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The Centre for Cognitive Neuroscience (CCNS) at the University of Salzburg presents

the 2nd Salzburg Mind – Brain Annual Meeting, SAMBA 2018.

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PROGRAM

TIME	JULY 12	TIME	JULY 13
08:15	Registration & Coffee		
08:50	Opening Remarks		
09:00	Talk 1: Radoslaw Cichy Dynamics of visual cognition: A spatio-temporally resolved and algorithmically explicit account	09:00	Talk 7: Simon Eickhoff From large-scale inference on brain organization to single-subject predictions
10:00	Coffee Break	10:00	Coffee Break
10:30	Talk 2: Floris de Lange How is visual perception biased?	10:30	Talk 8: Saskia Haegens Oscillatory building blocks underlying perception & cognition
11:30	Short Break	11:30	Short Break
11:45	Talk 3: Andreas Wutz Neural oscillations influence how fast we see and how abstract we think	11:45	Talk 9: Katharina von Kriegstein Understanding what is said in human communication
12:45	Lunch	12:45	Lunch
14:15	Talk 4: Uta Noppeney Laminar BOLD profiles dissociate attentional and crossmodal influences in sensory cortices	14:15	Talk 10: Tamar Makin The neural fingerprints of a missing hand
15:15	Short Break	15:15	Poster Session
15:20	Talk 5: Anne-Marike Schiffer Introducing Nature Human Behaviour	17:15	Talk 11: James Haxby A computational model of shared fine-scale structure in high-dimensional cortical information spaces
15:45	Poster Session & Discussion with Anne-Marike Schiffer	18:15	Closing Remarks & Poster Awards
17:45	Talk 6: Kia Nobre Premembering Cognition	19:00	SOCIAL EVENT
20:00	SPEAKER DINNER		

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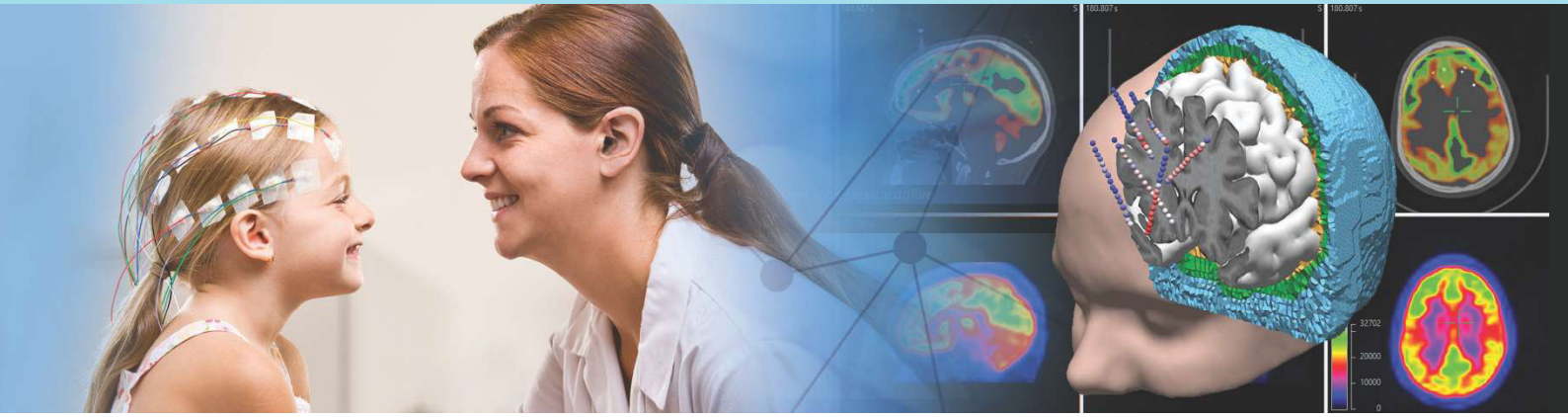

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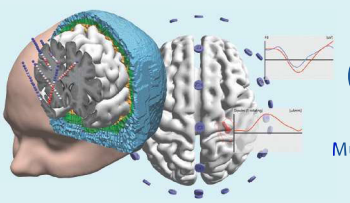

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TALKS

Talk 1: Dynamics of visual cognition: a spatio-temporally resolved and algorithmically explicit account

Radoslaw Martin Cichy

FU Berlin, Berlin, Germany

Understanding visual cognition in the brain requires answering three questions: what is happening where and when in the human brain when we see? In this talk I will present recent work that addresses these questions in an integrated analysis framework combining human magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI) and deep neural networks (DNNs). The talk has three parts. In the first part, I will show how fMRI and MEG can be combined using multivariate analysis techniques (classification plus representational similarity analysis) to yield a spatio-temporally integrated view of human brain activity during object vision (Cichy et al., 2014 NatNeuro). In the second part I will show how DNNs can be used to understand the human visual system. In one study, we showed that DNNs predicted the spatial-temporal hierarchy of the human visual system. In another study, we showed that representations of abstract visual properties, such as scene size, find an analogue in DNNs. In the third, shorter part, I will describe ongoing work and future directions.

Talk 2: How is visual perception biased?

Floris de Lange

Donders Institute for Brain, Cognition, and Behaviour, Nijmegen, Netherlands

Sensory signals are highly structured in both space and time. These regularities allow expectations about future stimulation to be formed, thereby facilitating perceptual decisions about visual features and objects. In my talk, I will discuss recent data that elucidate how temporal and spatial context change sensory computations in the visual system and modify perception and post-perceptual decision-making. I will also compare the effects of time and space with the effects of learnt statistical regularities on the neural and behavioral response.

Talk 3: Neural oscillations influence how fast we see and how abstract we think

Andreas Wutz

MIT, Cambridge, USA
University of Salzburg, Salzburg, Austria

The functional relevance of neural oscillation patterns for perception and cognition has become a hot topic for cognitive neuroscience. Here, I present two novel examples showing that different properties of neural oscillations (their frequency and power) shape our vision and our thought. Using whole-brain, human magnetoencephalography recordings, I first show that the frequency of occipital alpha oscillations (8-12 Hz) can be strategically speeded-up or slowed-down when visual task demands require temporal segregation vs. integration, respectively. These results demonstrate a novel top-down mechanism by which the brain controls the temporal resolution of visual processing. Second, I show intracranial multi-electrode recordings from prefrontal cortex (PFC) of non-human primates during a dot-pattern categorization task. The abstraction level was varied by the degree of spatial distortion of each exemplar from its category prototype. Low-distortion exemplars look alike (e.g. housecat) and can be judged based on sensory similarity (bottom-up). High-distortion exemplars require greater abstraction of the category's ''essence'' (e.g. animal) and thus more top-down thought. Gamma power (>40 Hz) in ventrolateral PFC signaled low-level categorization, whereas beta power (~20 Hz) in dorsolateral PFC signaled high-level category abstraction. In sum, these findings suggest that specific attributes of neural oscillations are informative about specific bottom-up and top-down aspects of perception and cognition.

Talk 4: Laminar BOLD profiles dissociate attentional and crossmodal influences in sensory cortices

Uta Noppeney

University of Birmingham, Birmingham, United Kingdom

In our natural environment our senses are constantly bombarded with a myriad of diverse signals. Where and how the human brain integrates signals from different senses is critical for our understanding of the cortical organization of sensory processing. Visual stimuli can directly drive and modulate BOLD responses to auditory stimuli in auditory cortices and vice versa in visual cortices. Yet, the neural mechanisms remain unknown. Multisensory influences on BOLD responses in early sensory cortices may rely on top-down attentional or sensory-driven mechanisms. Recent advances in high-resolution fMRI, allowing the characterization of laminar activation profiles, promise new insights into the information flow in cortical circuits, and can dissociate feed-forward vs. feed-back driven activations. We demonstrate that both highly salient visual looming stimuli and modality-specific attention directed to the visual (as compared to auditory) modality suppress BOLD-responses in auditory cortices. Yet, they do so with distinct laminar profiles. These results strongly imply that crossmodal and attentional influences in early sensory cortices rely on partly distinct neural mechanisms.

Talk 5: Introducing Nature Human Behaviour

Anne-Marike Schiffer

Associate Editor, Nature Human Behaviour

Launched in January 2017, Nature Human Behaviour is part of the Nature Research family of journals. Our aim is to publish research of outstanding significance into any aspect of individual and collective human behaviour. The journal's scope is thematic rather than discipline-based, drawing from a broad range of disciplines that span the natural and social sciences, including (but not limited to) psychology, neuroscience, genetics, evolution, anthropology, sociology, economics, and political science. Our goal is to strengthen the visibility and impact of the disciplines that study human behaviour, promote interaction among disciplines, and support robust scientific practices. In this presentation, I will discuss the scope and aims of the journal, how it relates to other highly selective journals, including Nature and the Nature Research journals. I will also discuss the editorial processes at Nature Human Behaviour and the other Nature Research journals (including Nature, Nature Neuroscience, Nature Communications, and Scientific Reports): I will explain what editors look for in the papers we want to publish, how we make decisions, and how to write a paper for submission to Nature Human Behaviour and other Nature Research journals.

Talk 6: Premembering cognition

Kia Nobre

University of Oxford, Oxford, United Kingdom

In my talk, I will discuss how the brain uses multiple time scales of experience to anticipate relevant events proactively and dynamically in order to facilitate the analysis and utilisation of information to guide adaptive behaviour.

Talk 7: From large-scale inference on brain organization to single-subject predictions

Simon Eickhoff

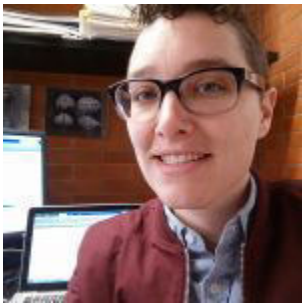
University of Düsseldorf, Düsseldorf, Germany
Research Center Jülich, Jülich, Germany

While neuroimaging and experimental psychology have long focussed on investigating average group effects or differences, there is currently a substantial shift in research objective towards individual, i.e., single-subject prediction. Relying on multivariate statistical learning methods and evaluated by their ability to correctly infer, e.g., clinical diagnoses or cognitive phenotypes in previously unseen subjects, individual predictions hold the potential to open new frontiers in basic and clinical neuroscience. In this talk, I will not only provide an overview on this emerging topic and examples of current potential and future directions, but in particular also highlight, why individual prediction should go hand in hand with large scale aggregation for the understanding of human brain organization. In particular, I will illustrate, that an improved mapping of brain regions and networks will be critical to advance machine-learning applications in brain research.

Talk 8: Oscillatory building blocks underlying perception and cognition

Saskia Haegens

Columbia University, New York, USA
Donders Institute for Brain, Cognition, and Behaviour, Nijmegen, Netherlands



In daily life, we receive a continuous stream of information. This sensory input has to be filtered and processed when relevant, while irrelevant or distracting input has to be suppressed. In my view, oscillations provide the scaffolding for information transfer, and understanding these oscillatory mechanisms is critical to understanding higher-level cognitive functions. The oscillatory building blocks I consider here, and their proposed mechanistic roles, are: (i) slow oscillations in the delta/theta bands (1–7 Hz), providing selective sampling of sensory input, (ii) the alpha rhythm (8–14 Hz), involved in active functional inhibition, and (iii) beta oscillations (15–30 Hz), forming transient, flexible neural ensembles. I study these oscillatory mechanisms in the context of attention and perceptual decision-making, using a combination of techniques including spike and LFP recordings, ECoG, MEG, and psychophysics.

Talk 9: Understanding what is said in human communication

Katharina von Kriegstein

TU Dresden, Dresden, Germany
Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Understanding what is said from auditory speech is one of the main tasks that the brain is faced with in human communication. Current neuroscientific models for speech processing mostly focus on auditory and language regions to explain speech recognition. However, our research has shown, that the brain uses even more complex processing strategies for recognising auditory speech, that is the recruitment of dedicated visual face areas, of voice-sensitive areas, as well as subcortical sensory thalamus structures. In my talk I will focus on the contribution of subcortical sensory thalamus structures to speech recognition. I will review neuroimaging findings from neurotypical participants as well as developmental dyslexics that suggest a major role of the sensory thalami in speech recognition. I will also integrate these findings into a novel view of how cerebral cortex areas interact with subcortical sensory pathway structures to optimise speech recognition.

Talk 10: The neural fingerprints of a missing hand

Tamar Makin

University College London, London, United Kingdom

Following arm-amputation, brain areas that previously operated the hand will be freed-up, and could potentially be "recruited" to work for other body parts. This process, termed brain plasticity, is widely held to result in the experience of phantom limb pain (pain that is perceived to be arising from the missing hand), and is therefore considered to be maladaptive. I will present evidence to challenge the proposed link between brain plasticity and phantom pain, and instead demonstrate that brain representation of the missing hand persists decades after amputation. Based on converging evidence in individuals with congenital or acquired hand loss, I will further show that the brain resources of the missing hand can be used by a multitude of body parts, and even artificial limbs. I will argue that brain reorganisation is not inherently harmful, and could be exploited for improving rehabilitation, with exciting opportunities for neuroprosthetics.

Talk 11: A computational model of shared fine-scale structure in high-dimensional cortical information spaces

James Haxby

Dartmouth College, Hanover, USA

Multivariate pattern analysis reconceptualizes cortical functional architecture as high-dimensional information spaces. This architecture is contained in fine-grained topographies of response tuning and functional connectivity patterns. We have developed a high-dimensional computational model of the structure in these response and connectivity topographies that is shared across brains. We derive this model with new algorithms called response hyperalignment and connectivity hyperalignment. Our model captures shared information as basis functions for response tuning and functional connectivity that are common across brains. These response and connectivity basis functions are instantiated in individual brains as multiplexed topographic basis functions that are specific to each individual brain. We developed this model using fMRI data collected while subjects watched meaning, dynamic naturalistic stimuli, namely movies, and during the resting state. In principle, the conceptual framework and computational structure could be applied to data from other methods for measuring brain activity, such as measuring population responses with single unit recording, MEG, or EEG. We are now investigating how to leverage this model for more sensitive analyses of individual differences in cortical functional architecture.

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POSTER ABSTRACTS

1 An electrophysiological index of temporal integration boundary crossing

Simon, J., Balla, V., and Winkler, I.

Research Centre for Natural Sciences, Budapest, Hungary

The aim of the present study was to identify an electrophysiological index of temporal integration boundary. Methods. EEG was recorded in passive listening while dichotic tone pairs were presented via headphones. The within-pair inter-stimulus interval (ISI) was parametrically varied from 25 to 75 ms. In the first experiment, the statistical context was also varied. The standard pair (60% occurrence) was either the pair with the shortest, longest, or middle ISI. In the second experiment, pairs with different ISIs were equiprobably presented and the two conditions differed in the ISI range. Results. In the first experiment, a qualitative change was observed between 55 and 65 ms ISI. This boundary showed a context effect as it was shorter in the condition dominated by short ISIs. A boundary was also identified in the second experiment; however, it was at a shorter ISI than in the first experiment. This boundary was not affected by the removal of the longer-ISI pairs, thus excluding the mean-ISI based explanation of context effects.

2 Body rhythms in concert? Integrity of circadian rhythms is related to the state of brain-injured patients

Blume, C., Angerer, M., Del Giudice, R., Trinka, E., and Schabus, M.

University of Salzburg, Salzburg, Austria

In healthy individuals, stability of the circadian sleep-wake cycle results in consolidated periods of conscious wakefulness and unconscious sleep. Circadian rhythms have therefore been suggested to contribute to consciousness levels in patient groups characterised by a relative instability thereof such as patients with disorders of consciousness (DOC) following severe brain injury. Going beyond earlier studies, we have adopted a systems-level perspective and assessed the joint predictive value of three circadian indexes of body temperature, melatonin and activity for DOC patients' behaviourally assessed state using multilevel modelling. Additionally, we have assessed whether patients' performance varies with time of day or the time offset from the body temperature maximum, that is when cognitive performance is expected to peak. We find that a higher integrity of the circadian melatonin and temperature rhythms predicts a better state of patients. Moreover, higher scores are predicted by less deviation from the pre-specified time of occurrence of the body temperature maximum (median at 2:25pm) and higher CRS-R scores are associated with later daytime. In conclusion, results suggest that therapeutic approaches should aim at improving circadian rhythms in brain-injured patients and diagnostic procedures should be scheduled around the preassessed body temperature maximum.

3 Phasic and sustained performance enhancement by combining multisensory interplay and temporal expectation

Ball, F. and Noesselt, T.

Otto-von-Guericke-University, Magdeburg, Germany

Every moment organisms are confronted with complex streams of information which they use to generate a reliable mental model of the world. There is converging evidence for several optimization mechanisms instrumental in integrating (or segregating) incoming information; among them are multisensory interplay (MSI) and temporal expectation (TE). Both mechanisms can account for enhanced perceptual sensitivity and are well studied in isolation; how these two mechanisms interact is currently less well-known. Here we tested in a series of four psychophysical experiments for TE effects in uni- and multisensory contexts with different levels of modality-related and spatial uncertainty. We found that TE enhanced perceptual sensitivity for the multisensory relative to the best unisensory condition (i.e. multisensory facilitation according to the max-criterion). In the latter TE effects even vanished if stimulus-related spatial uncertainty was increased. Accordingly, computational modelling indicated that TE, modality-related and spatial uncertainty predict multisensory facilitation. Finally, the analysis of stimulus history revealed that matching expectation at trial n-1 selectively improves multisensory performance. Together, our results indicate that the benefits of multisensory stimulation are enhanced by TE especially in noisy environments, which allows for more robust information extraction to boost performance on both short and sustained time ranges.

4 The effect of outliers and their exclusion on resting-state connectivity-based parcellation

Reuter, N., Genon, S., Kharabian, S., Eickhoff S., and Patil, K.

Research Center Jülich, Jülich, Germany

Regional connectivity-based parcellation aims to find biologically meaningful parcels or subregions. This is achieved by clustering the voxels in a region of interest based on their connectivity profiles. Using a large resting-state fMRI sample, we show that deviant connectivity profiles substantially influence group-based clustering results. Such outliers can arise due to various reasons and we investigated one possible reason for high dimensional data: difference in intrinsic dimensionality.

5 Perceptual expectations of object stimuli modulate repetition suppression in a delayed repetition design

Kronbichler, L., Said-Yürekli, S., and Kronbichler, M.

Neuroscience Institute, PMU, Salzburg, Austria

Several fMRI and EEG/MEG studies show that repetition suppression (RS) effects are stronger when a stimulus repetition is expected compared to when a stimulus repetition is less expected. To date, the prevalent way to assess the influence of expectations on RS is via immediate stimulus repetition designs, that is, no intervening stimuli appear between the initial and repeated presentation of a stimulus. Since there is evidence that repetition lag may alter RS effects in a qualitative manner, the current study investigated how perceptual expectations modify RS effects on object stimuli when repetition lag is relatively long. Region of Interest analyses in the left occipital cortex reveal a similar activation pattern as identified in previous studies on immediate lag: RS effects were strongest when repetitions were expected compared to decreased RS effects when repetitions were less expected. Therefore, the current study expands previous research in two ways: First, we replicate prior studies showing that perceptual expectation can be observed in object-sensitive occipital areas. Second, the finding that expectation effects can be found even for several-minute lags proposes that bayes inference processes are a relatively robust component in visual stimulus processing.

6 Characteristics and behavioral relevance of neural activity truncation by image familiarization

Manahova, M.E., Spaak, E., and De Lange, F.P.

Donders Institute for Brain, Cognition, and Behaviour, Nijmegen, Netherlands

Recent studies have proposed that image familiarization leads to a rapid truncation of neural activity in visual cortex for familiar visual input. It has been put forward that the function of this rapid truncation might be to put neurons in a state of readiness to respond to new input. Here, we test this hypothesis by presenting participants with rapid streams of familiar or novel input at different speeds of presentation. We investigated whether signal truncation was dependent on presentation speed and examined whether this phenomenon bore relationship to participants' ability to detect target items within a stream of visual input. Pilot data suggest truncation of neural signals for familiar input and strong benefits of image familiarization for visual detection of targets. The interrelationship between these two phenomena will be discussed.

7 Predictability of salient distractor increases top-down control in healthy younger and older adults

Haupt, M., Sorg, C., and Finke, K.

Ludwig-Maximilian-University of Munich, Munich, Germany

In younger adults, visual attention functions can be altered by preparation effects, such as prior expectancy about upcoming distractor locations induced by spatial cues. It is controversial if such preparation effects also affect visual attention functions in normal aging. The present study addresses preparation effects on top-down control in healthy younger and older adults. The individual degree of top-down control can be assessed in a partial report of letter arrays based on the Theory of Visual Attention. In our study, we combine a partial report with rapid-onset cues that enhance the saliency of upcoming information at the indicated position and measure the ability to prioritize targets over distractors. The probability that the cue indicates the distractor varies over experimental blocks (33.3 vs. 66.6%). We assess whether predictability affects the degree of top-down control and whether this effect is modulated by normal aging. The results show that the ability to predict an upcoming salient distractor leads to decreased distractor weighting and that this ability is preserved in normal aging. Hence, the results suggest that healthy younger and older adults can use prior expectancies to shield against irrelevant information.

8 Detailing the electrocortical signature of emotion processing: a systematic comparison between faces, gestures and scenes

Kenter, A., Flaisch, T., and Schupp, H.T.

University of Konstanz, Konstanz, Germany

Previous research consistently observed that the processing of emotional compared to neutral pictures is associated with an increased early posterior negativity (EPN) and late positive potential (LPP) with differences in amplitude, topography, and latency for different stimuli. Here, we used high-density EEG to compare the EPN and LPP elicited by faces, gestures and IAPS images. In addition, we investigated the influence of the stimulus context in which these images are presented. Participants viewed negative and neutral pictures from all stimulus classes, which were either presented in separate blocks, or in an intermixed block containing images from all classes. When viewed in isolation, emotional EPN and LPP effects were observed for all stimulus classes. However, differences in latency and topography emerged. Specifically, for the EPN, faces showed the earliest onset (140ms), followed by IAPS pictures and gestures (220ms). For the LPP, faces and IAPS pictures displayed earlier latencies (300ms) than gestures (480ms). Compared to gestures and faces, emotional ERP effects were largest for IAPS images, which also showed a distinctly more posterior topography. When presented intermixed, faces only showed an EPN, but no LPP modulation. Differences in amplitude, topography, and latency are discussed with respect to a network model of emotion.

9 Pre-stimulus gamma power predicts response in downstream areas

Van Es, M.W.J. and Schoffelen, J.M.

Donders Institute for Brain, Cognition, and Behaviour, Nijmegen, Netherlands

The efficiency of information transfer in activated brain networks may affect behavioral performance. Gamma-band synchronization has been proposed to be a mechanism that facilitates neuronal interactions. In line with this, it has been shown that strong gamma band activity in visual areas leads to faster responses to a visual go cue. We investigated whether there are directly observable neuronal consequences of trial-by-trial fluctuations in non-invasively observed gamma activity. Specifically, we hypothesized that the amplitude of the visual evoked response to a go cue can be predicted by gamma-band activity just prior to the go cue. Subjects performed a visual speeded response task during MEG recording. They had to respond to a stimulus reversal of a moving grating. We estimated the effect of pre-stimulus gamma power on the ERF amplitude, using a general linear model. We confirmed that visual gamma power predicts reaction times (DOI: 10.1016/j.neuroimage.2010.03.041). We found no correlation between gamma activity and the amplitude of early visual activity. However, high gamma power did lead to a stronger response in motor areas, suggesting that gamma synchronization in visual areas affects the response in downstream task-relevant areas.

10 The time course of object location representations depends on clutter

Graumann, M., Ciuffi, C., and Cichy, R.M.

FU Berlin, Berlin, Germany

The prevailing view of the ventral visual system is that object representations tolerant to particular viewing conditions such as location in the visual field emerge in high-level visual area IT, whereas object properties particular to the viewing situation are represented in low-level visual areas. Here, we investigated the processing of object location and category and its dependence on the nature of the background of the visual scene in the human brain using EEG and multivariate pattern classification. The rationale was that the latency with which object category and location representations emerge in the human brain indicate the processing stage in the ventral visual stream at which they emerge. In the experiment, participants (N=27) viewed object images from four different categories, in four different locations displayed in three background conditions (high-, low-, and no-clutter). We found that representations of object location emerged 100 ms later in time when objects were presented on cluttered backgrounds. Further analysis comparing the temporal dynamics with which location representations emerged in the clutter- vs. no-clutter condition revealed similar representations shifted in time, rather than different representations. Our findings suggest that under more realistic viewing conditions, object location is represented in later processing stages.

11 Interactive effect of menstrual cycle and dopamine baseline levels on brain activation and functional connectivity during an n-back task

Hidalgo-Lopez, E. and Pletzer, B.

University of Salzburg, Salzburg, Austria

Female sex hormones interact with dopamine (DA), which relates to executive control functions in an 'inverted u-shaped' manner. Given the different optimum levels for different functions; cognitive performance, brain activation and connectivity are expected to change along the menstrual cycle, related to individual DA baseline levels. Accordingly, it has been demonstrated that working memory and activation in the DLPFC are enhanced or impaired during the pre-ovulatory phase depending on DA baseline levels. In the present study we seek to extend these findings to changes in brain connectivity patterns. 38 women completed three fMRI sessions time locked to their menstrual cycle. During each session women performed a verbal N-back task as measure of working memory. Spontaneous eye blink rate (EBR) was recorded during menses as an indirect measure of striatal DA levels. Saliva samples were collected before and after the session in order to analyse hormonal levels. Menstrual cycle dependent changes in activation and connectivity of the MFG during targets was modulated by EBR, related to progesterone levels. MFG activation and connectivity during lures were modulated only by cycle phase irrespective of EBR. Other brain areas associated to executive functions also showed menstrual cycle modulation, related to estradiol levels.

12 Evaluating speech comprehension in patients with disorders of consciousness: towards an optimized paradigm for N400-effect elicitation

Waibel, A.M., Czypionka, A., Spiteri, S., Hassa, T., and Eulitz, C.

University of Konstanz, Konstanz, Germany

Patients with severe head trauma in post-comatose states often cannot overtly communicate. Two central questions for therapy are: (1) Is speech processing intact? (2) Will the patients regain consciousness? Event-related potentials provide insight into a patient's cognitive processing without requiring an overt response. Prior research has shown that the N400-effect is predictive of recovery. However, in search for paradigms to elicit reliable N400-effects in healthy single subjects, the best reported hit rate we found was 50%. The present study was aimed to maximize a possible N400-effect. The final words of semantically congruous and incongruous spoken German sentences were selected based on cloze probability and acceptability ratings, as well as matched on linguistic parameters (length, word class, countability, phonological properties, concreteness, animacy). We were able to measure an N400-effect in 13 out of 14 healthy individuals, and 3 out of 3 brain-damaged, but communicative patients. This is a considerable improvement of the detection rate in healthy subjects compared to previous studies. On top of these data, we will present more data from brain-damaged, but communicative patients, as well as patients with disorders of consciousness to describe the chances and limitations of the optimized paradigm in more detail.

13 Spatial hearing: from acoustics to cognition

Majdak, P. and Baumgartner, R.

Austrian Academy of Sciences, Vienna, Austria

Human listeners need to permanently interact with their three-dimensional (3-D) environment and, to this end, require efficient perceptual mechanisms to evaluate auditory spatial information. Spatial hearing is particularly important to monitor the environment for interesting or hazardous sounds and to selectively attend to them. In this contribution, we discuss the links between cognition, acoustics, neurophysiology, and psychophysics required to create spatial representations of the 3-D auditory environment. We briefly describe the acoustic signals available at our ears and discuss the spatial information they convey. We look into neurophysiology, pointing to the neural substrates of auditory spatial processing, as well as elaborate on psychophysical spatial tasks and percepts. Finally discuss recent cognitive concepts for creating internal models of the complex auditory environment.

14 Affective processes of reading in patients with juvenile myoclonic epilepsy- preliminary results

Rainer, L.J.[1,2], Trinka, E.[2], Kuchukhidze, G.[2], Höfler, J.[2], Schmid, E.[2], Kirschner, M.[2], Kronbichler, M.[1], and Braun, M.[1]

[1]University of Salzburg, Salzburg, Austria
[2]Neuroscience Institute, PMU, Salzburg, Austria

Aim: The study on patients with juvenile myoclonic epilepsy (JME) aims to investigate whether JMEs, their siblings and healthy controls show differential hemodynamic activation by processing single words, reflecting either a discrete emotion (fear) or an affective dimension (negativity), and furthermore, if this processing is located at different hierarchical levels in the sense of Panksepps hierarchical emotion model (Panksepp. In: Affective Neuroscience. Oxford University Press, New York, 1998). Method: The design of this study is prospective cross-sectional. We will recruit about 100 patients and 100 controls, of which 50 controls would be first-degree relatives of patients with JME and 50 healthy controls. All participants will be above 18 years of age. All individuals will complete a sentence-reading test to assess reading proficiency and afterwards perform a lexical decision task (LDT) in the fMRI-scanner. Results: As JMEs show impairments in emotion recognition, empathy (Jiang et al., Epilepsy & Behavior 2014; 34:139-144) and social cognition (Realmuto et al., Epilepsy & Behavior 2015; 47:98-103) we were interested in the potentially different processing of emotional content of words and the brain regions involved by JMEs and their siblings compared to healthy controls.

15 Beauty and the brain

Pazhoohi, F., Arantes, J., Sampaio, A., and Pinal, D.

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Whether the beauty is in the brain of the beholder has recently attracted scientific interest. Previous behavioural studies showed that the waist-to-hip ratio (WHR) in the feminine body and shoulder-to-hip ratio (SHR) in the masculine body are considered to be crucial features affecting attractiveness. Nevertheless, the dynamics of brain activation reflecting attractiveness are still unclear. Thus, in order to shed light in this topic EEG and behavioural responses of 50 healthy young participants were assessed in two different experiments in which they have (a) to judge the attractiveness of female realistic avatars with three different WHRs (0.6, 0.7 and 0.8); and (b) to judge the attractiveness of male realistic avatars with three different SHRs (small, medium and large). Behavioural results showed that WHRs of 0.8 in females were considered less attractive and received quicker judgments than the other WHRs, while large SHRs in male avatars were considered the most attractive. EEG analyses of canonical frequency bands power and event-related spectral perturbation at the moment of avatars presentation and of rating scale onset are being conducted at the moment. Special emphasis will be made on alpha band (8-12 Hz) given its relation with attention.

16 Spontaneous action initiation with temporal constraints on the response time

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The Readiness Potential (RP) is a slowly increasing surface-negative cortical potential that precedes spontaneous voluntary movements. A recent interpretation provided by the Stochastic Decision Model (Schurger, 2012) suggests that this slow buildup could be the result of event-locked averaging of ongoing sub-threshold fluctuations in neural activity. In particular, the model predicts that movement is more likely to happen at a 'crest' in these ongoing fluctuations, and less likely at a trough. In classical RP studies subjects are instructed that they have an unlimited amount of time in which to perform the movement. We developed a new experimental paradigm in order to investigate the effect of varying amounts of temporal freedom on the shape of the RP/RF (Readiness Field, for MEG recordings). We perform a variant of Libet's (1983) task to investigate parametric variations of the shape of the Readiness Potential/ Field under temporal uncertainty. Our main prediction is that the movement-preceding activity will appear to begin earlier, and be more prominent in the time-locked average, as the window of time within which the subject is allowed to move becomes longer. The temporal constraint is predicted to affect the Early but not the Late component of the RP/ RF.

17 Perceptual decision making is supported by a hierarchical processing cascade, in both biological and artificial neural networks

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Models of perceptual decision-making have historically been designed bottom-up: maximally explain behaviour and brain activity, independent of task performance. Recently, hidden activity states within performance-optimised models have been shown to correlate with the neural responses elicited by images: offering a complementary top-down approach. In the present study, we test how well such top-down models can account for the spatio-temporal organisation of neural responses elicited by ambiguous visual stimuli. Forty-six participants made perceptual decisions on briefly flashed symbols, spanning a letter<->digit continuum. Stimuli had 7 orthogonal properties, ranging from low-level sensory (e.g. spatial location) to higher-level perceptual (letter vs. digit decision) features. Magneto-encephalography decoding analyses revealed that these 7 levels of representation are sequentially encoded along the cortical hierarchy, and actively maintained until the subject responds. This hierarchy was not well captured with a normative, drift-diffusion, or 5-layer convolutional neural network (CNN) optimised to categorise alpha-numeric characters. But it partially matched the sequence of activations of 3/6 state-of-the-art CNNs trained for natural image labelling (VGG-16, VGG-19, MobileNet). Overall, the results inform our understanding of the cognitive architecture supporting perceptual decision-making, and strengthen the notion that performance-optimised algorithms can converge towards the computational solution implemented by the human visual system.

18 Frequency-specific codes of auditory working memory in humans

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Frequency information is shown to be parametrically coded in frontal regions during working memory (WM) retention. Non-human primate electrophysiology and human EEG studies have furthermore indicated that this parametric representation is independent of stimulus modality, suggesting that quantitative information is encoded in frontal brain regions in a supramodal manner. Additionally, recent fMRI multivariate pattern analysis (MVPA) studies have revealed an overlapping multimodal network for the maintenance of visual and tactile frequency information over a frontoparietal network. The current study extends the investigation for WM maintenance of frequencies to the auditory domain. To this aim, we used MVPA on fMRI data that was collected during a WM task for auditory frequencies. Our support vector regression analysis revealed frequency representations in secondary auditory areas and, consistent with the earlier findings of parametric WM, in frontal and parietal brain regions. A direct comparison to a vibrotactile parametric WM dataset that used the same experimental paradigm revealed an overlap of information coding in prefrontal regions. Thereby our findings reveal further evidence that the prefrontal cortex represents frequency-specific WM content irrespective of the modality.

19 Investigating the role of prediction in trans-saccadic perception: the peripheral preview effect for the fixation-locked N170

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One explanation for the world's stable appearance despite saccadic eye movements is that the efference copy of the motor plan enables predictions about what will be perceived after the saccade. If so, a violation of this prediction should be detrimental to post-saccadic perceptual processing, and the resulting prediction error signal should be modulated by the frequency of a prediction violation. In Experiment 1, participants made cued saccades to one of two lateral upright and/or inverted faces. During the saccade, the faces could change their orientation (invalid) or remain the same (valid preview). Valid previews led to a behavioral benefit (RT, accuracy) and a significant reduction in fixation-locked P1, N2, and N170 components, demonstrating a general preview reduction that is consistent with a prediction error signal. In Experiment 2, we replicated these findings while also manipulating the proportion of valid and invalid trials within blocks. Interestingly, the proportion manipulation did not affect behavioral responses or the magnitude of preview reduction in the fERP. Evidence for the absence of this effect was provided by a whole-scalp Bayes factor analysis. This pattern of local (across one saccade) but not contextual (across trials) effects constrains theories about the role of prediction in trans-saccadic perception.

20 Brain functional connectivity signatures of neuropathic pain-induced depression in a preclinical model

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Chronic pain disorders are associated with high prevalence of depression which points to a link between two pathologies; although the underlying mechanisms remain elusive. As a translational approach, preclinical MR imaging offers a unique opportunity to reliably establish causal relations between the pathological conditions and brain function in vivo. In this study, we used a mouse model of neuropathic pain to investigate affective consequences of chronic pain. We performed behavioural assessments as well as resting-state fMRI and our results show a remodelling of functional connectivity in regions belonging to default-mode network and the reward system in mice with pain-induced depression.

21 Filtered white noise stimulation on tinnitus perception and related oscillatory brain activity

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Tinnitus is the perception of a sound without an external source. Several different treatment approaches exist, but due to the heterogeneity in phenotype and etiology, the achieved effects are very variable. Acoustic stimulation with broad-band noise or filtered noise was shown to be a promising approach to suppress tinnitus temporarily by effects termed residual inhibition and lateral inhibition. However, little is known about the effect of various filter-techniques deployed to white noise on neural activity. Herewith, we want to overcome the limitations of previous acoustic stimulation studies, namely a lack of neurophysiological measurements, by conducting electroencephalography simultaneously to filtered white noise stimulations. By the use of bandpass and bandstop filters applied at patient's individual tinnitus frequency we are not only examining their effects on tinnitus suppression in general, but also their consequences on ongoing brain activity to identify possible oscillatory markers of residual inhibition and lateral inhibition. Preliminary results will be presented.

22 The effects of regular sports exercise on human brain structure

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A growing body of neuroscience research has evidenced the beneficial effects of physical activity on diverse aspects of human cognition and mental health. In this magnetic resonance imaging study we investigated the influence of regular sports exercise on brain structure. Specifically, we used Voxel-Based Morphometry in order to compare gray and white matter volume in 82 healthy adult participants who had or had not engaged in regular sports activities in the last four weeks before brain scanning. Higher gray matter volume in the sports group compared with the no-sports group was identified in the somatosensory cortex, whereas lower gray matter volume in the sports group compared with the no-sports group was identified in the angular gyrus. Regarding white matter, higher volume in the sports group compared with the no-sports group was identified in the bilateral corticospinal tract connecting the motor/somatosensory cortex to the motor neurons and interneurons in the spinal cord. No regions exhibited the opposite effect, that is, lower white matter volume in the sports group compared with the no-sports group. The results of the present study may provide further insight into the structural neuroanatomical basis underlying the effects of physical activity on human cognition and mental health.

23 Fluid intelligence predicts novel rule implementation in a distributed frontoparietal control network

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Fluid intelligence has been associated with a distributed cognitive control or multiple-demand (MD) network, comprising regions of lateral frontal, insular, dorsomedial frontal and parietal cortex. Human fluid intelligence is also intimately linked to task complexity, and the process of solving complex problems in a sequence of simpler, more focused parts. Here, a complex target detection task included multiple independent rules, applied one at a time in successive task epochs. Though only one rule applied at a time, increasing task complexity (number of rules) impaired performance in participants of lower fluid intelligence. Accompanying this loss of performance was reduced response to rule-critical events across the distributed MD network. The results link fluid intelligence and MD function to a process of attentional focus on the successive parts of complex behavior.

24 Theta:gamma phase coupling is associated with the fidelity of mental templates in visual perception

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Transient theta:gamma phase coupling around 150 ms post-stimulus in parieto-occipital cortices has been proposed as brain oscillatory correlate of matching bottom-up sensation and top-down prediction (i.e., mental templates held in working memory) in visual perception. Here, we investigated theta:gamma phase coupling as a function of template fidelity. To this end, we recorded EEG during a target identification task, in which participants learned to form increasingly concrete predictions about an upcoming target symbol, which were to be compared against a test symbol (match vs. nonmatch). Afterwards, participants were asked to sketch the learned targets in an unannounced free recall drawing task. Our results indicate that participants improved in the correct identification of test symbols from the first to the second test half. Larger performance increments were associated with higher template drawing fidelity. Against our expectations, this improvement was not accompanied by stronger matching-related theta:gamma phase coupling in the second test half. However, stronger matching-related theta:gamma phase coupling in half two 150-300 ms post-stimulus localized to visual area V2 was correlated with higher fidelity of template drawings. These results suggest that theta:gamma phase coupling may serve as general mechanism of template-to-input matching, which reflects the fidelity for mental templates in visual perception.

25 fMRI decoding of working memory representations of individual and grouped tactile stimuli

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Everyday stimuli are often embedded within a larger context, yet much of the research on working memory (WM) employs context-less stimuli. Previous work in monkeys explored the WM representations of visual and tactile groups of stimuli, a step towards larger context, identifying group-related information in the frontal eye fields (FEF) and lateral intraparietal regions (LIP). The present study extends this research to humans using whole-brain, multivariate analysis. We collected fMRI data from 24 participants while they performed a delayed-match-to-sample task consisting of two blocks. In the stimulus block, participants remembered the presented stimulus, whereas in the group block they remembered the stimulus and the associated group member. Groups were arbitrarily predefined and randomly assigned. A cross-validation scheme determined stimulus and group-specific information-supporting regions during the WM delay. We identified stimulus-specific information across a frontoparietal network including the human FEF, LIP and right inferior frontal gyrus. Group-specific information was limited to the precuneus, left middle and superior frontal gyri and right supramarginal gyrus. A conjunction of the two analyses indicated overlapping information in the precuneus. Therefore, whether stimuli are retained as individuals or as members of arbitrarily defined groups affects the network of brain regions encoding corresponding information in WM.

26 Classification of depression based on resting state fMRI dynamic functional connectivity

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Resting state fMRI (rs-fMRI) functional connectivity (FC) patterns have recently gained popularity for classification of Major Depressive Disorder (MDD). In this work, we used rs-fMRI data from three different sites to classify MDD patients vs. healthy controls (in total 269 subjects per group, age-sex matched). Preprocessing and denoising was implemented using CONN toolbox [1]. We adapted three different classification pipelines that extract informative dynamic FC (dFC) features for classification and compared the results with static FC (sFC)-based cross-validated classification. Dynamic FC was calculated using tapered sliding time window correlation. Two of the methods utilized k-means clustering to identify dFC states [2, 3] and employed regression and Euclidian distance to sFC matrices for feature extraction respectively. Other method utilized Root-Mean-Square as a feature extracted from dFC signal between each ROI augmented with 2-step feature selection algorithm [4]. We tested all pipelines on three different sites using both within and cross site classifications. The best predictive accuracy was 70% and 60.6% for within and cross site classification respectively. Our results did not show an advantage of dFC over sFC in terms of classification performance. However, this is probably due to the complex nature of MDD and the high dimensionality of the data.

27 Modulation of selective attention and its lapses in the auditory and visual cortex

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The essentials of human communication are the appropriate recognition, processing and reaction to external stimuli. The brain has the important job to extract relevant information from the environment. Previous studies have shown that certain oscillations align to external stimuli in order to process the received information. This certain reaction of the brain is called oscillatory entrainment. Furthermore, sometimes the brain fails to perceive presented stimuli although the attention was drawn to them. To investigate the dynamics of oscillatory entrainment and these attentional lapses, an experiment was conducted where participants had to perform a selective intermodal attention task. Beeps and a flickering circle were presented simultaneously with a repetition rate that corresponded to the frequency of delta oscillations. Subjects had to draw their attention to one of the stimulus stream and detect targets (either the beep was higher, or the flickering circle was brighter). We computed the inter-trial coherence for attended and not attended stimulus streams and found a higher inter-trial coherence for stimuli where the attention was drawn to, suggesting that attention modulates entrainment. Additionally, the neuronal dynamics of attentional lapses will be discussed.

28 Implicit temporal predictability enhances auditory pitch-discrimination sensitivity

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Here, we studied whether and how human listeners exploit strictly implicit temporal contingencies in an auditory pitch discrimination task. We presented tone pairs (standard and probe) embedded in white noise. Critically, and unbeknownst to participants, the standard pitch could be deterministically predictive of the time of occurrence of the probe pitch, or have no predictive value. Both conditions were presented interleaved in one stream, and separated by variable inter-stimulus intervals such that there was no dominant stimulus rhythm throughout. Pitch discrimination sensitivity (assessed via the slope of the psychometric function) increased when the onset of the target tone was predictable in time. In the concurrently recorded EEG data set, we found that the standard tones which initiated predictions evoked a more negative N1 component than non-predictive standards. Furthermore, predictive standard tones evoked a more efficient delta phase reset, which in turn was related to pitch discrimination sensitivity. In sum, the data show that even if a sensory task does not require timing explicitly, human listeners exploit and utilize implicit non-rhythmic temporal contingencies. The EEG results provide evidence for a role of slow neural oscillations in governing temporal prediction, even for single temporally predictive intervals.

29 Human oculomotor system codes somatosensory choices independently of sensory inputs and motor outputs

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Decision making in the somatosensory domain has been studied intensively using vibrotactile frequency discrimination tasks. Results from human and nonhuman primate electrophysiological studies from this line of research suggest that perceptual choices are encoded within a sensorimotor network. These findings, however, rely on experimental settings in which choices were coupled to the sensory and motor components of the task. Here, we devised a novel version of the vibrotactile discrimination task with saccade responses. This variant of the task has the crucial advantage of decoupling perceptual choices from sensory and motor processes. We recorded fMRI data from 32 human subjects while they performed the task. Using an assumption-free, whole-brain searchlight multivariate classification technique, we identified the left inferior prefrontal cortex and the oculomotor system, including the bilateral frontal eye fields (FEF) and intraparietal sulci, as encoding perceptual choices. Moreover, we showed that the amount of choice information in the right FEF were strongly linked to the performance behavior. Not only are these findings in substantial agreement with previous work, they also provide unambiguous evidence for a choice coding property in the oculomotor system, which is not limited to motor decisions, but pertains to situations where abstract perceptual are made.

30 Pre-stimulus connectivity patterns predict perception at binocular rivalry onset

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Binocular rivalry is a powerful tool for studying the neural correlates of visual attention and perception. When two stimuli are presented dichoptically in a controlled setting, people report seeing one dominant percept at a time rather than a combination of the two stimuli. In a MEG study, I show that pre-stimulus connectivity patterns in category-sensitive brain regions could predict participants' percept of a face or a house at the onset of binocular rivalry. Additionally the percept can be very reliably decoded from post-stimulus evoked responses.

31 Interference in the retrieval of lexical and arithmetic knowledge modulates common brain regions: evidence from fMRI

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Interference control (IC) plays a crucial role in retrieving correct information from semantic long-term memory. Previous studies mainly focused on IC during the processing of lexical information. However, to date, no study has investigated whether IC during the retrieval of arithmetic facts draws upon similar or different brain mechanisms. To answer this question 46 students worked on two verification tasks during fMRI: the operand-related-lure paradigm (OR) was used to investigate brain activation associated with arithmetic interference and the picture-word paradigm (PW) was applied to examine lexical interference. In the OR paradigm participants had to verify the correctness of a given solution to a single-digit multiplication problem. In the PW paradigm, participants had to judge whether a presented word matches the concept displayed in a picture or not. Analysis of the OR paradigm showed that resolving arithmetic interference is accompanied by activation of a widespread fronto-parietal network, similar to previous findings related to IC. Conjunction analyses confirmed the involvement of the left inferior frontal gyrus and left intraparietal sulcus in both tasks. These findings not only indicate that IC plays a crucial role in arithmetic fact retrieval but also it is supported by common brain regions across semantic domains.

32 Oink piggy oink a biomarker for preserved sound localization capacities in cochlear implant users

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Acting in a multisensory environment, it is predominantly the auditory cues which direct attention to relevant targets. While cochlear implants have been optimized for language comprehension the localization of sounds and thus the control of attention by auditory cues has been largely neglected. However, cochlear implant users can have considerable sound localization capabilities that might be even improved by appropriate training strategies. Here, we present a novel multimodal training approach in which auditory stimuli coming from different spatial directions are paired with visual stimuli from the same direction. In each trial, the audio-visual stimulus is presented 4 times in a row. To infer localization performance, a fifth auditory only stimulus is presented, either from the same direction as the previous stimuli or from a different direction. Subjects have to indicate the sound direction by means of a pointing device. Depending on subjects' localization capabilities an EEG mismatch response can be recorded. Since in congenitally deaf the preferred age of implantation is below 2 years biomarkers that allow for the non-verbal inference of sound localization capabilities are needed. Moreover, in trainings of sound localizations a marker potentially sensitive to pre-conscious sound localization capabilities might be helpful for optimizing individual rehabilitation trainings.

33 On a heuristic for cross-frequency coupling: EEG analysis of a simple arithmetic task

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The synchronization of neural oscillations in different frequency bands (i.e. cross-frequency coupling) is a general mechanism for the coordination and integration of neural systems in different spatio-temporal scales. It has been proposed that constant changes in the center or "peak frequencies" within different frequency bands could maximize transient cross-frequency coupling or decoupling. This idea is based in the premise that a harmonic relationship between the peak frequencies of two neighbouring bands leads to a regular pattern of phase meetings and therefore, increases the probability of synchronization. However, it has not been tested yet whether transient changes in peak frequencies and, above all, their relationship, play a role in cognitive processing. In this EEG study, we assess the transient harmonicity (i.e. 1:2 ratio) between alpha and theta2 peak frequencies during an arithmetic task. We show that the proportion of time points in which alpha and theta peaks form a 1:2 ratio is significantly higher during arithmetic task (compared to rest) and correlates significantly with reaction time. We propose that the transient emergence of theta2 peaks in a harmonic position with respect to the alpha peak appear in task-relevant areas to facilitate selective information processing.

34 Ongoing alpha oscillations, visual perception and neural mechanisms: a formal model

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A growing body of evidence has shown that prestimulus M/EEG power and phase in the alpha band account for a significant portion of trial-to-trial variability in visual perception. However, up to now the neural mechanisms related to ongoing alpha activity are not fully understood; moreover, only few studies have investigated the effects of prestimulus oscillations by evaluating the full psychometric function, which provides valuable information on the functional mechanisms involved. In the present work we describe a formal model with the aim of exploring possible neural mechanisms associated with the effects of ongoing alpha activity on visual perception, by linking the response probability of sensory neurons with the psychometric function at the behavioural level.
We identified three possible mechanisms through which alpha activity may regulate sensory processing: it may alter (1) the amplitude of subthreshold oscillations, (2) the degree of synchronization, and (3) the input to sensory neurons. According to the model, each mechanism has a specific effect on the response probability function, by affecting (1) the slope, (2) the upper asymptote and (3) the threshold. Therefore, we hypothesized that selective modifications of the psychometric function could provide suggestions on the associated neural mechanisms, which cannot be distinguished non-invasively.

35 Brain oscillatory dynamics in the bottom-up/top-down balance of auditory attention: intracranial recordings

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Attention is a cognitive function that improves the processing of incoming information by enhancing relevant and filtering non-relevant information. This filtering relies on two types of processes: top-down and bottom-up processes. While these processes have been explored separately in previous studies, little is known on how these two processes interact at the level of brain oscillations. To explore this question, intracranial activity (sEEG) was recorded in 11 pharmaco-resistant epileptic patients performing a new paradigm measuring the interaction of these two processes. In this task, the presentation of a cue indicating (informative) or not (uninformative) the side of ear stimulation (i.e. an auditory target), triggers top-down attentional processes toward the target which was reflected by an alpha desynchronization in contralateral temporal electrodes. The occurrence of distracting sounds during the cue-to-target delay disrupted participant top-down attention, which was reflected by smaller alpha desynchronization and smaller gamma evoked activity during the post-target period in temporal electrodes suggesting a less efficient auditory processing of the target. These results suggest that top-down and bottom-up mechanisms dynamically interact and compete at the level of brain oscillations, which has an impact on the efficiency of information processing from our environment.

36 Attentional networks they are a-changing: age-related modulations of oscillatory patterns underlying top-down and bottom-up attention

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In this study we assessed how ageing affects top-down (TD) and bottom-up (BU) auditory attentional mechanisms and the balance between them. MEG data were collected from 14 elderly (mean age = 67) and 14 matched young (mean age = 25) healthy participants. Participants performed a modified version of the Competitive Attention Task in which they were required to discriminate the pitch of a target sound. TD attention was manipulated by a visual cue that was either informative or not of the side of the monaural target sound. BU attention was triggered by a binaural distracting sound that was played (25% of trials) between the cue and the target. Behaviourally, older participants' performances were comparable to the young group, except an exacerbated attentional capture by late distractors. Analysis of post-cue alpha activity demonstrated that with age top-down mechanisms are modified: while auditory alpha lateralisation is preserved, irrelevant (visual) information are filtered out to a lesser extent, and alpha peak frequency differences between cortical regions are less prominent. Moreover, distractor-induced gamma responses in frontal inhibitory regions were found reduced and TD modulated to a lesser extent with ageing.

37 Increased neural processing of trauma films increases subsequent intrusive memories only in individuals with a history of adverse events

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While many individuals experience a potentially traumatic event such as car accident or natural disaster during lifetime, only some develop posttraumatic stress disorder (PTSD). Research suggests that resilience, i.e., ability to function normally despite adversity, decreases with increasing number of lifetime adverse events (LAEs). This could imply that peri-traumatic cognitive processing that has previously been linked to PTSD development, may affect individuals differently, depending on the number of LAEs. Analogue research has shown that increased neural processing of trauma films in structures related to emotion generation/regulation and memory predicts subsequent intrusions, a hallmark symptom of PTSD. We investigated if LAEs moderate the relationship between peri-traumatic neural processing and intrusions. Fifty-three healthy women watched aversive vs. neutral films in the fMRI scanner and reported involuntary recollections of aversive film content during three consecutive days. Increased processing of aversive vs. neutral films in the amygdala, insula, dorsal anterior cingulate cortex, and hippocampus increased intrusions in participants reporting more than five LAEs. For participants reporting less than five LAEs, no such relationship was found. A history of adverse events may decrease resilience with respect to future traumatic incidents, particularly if neural processing in structures involved in emotion generation/regulation and memory encoding is high.

38 Modular segregation of brain networks underpins speech comprehension in middle-aged listeners

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Middle-aged adults often show sizable inter-individual variability in speech comprehension under challenging listening situations. Whether and how cortical network dynamics relate to this inter-individual variability is unknown. The present fMRI study addresses this question using a dichotic listening paradigm which probes how selective attention and semantic predictability facilitate sentence comprehension. In a sample of middle-aged adults, brain activity was measured during resting state and the listening task. During the task, the listeners were cued to the side (selective/divided attention) and the semantic category (general/specific) of to-be-detected sentence final words. We tested the hypothesis that inter-individual variability in speech comprehension relates to reconfiguration of brain networks from resting state to the listening task. Using connectomics, we show that higher modular segregation of brain networks relative to resting state reliably predicts the listeners' performance. Specifically, stronger network segregation in an auditory and cingulo-opercular module positively correlated with the listening performance under the least informative, hence more demanding cue condition. Our results suggest a central role for cortical network dynamics across auditory and cingulo-opercular regions in speech processing. Notably, modularity of this network during listening relative to resting state is able to explain inter-individual variability in speech comprehension across middle-aged adults.

39 Formation of predictions in auditory modality is reflected by systematic changes in oscillatory activity

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Formation of expectation based on prior experience influences constitution of sensory perception. In the present study, we aim to advance our understanding on how neural activity reflects prediction formation in auditory modality. We applied paradigm recently developed in our group and magnetoencephalography (MEG) measurements. Participants passively listened to sound sequences of varying regularity (i.e. entropy), where sound presentation was occasionally omitted. This allowed us to assess whether and how MEG signal is modulated according to the entropy level during sound stimulation and omission period. In the previous analysis using decoding technique we were able to establish for the first time that auditory predictions can be sharply tuned down to the tonotopic level. Currently, we are following up this analysis by investigating differential oscillatory contributions to this effect. Our results indicate systematic increase in low-beta range power consistent with the level of regularity visible over parietal cortex. These outcomes are supportive to the predictive coding model in which beta oscillation reflect prediction formation in the top-down stream of neural pathway.

40 The interplay of cross-modal integration and reward learning

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Despite rich literatures on both cross-modal integration and reward learning, only very few studies have investigated if associating multi-sensory stimuli with reward alters cross-modal integration in the human brain. Here we used representational similarity analysis of fMRI data to investigate stimulus representations in uni- and multi-sensory areas—and if reward learning modifies these representations. The task consisted of a sequence of blocks: In a first "cross-modal block," pictures of objects were presented with their respective sounds—or the pictures or sounds were presented alone. In the "reward-learning block," pictures and sounds were presented together and participants had to learn which of the two modalities was monetarily rewarded. A second "cross-modal block," which was the same as the first, allowed to compare stimulus representations before and after reward-learning. Participants (n=43) readily learned reward contingencies and reward receipt correlated with activity in ventral striatum and ventral medial prefrontal cortex. The "cross-modal blocks" revealed correspondences between representations elicited by uni- and multi-sensory stimuli in visual, auditory, and multi-sensory areas. Multisensory representations in the superior temporal sulcus were altered by reward associations in specific cases. Thus, our study suggests an intricate, partly reward-susceptible, interplay between areas involved in uni- and multi-sensory representations.

41 Inversion of a large-scale computational model reveals a cortical hierarchy in the dynamic resting human brain

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Parsimonious but biophysiological plausible neural mass models has the potential to bridge the brain micro-scale anatomical information and macro-scale brain activity. One of them is mean field model, which was well explored and validated in case of modeling rs-fMRI in literature, but its model parameters were manually tuned in previous studies. Here we adopted stochastic optimization framework to invert this large-scale model of neural dynamics with region-specific micro-scale properties. Our automatic framework yielded dramatically better fit to rs-fMRI data. Furthermore, without assuming the existence of a hierarchy, the estimated model parameters revealed a large-scale cortical gradient. At one end, sensory-motor cortex possessed strong recurrent connections and excitatory subcortical inputs, consistent with localized processing of external stimuli. At the opposing end, the default network possessed weak recurrent connections and excitatory subcortical inputs, consistent with its role in internal thought. Finally, recurrent connection strength was associated with laminar-specific neuronal cell density, but not cell size. Overall, this study provides micro-scale insights into a macro-scale cortical hierarchy in the dynamic resting brain.

42 Neural correlates of cross-modal visual spatial selective attention in patients with amblyopia: an ERP study

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Several studies suggest attentional deficiencies in amblyopic patients, whereas a recent study points to intact endogenous visuospatial attention. However, as behavioral measurements are unable to capture the neural correlates of such deficits, EEG was recorded in the current experiment in which an auditory cue indicated the most likely location of an upcoming Gabor patch followed by the presentation of two Gabors. Twelve amblyopic patients and eight sighted controls had to detect the target Gabor as fast and as correct as possible. Behavioral results revealed better performance in validly cued trials compared to invalid trials in both groups. By testing either the amblyopic eye or the fellow eye in patients and the dominant versus the non-dominant eye in controls, event related potentials recorded to the onset of the visual standard Gabors were delayed in the amblyopic eye in the time range of the N200 compared to the fellow eye. In contrast to sighted controls, ERPs revealed a less pronounced positivity recorded to the amblyopic eye compared to the fellow eye in the time range of the P2. These results indicate processing alterations in amblyopes when searching for a target and could reveal deficient neural mechanisms in cross-modal visual spatial selective attention.

43 Measuring hippocampal activity with MEG

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Hippocampus participates in complex cognitive tasks such as spatial orientation or episodic memory encoding and retrieval. However, hippocampus is also a small curved bilateral structure concealed within the medial temporal lobes and for which it may be difficult to record activity non-invasively. Reconstruction of deep brain sources using MEG remains controversial because (i) the spatial location of hippocampus is inferred from statistical peak in volumetric inference, which can be altered by head movement (e.g. co-registration error), and (ii) the cylindrical geometry of hippocampus which causes signal cancellation. These reasons led several studies to use anatomically realistic generative models (Meyer et al., 2017) to study the hippocampal activity that accounts for geometry, depth and cell types. In this project, we built a realistic anatomical model of hippocampus using MRI data. We segmented the hippocampus using Freesurfer, and modelled sources with MNE-python (Gramfort et al., 2014). Anatomical model was used as a forward model to reconstruct the source location and compared with current state-of-art reports (Meyer et al., 2017) for validity. We then applied this approach to a cognitive study focusing on mental travels in time and space (Gauthier et al., 2017) to investigate the debated involvement of hippocampus in this task.

44 Neural basis of target detection: dissociating somatosensory awareness from perceptual uncertainty, response selection, and motor planning

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The scientific study of somatosensory awareness has yielded highly diverse findings with putative neural correlates ranging from local interactions within somatosensory cortices to activation of widely distributed frontoparietal networks. A potential source of these divergent results may reside in latent cognitive processes that often coincide with stimulus awareness in experimental settings. Here, we employed a novel somatosensory detection task in combination with functional magnetic resonance imaging (fMRI) to dissociate somatosensory awareness from perceptual uncertainty, response selection, and motor planning. Participants received electrical target stimuli at intensities spanning the full range of their psychometric functions to vary stimulus uncertainty while maintaining spontaneous fluctuations in stimulus awareness. Instead of directly reporting target detection, participants assessed the congruence of their somatosensory percepts with simultaneously presented visual reference cues and reported a match or mismatch by making saccadic eye movements, such that target detection was independent of response selection and motor planning. Using model-based fMRI, we track the transformation from physical to perceptual stimulus representations along the somatosensory hierarchy. We show that the emergence of stimulus awareness is largely restricted to somatosensory and posterior parietal areas, whereas frontal activity reflects perceptual uncertainty, response selection, and motor planning.

45 Synchronization analysis of obsessive compulsive disorders with inter-trial phase clustering method

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Obsessive Compulsive Disorders (OCD) effects on brain structures, networks and functional connectivity, were examined using electrophysiological data. ITPC method calculates degree of phase coupling between EEG data epochs after the data has been segmented as shorter temporal parts for each channel. Significantly loss of synchronization was detected in delta band (p<0.001) and beta-3 band (p<0.013) for results of GFS analysis for Frontal lobe and in delta band (p<0.001), beta-2 band (p<0.0015) analysis for all channels. Decreased synchronization was observed in all channels and all bands -only except O1 channel in beta-2 band and T6 channel theta band- as a result of ITPC analysis. Results were classified by Support Vector Machine (SVM) method and successful accuracy scores of over 85% were obtained. According to these results, it is detected that OCD causes loss of synchronization, decreased functional connectivity, and impairment in some cognitive functions.

46 Perception of facial expressions of emotion in migraine

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It has been recently speculated that the perception of emotional facial expressions may be altered in individuals with migraine. Participants looked at a neutral face on a computer screen which was gradually morphing to a face with either happy, fearful, or angry expression. Participants were instructed to press a corresponding button as quickly and accurately as possible when the expression was detected. No significant interaction was found between group and emotion in the early P1, N170, early posterior negativity, or late positive potential, indicating that the migraine group, compared to the control group, did not show a preferential cognitive bias toward a certain expression. Behavioral results were consistent with electrophysiological findings. Migraine individuals, compared to healthy controls, were not biased in recognition of expressions toward positive or negative expression. In addition, the mean reaction time for recognizing an expression did not differ between groups and it was not at a cost of more incorrect responses. Interestingly, the amplitude of the early posterior negativity had a negative correlation with the time interval since the last attack. It is concluded that young female individuals with migraine, compared to healthy controls, do not show cognitive processing bias toward negative or positive facial expressions.

47 Connectivity architecture underlying brain activation for theory of mind: converging or separable networks?

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This poster presents meta-analytic and empirical evidence from functional brain imaging on the separation of functional processes for understanding other's (theory of mind) in the lateral posterior parietal cortex. We carried out quantitative neuroimaging meta-analyses (Schurz et al., 2014; in preparation) and a probabilistic labeling review (Schurz et al., 2017) of reported brain activation around the temporo-parietal cortex for theory of mind tasks. These works suggest that, in this region, brain activation for theory of mind and affect sharing is shaped by underlying structural brain connectivity networks, which converge around parietal association cortex. To follow up our hypothesis, we carried out a new fMRI study, scanning BOLD activity for a number of theory of mind tasks, as well as brain connectivity from diffusion MRI and resting-state fMRI. The temporo-parietal area was parcellated according to whole-brain connectivity fingerprints, and relationships to functional brain activity were analyzed. Findings are relevant for understanding to what extent activations for different theory of mind tasks in the temporo-parietal cortex reflect operations of a single, common brain network (i.e. fall within one parcellated area), and if they are rather shaped by conjoint operation of multiple networks (i.e. a border area between parcellations).

48 Simultaneous scalp- and subcortical EEG recordings during a visual oddball paradigm

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The P300 Event-Related Potential (ERP) is widely used to study a variety of cognitive processes and their relation to pathology. Its neural sources are distributed over the cortex and even thought to include subcortical regions such as the subthalamic nucleus (STN). However, it is not yet clear to what extent the characteristics (e.g., latency) of the subcortically recorded ERP components correspond to those of its scalp-recorded counterpart. In this contribution, we aim to shed light on this issue by simultaneously recording from both left and right STN (4 electrodes each) and scalp-EEG (12 electrodes evenly distributed over the scalp) while administering a standard visual oddball paradigm to a patient with Parkinson. In some of the implanted electrodes, the oddball stimuli evoked a significant negativity peaking around 400 ms post-onset whereas the central scalp-electrodes showed a positivity peaking around 300 ms, in accordance with the traditional P300 response. While the involvement of the STN in executive functions has been reported, including the observation of a "P300-like" ERP component, our results suggest that STN's ERP response is considerably different from the traditional scalp-recorded P300 ERP. Additional simultaneous scalp- and subcortical recordings are needed to investigate the possible relation between these response components.

49 Effect of intensive speech therapy on N400 event-related potential in different types of aphasia

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The EEG-recorded N400 event-related potential (ERP) in aphasia patients has been shown to depend on levels of comprehension deficit and type of aphasia. Its scalp distribution has also been shown to differ before and after rehabilitation. The latter suggests the activation of compensatory mechanisms leading to improved speech and/or comprehension. However, results on the N400 before and after rehabilitation, for different types of aphasia, have not yet been reported. We recorded N400 ERPs in response to 120 related and 120 unrelated Dutch word-pairs from one patient with Broca (LV) and one patient with global (TW) aphasia before and after 12 sessions of intensive speech therapy. After completing the rehabilitation program, TW improved in naming and repetition, while LV improved in comprehension. The ERP image of LV showed a shortening of N400 latency and an increased difference in N400 amplitudes in response to related and unrelated word-pairs (N400 effect). On the other hand, TW showed a qualitative change in ERP image after rehabilitation. Here, instead of the previously observed late positive component, an early negativity was noticed. In conclusion, we showed that, depending on the type of aphasia, speech therapy could differentially influence the ERP image of aphasia patients.

50 Clustering and switching in semantic fluency: a covert fMRI study

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In semantic fluency tasks participants are asked to generate as many words belonging to a pre-defined category. Two distinct strategies in verbal fluency tasks are observed: clustering versus switching. Even though they share some mechanism switching mainly requires cognitive flexibility, whereas clustering refers to a more automatic process, accessing ones' semantic memory storage. Neuroimaging studies indicate that clustering is associated with temporal lobe activations, whereas switching is mainly related to activation in frontal regions. However, by now no study has directly compared the networks underlying both strategies in healthy participants. In the recent study a semantic fluency task was administered to 36 women during fMRI measurement. Participants were instructed to shift strategies, either emphasizing on the clustering or the switching strategy in several verbal fluency items. Results indicate that when applying the clustering strategy there are greater activations in temporal lobe regions, as well as in the basal ganglia, whereas during switching greater activations were found in the left dorsolateral prefrontal cortex as well as in the middle cingulate cortex and precuneus. This suggests that regions activated by clustering are associated with semantic memory and word retrieval, whereas regions associated with switching are associated with cognitive flexibility and attention shifting.

51 Modulation of spontaneous otoacoustic emissions (SOAE) during auditory and visual attention

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Otoacoustic emissions (OAEs) are faint, high frequency sounds elicited by the inner ear. They reflect fine-tuning of the basilar membrane, modulation of the cochlear amplification, and presumably attentional mechanisms in general. For evoked and distortion product OAEs it is well-established that they are reduced when attention is focused on the visual modality while there is a distractive acoustic stimulation. It is speculated that this decrease is top-down modulated by the auditory cortex via the auditory efferent pathway. In the past it was demonstrated that there is no attentional modulation of spontaneous OAEs (SOAEs). This study aims to investigate if SOAEs truly do not show any effects of intermodal attention modulation albeit the innervation of OHCs eliciting SOAEs is the same as for OHCs eliciting the other types of OAEs. The results revealed that SOAEs were decreased for periods of selective visual attention and distracting acoustic stimulation. Additionally, this is the first study simultaneously recording OAEs and magnetoencephalography to shed light on the cortical mechanisms that modulate SOAEs during selective attention. An explorative analysis demonstrated higher cortico-cochlear coherence for the auditory cortex when attention was shifted to the auditory modality. These findings indicate that SOAEs are modulated by attention processes.

52 Evaluation of joint motion-onset and P300 target encoding for brain-computer interfacing

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A Brain-Computer Interface (BCI) aims to establish a direct communication channel between the brain and an external device. Several EEG-based BCI paradigms have been described, one of which is based on the motion-onset visual evoked potential (mVEP), recorded over the occipital pole: a clear biphasic amplitude deflection in response to an initially stationary, gazed stimulus that suddenly starts to move. By overlaying targets with vertical bars that can start to move one target at a time and in a random manner, and by detecting the occurrence of an mVEP, one can deduce the gazed target. In this contribution, we investigate whether simultaneous highlighting of the moving bar, for which we expect the traditional P300 response, improves target detection accuracy. Our results show that the joint mVEP-P300 stimulation slightly reduces the amplitude of the biphasic response and does not exhibit a prominent P300 response. As the detection accuracy does not improve with additional highlighting, and since the latter increases the visual demand, we advise against using joint mVEP-P300 stimulation.

53 Spatiotemporal signatures of rapid emotional face processing

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Although faces have provided an informative window into unconscious perception, the extent to which emotional expressions are processed outside awareness remains the subject of debate. To address this, we recorded magnetoencephalography (MEG) data while participants viewed backward-masked emotional faces and phase-scrambled control stimuli presented for 10, 30, and 150 ms. Participants performed an expression discrimination task and provided perceptual awareness ratings. As expected, faces presented for 10 ms were overwhelmingly reported as not perceived (84.5% of trials). Despite this and after excluding exception trials, we found a neural response to subjectively invisible faces over occipito-temporal sensors at M170 latencies. Furthermore, expressions presented for 30 and 150 ms could be decoded from MEG data starting at 100 ms. Cross-temporal decoding revealed a sustained representation of emotion that differentiated between angry and neutral faces earlier (~300 ms) than between happy and angry or neutral faces (~500 ms). However, we found no difference in patterns between expressions presented for 10 ms. Our results suggest that, given sufficient stimulus exposure, expression-specific responses emerge as early as 100 ms after stimulus onset. Although initial face processing can occur unconsciously and within 10 ms, this is not sufficient for the extraction of expression-related information.

54 Transcranial direct current stimulation of the visual cortex: evaluating effects with concurrent NIRS-MEG

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Transcranial direct current stimulation (tDCS) is a non-invasive neurostimulation technique widely used in experimental psychology. However, its neurobiological mechanisms of action are incompletely understood, and it is unclear how they relate to behavioural outcomes. Using state-of-the-art neuroimaging techniques represents the best means to establish transfer functions between behavioural tDCS effects and their underlying causes. We present pilot data on a multimodal approach investigating the effects of 'online' tDCS on neurovascular response using near-infrared spectroscopy (NIRS) whilst recording neuronal activity with magnetoencephalography (MEG) in participants performing a visual task. MEG captures electrophysiological activity with a high temporal resolution, whereas NIRS monitors hemodynamic changes without perturbation from tDCS – a unique advantage over other neuroimaging techniques. Based on finite-element models of tDCS and NIRS photon migration, we have developed an electrode-optode configuration that allows for the concurrent use of tDCS and NIRS. In two sessions, anodal and sham tDCS is applied to the visual cortex while eye movements, head motion, heartrate and respiration are co-recorded. To address individual anatomical differences, we generate subject-specific models of current distribution and NIRS sensitivity profiles using SimNIBS and HomER/AtlasViewer. With this approach, hemodynamic and electromagnetic signals are characterised to elucidate neuronal and neurovascular tDCS effects.

55 The changes of direction of functional connectivity between midbrain and cortex during consciousness recovery

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The study was aimed to calculate functional connectivity between cortex and midbrain area (periaqueductal grey, PAG). The shunt combined with deep electrode was implanted in 5 patients with tumor of pineal area at the final stage of oncothomy to prevent occlusal hydrocephaly and to record brain activity. ERPs were recorded simultaneously from deep electrodes located close to intact PAG area and scalp electrodes using auditory two-tone oddball paradigm. Brain signals were analyzed with Matlab Brainstorm toolbox. Peaks recorded on deep electrodes were considered under the same names (N100, N200 and P300) for convenience of description and comparison with those recorded on scalp sites. Functional connectivity was calculated in time windows including 65 ms before and after peak latency on deep electrode by the Granger causality test (value of model order n=10). The changes of direction of functional connectivity was detected during the consciousness recovery: direct connectivity from the frontal area to brainstem was revealed in post-anesthesia disorders of consciousness and obnubilation with the connectivity value greater in post-anesthesia disorders of consciousness, and the direct connectivity from the brainstem to left cortex area was detected in clear consciousness. Study was supported by RAS and RFFI 18-013-00967.

56 Effect of cooperative and non-cooperative interactions on personal space regulation in adults with autism spectrum disorders: an fMRI study

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Personal Space (PS) is the space immediately surrounding an individual. Previous studies have shown that in autism spectrum disorder (ASD) the regulation of PS is often altered compared to typically developing (TD) children and/or not modulated by changes in the quality of experienced social interactions. This study aimed at investigating the behavioral and neurophysiological underpinning of PS and its modulation by social interactions in the ASD adult population. Fifteen ASD and fifteen TD matched participants underwent fMRI investigation while performing a distance task for measuring PS preferences. Between the two sessions of the distance task, participants and confederates played a repeated trust game session, in which cooperative and non-cooperative interactions were experimentally manipulated. We observed a significant modulation of the trust game on the PS, as TD participants showed increased comfort toward the cooperative player and increased discomfort towards the non-cooperative one, associated with modulation of emotional brain areas (bilateral insula). Notably, we observed the same effect in the ASD population on the behavioral level, but reduced insular activity on the neural level. The findings suggest differences between ASD and TD in processing the emotional saliency of an approaching person, as result of the type of social interaction previously experienced.

57 Task related effects during abstract and concrete word processing

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Neuroimaging studies investigating abstract and concrete word processing reported thoroughly diverse findings. To evaluate potential sources of inconsistencies the present study investigated task-related effects on the processing of auditory-presented abstract and concrete words. More in detail, we used magnetoencephalography (MEG) to measure differential brain responses to abstract and concrete words in a lexical decision task (i.e., recognize real words) and a semantic decision task (i.e., recognize words related to one or more of the senses). Analysis of evoked responses and their spatiotemporal dynamics evidenced a significantly larger response to abstract as compared to concrete words in the lexical decision task. This was manly left lateralized and peaking around 450 ms after stimulus onset. In the semantic decision task, we observed the reversed pattern (i.e., concrete > abstract), with similar latency and topographical distribution. These preliminary results suggest that both task demands and semantic word-level processes were reflected in the N400 amplitude.

58 Coupled memory consolidation? Slow oscillation-spindle-coupling from childhood to adolescence

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Sleep spindles and slow oscillations are key players in the sleep-dependent memory consolidation (SDMC) process. Recently, it was found that the precise timing of sleep spindles within slow oscillation up-states is crucial for SDMC and that this precise timing deteriorates with aging. The time window with the most rapid and drastic changes to sleep spindles and slow oscillations however, is during puberty. So far it has not been investigated whether and how slow oscillation-spindle-coupling changes from childhood to adolescence and whether it influences SDMC. Therefore, we recorded polysomnographies during four nights for each of our 34 healthy subjects. The first two nights were recorded during childhood (age range 8-11 years) and the second two nights were recorded during adolescence (age range 14-18 years). Subjects had to recall previously learned word pairs before and after sleep at both times. So far our results show that both, fast spindle density and slow oscillations up-state duration increase across adolescence. Furthermore, not only the developmental increase in fast spindle density, but also the developmental extension of the slow oscillation up-state correlated positively with enhanced SDMC. These results hint at a change in the underlying mechanism of slow oscillation-spindle-coupling, which is currently investigated.

59 Mineralocorticoid receptor genotype influences resting-state EEG theta/beta ratio in healthy pre-menopausal women

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Oral contraceptives (OCs) chronically reduce endogenous estrogen and progesterone concentrations. Previous research suggests female hormones to modulate cortical-subcortical neural circuits involved in emotion regulation. Hence, OC use may influence cortical regulation of subcortical emotion systems. We examined this question with resting-state (rs) electroencephalography (EEG) theta/beta ratio (TBR), a marker of cortical control over the affective system. Since genetic variation of the mineralocorticoid receptor (MR) has previously emerged as a moderator of the relationship between female hormonal status and emotion processing, we examined whether MR-haplotypes moderated the influence of OC use on TBR. We acquired rsEEG from 44 OC users and 44 naturally cycling (NC) women, once during low and once during high hormonal status. There was a main-effect for MR-haplotype on TBR, regardless of the female hormonal status. Specifically, MR-haplotype 2 homozygotes had lower TBR scores than MR-haplotype 2 heterozygotes. There were no significant differences between OC users and NC women on TBR. Future research may compare OC users with NC women in the late-follicular phase. Lower TBR in MR-haplotype 2 homozygotes may reflect improved emotion regulation ability and might provide an explanation for the higher resilience to stress previously observed in this group.

60 Attentional alterations in migraine: a MEG/EEG study

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Migraine is a common neurological disorder associated to hypersensitivity to light, sound and odours. Attentional deficits may account for their impaired ability to suppress environmental stimuli. This study aims to determine if migraine patients present attentional abnormalities and to characterize these deficits. To assess both top-down and bottom-up attentional processes, we used a paradigm using target sounds to detect and distracting sounds to ignore. We recorded electroencephalography and magnetoencephalography in 19 migraine patients without aura and 19 control participants during the task. Behaviourally, migraine patients' performances do not significantly differ from control participants. They present an increased N1 orienting component and a decreased P3a and RON to task-irrelevant distracting sounds. Increasing the task-load in top-down attention is found to enhance even more target processing in migraine. Using source reconstruction, we observe modulations of the activation of some components of the ventral attention network involved in bottom-up processes. Migraine may be characterized by exacerbation of both bottom-up and top-down attentional processes.

61 Resonance property of the auditory cortex: a MEG study

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The Dynamic Attending Theory is very influential in the auditory research field. It stands that auditory processes are based on the coupling between intrinsic oscillators and temporal regularities in the stimuli: (1) intrinsic oscillators frequency and phase synchronize with the stimuli and (2) these oscillations last in time, even after the disappearing of the stimuli. Prediction (2) is diagnostic because it makes the distinction between simple evoked activity and a genuine entrainment of intrinsic oscillators. Despite numerous studies showing (2) in human behavior, no study has addressed the question from the neural point of view. Using MEG, we recorded brain activity during and after the presentation of a regularly paced sequence of tones. Our results replicates previous findings, notably a modulation of the amplitude of the beta-band at the stimulus pace. After the presentation of the tones, results were less clear, especially because of strong inter-individual differences. A combination of classical time-frequency analyses and new techniques based on encoding models (mTRF) allowed us to show that intrinsic oscillators continue to oscillate at the stimulus pace, even after the presentation. Caution should nonetheless be taken as effects were small, noisy, and subject to inter-individual differences, despite a large amount of data.

62 Political extremism increases attentional gating of expectancy violations

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People create meaning frameworks to make sense of the world. Moderate political or religious attitudes require individual meaning frameworks to be flexible and changeable, whereas extreme attitudes are based on fortified, rigid, and hard-to-change meaning frameworks. Research has shown that individuals with extreme (vs. moderate) political or religious attitudes react to expectancy violations with reduced neurophysiological markers of arousal. To test the assumption that these reduced immediate reactions are due to top-down attentional processes, we recorded electrophysiological activity during the presentation of normal and anomalous playing cards (N = 79). The presence of anomalous playing cards in the stimulus set boosted prestimulus alpha power, an index of top-down attentional processing, among individuals with extreme, but not moderate political attitudes. On the other hand, anomalous playing cards increased the late positive potential (LPP), a marker of allocation of attentional resources, among moderates, but not extremists. The findings support the assumptions that extremists engage in more top-down attentional processing, presumably to prevent their fortified meaning systems to be modified through novel experiences. This might partly explain why extremists also attend to perceptual anomalies less than moderates.

63 Proactive interference modulates frontal midline theta dynamics

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Proactive interference (PI) in working memory (WM) is the disruptive effect of no longer relevant information on memory retrieval. Overcoming PI is thought to rely on cognitive control capacity. At a functional level, cognitive control has been consistently related to Frontal Midline (FM) theta (4-7 Hz) activity in human EEG. Although previous research has investigated the brain dynamics related to overcoming PI, FM-theta activity modulations related to PI are still unclear. In order to shed light on this topic, we assessed FM-theta in EEG signals recorded with 35 young adults while they performed a modified recent probes task that had trials eliciting either high- or low-PI. PI effects were found on participants' accuracy and RTs during the task; they responded to high-PI trials less accurately and slower than low-PI trials. EEG analyses revealed higher FM-theta power for high-PI trials compared to low-PI trials. Furthermore, FM-theta showed higher synchrony (compared to baseline) between 500-750 ms after stimulus onset for high- than low-PI trials. Our results are in line with previous reports on the association between FM-theta and cognitive control, and disclose the relation between PI conditions and FM-theta activity for the first time.

64 Unconscious detection of one's own image

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The question of whether unconscious processing is involved in the detection of one's own image is yet to be answered. In recent studies an automatic shift of attention toward this stimuli was shown. Here, based on theoretical framework of bottom up visual selection we predicted the emergence of an N2pc component (neural marker of attentional shifts) in conditions where identification of one's own face was precluded. This hypothesis was tested in a dot-probe paradigm with masked and unmasked pairs of faces (other and self) coupled with electrophysiological (EEG) recording. A clear N2pc was found in both masked ($t(17) = -2.34$, $p = .031$, 95% CI = [-0.48, -0.03], $d = -0.55$, BF = 4.07) and unmasked ($t(17) = 2.91$, $p = .01$, 95% CI = [-0.87, -0.14], $d = -0.67$, BF = 10.71) tasks which indicates automatic allocation of attention towards self-face in both unconscious and conscious conditions. This supports the notion that the self-recognition process has a strong unconscious component and sheds new light on the ongoing debate regarding the dissociative nature of attention and consciousness.

66 Lateralized EEG responses during vection from visual flicker in the alpha range and modulation using frequency matched tACS

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Self-motion perception is a key aspect of higher vestibular processing which has been suggested to rely upon hemispheric lateralization of cortical function and alpha-band oscillations. Here we investigate the role of alpha oscillations, and their lateralization, in the illusory sense of self-movement that can be caused by large optic flow stimuli (vection). We used visual stimuli that flickered at alpha-frequency (approx. 10 Hz) in order to produce steady state visually evoked potentials (SSVEPs) and found differential lateralization of the SSVEP response during vection compared to a matched random motion control condition. We then tested for a causal role of the right hemisphere in producing this lateralization effect by applying transcranial alternating current stimulation (tACS) over the right hemisphere simultaneously with SSVEP recording, using a novel artifact removal strategy for combined tACS-EEG. During tACS, the alpha lateralization effect of vection was reduced and SSVEP amplitudes were enhanced. Subsequent control experiments showed the effect of tACS requires the flicker frequency and tACS frequency to be closely matched. The combination of SSVEPs and tACS is promising method both for future investigation into the role of neural oscillations and attention, as well as for optimising tACS as a research tool or clinical intervention.

67 The role of the frontal eye field in visual stability: optokinetic stimulation during TMS-EEG

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The frontal eye field (FEF) is activated during optokinetic stimulation (OKS) which induces an optokinetic nystagmus (OKN). Previous work showed FEF TMS can not only delay eye movements, but also facilitates perception. We hypothesized that the FEF plays a driving role in maintaining visual stability in OKN, not (only) through generating eye movements but also compensating for the perceptual consequences of those eye movements. We stimulated right FEF during leftward OKS in 16 healthy volunteers. Visual target stimuli were presented and participants responded to the direction of dot motion by button press. Participants were more accurate in detecting still dots and less accurate in detecting leftward moving dots following TMS of the right FEF. TMS showed a causal role for the FEF in visual stability not only when the eyes were moving (OKN) but also during fixation. This direction-specific TMS effect was also present in the EEG; the FEF TMS increased the amplitude of late right frontal evoked related potentials (ERPs), implying a contribution of the FEF in later frontal stages of processing. No effect was found during control TMS (right M1). These results suggest the FEF involvement in OKS through playing a causal role in maintaining visual stability.

68 An ERP study investigating the palatability of food vs. objects and possible mood effects in anorectic patients compared to healthy controls

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Anorexia Nervosa (AN) is a life-threatening disease with high mortality rates. Affected individuals restrain their calorie intake and show high cognitive control when confronted with food cues. Further, this restraint serves as an emotion regulation strategy. To date, there is very little knowledge on involved neural mechanisms and how these are altered compared to healthy controls. In an EEG study, we combined a negative mood induction by inquiring a personal experience with viewing and rating the palatability of food items compared to neutral objects. ERPs of female patients diagnosed with AN (N=42) were compared to matched controls (N=42) by calculating difference scores. We expected an attentional bias displayed by a bigger P300 difference in AN when viewing food items compared to objects. The negative emotion condition compared to the neutral condition is expected to reinforce these patterns, which will mainly show in a bigger difference in late positive potential (LPP). Results will be presented and their implications for the understanding of AN will be discussed. Findings can explain the influence of negative emotions on underlying brain mechanisms and neural patterns related to palatability and restraint in AN. This will increase understanding of disordered eating and can guide personalized treatment approaches.

69 Even the sleeping brain discerns relevant information

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During sleep our consciousness fades away, and our brain engages into "housekeeping" activities, like memory reorganization or removal of neurotoxic waste. Surprisingly, resent research suggests that also environmental stimuli are processed to some extend by the sleeping brain. Yet, to what extend does such processing of potentially relevant information change across sleep? To answer this question we invited 21 healthy subjects to take part in a combined EEG-MEG study. After 20min of wakefulness, participants were given an opportunity to sleep for 2h. Over the entire course of the experiment subjects were presented with a stream of auditory stimuli that consisted of subject's own name and other unfamiliar names, which were additionally spoken either by a close relative/friend or by a stranger. During wakefulness, brain responses significantly differed depending on which type of voice and which type of name was presented. Interestingly, after falling asleep (N1 and N2 sleep stages), only the own name kept inducing stronger oscillatory response than unfamiliar names, over a similar topography and frequency band as during wakefulness. Even though a complete "shielding" of the environment during sleep seems beneficial, the brain's preserved capacity for processing environmental stimuli could have potential relevance for health and even survival.

70 Characteristics of perinatal memory in 2- and 5-week-old infants

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Newborns are reported to recognize their mother's voice after birth, suggesting that a fetus has in principal the ability to learn. We were addressing the question whether newborns show overt signs of recognition to a more complex stimulus, a nursery rhyme, repeatedly presented before birth. Pregnant women (n=16) either replayed a taped nursery rhyme from week 34 of gestation until birth, twice a day, to the unborn (=EG) or did not (CG; n=14). After birth (2 and 5 weeks), infants' ECG was collected while playing the familiar rhyme and a newly presented rhyme back, each with maternal and a stranger's voice. Analysis revealed a distinct heart rate (HR) response to the prenatally learned vs. the newly presented rhyme (p=.042) at week 2. Furthermore, response to the prenatally learned rhyme differed between EG and CG (p=.021). Additionally HR gradually decreased over recording time in the EG, whereas infants unfamiliar with prenatal stimulation (CG) had higher HR (p=.004) and lower parasympathetic activity (high-frequency power; p=.001) during stimulus presentation. Our findings suggest moderate signs of perinatal memory also for more complex material like nursery rhymes. Newborns familiar with prenatal stimulation may soothe when stimulation material is presented again.

71 Left inferior parietal lobe (IPL): key region for general identity reasoning and perspective tasks

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Previous neuroimaging (Arora et al., 2015) and developmental (Perner et al., 2011) studies on identity reasoning support the claim of common neural correlates for perspective taking tasks (e.g. false belief reasoning, visual perspective taking, and episodic memory). In the present study, first task investigated the neural correlates of identity reasoning in mathematical equations (e.g. 3 × 8 = 36 - 12) compared to non-identity reasoning in equations (e.g. 25 – 10 = 3 × 6). Primarily, we observed a centro-parieto-occipital network activity for mathematical identity task. In a second task we presented identity vignettes (e.g. the dentist goes to his clinic. Lilli finds Mr. Dietrich's bag. Mr Dietrich is the dentist.). We observed left inferior parietal lobe (IPL) and precuneus activation when identity vignettes were compared with non-identity vignettes. A conjunction analysis of the identity conditions from both tasks shows conjoint activation in the left IPL and precuneus. Thus our results validate earlier findings of Arora et al., (2015) and localize the identity activation in mathematical equality tasks. The present finding further highlights the fact that domains of knowledge (mathematics, language processing) do not operate independently in the brain but share regions for a particular competence (identity reasoning).

72 Functional cytoarchitecture of primary and associative auditory cortices

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Auditory neuroscience has provided strong evidence that neural oscillations play a pivotal role in speech perception. Neural entrainment of cortical oscillatory dynamics to the stimulus acoustic envelope has been described, suggesting a prominent role of auditory delta (1-4 Hz), theta (4-8 Hz), and low-gamma (25-45 Hz) frequencies in speech parsing. Auditory linguistic information is thus sampled at multiple time-scales simultaneously. There is emerging consensus that speech perception is mediated bilaterally. The asymmetric sampling in time theory posits that the left auditory cortex is better suited to process temporal information whereas its right counterpart is better at processing spectral information. To have a better understanding of those differences, 90 epileptic patients were presented with pure tones and syllables (Ba/Pa) while recorded with intra-cranial electrodes implanted in the primary and associative auditory regions. Specific pattern of activity of these regions were observed in response to the stimuli, reflecting the intrinsic properties of auditory cortices. This activity was prominent in distinct frequency bands (theta, alpha, low gamma and high-gamma). Moreover, differences were present between hemispheres in low and high frequencies, indicating the existence of an asymmetry across auditory cortices based on distinct dominant oscillatory regimes.

73 How motor pre-selection influences brain activity related to the observation of others' actions

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According to many results, action observation automatically activates motor representations correspondent to the observed actions. However, in real life we do not feel the urge of imitating others actions so often, not even when we are required to react to them. So which are the mechanisms that allow us to control our motor system in a context in which we observe others' actions in order to react to them? A role could be played by "motor pre-selection": usually, in order to react to observed actions, we prepare (pre-select) actions that do not resemble those observed; this feature marks a critical difference to the automatic imitation paradigm, in which participants observe two actions while being required to produce similar actions to those observed. In a Magnetoencephalography experiment we ask participants to observe hand actions while providing either responses with the hand in a delayed automatic imitation paradigm ('standard' condition), or responses produced with the feet ('neutral' condition). Our results show that Beta power desynchronization on the hand motor cortex was more pronounced in the standard condition compared to the neutral condition, suggesting that action observation effects onto the motor system were weakened by the pre-selection of actions not resembling those observed.

74 Theta and beta neural signatures predict different post-error behavioural adjustments

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Behavioural adjustments after making an error are crucial in everyday life. Changes in oscillatory power have recently been shown to correlate with these errors. Specifically, an increase in theta power (3-6 Hz) and a decrease in alpha power (10-11 Hz) can be observed shortly after an error. Moreover, these signals have been found to be significantly anti-correlated with each other. Here, we attempted to replicate these previous findings and more importantly, we examined how these findings relate to behavioural adjustments on trials following the error. Interestingly, we found that theta power increases are positively correlated with response times on trials that follow the subsequent trial (n + 2 trials), but not with the subsequent trials (n + 1 trials) itself. In addition, beta rebound (15-20 Hz) after false alarms correlated negatively with response times on n + 1 trials. We showed that different neural signatures correlate with behavioural adjustments after committing an error. We speculate that the theta signature leads to higher cognitive adjustments on n + 2 trials, whereas the beta rebound after a false alarm reflects the state of the motor system, where larger beta rebounds lead to faster responses on the n + 1 trials.

75 The role of the intraparietal sulcus during subjective visual vertical judgments: multisensory integration and attention

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Spatial orientation and navigation is dependent upon our ability to form a stable and precise perception of verticality, which in turn is posited to rely on a distributed network of multisensory regions. The right posterior parietal cortex, especially the right intraparietal sulcus (IPS), has been consistently related to spatial orientation and attention. Therefore, we hypothesized that the right IPS plays a causal role in the neuronal implementation of verticality perception. We employed a combined EEG-TMS paradigm to investigate the role of the human parietal cortex in both verticality perception (i.e. SVV task) and spatial attention (i.e. Landmark task) in healthy controls. Our results indicate that repetitive right TMS facilitated verticality perception by normalizing individual SVV biases, which was also reflected on an electrophysiological level over a frontocentral site. No such hemisphere-specific results were found for the Landmark task. Moreover we found a link between baseline SVV bias and post-stimulus activity in the alpha band within the dorsal visual pathway. Thus, this study points to a hemisphere-specific role of the ventral IPS region in verticality perception and spatial attention and provides a promising new direction for furthering our understanding about the neural implementation of spatial orientation in healthy and clinical populations.

76 Studying the effects of perceptual history on deciding between percepts of ambiguous moving plaids

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Current literature states that perceptual hysteresis arises from different trajectories of visual experience on perception. However, is recent perceptual history accountable for creating this effect? How do perceptual persistence and sensory adaptation mechanisms mediate bistable perception of a moving stimulus? We acquired fMRI data on 25 participants during the visualization of a moving plaid. This plaid was superimposed with dots which moved from 0 to 100% in the direction of each possible percept (coherent or incoherent). By gradually changing this percentage, we were able to force a perceptual transition. We hypothesized that the moment of this transition would be affected by recent perceptual experience. Our results showed that persistence was mainly experienced while transitioning from incoherent to coherent perception of motion while adaptation was in the opposite case. Contrasting both effects, we found a significant difference in the activation of the anterior insula. Importantly, both perceptual history effects showed high variability among participants and depended strongly on the perceived type of motion. Our findings add to the understanding of perceptual bistability and elicit a contribution of the anterior insula on the creation of perceptual hysteresis.

77 Verbal priming with associative and labeling words facilitates visual face gender categorization

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Language influences visual perception, for example, by facilitating categorical decision about visual stimuli (Carroll & Young, 2005; Francken et al., 2015; Meteyard et al., 2007). However, the level at which language influence categorical decision is still a matter of controversy. We aim to explain a) whether language effects are manifested at the early stages (i.e., "sensory" system), or later conceptual (i.e., "decision" system) and b) which aspects of the decision formation are affected by linguistic priming. To disentangle this, we use a Drift Diffusion Model (HDDM) to model reaction time and forced two-choice responses in a linguistic priming experiment, where faces are primed with gender labels "man", "woman" or associative words such as "tie", "lipstick". We show that a) words, depending on their type interact with visual categorization at different processing stages and b) words, regardless of their type enhance evidence accumulation from visual input. We propose that decision making framework can provide new insights on linguistic effects on visually driven decisions.

78 Human speech cortex tracks speech amplitude envelope through discrete encoding of auditory edges

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Slow modulations of the speech amplitude envelope reflect its syllabic structure, and listeners rely on it to understand continuous speech. It is thought that the speech envelope is processed as a continuous signal. But theoretical and behavioral studies have suggested that speech recognition relies on the detection of discrete landmarks in this continuous signal. Using direct recordings of neuronal responses from human speech cortex in the superior temporal gyrus we found that speech envelope tracking over the bilateral STG encodes discrete events in the speech signal, specifically the maximal rate of amplitude rise, maxRise. Envelope maxRise was selectively encoded at single electrodes, and was distinct from encoding of spectral/phonetic content. Acoustic analysis demonstrated that maxRise events marked the timing of discrete epochs of high information content, the onset of stressed vowels (or consonant-vowel transition), which are indispensable for comprehension. Controlled non-speech stimuli showed a monotonic mapping of maxRise on neural response magnitude, leading to largest responses to fast changes, another marker of prominent syllables in continuous speech. Together, our results suggest that human speech cortex detects discrete amplitude rise events in speech, which cue neural processing towards critical information-rich portions of the speech signal.

79 Alpha frequency does not always impact visual temporal discriminability

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Previous research has reported a relationship between peak alpha frequency over posterior channels and visual temporal discriminability. A higher peak alpha frequency was associated with a smaller temporal binding window and greater temporal discriminability. Nevertheless, the underlying neural mechanism remains opaque. First, there is considerable variability in i. the alpha frequency range considered and ii. the EEG channels or sources that exhibit a significant relationship. Second, it remains controversial whether alpha frequency varies with perception within individuals, between individuals or both. Third, previous experimental paradigms did not always allow dissociating temporal discriminability from perceptual and response biases. The current study investigated the role of trial-specific pre-stimulus or trait individual alpha frequency on temporal discriminability of two flashes in a unisensory visual or audio-visual yes-no and two interval forced choice task. Our sensor and source level results provide robust evidence that neither inter-trial nor inter-subject variability in alpha frequency influence temporal discriminability. These results question the role of peak alpha frequency in temporal discriminability.

80 Associations between stress responses after social-evaluative threat

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Social-evaluative threat (SET) – when the self could be negatively judged by others – can cause significant stress responses in self-reported states, cardiovascular indices, and hormonal indices. Previous studies have found that the coherence between these different stress systems is low, but it might be influenced by sex. The current study set out to investigate sex differences in the coherence between stress responses to SET. We expected to find similar stress responses to SET in men and women, but potential gender differences in stress coherence. 37 men and 30 women participated in the experiment. An impromptu public speaking task in front of a camera and a pre-recorded audience was used to induce SET. Self-reported states were measured throughout the experiment, as well as multiple cardiovascular and hormonal responses. Individual reactivity was calculated for self-reported and cardiovascular indices by subtracting baseline from peak values. Results showed that SET successfully induced changes in all stress systems, without sex differences in SET reactivity. Men showed low to moderate correlations between stress systems: larger cortisol increases after SET were related to larger responses in all measured cardiovascular indices. In contrast, cortisol responses in women were not significantly related to other stress responses.

81 Machine learning for classifying sleep in newborns

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Human newborns spend up to 18 hours sleeping. The organization of newborn sleep differs from adult sleep, and its changes corresponds with cortical development. However, scoring in this population is challenging given frequent artifacts in polysomnography and absence of established staging criteria. In order to assess performance of automatic sleep scoring, we analyzed PSGs from 36 newborns recorded twice (at week two and five after birth). To promote robustness we computed permutation entropy (PE). Next SVM was used to perform an epoch-by-epoch classification (waking, NREM, REM) in which the training and the validation epochs (30-s each) may come from the same or different recording time. We found significant relation between depth of sleep and PE (NREM sleep and waking have lowest and highest permutation entropy respectively) in the later recording time (week five). Furthermore, here the classifier achieved high scoring (F1 score of 74%). Week two was characterized by reduced relative differences between sleep stages as well as low classification accuracy. Interestingly, generalization across time was present only in several subjects suggesting inter-individual variability in the sleep development. Altogether, we present a novel data-driven application of machine learning that can be used to gain unambiguous insights into sleep in newborns.

82 Distinct levels of visual adaptation due to coherent and incoherent motion perception

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Visual adaptation, which describes the continuous visual system adjustment to changes in the environment, has been pointed out as one of the causes of perceptual bistability. Ambiguous moving plaid stimuli are an example of such bistability. They can be perceived as two surfaces sliding incoherently over each other (incoherent motion) or as a single coherent surface (coherent motion). Here we asked if adaptation coexists for both of these perceptual states and if it shows significantly different levels, providing a possible mechanism for differential modulation of each percept duration. To investigate how the activity in visual cortex is modulated by adaptation to the two possible percepts of a moving plaid, we focused on the human motion complex (hMT+), a region tightly related to the perceptual integration of visual motion. We hypothesize that visual perception of global coherent and incoherent moving surfaces leads to different levels of adaptation. We found that, although not as strong as for the coherent percept, visual adaptation due to the incoherent percept is also present in hMT+, and thereby may also contribute to regulate perceptual bistability. These findings have strong implications in models of perceptual decision and might explain why equally possible perceptual periods are perceived unequally.

83 Time to be random: effect of inter-response interval on choice redundancy and electrophysiology during a competitive game

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In some contexts it may be desirable to be unpredictable (e.g. for the sake of exploration, competitiveness, or originality). Accordingly, humans and animals are able to adapt their level of behavioural variability to environmental demands, although the cognitive and neural mechanisms behind these findings remain poorly understood. Previous research has shown that humans and pigeons choices become more predictable with shorter Inter-Response Intervals (IRIs), suggesting that memory of past actions interferes with unpredictability. We explore possible neural mechanisms mediating this effect in an MEG experiment where we manipulate IRI while reinforcing unpredictability (participants must avoid being predicted by an Artificial Intelligence which has access to their choice history). We expect activity in Anterior Cingulate Cortex (ACC) to play a major role in this phenomenon, given that recent research in rats has shown its causal relevance for switching between strategic and stochastic modes of action. Additionally, we aim to apply Reinforcement Learning models to separate learning effects from decision noise. We hypothesise that 1) Longer IRIs will lead to lower choice redundancy 2) pre-response alpha power in topographies compatible with ACC will be directly proportional to IRI 3) ERN will be inversely proportional to IRIs.

84 Auditory stimulation induces changes in sleep micro-structure

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Brain responses to sensory stimuli differ from wakefulness to sleep while the processing of salient information continues even during the deepest stages of sleep (Blume et al., 2017). A major change that is observed in the EEG background activity during sleep is the appearance of sleep-specific microstructures such as K-complexes, sleep spindles and slow oscillations. While these microstructures influence sensory processing (Schabus et al., 2012; Cairney et al., 2018), it remains unclear to what extent salient stimuli are processed when they coincide with these microstructures. During full night sleep, polysomnography data was recorded in 17 healthy subjects and subject's own name and unfamiliar names were presented throughout the night. The stimuli were uttered by a familiar or an unfamiliar voice. Preliminary analysis shows an increase in the duration of NREM K-complexes during auditory stimulation. Interestingly, this increase was localized to the right hemisphere. Spindle analysis revealed an increase in the length of fast spindles (13-15 Hz) during auditory stimulation as compared to baseline. Ongoing analyses focus on the subtle alertness changes (evaluated by the Hori scale; Tanaka et al., 1996) evoked by different auditory stimuli. Our results suggest that information processing persists even during the most "inhibitory" events in sleep.

86 Filling the gap: mapping the facial homunculus in one-handed individuals and controls

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One of the most striking demonstrations of cortical reorganisation in humans occurs in the primary sensorimotor cortices following congenital and acquired limb loss. Previous work has shown the 'invasion' of the deprived hand area by facial representations. However, face-to-hand reorganisation, and its perceptual outcomes, are debated. Furthermore, facial topography in humans is unclear, with results suggesting either upright or inverted medial-to-lateral organisation. We aim to fill this gap in the homunculus by investigating the topographic organisation of the face, and examine patterns of reorganisation in one-handed individuals. Functional and anatomical MRI data were obtained used a 3 Tesla prisma, with a spatial resolution of $2mm^3$. Participants were instructed to move different parts of their face (e.g. lips/forehead/nose) or hands. We found, using a univariate analysis, a clear upright medial-to-lateral facial topography. However, irregularities were noted, which may explain previous conflicting results. The poster will present additional multivariate results and facial mapping in one-handed populations. It is hoped these results will allow us to differentiate between facial body-parts, characterising the facial homunculus and its spatial relationship to the hand after hand amputation.

87 Can heart rate variability contribute to the differential diagnosis of disorders of consciousness?

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Current research suggests that the presence of circadian temperature and activity rhythms is related to higher "awareness" in patients with disorders of consciousness (DOC). As heart rate variability (HRV) clearly changes across the sleep-wake cycle in healthy controls, we investigated whether also HRV-parameters and their circadian patterns are informative for the arousal level or "awareness" in DOC-patients.

Analysis of 24-48 h 3-lead-ECG-recordings in 11 DOC-patients (6 in vegetative state/unresponsive wakefulness syndrome [VS/UWS], 5 in minimally conscious state [MCS]) and 3 healthy controls revealed that the interbeat variability during the day differentiated between patient groups (i.e. VS/UWS, MCS, or controls) with VS/UWS patients having the lowest and healthy controls the highest interbeat variability. Interestingly, MCS but not VS/UWS patients showed day-to-night fluctuations with a significantly higher parasympathetic activity during the night than during the day as measured by ECG high frequency power (0.15-0.4 Hz).

In conclusion, results suggest that patients with better diagnosis and higher "awareness" are able to better adapt to environmental changes as reflected by higher interbeat variability indicating that their autonomic nervous system is better aligned to the circadian rhythm. Thus, our findings render HRV-parameters an interesting tool to learn more about the consciousness state of severely brain-injured patients.

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88 Into the deep – capturing the sources of early auditory activity

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Early auditory evoked potentials occur within the first ten milliseconds after acoustic stimulation. The recording of these potentials usually consists of five vertex waves with different peaks and droughts, each being associated with an anatomical structure in the auditory pathway.
These waves are typically analyzed to provide diagnostic value in patients with hearing disorders. One of the most commonly used methods of measuringthese electrical signals originating in the cochlea is Electrocochleography (EcochG).

By means of extra-tympanic electrodes, we can measure these signals traveling through the auditory pathway across the brainstem into the auditory cortex.

Here we employed EcochG as a reference to extract this early auditory activity from the magnetoencephalographic (MEG) signal.

The signal as measured by the EcochG is then used to build a spatial filter for the MEG data, to access the subcortical structures associated with early auditory processing, such as the auditory nerve (wave 1) or the lateral leminiscus (wave 5). This information will then be used in further analysis to see how early attentional modulation happens in the auditory pathway.

90 Visual cortical entrainment to unheard acoustic speech reflects intelligibility of lip movements and is mediated by dorsal stream regions

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Successful lip reading requires a mapping from visual to phonological information (Lazard & Giraud, 2017). Recently, visual and motor cortices have been implicated in tracking lip movements (e.g. Park et al., 2016). It remains unclear, however, whether visuo-phonological mapping occurs already at the level of the visual cortex, that is, whether this structure tracks the acoustic signal in a functionally relevant manner. In order to elucidate this, we investigated how the cortex tracks (i.e. entrains to) absent acoustic speech signals carried by silent lip movements. Crucially, we contrasted the entrainment to unheard forward (intelligible) and backward (unintelligible) acoustic speech. We observed that the visual cortex exhibited stronger entrainment to the unheard forward acoustic speech envelope compared to the unheard backward acoustic speech envelope. Supporting the notion of a visuo-phonological mapping process, this forward-backward difference of occipital entrainment was not present for actually observed lip movements. Importantly, the respective occipital region received more top-down input especially from left premotor, primary motor, somatosensory regions and, to a lesser extent, also from posterior temporal cortex. Strikingly, across participants, the extent of top-down modulation of visual cortex stemming from these regions partially correlates with the strength of entrainment to absent acoustic forward speech envelope but not to present forward lip movements. Our findings demonstrate that a distributed cortical network, including key dorsal stream auditory region (e.g. Hickok & Poeppel, 2007; Rauschecker, 2012, 2014), influence how the visual cortex shows sensitivity to the intelligibility of speech while tracking silent lip movements.

91 Better experiments that run everywhere - introducing the O_PTB toolbox

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The Psychophysics-Toolbox (PTB) is widely used to develop experiments in the fields of psychology and neuroscience. It provides an interface between Matlab and the hardware (video and sound cards, Datapixx/Videopixx system, button boxes, eye-trackers). High temporal accuracy can be obtained if the hardware is of good quality and the PTB is used correctly.

The PTB operates at a low level: Instead of images, OpenGL textures are used, trigger hardware needs to be operated at the driver level, auditory stimulation works via a direct interface to PortAudio. Using special stimulation and/or response equipment like the Datapixx/Vpixx system requires entirly different code.

According to our experience, developing experiments at such a low level is error prone, results in extra work as code cannot be reused between paradigms and is hard to maintain.

O_PTB (Objective PTB) solves these problems by introducing a layer on top of the PTB. Visual stimuli are represented as objects (e.g., images, text, fixation crosses). Auditory stimuli (wav files, sine-waves, white noise) and triggers are sent using a unified interface agnostic to the underlying hardware. Responses can be acquired using a keyboard or a response pad (if available) with the same commands.

O_PTB is freely available under the GPL3.

92 Novel sounds cause an involuntary shift of spatial attention – Indices from reaction time and magnetoencephalographic data

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Unexpected deviants in an otherwise repetitive soundscape capture attention involuntarily. This results in a time penalty that becomes visible in slower responses in an unrelated primary task. The cognitive determinants and neural underpinnings of that behavioural distraction effect are not well understood. Here, we examined whether task-irrelevant deviants cause an involuntary spatial shift of attention towards their location. Additionally, we studied neural facets of behavioural distraction via event-related fields and oscillatory activity with a focus on the alpha frequency band. We utilized a cross-modal distraction paradigm in which lateralized deviants occurred in an otherwise repetitive sound sequence (standards). After each sound, a target appeared on the screen. Participants responded whether it appeared on the left or the right. Crucially, the locations of consecutive deviant and target events were either congruent or incongruent. We found a clear behavioural distraction effect in that responses to targets were slower when preceded by deviants as compared to standards. In support of the spatial attention shift hypothesis, responses to targets were faster when preceded by deviants at congruent vs. incongruent locations. Further, alpha power to deviants was modulated in a spatially selective manner. This might showcase alpha power as a neural signature of involuntary attention.

93 What should we plan next: a standard or a deviant tone

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Oddball paradigms remain gold standard to investigate how the brain infers and tracks (causal) structure in the environment. Evoked brain responses, particularly the MMN, could reflect these processes. Recently, dynamic causal models of such evoked responses and similar models of perceptual inference and learning have been proposed. However, as models get more realistic and complex, disentangling between alternative hypotheses, especially at the individual level, will require to carefully optimize the experimental design.

Therefore, we propose the principle of Active SAmpling Protocol (ASAP). As opposed to classical (static) experimental protocols, ASAP rests on real-time data processing and implements online model comparison. It thus enables the optimization of design parameters in the course of data acquisition.

On simulations, we demonstrated the face validity of ASAP and showed that it concludes more accurately and faster than classical oddball designs. In order to instantiate ASAP in a real experiment, we need to overcome the challenge of dealing with EEG artifacts online, as in the field of Brain-Computer Interfaces.

Beyond this technical challenge, we discuss the new perspectives offered by ASAP. In the clinical domain, it could play a major role in enabling the testing of neurocognitive models at the individual level.

94 Alpha oscillations are not involved in reactive distractor inhibition during working memory retention

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In our daily life, it is essential to focus on and maintain relevant information (working memory; WM) while ignoring distracting information. The neural mechanisms of distractor inhibition in WM are not fully understood, but several studies suggest that alpha oscillations (~8–14 Hz) play an important role. Alpha power increases with increasing set size in WM tasks and alpha power increases are related to inhibition of sensory processing in perceptual tasks. Hence, researchers speculated that alpha oscillations might inhibit task-irrelevant information during WM maintenance in order to protect memories of relevant information. However, this assumption has not been tested rigorously by e.g. presenting varying levels of distractors during WM maintenance (i.e. protection is more important when distraction is strong). Here, we manipulated set size and the strength of distractors presented during WM maintenance. Computational modelling showed that performance decreased with increasing set size and stronger distraction. During WM maintenance, alpha power increased with set size, replicating previous studies. However, here stronger distractors reduced alpha power. This finding is in clear contradistinction to previous suggestions, as alpha power decrease indicates higher neuronal excitability. Thus, our data do not support the suggested role of alpha oscillations in inhibition of distraction in WM.

95 Functional neuroimaging in newborns with perinatal asphyxia - a preliminary study of neurodevelopmental prognostic value

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Perinatal asphyxia (PA) is a major cause of death and long-term neurodevelopmental disability due to hypoxic ischemic encephalopathy (HIE), namely cerebral palsy but also sensory and cognitive disabilities. There is no efficient method for predicting neurodevelopmental outcomes in infants with HIE. Functional neuroimaging may have the potential to identify useful predictors of neurodevelopmental impairment and provide early intensive and targeted intervention.

We performed fMRI acquisitions with passive visual, auditory and motor stimulation tasks in 18 newborns with PA and investigated cerebral blood oxygenation modulation patterns in regions of interest in the visual, auditory and motor cortices.

Despite the low SNR in newborns, we have found significant local negative fMRI signal changes during visual stimulation (9 out of 18 newborns), which was also observed during the auditory task (10 out of 18). On the other hand, most newborns had a positive increase in BOLD signal during motor stimulation (14 out of 18).

Infants are returning after 18 months and we expect the correlation of imaging measures with neuropsychological and neurodevelopmental assessment to entail a feasible physiological assessment tool in PA. This is of great interest because fMRI could help in neurodevelopmental prognosis.

96 Dissociated role of subcortical neural circuits in rhythm-based and interval-based temporal prediction and attention

Breska, A., Duberg, K.T., and Ivry, R.B.

University of Berkeley, Berkeley, USA

Humans routinely use temporal regularities in the world to predict the timing of upcoming events and prepare for them by adjusting attention in time. This is typically done both in (quasi-) rhythmic contexts, like speech, music or dance, or when the interval between two isolated events is known, such as when predicting the moment the traffic light changes from red to green. In two studies, we used a combined neuropsychological and electrophysiological approach to examine whether temporal predictions are mediated by functionally and anatomically distinct neural mechanisms in these two contexts. In the first study, we found that individuals with cerebellar degeneration were impaired in forming isolated interval temporal predictions, but not rhythm-based predictions. In contrast, individuals with Parkinsons's disease were impaired in forming rhythm-based, but not interval-based temporal predictions. In the second study, we show that cerebellar degeneration impaired well known EEG signatures of temporal prediction, in both delta (0.5-3 Hz) and beta (15-25 Hz) bands. However, this impairment was found to be limited to temporal predictions of isolated intervals, but not to rhythm-based temporal predictions. Together, these findings corroborate a double dissociation between these two functions, and confirm the role of subcortical structures in temporal prediction and attention.

97 Hierarchical duration discrimination in vision

Kiai, A.[1,2,3], van Wassenhove, V.[3], and Melloni, L.[1]

[1]Max Planck Institute for Empirical Aesthetics, Frankfurt, Germany
[2]EHESS/Ecole Normale Superieure, Paris, France
[3]NeuroSpin, CEA Saclay, Paris, France

One of the central organizing principles of primate visual cortex is the spatial hierarchy: as one progresses from early visual regions to extrastriate cortex and beyond, neurons exhibit selective activation to larger and larger regions of physical space. Studies in electrophysiology, human neuroimaging, and computational modelling suggest visual cortex also features a temporal hierarchy such that neurons further along the ventral visual pathway exhibit reliable peak responses at lower stimulus presentation rates (Murray et al. 2014, Hasson et al. 2008) and feature more persistent responses, even after offset for brief stimuli. (Chaudhuri et al. 2015, Keysers et al. 2001) These differences in temporal tuning may result in a hierarchy of temporally specialized cortical regions, where some are better adapted to detect rapid changes in stimuli, while others are more suited to perform longer, integrative computations. (Kiebel et al. 2008) Whether these differences in the temporal dynamics of cortical regions have a limiting effect on the precision of temporal perceptions remains an open question. In our study, we examine whether the intrinsic timescales of neural responses in different regions of visual cortex serve as a lower bound of temporal acuity in a duration discrimination task.

98 Online processing of Austrian sign language (ÖGS) – relevance of nonmanuals and transitional movements

Krebs, J.[1], Wilbur, R.B.[2], and Roehm, D.[1]

[1]University of Salzburg, Salzburg, Austria
[2]Purdue University, West Lafayette, USA

For various spoken languages it has been shown that locally ambiguous argument structures are preferentially interpreted as subject-object-verb orders, leading to the effect that ambiguous object-initial sentences have to be reanalyzed (the "subject preference"). We present EEG and behavioral data showing subject preference in a sign language (Austrian). Interestingly, local ambiguity was resolved earlier than expected, namely before the disambiguating verb onset. We suggest that the transitional movement between signs and/or nonmanual markings indicate the argument structure. These findings emphasize the relevance of transition phases and nonmanual markings to the processing of sign language syntax. Thus, the visible articulators as well as the layering of (non)manual components lead to an earlier disambiguation of locally ambiguous argument structures compared to analogous structures in spoken languages which are (mostly) serially organized.

INFORMATION

The SAMBA-Meeting takes place at the Unipark Nonntal.

University of Salzburg
Unipark Nonntal
Erzabt Klotz Strasse 1
5020 Salzburg, Austria

How to get to the venue?

By car

Motorway A10 exit Salzburg Süd / Anif (in the direction Salzburg Zentrum). Go along Alpenstraße for about 6 km until you reach the Shell filling station. Turn left in the Akademiestraße. Take the first exit in the roundabout traffic and follow the Ulrike-Gschwandtner-Straße. After the sports centre you will find Unipark and the entrance to its paring area Unipark / Nonntal.

Parking areas at or nearby the venue (with costs)

- Tiefgarage Unipark / Nonntal
- Tiefgarage Hypogarage (1-minute-walk),
- Parkplatz Akademiestraße (5-minute-walk)
- Parkplatz Petersbrunnhof (5-minute-walk)

Public transport

Bus tickets can be purchased at kiosks (so called "Trafik"), 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: salzburg-public transport.

Bus stations near the venue

- Unipark (in front of the Faculty)
- Justizgebäude

From the main train station

option 1: take the bus line 25 (in the direction of Grödig Untersbergbahn) or bus line 5 (in the direction of Birkensiedlung) until the exit Justizgebäude (11 min, 6 intermediate stops). The Unipark is in ~120 m walking distance.
option 2: take the trolley bus line 3 (in the direction of Salzburg Süd) or 6 (in the direction of Parsch) until the exit Justizgebäude (11 min, 6 intermediate stops). The Unipark is in ~350 m walking distance.

From the airport

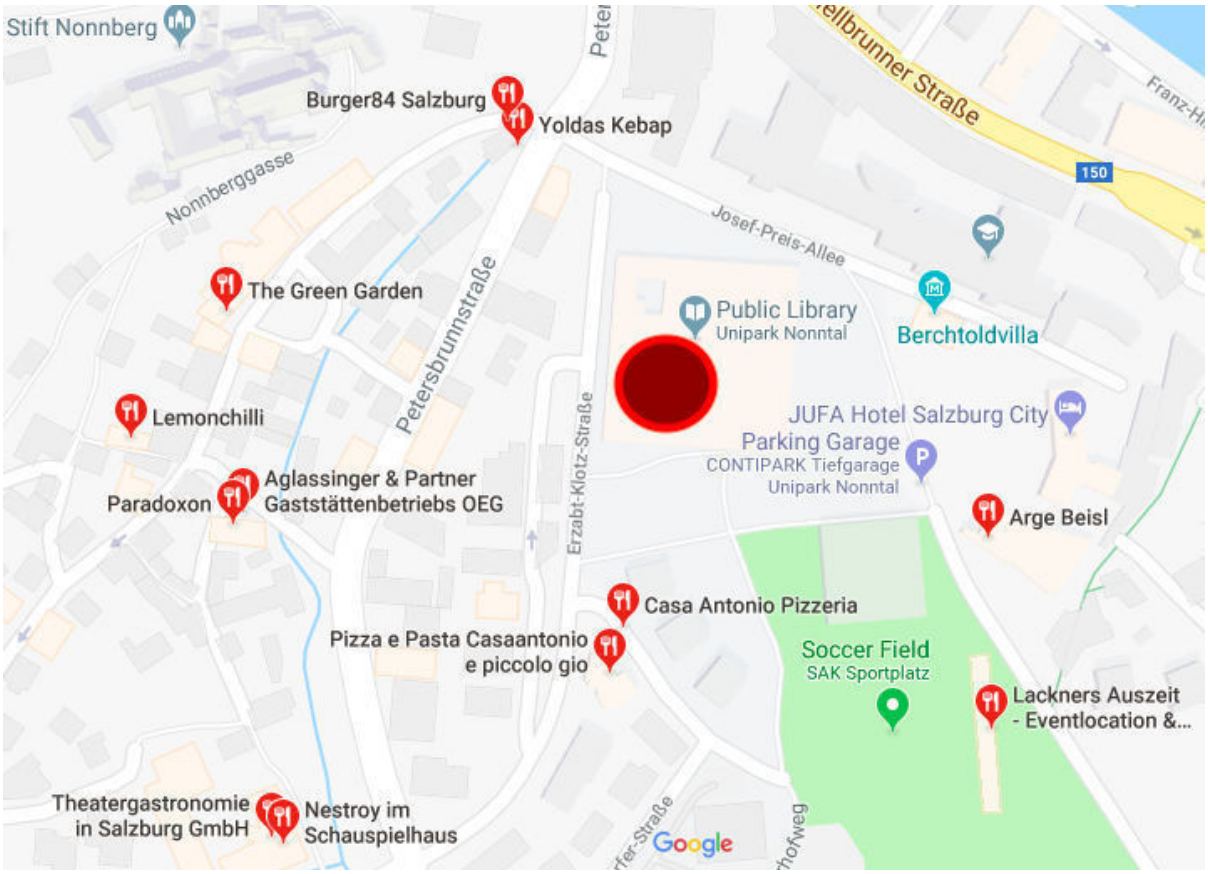
take the trolley bus line 10 (in the direction of Sam) until the exit Justizgebäude (21 min, 13 intermediate stops). The Unipark is in ~320 m walking distance.

Local Supply

The venue is very close to the city center which offers lots of opportunities.

Nearby spots for lunch:

- Arge Beisl
- Lackners Auszeit
- Casa Antonio
- Jufa
- Pommes Boutique
- The Green Garden
- Lemonchilli



Bars / Restaurants

Some places we recommend to have a good Austrian meal:

- Bärenwirt (city centre)
- Kastners Schenke (city centre)
- Restaurant Stiglkeller (city centre)
- Raschhofer Herrnau (10-minute-walk from the venue)
- Gasthof Überfuhr (25-minute-walk from the venue)

To have a drink after the meeting we recommend:

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

Hotels / Hostels

Salzburg offers several accomodations. Some of them are listed below. You may also be interested in airbnb.

- Via Roma
- Arcotel Castellani
- Motel One Alpenstraße

  If you walk it will take around 30 minutes. From the bus stop "Salzburg Polizeidirektion" you can take bus nr. 3 or 8 until the exit Justizgebäude (8 min, 4 intermediate stops). Then it is only a 5-minute-walk to the Unipark (~320 m).
- Austria Classic Hotel Hölle
- A&O Salzburg Hauptbahnhof

  By the trolly bus line 3 you can reach the venue easily, as described above (cf. How to get to the venue).
- Eduard-Heinrich Haus (hostel)

  If you walk it will take around 35 minutes. From the bus stop „Salzburg Herrnau" you can take bus nr. 3 or 8 until the exit Justizgebäude (6 min, 3 intermediate stops). Then it is only a 5-minute-walk to the Unipark.

Poster prints

If you need to print your poster directly in Salzburg you can do it in one of the local copy shops. We recommend to contact the copy shop before your arrival and ask for the exact conditions and prices.

- printcenter (printcenter@sbg.ac.at)
- colibri
- copypoint
- we copy

SOCIAL EVENT

When:

Friday, July 13th 2018, starting 7:00 pm

Where:

"Schnaitl" - Bergstraße 5, 5020 Salzburg

How much:

EUR 20.- registration fee

drinks free of charge (while supply lasts)

The small financial contribution of €20 (if you signed up for the social event, this was included in the amount you have paid) includes a buffet and a drink of your choice at the bar.

Didn't sign up for the social event?

No Problem!

You won't be able to join the buffet, just grab something to eat somewhere else and then join us at "Schnaitl". Delicious free beer for everyone from the traditional private "Schnaitl" brewery will be available on a first come, first served basis.

Planing to join us at "Schnaitl"?

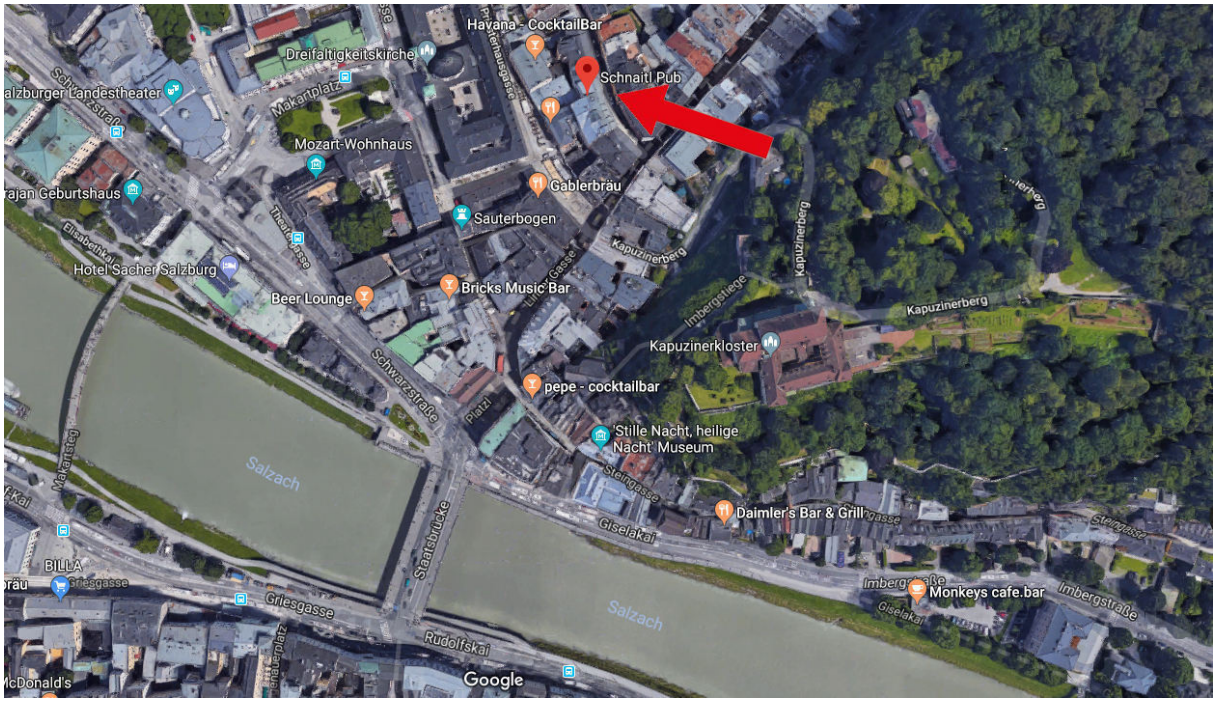
Please bring your name badge with you as it serves as an entry ticket!

Regardless of whether you already signed up or you would just like to join for drinks, you will need your name badge!

Location of the social event

This year's Social Event will take place on July 13th in "Schnaitl" which is one of the most popular pubs in the heart of the old town of Salzburg. We can promise a good choice of local beers including the "Schnaitl" and most importantly, lots of fun!

To prevent you from getting lost in a different pub, this is the location:
Bergstraße 5
5020 Salzburg



Finding the location is easy. You can take bus number 3, 5 or 6 from station "Justizgebäude" (next to Unipark) to station "Makartplatz/Theatergasse" (3rd stop).
Alternatively, just walk 15 minutes from Unipark down the "Salzach" to "Staatsbrücke" (see map: the big bridge). Go to "Platzl" (north of "Staatsbrücke" and walk up "Linzergasse". Take the third street left. After 100 meters "Schnaitl" is on the left hand side.

Don't forget to bring your name badge!

WIFI AND LINKS

You can use the following credentials for WiFi at the venue

SSID: Plus_Event

User: samba18

PW: rd2Waa3

Find us online at

University of Salzburg

SAMBA

CCNS

OBOB Lab

@Salzburg_SAMBA