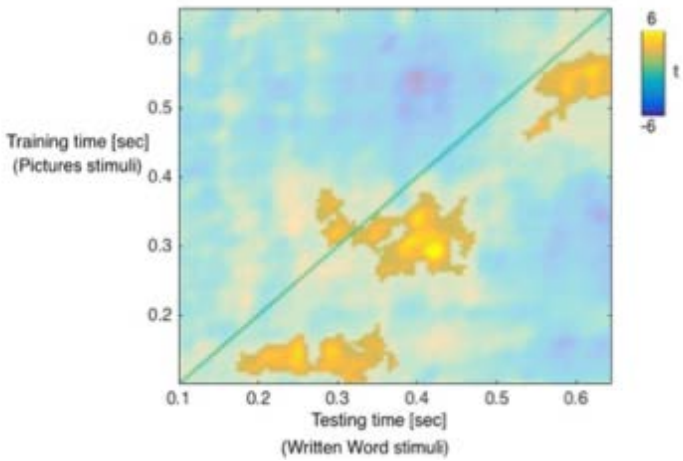
Previous research has shown that the brain engages different neural substrates, when retrieving semantic knowledge that is referred to different categories, i.e. people or places (e.g.: is the Big Ben/Margaret Thatcher British?). Here we investigate the temporal aspect of retrieving semantic information specific to faces or places, by exploiting the precise temporal resolution of magnetoencephalography (MEG). Crucially, we presented the stimuli in two modalities: pictures (PIC) and written words (WW), so to test supramodal semantic representations, independently from the process used to access this information.
During MEG recording we presented participants with a stimuli-set of (famous) faces and (famous) places, first as WW and then as PIC. Participants were asked to make different judgements: either a simple "shallow-level" judgement ("place or face") or more abstract judgement (if the presented stimulus was Italian or foreign).
To test supramodal semantic representations, we exploited a multivariate approach: we trained a classifier to identify faces/places specific neural patterns in the PIC modality, and tested it in the WW. Results show that access to faces and place information dissociated in the brain at three different stages, an early one, an intermediate one and a late one (p1=.002, p2=0.002, p3=0.001 - cluster corrected for multiple comparison, see figure for precise timing). Moreover, these processes were delayed of about 50 for WW than for PIC.
These results show supramodal differential encoding of semantic information for different categories and indicate that these category-selective neural populations come online at multiple stages of the semantic processing.



30 Alpha oscillations and the allocation of attention towards binding during episodic memory encoding

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Directing mental resources, i.e. attention, to a relevant stimulus is a critical part of the formation and retrieval of memory traces – be it in working memory (WM) or long-term memory (LTM). For the formation of episodic memories the relevant stimuli furthermore need to be processed in relation to each other and/or to their context. Research into the neural correlates of the allocation of attention in mnemonic processing has received increasing interest in the last few years. The EEG correlates of attention allocation to item and context information during episodic encoding, on the other hand, are not yet fully understood. We designed an episodic LTM EEG experiment where we examined the oscillatory activity associated with attention allocation as well as the binding of items and their context in episodic LTM encoding.

Here, we will present evidence indicating that the manipulation of the distribution of attentional resources to the different stimuli and their relation led to differences in the performance on a later LTM recognition test. Furthermore, we will present EEG oscillatory correlates in the alpha band – on scalp as well as source level - highlighting activity representing allocation of attention towards the binding of an item and its context in episodic memory encoding.

31 Differences in Sleep Physiology Relate to Impaired Memory Retention in Old Age

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Sleep benefits the stabilization of newly acquired information. Age-related alterations in sleep physiology may impair system-level consolidation and account for reduced episodic memory performance in old age. Here, we examine if age differences in neuro-electric activity during sleep predict the consolidation of associative memories.
29 younger (YA, 19-27 years) and 36 older participants (OA, 65-73 years) completed an associative memory paradigm, consisting of a learning session and a delayed cued-recall task on the following day. During the nights before and after learning sleep was monitored by ambulatory polysomnography (PSG). We focused on the presence of sleep spindles and slow oscillations (SO) during non-rapid eye movement (NREM) sleep. Structural brain integrity was assessed by voxel- based morphometry of structural magnetic resonance images.
Both age groups demonstrated comparable overnight memory gains for items not known on the first day. However, overnight retention of previously acquired memories was worse in OA. These deficits were accompanied by reduced occurrence of sleep spindles and SO. Analyses of grey matter volume supported the importance of structural brain integrity in generating SO. Nevertheless, contrary to recent findings, we identify age and not sleep physiology as major source of inter-individual differences in memory consolidation.
Our findings underline the memory function of processes triggered by spindles and SO. The reduction of SO and sleep spindles in OA likely impedes the reactivation of memory traces and their redistribution to the brain's long-term storage. Whether altered sleep really is the driving force behind memory impairments in senescence is yet to be identified.

32 Theta activity orchestrates the reinstatement of memories during NREM sleep

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The memory function of sleep relies on the spontaneous and repeated reactivation of newly acquired information during subsequent NREM sleep. Triggering reactivation processes by re-exposure to associated memory cues (e.g., odors, sounds) improves memory consolidation. The successful cueing of memories during sleep has been repeatedly associated with increases in oscillatory theta and sleep spindle activity. This oscillatory signature of cueing success has also been associated with the triggered reactivation of foreign vocabulary.
However, the precise underlying mechanisms such as the processes, which temporally orchestrate the reinstatement of individual memories during sleep in humans, are largely unknown. Furthermore, theta oscillations have not yet been included in theoretical accounts of sleep and declarative memory consolidation. To elucidate the temporal dynamics of memory reactivation during sleep and the role of theta oscillations specifically, we applied an RSA-based method to data, derived from the foreign vocabulary cueing studies mentioned above. Using phase patterns of neural oscillations, we aimed at decoding content- specific signatures of triggered memory reactivations during sleep. We show that temporal phase patterns in the theta band, which were present during successful recall before sleep, reappear in the case of successful memory reactivations during sleep. These results provide first indication that theta activity during NREM sleep guides and orchestrates the reactivation of memories, by carrying the temporal signature of reinstated memories. Still, the potential interplay of theta with the cardinal sleep oscillations (slow oscillations, sleep spindles) remains to be clarified.

33 Reactivating vocabulary memory during the slow-wave up-state enhances, while the down-states deteriorates memory

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Slow-wave sleep is thought to play a key role in declarative memory consolidation. This role appears to be related to the spontaneous reactivation of memory traces during sleep. It is possible to interfere with this natural brain process, using external cues to reactivate specific memory traces. This so-called "Targeted Memory Reactivation" (TMR) is associated with memory enhancement.
The slow-wave dynamics of sleep entail depolarised 'up-states' and hyperpolarised 'down-states'. Using a new, highly precise method to lock stimuli to oscillatory phase, we show for the first time that memory enhancement by TMR is slow-wave up-state specific. Moreover, we show that reactivations in the slow-wave down-state, deteriorate the memory. The latter could be of importance in the non-invasive treatment of disorders with maladaptive memories. In conclusion, we show that slow- wave phase crucially determines the fate of reactivated memory traces, leading to memory enhancement during up-states and depression during down-states.

34 Short and long-term effects of full-night sleep on procedural memory performance

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Studies on sleep and memory primarily focus on overnight rather than long-term performance changes. Investigating associations between performance changes and sleep architecture benefit from more in-depth analyses of sleep characteristics (i.e. sleep spindles and slow oscillations). The present study investigated the effects of full-night sleep on procedural memory performance after one night and a one-week follow-up. Additionally, the functional significance of spindles and slow oscillations for procedural memory consolidation will be investigated. Participants (N = 23, Mage = 23.17 ± 2.66 years) were trained on a procedural mirror-tracing task during counterbalanced learning (mirrored vision) and control (normal vision) conditions. Participants traced 12 figures as quickly and accurately as possible within a 90s timeframe during the evening training session. Performance was evaluated for speed and accuracy directly following training, after a full-night of sleep, and a one-week follow-up. Twenty-one channel electroencephalography was recorded during task execution, with polysomnography recorded during the night. Performance changes, sleep architecture, as well as spindle and slow oscillation activity were analyzed for both conditions. Preliminary findings indicate no performance changes for the control condition. The learning condition showed no overnight improvement for speed but rather a significant improvement during the follow-up. In contrast, accuracy significantly increased following full-night sleep and stabilized for the subsequent follow-up. Further associations between performance changes, sleep spindles, and slow oscillations will be investigated. This study shows that performance on a procedural memory task can be improved by full-night sleep, and that additional performance changes can occur after a longer time period.

35 Continued Evaluation of Stimulus Familiarity during Naturally Occurring Unconsciousness

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Previously, stimuli such as a subject's own name (SON) or a familiar voice have been shown to be processed preferentially during wakefulness. SONs and negative prosody have been shown to continue being salient even during unconscious N2 sleep. We here investigate stimulus processing during wakefulness and across all sleep stages (i.e. non-rapid eye movement (NREM) sleep stages N1, N2, N3 and REM sleep). Furthermore, we also investigate oscillatory sleep EEG phenomena, i.e. sleep spindles and slow oscillations (SOs) and how their occurrence and characteristics relate to stimulus processing.
Modulation of stimulus processing by stimulus salience was studied by means of evoked oscillatory responses (event-related de-/synchronisation [ERS/ERD]) and event-related potentials (ERPs) using high-density electroencephalography (EEG). Specifically, we varied stimulus salience on two dimensions, (i) subjective relevance and (ii) paralinguistic aspects of emotional relevance. To this end, we presented participants with SONs vs. unfamiliar names (UNs) and additionally varied the familiarity of the voice, i.e. familiar vs. unfamiliar voice (FV vs. UFV). We show that familiarity of a voice continues to be evaluated even during deep N3 and REM sleep giving rise to a differential EEG response. Thus, we add to existing evidence that the brain is in a kind of 'sentinel processing mode' during sleep, i.e. it continues to evaluate environmental stimuli even in the absence of consciousness. Beyond this, sleep spindles and a negative slope of SOs do not seem to uniformly inhibit information processing. Rather, inhibition seems to be tuned paralinguistic emotional stimulus characteristics.

36 I want to sleep better: Effects of volunarly control on objective sleep parameters

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Sleep is mainly regulated by homeostatic and circadian factors, and sleep disturbances are typically treated by pharmacological interventions. However, a large portion of non-organic sleep disturbances are caused by psychological factors including worrying, perceived prospective threats and negative recurrent thoughts, suggesting that sleep is strongly influenced by cognitive and affective mechanisms. In support of this notion, we have recently shown the duration of objectively measured slow-wave sleep (SWS) can be extended by using hypnotic suggestions to sleep deeper. Here we aim at testing whether healthy participants are capable of voluntarily influencing objective sleep parameters even without hypnosis. We predict that participants can voluntarily worsen but not improve their sleep as compared to a normal sleep condition.
18 healthy young volunteers participated in one adaptation night and three experimental nights. All nights were done on the same weekday with an interval of one week. Polysomnography and subjective sleep quality was measured during all four nights. In the three experimental nights, participants either had to sleep "normal", worse than normal or better than normal, in a balanced order.
The results show that the subjective and objective sleep onset latency as well as the time spent awake after sleep onset could be significantly altered. In a same direction changed the parameters slow wave sleep and total sleep time, which showed a significant increase. The results demonstrate that it is possible to influence sleep voluntarily. Findings show a first answer to the question if sleep is influenceable within one´s mean.

37 Stable structures and dynamic aspects of sleep EEG

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Electroencephalographic scalp recordings (EEG) are noise contaminated and highly non-stationary. Therefore one might expect that averages of an interrelation measure like the Pearson coeficient, which may take positive and negative values with the same probability, should (almost) vanish when estimated over long data segments. However, the average zero-lag cross correlation matrix, estimated over long periods of sleep stages of healthy subjects show a characteristic, highly pronounced correlation pattern, which is almost independent of the physiological state (Figure 1) and even if calculated for different subjects we find an amazing similarity between average correlation structures. It seems to reflect a generic feature of the brain dynamics and was interpreted as a kind of basal dynamical state of the brain activity. Consequently, dynamical aspects of the brain dynamics should be studied as deviations from this stable pattern. Based on this findings we present a new methodology for studying dynamical aspects of brain activity, which identifies more clearly differences between sleep stages, it provides a more homogeneous picture across subjects and provides a consistent physiological picture compared to established theories about the “sleeping brain”.

38 Developmental changes of slow wave activity during sleep reflect changes in cognitive abilities across puberty

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Theoretical background: Puberty is considered as a phase of cortical restructuring due to synaptic pruning. Developmental trajectories of slow waves during sleep follow the same time course and thus are believed to be an indicator of this restructuring process.
Objectives: This longitudinal approach aimed to investigate developmental changes of slow wave sleep activity from pre- to post-puberty and whether they are connected to individual differences in memory consolidation and general cognitive abilities.
Methods: Sleep polysomnography, declarative learning (word pair association task) and general cognitive ability assessments were performed in 16 healthy subjects (7 male, 9 female) at pre-pubertal age (8-11) and 7 years later at post-pubertal age (14-18 years). Polysomnography was recorded ambulatory during 4 nights per subject (2 nights pre-pubertal, 2 nights post-pubertal). General cognitive abilities were assessed using the Wechsler Intelligence Scale (WISC).
Preliminary results: At pre-pubertal age, slow wave amplitudes were higher with steeper slopes as compared to post puberty. In contrast, slow wave lengths increased from pre to post- pubertal age. Interestingly, our data revealed that the decrease of the centro-parietal slow wave slopes was associated with performance increases in spatial intelligence (WISC), whereas the increase in central slow wave length was related to a boost in declarative memory capacity from pre- to post-pubertal age.
Conclusions: Centro-parietal cortical activations are involved in working memory tasks. Thus the developmental changes of slow waves during sleep could reflect the development of a more effective working memory network across puberty, which might be related to higher cognitive functioning.

39 Multiple faces of prestimulus somatosensory alpha power modulations?

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The outcome of various near-threshold (NT) paradigms suggests that conscious perception requires certain neural predispositions at the time point when the to-be- perceived external stimulus enters the respective sensory system. Those behaviorally relevant brain states are less well studied to date and are subject of the current work. The NT paradigm utilizes a stimulus that is matched to the subjective perceptual threshold. That is, in about 50% of the trials participants perceive the target (hits) while in the other ~50% they don't (miss). Contrasting brain activity of hits vs. misses commonly shows an increase in alpha activity in the pre-target time window over respective sensory areas ipsilateral to the target and an increase in alpha power over the respective sensory areas contralateral to the target. The former reflects the inhibition of task-irrelevant processes while the latter reflects the enhancement of task-relevant ones. Interestingly, a similar pattern of alpha lateralization has been observed in covert spatial attention tasks. The close resemblance of neural oscillatory alpha power effects in the pre-target time window obtained with both paradigms calls for their better characterizations and functional dissociation. We tackle this challenge in the current work. That is, we aim to disentangle the alpha power effects in the pre- target time window which have been related to attention from those which predispose conscious perception (but which are not modulated by attention).

40 Triggering tactile perception with concurrent transcranial alternating current stimulation in the alpha band: an MEG study

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In the current study, we investigate neural oscillations during tACS using MEG. Specifically, we addressed the question how tACS at 10Hz interacts with ongoing oscillatory activity in the alpha band during a somatosensory perception task. We conducted a near-threshold somatosensory detection paradigm and simultaneously applied tACS at 10Hz (experimental condition). In control conditions, there was either no electrical stimulation at all or tACS at 35Hz.
We show that neural signatures of ongoing physiological processes that influence perception, i.e. alpha power modulations, can be uncovered with MEG even during electrical stimulation (at 10Hz and 35Hz). Moreover, the tACS- induced 10Hz power increase was found to be state-dependent with relatively bigger power induction prior to undetected stimuli as compared to detected stimuli. Furthermore, we show that there is a phase-dependent modulation of task performance during 10Hz- but not 35Hz-tACS, indicating that 10Hz-tACS can be employed to modulate perceptual report.
Overall, the present study provides evidence that oscillatory activity measured with MEG can be successfully analysed during tACS and that electrical stimulation interacts with ongoing physiological processes.

41 MEG adaptation reveals action representations in posterior occipitotemporal regions

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When we observe other people's actions, a number of parietal and precentral regions known to be involved in the planning and execution of actions are recruited. It has been argued that this recruitment reflects the process of simulating the observed action, thereby providing access to the meaning of the action. Alternatively, parietal and precentral regions might be recruited as a consequence of action understanding, with the cognitive processes underlying action understanding being represented outside the motor system. To determine where in the brain and at which time point it is possible to distinguish between simple observed hand actions performed with the left or right hand towards a target on the left or the right side. In each trial, participants were presented with two subsequent videos depicting either the same (repeat trials) or different (non-repeat trials) actions. We predicted that areas that are sensitive to the type of action should show stronger adaptation (i.e. a smaller decrease in alpha and beta power) in repeat in comparison to non-repeat trials. Indeed, we observed less alpha and beta power decreases during the presentation of
the second stimulus in repeat compared to non-repeat trials, indicating action- selective adaptation. Sources were exclusively in posterior, occipitotemporal regions, supporting the notion that an early differentiation of actions occurs outside the motor system.

42 Modulation of subthalamic nucleus beta oscillations during stepping-in-place is enhanced by auditory cues

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Gait disturbances are common in patients with Parkinson's disease, can cause falls and are often unresponsive to medication or deep brain stimulation therapy. We set out to answer if population activity in the left and right subthalamic nucleus (STN) is modulated by gait in unison or in an opposing manner. As rhythmic auditory cues can improve gait rhythmicity and gait disturbances, we also tested how gait-related power modulation is altered in the presence of auditory cues.
We recorded local field potentials from both STN in 9 Parkinson's disease patients during stepping in place on a foot pedal. Patients sat on a chair to avoid falls and movement artefacts. The constant step interval of 1s was dictated by a looped video of a walking man. 7 of the 9 patients were also provided with a metronome sound synchronised with each heel strike in half of the stepping sequences.
We found that 20-30 Hz beta oscillations were most likely to occur after the contralateral step, when the contralateral foot rested on the pedal. When the contralateral foot had to be raised, beta oscillations were least likely. Power in the left and right STN was thus modulated separately in opposite patterns.
The metronome improved patients' synchrony with the heel strikes displayed in the video and also increased beta modulation. Our results raise the possibility that alternating DBS patterns may provide better control of gait than constant stimulation of both STN.

43 Brain networks of tonic experimental pain assessed by EEG

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Pain is a complex phenomenon which results from the integration of sensory, cognitive, emotional and motor processes. In the brain, pain is associated with an extended network of brain areas displaying oscillations and synchrony at different frequencies. However, brain networks of pain have mostly been investigated in relation to brief experimental pain stimuli whereas the main clinical problem of chronic pain is characterized by longer-lasting pain. We have therefore recorded electroencephalography (EEG) during 10 minutes of tonic heat pain applied to the hand in 39 healthy volunteers. To assess tonic pain-related brain activity at the network level, we are currently performing graph theory-based network analyses of EEG data at theta (4-8 Hz), alpha (8-13 Hz), beta (14-30 Hz) and gamma (60-100 Hz) frequencies. Network analyses based on functional connectivity measured by the debiased weighted phase lag index and the amplitude envelope correlation will be performed. Different measures of local and global network organization will be determined and compared between tonic pain and an appropriate control condition. We expect to find changes in local graph measures, such as an increase in local clustering coefficient during tonic pain within the alpha and beta frequency range. The replicability of the findings will be tested by comparing stimulations of the left hand and the right hand. These analyses will extend the understanding of the brain mechanisms of pain to the network representation of longer-lasting pain as a hallmark of chronic pain syndromes.

44 Brain networks of chronic pain assessed with resting-state EEG

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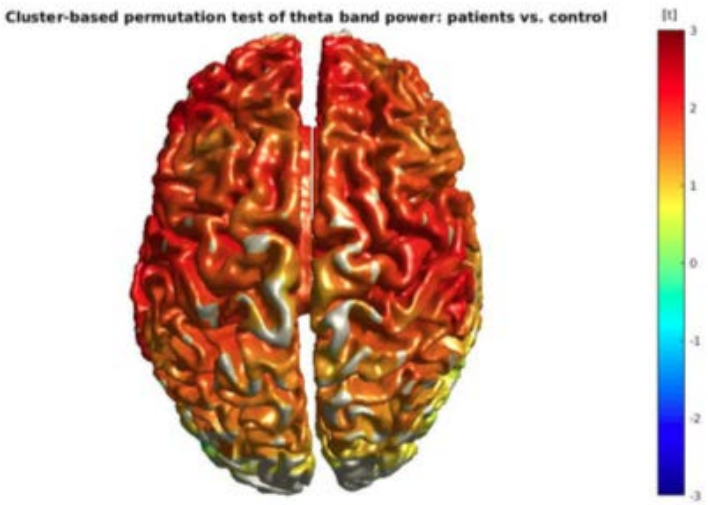
Chronic pain is a major healthcare issue whose causes are not fully understood and whose treatment is often unsatisfactory. Magnetic resonance imaging has shown structural and functional changes during the resting state in different brain networks at frequencies below 0.1 Hz in the brains of chronic pain patients. Whether changes of brain networks also occur at higher frequencies assessed by electrophysiological recordings has remained largely unknown. We have therefore recorded electroencephalography (EEG) during the resting state in 20 chronic pain patients suffering from Fibromyalgia and 22 matched healthy controls. In accordance with previous findings, we observed a trend towards increased frontal brain activity at theta (4 – 8 Hz) frequencies in chronic pain patients. To assess potential changes of brain activity at the network level, we have performed graph theory- based network analyses of EEG data at theta (4 – 8 Hz), alpha (8 – 13 Hz), beta (14 – 30 Hz) and gamma (60 – 100 Hz) frequencies. Network analyses based on functional connectivity measured by the debiased weighted phase lag index did not differ significantly between groups. To increase statistical power and investigate not only phase coupling but also amplitude coupling effects, we are currently extending the analyses to a larger cohort of 100 chronic pain patients with respective controls and the amplitude envelope correlation as a complementary measure of functional connectivity. These analyses promise to further the understanding of the brain mechanisms of chronic pain and might help to define brain-based biological markers of pain assessed by portable and affordable devices.



45 The monitoring system is sensitive to the error *per se*, not to violation of expectation

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Neural correlates of performance errors are thought to indicate the need for top-down control. Mid- frontal Theta oscillatory activity (4-8Hz) is a well-established marker of committed or observed errors. By combining EEG and immersive virtual reality (IVR-CAVE system), we previously reported that observing errors in reach-to-grasp actions of an avatar seen from a first-person perspective elicited greater theta oscillations over fronto-central electrodes (Pavone et al., 2016). Former studies on committed or observed errors used sequences of trials were erroneous actions were less frequent than correct actions (e.g. 30% vs 70%). Therefore, it was not possible to disentangle whether the activation of the performance system was due to error per se or to surprise/novelty effect associated with rare and less predictable events. To address this issue, we recorded the EEG signal of 23 participants observing correct or erroneous actions performed by an avatar in first-person perspective. Importantly, differently from Pavone et al, (2016) the proportion of erroneous vs correct actions was 70% vs 30%. The results show that observation of erroneous actions enhanced Theta power compared to correct actions. Additionally, correct trials showed stronger Alpha suppression than erroneous trials, in line with previous works. Taken together, our data suggest that error per se, and not its percentage of occurrence, triggered the activity of the performance monitoring system, likely with the aim of flexibly adapting actions to the challenges of the external environment.

46 Regulation of personal space by socio-economical interactions in adults with autism spectrum disorders – an fMRI study

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Personal Space (PS) is an area which an individual tries to maintain around him/herself. Developmental and psychiatric disorders influence the regulation of PS. Importantly, in case of autism spectrum disorders (ASD), a condition characterized by deficits in interpersonal interaction, it has been recently shown that the regulation of PS is altered compared to typically developing (TD) children. Since the importance of regulation of PS, this study aimed at extending the previous findings to the ASD adult population and to investigate the behavioral and neurophysiological underpinning of PS and its modulation by different types of social interactions.
15 ASD and 15 TD matched participants undergone fMRI investigation while performing a modified version of the stop-distance paradigm for measuring PS preferences. In particular, participants were presented with several prerecorded videos in first person perspective: an actor moving a predetermined number of steps towards them. They were asked to specify how comfortable they perceived the observed distance from the confederate. In order to see the effect of social interaction on PS perception, the participants and the confederate played a one-shot trust game session, in which cooperative and non-cooperative interactions were experimentally manipulated. After the game, the participants were presented a second time with the distance task, in order to measure PS preference variation due to the type of social interaction (cooperative or not) previously experienced.
We observed a significant modulation of the trust game on the PS, in that TD participants showed increased comfort toward the cooperative player and increased discomfort towards the not-cooperative one. Notably, we also observed the same effect in the ASD population, suggesting that the perception of a cooperative (or not) interaction is intact and has an impact on other social variables. A better understanding of these behavioral characteristics and the neuronal mechanisms underlying them could improve the overall ability to understand the development of ASD.

47 Wanting and liking of food and social rewards

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It is the matter of intense scientific debate whether identical or separate neural networks underlie the processing of and the responding to primary rewards (e.g. food), and social rewards (e.g. physical contact and social interaction with pairs). The relevance of this question is provided by the observation that people with autism spectrum disorders might have specific social motivation deficits. However, much of prior work in humans has investigated only one type of reward, making a direct comparison impossible, and often relied mainly on participants' subjective ratings, which are prone to social desirability bias. Therefore, the development of comparable paradigms testing both types of reward is fundamental. Here, using a within-subjects design, healthy male and female participants were tested in a real effort task, to determine their subjective (ratings of wanting and liking) and objective (squeezing of hand dynamometer) responses to both primary and social rewards. As a primary reward, small amounts of milk with different concentrations of cacao were delivered using computer-controlled pumps. As a social reward, participants received forearm caresses at different speeds by a same-sex experimenter. Moreover, in each trial the amount of muscular effort exerted by the participant determined the probability of receiving one of two rewards (e.g. 100% or 25% of cacao). Preliminary subjective and behavioral data suggest comparable responses of wanting and liking to both food and social rewards.

48 Visual predictive processes – Introducing a new method for agency research

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The neural basis of the feeling of agency has been associated with internal forward modeling which is considered to rely on sensory predictions. These processes were suggested to be disrupted in disorders such as schizophrenia or obsessive-compulsive disorder. Only a few studies were investigating this phenomenon in the visual modality and none of them were using biofeedback-based priming. In this study we examined prediction-related modification of visual event-related potentials elicited by movement-evoked stimuli. Twenty-two healthy adults participated in our experiment. We used the Myo Armband to evoke a stronger sense of ownership of the stimuli. In the ACTIVE condition, hand stimulus appeared after wrist dorsiflexion, while in the PASSIVE condition, participants were only observing the images without any movement. According to our results with Myo-based induction, stimuli depicting hands evoke a stronger sense of ownership. By contrasting passive viewing with active, movement-related stimulus presentation, neural signatures of predictive processes characterized by ERP amplitude modulations were more robust. These results present experimental evidence for the utility of the Myo Armband for inducing neural effects that contribute to the sense of agency, affecting visual ERPs signaling more complex, object sensitive visual processing (i.e. the N170) as well.

49 Fixation-locked ERPs suggest predictions of visual content across saccadic eye movements

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The world around us appears stable although visual perception only provides discrete snapshots separated by saccadic eye movements. One explanation for visual stability is the hypothesis that the brain predicts visual input across saccades. If post-saccadic input was predicted for each saccade based on peripherally available information from the saccade landing position, a change of visual input during the saccade should elicit post-saccadic prediction error effects in neural and behavioral responses.
In the present study, participants made eye movements to bilaterally presented upright and inverted face stimuli while combined eye-tracking and EEG data was recorded. During the endogenously color-cued saccade, the target face could change its orientation from inverted to upright or vice versa (invalid preview) or could remain the same (valid preview). After the saccade participants reported whether the target face was tilted slightly to the left or to the right.
Corroborating the hypothesis that valid predictions facilitate responses, participants were faster in valid than in invalid preview conditions. In addition, post-saccadic ERPs exhibited the well-known face inversion effect consisting in a more pronounced N170 component for inverted than for upright faces. Importantly, the onset of this inversion effect tended to be earlier for valid than for invalid previews suggesting the presence of an additional prediction error signal in case of a prediction violation. The results are, thus, in line with the idea that visual input is predicted across saccadic eye movements.

50 EEG correlates of body-parts visual perception

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Categorical clustering in the visual system is thought to have evolved as a function of intrinsic (intra-areal) and extrinsic (inter-areal) connectivity and experience. In the visual system, a region in the occipito-temporal region (Extrastriate Body Area, EBA) responds to full body and body parts images under the organizational principle of their functional/ semantic meaning. Although band-specific modulations of neural activity associated to perceptive and cognitive functions are gaining attention, no description has been provided as to whether perceiving single body-parts with different functional meaning and full body images induces early time-frequency power (ERD/ERS) and phase (ITPC) modulations over the EBA. Here we intended to study this issue by measuring EEG in participants who passively observed four different kind of body stimuli (fingers, hands, arms and faceless full bodies) and four hierarchically comparable plant stimuli. Besides confirming that parieto-occipital electrodes show a larger Event Related Potential (ERP, N190) for body-related images, we identified a body-part specific (i.e. hand and arm) theta ERS (125-225 ms) and a theta ITPC (25-225 ms) increase over the same electrodes. In line with recent findings of categorical organization of neural responses to human effectors in the lateral occipital cortex, the present results suggest that frequency modulations over occipito-parietal cortices associated to perception of body effectors may support a segregated processing fate of these body districts.

51 Dynamics of brain oscillations during Bayesian perception

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In human brain, previously acquired knowledge interacts with novel information. Consequently our percepts are shaped not only by observations, but also by expectations. Recent studies suggest that top-down and bottom-up information are integrated in a Bayes-optimal way. In our study we manipulated precision of sensory inputs and prior expectations, to examine their impact on behaviour and underlying oscillatory processes.
Twenty-four participants performed a face/house discrimination task in an MEG scanner. Clarity of the pictures (sensory information) was manipulated by adding random noise to their phase components. Probability of occurrence of the two stimulus categories (prior information) was altered over the course of the experiment. Individual structural MR images were acquired for source- analysis.
The impact of expectations on behaviour was higher for less visible pictures. Furthermore, more accurate sensory information led to enhanced post-stimulus gamma synchronization, whereas increased precision of expectations modulated predominantly pre-stimulus alpha/beta synchronization over occipital cortex.
Our findings suggest that humans are capable to learn implicit priors and integrate them with stimulus information in a Bayesian way. Dynamic causal modelling will shed further light on the interaction between sensory and prior information.

52 See the rhythm, hear the rhythm: Investigation of cross-modal phase entrainment

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Our sensory systems often receive asynchronous but related input, so that visible events often precede and cause subsequent sounds. The synchronization of neural oscillations in the auditory cortex induced by visual rhythmic stimulation is called cross-modal phase entrainment. We investigated the influence of this cross-modal phase entrainment on auditory gap detection performance in two experiments, using electroencephalography (EEG) in the first and magnetoencephalography (MEG) in the second. Listeners were presented with auditory-only and visual-auditory stimuli and had to detect short silent gaps that were systematically distributed with respect to the phase of a 3 Hz frequency-modulated tone. In the visual-auditory condition, the visual stimulation consisted of a Gaussian pulsating circle, which preceded the auditory tone and was presented either in or out of phase. We found that gap detection performance increased for the visual-auditory conditions relative to the auditory-only condition and accuracies were modulated by stimulus phase. Analysis of the power spectral density revealed spectral peaks at 3 Hz and the 6 Hz harmonic at the sensor level (EEG) and in visual and auditory regions of interest (MEG). ERP analysis on the sensor level and ERF analysis in the auditory ROI revealed higher amplitudes for detected gaps. Analysis of the power spectral density showed enhanced power in the auditory cortex during visual stimulation (MEG). We showed that cross-modal phase entrainment leads to enhanced gap detection performance and neural entrainment effects. Connectivity analysis between the visual and auditory cortices will be presented, aiming to identify the mechanism underlying cross-modal phase entrainment.

53 Increased functional connectivity between visual and auditory cortices in cochlear implant users

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Previous studies have reported that compared to normal hearing (NH) controls, cochlear implant (CI) users showed elevated activation in auditory cortex for visual stimuli processing as well as elevated activation in visual cortex for auditory stimuli processing. This observation is often interpreted as cross-modal reorganization of both visual and auditory cortices in CI users as a consequence of sensory deprivation and restoration. However, the temporal correlations between the auditory and visual system in CI users remains unexplored. We here investigated task-induced intra-modal functional connectivity between hemispheres for both visual and auditory cortices and cross-modal functional connectivity between visual and auditory cortices using functional near infrared spectroscopy in post-lingually deaf CI users and age-matched NH controls. Compared to controls, CI users exhibited decreased intra-modal functional connectivity between hemispheres and increased cross-modal functional connectivity between visual and left auditory cortices for both visual and auditory stimulus processing. Importantly, the difference between cross-modal functional connectivity for visual and for auditory stimuli correlated with speech recognition outcome in CI users. Higher cross-modal connectivity for auditory than for visual stimuli was associated with better speech recognition abilities, pointing to a new pattern of functional reorganization that is related to successful hearing restoration with a CI.

54 Theta power reflects deficient cognitive control during a visual-auditory attention-distraction task in mild cognitive impairment

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Theta oscillations reflect top-down cognitive control processes in fronto-temporo-parietal networks. Albeit mild cognitive impairment (MCI) in old adults is characterized by greater than normal decline in cognitive function, little is known about theta dynamics during cognitive control tasks. Consequently, we explored whether old adults with MCI differ from healthy matched controls in resistance to distraction related theta activity. To that end, task performance and EEG were recorded from 41 MCI and 41 healthy control participants, while completing a paired passive auditory oddball and active visual Go/NoGo task. Only correctly answered Go trials were analyzed as a function of the accompanying to be ignored auditory stimuli (conditions: Standard-Go, Deviant-Go and Novel-Go). Mixed ANOVAs revealed significantly fewer hits for MCI than healthy adults. RT was significantly longer in MCI than healthy adults only in Novel-Go condition. Nonparametric statistical mapping (as implemented in sLORETA) revealed greater theta (4-7 Hz) power difference between Novel-Go and Standard-Go conditions at right medial and superior frontal gyrus for MCI than healthy adults. Both groups showed higher theta power in the former than the later condition. Further, Novel-Go theta power relation with accuracy significantly differs between groups. Thus, while MCI showed a strong negative correlation (r= -0.57) at left superior temporal gyrus, healthy adults presented a mild positive correlation (r= 0.24) at left middle frontal gyrus. These results indicate that MCI compared with control participants show less efficient cognitive control, which may be reflected by stronger and more widely distributed theta activity when facing distraction from novel sounds.

55 Decoding across sensory modalities reveals common supramodal signatures of conscious perception

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An increasing number of studies point to the relevance of the engagement of fronto-parietal brain structures in mediating conscious sensory experience. While a majority of studies have been performed in the visual modality, it is implicitly assumed that similar processes are involved in different sensory modalities. However, the existence of a supramodal mechanism related to conscious perception has not been demonstrated convincingly so far. In this study we directly address this issue, by investigating whether neural correlates of conscious perception in one specific modality can predict conscious perception in a different modality.
We capitalized on recent methodological advances in multivariate decoding analysis in order to depict spatio-temporal features of brain functions. By these means, we were successful in characterizing supramodal spatio-temporal neural activity patterns related to conscious perception across all sensory modalities. Our results suggest the involvement of sensory and fronto-parietal regions as well as deep cortical structures, such as precuneus and cingulate gyrus. Most interestingly, these supramodal patterns included late activity in primary sensory regions not directly relevant to the task (e.g. neural activity in visual cortex predicting conscious perception of auditory near-threshold stimulation). Our findings reveal for the first time within one experiment a common signature of consciousness across modalities and provide important new insights for the understanding of conscious perception.

56 The effect of visual reminders of death on steady-state spectral responses

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The terror management theory suggests that thoughts of death activate an exclusive anxiety mechanism different from the one activated by other types of symbolic threats. This notion is mainly supported by evidence showing how experimental participants verbally reflecting on their own death are then influenced in their opinions and behaviours. In two studies we questioned whether images conveying death-related vs. more generic threat-related content had a preferential effect on brain activity measured by means of electroencephalography (EEG). Images were matched for ratings of valence and arousal. We adopted fast visual stimulation to identify an objective implicit steady-state cortical signature of death-threat perceptual discrimination. To improve the discrimination we used an oddball design with neutral images constituting the standard familiar events and the death or threat images the deviant event presented each five images per second. Images were delivered at fixed intervals of 200 ms, thus resulting in a base rate presentation of 5 Hz and a deviant rate of 1 Hz.

Capitalising on the high signal-to-noise ratio response obtained with this approach we found that threat-related images elicited greater response magnitude over the parieto-occipital scalp regions, thus rejecting the hypothesis of a preferential effect of visual reminders of death on visual brain responses.

This evidence does not support the notion of a dominant role of death-related visual content in the brain as compared to similar negative and arousing content.

57 The cognitive neuroscience of face perception: from similarity to identity

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What is a representation? Despite a great intensity of research in psychology, philosophy of mind, and neuroscience, there is still no comprehensive theory about the representational system that constitutes our mind. This study changes our understanding demonstrating that representational processes do not only depend on what is represented but also on how we represent it. We investigate the brain activations when recognising the identity of a person's face that go beyond the process of establishing similarity. In an identity condition two similar faces have to be identified as the same person in contrast to a control condition, in which the same kind of faces have to be recognised as belonging to similar looking twins. Our results demonstrate that identity processing engages a network of areas comprising the left TPJ, posterior precuneus, right STS/MTG, and a cortico-striatal-thalamic circuit involving the medial frontal cortex, suggesting that recollective and perceptual information about the encountered individual is integrated at a higher level. We introduce mental files theory to interpret understanding of identity as a linking of co-referential files which allows us to relate our findings to delusional misidentification syndromes and theory of mind. We put a new perspective on the representational nature of the human mind in normal and neurologically impaired subjects and aim to connect different domains of research under a common framework.

INFORMATION

VENUE

UNIVERSITÄT SALZBURG

University of Salzburg
NAWI
Hellbrunner Strasse 34
5020 Salzburg
Austria

Photo: Scheinast

HOW TO GET TO THE VENUE?

By car

Motorway A10 exit Salzburg Süd – in the direction Salzburg – go along Alpenstraße until you reach the crossroads into Michael-Pacher-Straße – follow straight ahead until you are directly in front of the Faculty of Natural Sciences.

Please have a look for parking lots along Michael-Pacher-Straße – (mind that this is a short-term parking zone for a maximum of 3 hours – please do not forget to place your parking disc well apparent in your car) or use the underground car park of the Faculty of Natural Sciences (to enter the car park please dial the mentioned phone number given directly at the entrance).

Parking areas near the NAWI:

Parkplatz Akademiestraße (15-minute-walk)
Parkplatz Petersbrunnhof (15-minute-walk)
Tiefgarage Unipark / Nonntal (10-minute-walk)
Tiefgarage Hypogarage (15-minute-walk)

Bus

Bus tickets can be purchased at kiosks, vending machines or if you directly ask the bus driver (which is a little more expensive). To find the perfect connections via public transport in Salzburg please use: https://salzburg-verkehr.at.

Bus stations near the venue:

- Faistauergasse (a 5-minute-walk, but the most frequented bus stop)
- Michael-Pacher-Straße (in front of the Faculty)
- Blocksbergstraße (some minutes to reach the Faculty)

How to get to the venue?

From the main train station (option 1):
Take the trolley bus line 3 until exit Josefiau (in the direction Salzburg Süd) and change busses to line 22 until exit Bocksbergerstraße.

From the main train station (option 2):
Take the trolley bus line 3 (directly for about 11 minutes, or by changing busses – therefore take line 8 from Mozartsteg) until exit Faistauergasse (in the direction Salzburg Süd) go along Faistauergasse, Mascagnigasse, Michael-Pacher-Straße (a 5-minute-walk maximum).

From the airport:
Take the trolley bus line 2 (in the direction of Salzburg City Center) until exit Hans-Schmid-Platz, change busses to trolley bus line 1 (in the direction of Salzburg Arena) until exit F.-Hanusch-Platz, again change busses to trolley bus line 3 (in the direction of Salzburg Süd). This line takes you directly to the exit Faistauergasse -walk along Mascagnigasse and Michael-Pacher-Straße – it takes you about 5 minutes to reach the Faculty of Natural Sciences.

Local supply

Supermarkets near the venue can be found in the Herrnau-Center (go along Michael-Pacher-Straße until you reach the crossroads into Alpenstraße, then go right along Alpenstraße until you reach the Herrnau-Center). Two supermarkets, a drugstore and a restaurant called Raschhofer are located there.

HOTELS

- Vila Roma
- Arcotel Castellani
- Motel One Alpenstraße

  If you walk it will take around 20 minutes. From the bus stop "Salzburg Polizeidirektion" you can take bus nr. 3 or 8 and go to the station „Josefiau" (1 station). Then it is only a 5-minute-walk to the Faculty of Natural Sciences.
- Austria Classic Hotel Hölle
- A&O Salzburg Hauptbahnhof

  By the trolly bus line 3 you can reach the University easily, as described above (arrive at the Faculty of Natural Sciences by public transport).
- Eduard-Heinrich Haus (hostel)

  If you walk it will take around 20 minutes. From the bus stop „Salzburg Herrnau" you can take bus nr. 3 or 8 and go to the station „Josefiau" (1 station). Then it is only a 5-minute-walk to the Faculty of Natural Sciences.

BARS/ RESTAURANTS

Some places we recommend to have a good Austrian meal:

- Bärenwirt (city centre)
- Raschhofer Herrnau (5-minute-walk from the venue)
- Kastners Schenke (city centre)
- Gasthof Überfuhr (15-minute-walk from the venue)
- Restaurant Stieglkeller (city centre)

To have a drink after the meeting we recommend:

- Mentor`s Bar
- The Dubliner Irish Pub
- Glüxfall Café – BarRepublic Café
- Wein & Co

SOCIAL EVENT

When: Friday, July 14th 2017, 19.00 - 23.00 o´clock
Where: "Klavierterasse" (at the NAWI)
How: EUR 25.- registration fee

The fee includes the costs for the buffet as well as two vouchers for drinks. There will be a bar open the entire evening where you can buy additional drinks at own expense.
Celebrations at the University will come to an end at 23.00 o´clock but can be continued in the city centre which is within walking distance of the University.

Please note that for organisational reasons registration is binding and valid only with transfer of the registration fee. You will get a confirmation of payment as soon as we have received the transfer. If you have transferred the fee but didn´t get a confirmation by July the 12th please contact the SAMBA organizers.

IMPORTANT

Please bring your name badge with you as is serves as an entry ticket to the event.