SALZBURG MIND - BRAIN ANNUAL MEETING

11.-12.07.2019

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

the 3rd Salzburg Mind – Brain Annual Meeting, SAMBA 2019.

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PROGRAM

TIME	Thu, July 11	TIME	Fri, July 12
08:15	Coffee & Registration		
08:40	Opening Remarks		
09:00	Talk 1: **Sophie Scott** Sounds, speech and actions: towards a new model of human auditory processing	09:00	Talk 6: **Evelina Fedorenko** The language system in the human mind and brain
10:00	Coffee Break	10:00	Coffee Break
10:30	Talk 2: **Melissa Võ** Reading scenes: How scene grammar guides attention in real-world environments	10:30	Talk 7: **David Poeppel** Speech rhythms and their audiomotor foundations
11:30	Short Break	11:30	Short Break
11:45	Talk 3: **Sven Bestmann** The laminar and transient nature of sensorimotor beta activity	11:45	Talk 8: **Virginie van Wassenhove** Making sense of time in the human mind
12:45	Lunch Break	12:45	Lunch Break
14:15	Talk 4: **Jody Culham** “The treachery of images”: How the realness of objects affects brain activation and behavior	14:15	Talk 9: **Lars Muckli** Visual predictions in different layers of visual cortex
15:15	Coffee & Poster Session	15:15	Coffee & Poster Session
17:15	Talk 5: **Christoph Korn** Modelling the trade-offs between optimal and heuristic solutions for multistep decisions and social learning	17:15	Talk 10: **Peter Hagoort** Far beyond the back of the brain
		19:00	**SOCIAL EVENT**

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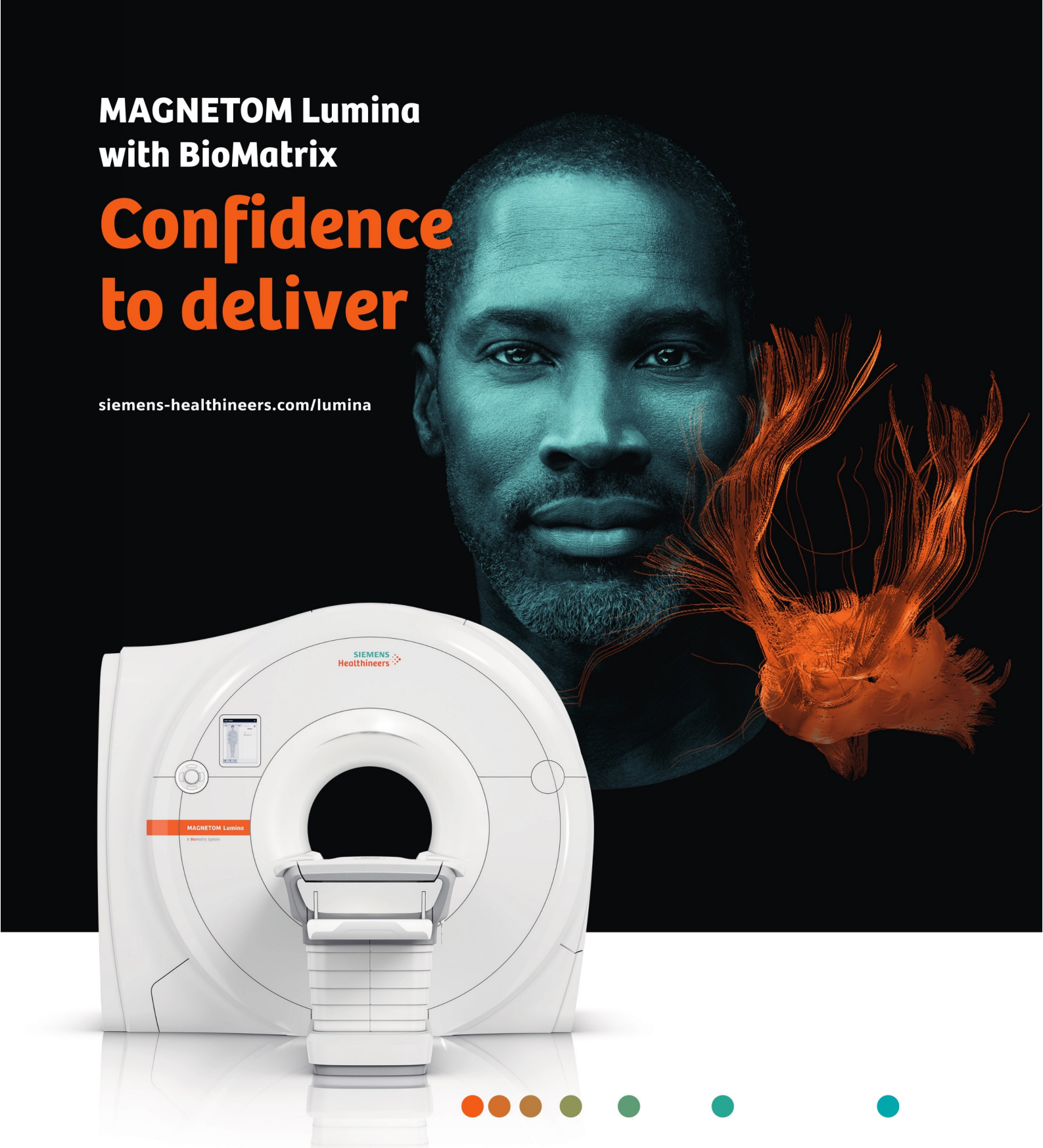

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TALKS

Talk 1: Sounds, speech and actions: towards a new model of human auditory processing

Sophie Scott

University College London, London, UK

We have known for over twenty years that the auditory system in humans and non human primates is organised into anatomical and functional streams of processing: a rostral stream associated with recognition processes and a caudal stream links variously to sensors-motor processing and/or spatial processing of sound. However, there were two clear limitations to this approach. The first being that there was no unifying, domain general framework emerging around these studies - all the theoretical models were focussed on more domain specific approaches (e.g. speech, language, music, prosody etc.). The second limitation was a lack of organisational or computational principles that might distinguish the kinds of processing that occurred within these different streams that might underlie these functional differences. Using new data from non human and human studies of audition, I will present a new domain general approach to this issue, using the different temporal response characteristics of the rostral and caudal streams as an example of their different computational properties.

Talk 2: Reading Scenes: How Scene Grammar Guides Attention in Real-World Environments

Melissa Võ

University of Frankfurt, Frankfurt, Germany

The sources that guide attention are manifold and interact in complex ways. Internal goals, task rules, or salient external stimuli have shown to be some of the strongholds of attentional control. But what guides attention in complex, real-world environments?
Following Wertheimer's Gestalt ideas, I will argue that a scene is more than the sum of its objects. That is, attention during scene viewing is mainly controlled by generic knowledge regarding the meaningful composition of objects that make up a scene. Contrary to arbitrary target objects placed in random arrays of distractors, objects in naturalistic scenes are placed in a very rule-governed manner. Thus, scene priors — i.e. expectations regarding what objects (scene semantics) are supposed to be where (scene syntax) within a scene — strongly guide attention. Violating such semantic and syntactic scene priors results in differential ERP responses similar to the ones observed in sentence processing and might suggest some commonality in the mechanisms for processing meaning and structure across a wide variety of cognitive tasks.
In this talk, I will highlight some recent projects from my lab in which we have tried to shed more light on the influence of scene grammar on visual search, object perception and memory, its developmental trajectories, as well as its role in the ad-hoc creation of scenes in virtual reality scenarios.

Talk 3: The laminar and transient nature of sensorimotor beta activity

Sven Bestmann

University College London, London, UK

Motor cortical beta activity (13-30 Hz) is a hallmark signature of healthy and pathological movement, but its behavioural relevance remains unclear. One reason for this is that slow, sustained changes in beta amplitude pre- and post-movement may not sufficiently summarize trial-wise dynamics in beta activity.
I will discuss recent approaches developed in the lab using high SNR magnetoencephalography (MEG) for laminar-specific analyses of beta signals including new approaches for obtaining better anatomical priors for MEG source reconstruction. I will present recent data on the laminar profile of average beta changes using some of these approaches, which support proposals about frequency specific channels for feedback and feedforward processing. However, the nature of high-power beta changes is transient, and dominated by punctate high-power beta events (bursts). Biophysical models and improved source reconstruction hints at a more complex laminar profile of transient beta events, with possible implication for theories of the laminar organization of these signals and their role in feedback/feedforward processing. These results indicate a necessary reappraisal of the functional role of sensorimotor beta activity in human cortex.

Talk 4: “The treachery of images”: How the realness of objects affects brain activation and behavior

Jody Culham

Western University London, Ontario, Canada

Psychologists and neuroimagers commonly study perceptual and cognitive processes using images because of the convenience and ease of experimental control they provide. However, real objects differ from pictures in many ways, including the potential for interaction and richer information about distance (and thus physical size). Across a series of neuroimaging and behavioral experiments, we have shown different neural responses to real objects than pictures, in terms of the level and pattern of brain activation as well as visual preferences as indicated by eye tracking. Now that these results have shown quantitative and qualitative differences in the processing of real objects and images, the next step is to determine which aspects of real and virtual objects drive these differences.

Talk 5: Modelling the trade-offs between optimal and heuristic solutions for multistep decisions and social learning

Christoph Korn

University of Hamburg, Hamburg, Germany

Humans face many complex decision-making and learning situations in which the computation of optimal solutions challenges – or even surpasses – cognitive capacities. Therefore, humans often resort to heuristic solutions. Formal models that adequately capture the neuro-cognitive mechanisms of the trade-offs between optimal and heuristic solutions are lacking. Here, I focus on two pertinent scenarios:
First, I will present a series of partly published studies that show how humans combine optimal and heuristic solutions to maximize rewards in multistep decision scenarios. Results obtained from behavioral modelling and functional neuroimaging suggest a role of the medial prefrontal cortex in the computation of the employed policies and of the uncertainty associated with relying on these policies.
Second, I will describe unpublished experiments that outline how humans get to know other persons by updating the estimations of these persons' character traits. The best-fitting models combine principles derived from reinforcement learning algorithms with participants' world knowledge about the distributions and interrelations of different character traits. Two functional neuroimaging datasets show that these interrelations between character traits are represented in the medial prefrontal cortex.
Taken together, the to-be-presented projects aim at providing neuro-computational accounts of the trade-offs in complex decision-making and learning processes.

Talk 6: The language system in the human mind and brain

Evelina Fedorenko

Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

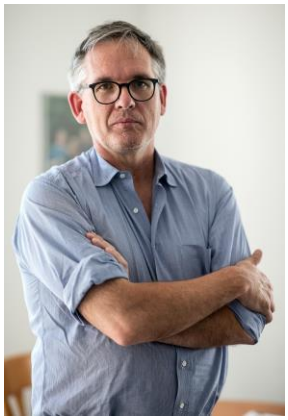
Human language surpasses all other animal communication systems in its complexity and generative power. I use behavioral, neuroimaging, and computational approaches to illuminate the functional architecture of language, with the goal of deciphering the representations and computations that enable us to understand and produce language. I will discuss three discoveries about the language system. First, I will show that the language network is selective for language processing over a wide range of non-linguistic processes. Next, I will challenge current proposals of the neural architecture of language, which argue that syntax (the rules for how words combine into phrases and sentences) is cognitively and neurally dissociable from the lexicon (word meanings). I will show that syntactic processing is not localized to a particular region within the language network, and that every brain region that responds to syntactic processing is at least as sensitive to word meanings, including when probed with a high-spatial/high-temporal-resolution method (ECoG). Finally, I will provide evidence that stimuli that are not syntactically well-formed but allow for meaning composition (operationalized within an information-theoretic framework) elicit as strong a response as intact sentences, suggesting that semantic composition may be the core driver of the response in the language-selective brain regions.

Talk 7: Speech rhythms and their audiomotor foundations

David Poeppel

New York University, New York City, USA
Max-Planck-Institut, Frankfurt, Germany

to be announced



Talk 8: Making sense of time in the human mind

Virginie van Wassenhove

Neurospin, France

The neural mechanisms supporting temporal cognition remain debated. In this talk, I will reframe temporalities from the perspective of the brain itself (as generator-observer of events) as opposed to that of the external observer. I will illustrate the importance of oscillatory activity in low-level temporal logistics of information processing for instance yielding temporal order and behavioral precision. I will also discuss recent findings showing that conscious timing may not linearly map onto neural timing – i.e., that temporalities are represented abstractly and intelligibly - and exemplify this with recent work focused on the generative nature of the psychological time arrow (mental time travel), and the ability to introspect about one's self-generated timing productions (temporal metacognition).

Talk 9: Visual Predictions in different layers of visual cortex

Lars Muckli

University of Glasgow, Scotland, UK

Normal brain function involves the interaction of internal processes with incoming sensory stimuli. We have created a series of brain imaging experiments that sample internal models and feedback mechanisms in early visual cortex. Primary visual cortex (V1) is the entry-stage for cortical processing of visual information. We can show that there are two information counter-streams concerned with: (1) retinotopic visual input and (2) top-down predictions of internal models generated by the brain. Our results speak to the conceptual framework of predictive coding. Internal models amplify and disamplify incoming information. The brain is a prediction-machinery. Healthy brain function will strike a balance between precision of prediction and prediction update based on prediction error. Our results incorporate state of the art, layer-specific ultra-high field fMRI and other imaging techniques. We argue that fMRI with it's capability of measuring dendritic energy consumption is sensitive to record activity in different parts of layer spanning neurons which enriches our computational understanding of counter stream brain mechanisms.

Talk 10: Far beyond the back of the brain

Peter Hagoort

Max Planck Institute for Psycholinguisics
Donders Institute for Brain, Cognition and Behaviour
Radboud University Nijmegen

Far beyond the back of the brain is where language happens. The infrastructure of the human brain allows us to acquire a language without formal instruction in the first years of life. I will discuss the features that make our brain language-ready. Next to the neuro-architectural features I will discuss the functional aspects of language processing. A central and influential idea among researchers of language is that our language faculty is organized according to Fregean compositionality, which implies that the meaning of an utterances is a function of the meaning of its parts and of the syntactic rules by which these parts are combined. FMRI results and results from recordings of event related brain potentials will be presented that are inconsistent with this classical model of language interpretation. Our data support a model in which knowledge about the context and the world, knowledge about concomitant information from other modalities, and knowledge about the speaker are brought to bear immediately, by the same fast-acting brain system that combines the meanings of individual words into a message-level representation. The Memory, Unification and Control (MUC) model of language accounts for these data. Resting state connectivity data, and data from a large MEG study (N=204 participants) will be discussed, specifying the contributions of temporal and inferior frontal cortex. I will also discuss fMRI results that indicate the insufficiency of the Mirror Neuron Hypothesis to explain language understanding. Instead, understanding the message that the speaker wants to convey requires the contribution of the Theory of Mind network. I will sketch a picture of language processing from an embrained perspective. Overall, I will argue that a multiple network perspective is needed to account for the neurobiological underpinning of language to its full extent. Finally I will illustrate why it is hard to give a good presentation.

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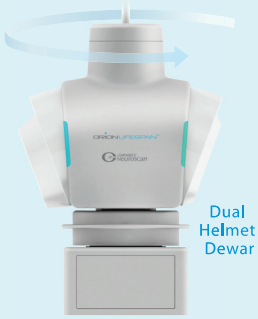

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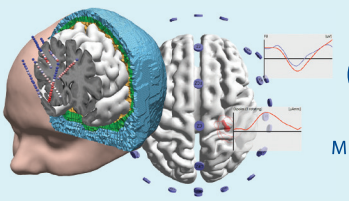

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POSTER ABSTRACTS

* = takes part in Poster Prize

1 Standing Sentinel during Human Sleep: Continued Evaluation of Environmental Stimuli in the Absence of Consciousness

Blume, C.[1]

[1]Centre for Chronobiology, Psychiatric University Hospital of the University of Basel

While it is well-established that subject`s own names (ONs) and familiar voices are salient during wakefulness, we here investigated processing of environmental stimuli during a whole night of sleep including deep N3 and REM sleep. Besides the effects of sleep depth on stimulus processing we also investigated how sleep-specific oscillatory EEG patterns (i.e., sleep spindles and slow oscillations [SOs]) relate to nocturnal processing. Using high-density EEG, we studied processing of auditory stimuli by means of event-related oscillatory responses (i.e., de-/synchronisation, ERD/ERS) and potentials (ERPs). We manipulated stimulus salience by varying the (i) subjective (i.e., SON vs. unfamiliar name) and the (ii) paralinguistic (emotional) relevance (i.e., familiar vs. unfamiliar voice, FV/UFV). Results reveal that the evaluation of the familiarity of a voice persists during all NREM sleep stages and even REM sleep, whereby our findings contrast previous reports of REM sleep resembling a “closed loop” with the brain being primarily focussed inwards. Especially UFV stimuli elicited larger responses in a broad 1-15 Hz range suggesting they continue being salient. In sum, this suggests a ‘sentinel processing mode’ of the human brain in the absence of consciousness. Furthermore, using stimuli of varying degrees of salience we show that, unlike previously suggested, sleep spindles and the negative slope of SOs do not uniformly inhibit information processing but their inhibitory potential seems to be tuned to stimulus salience.

2 Predictive coding in neuronal oscillations during natural reading

Himmelstoss, N. A.[1], Schuster, S.[1], Vignali, L.[2], Hawelka, S.[1], Hutzler, F.[1], Moran, R.[3]

[1]University of Salzburg, Austria; [2]University of Trento, Italy; [3]King´s College London, UK

There is growing consensus that in line with predictive coding theories of perception, reading entails the matching of linguistic input and predictions of upcoming words inferred from previous knowledge or context-based semantic or syntactic information. Within the language network it has been hypothesized that oscillatory network dynamics gate hierarchical information processing. Here, beta oscillations are assumed to transmit top-down predictions while gamma oscillations may indicate the matching of predictions and input as well as bottom-up driven prediction errors. Employing dynamic causal modelling (DCM) of coupled neuronal oscillations on simultaneously recorded eye-tracking and EEG data we sought to identify effects of context-based semantic predictions on fixation-related directed brain connectivity within the reading network. Applying DCM to source-reconstructed data from the left inferior frontal gyrus (lIFG) and the left inferior-temporal gyrus (lITG) we found significant effects of semantic congruence and cloze probability on top-down gamma-beta and bottom-up beta-gamma cross-frequency coupling both at sentence-final and pre-final words. Our data provide evidence that the reading network dynamically adjusts to contextual information which is reflected in specific frequency-frequency interactions as well as eye movement behaviour during self-paced sentence reading.

3* Pre-stimulus feedback connectivity biases the content of visual experiences

Rassi, E.[1], Wutz, A.[1], Müller-Voggel, N.[2], Weisz, N.[1]

[1]CCNS, University of Salzburg; [2]Center for Biomagnetismus, University Hospital Erlangen

Ongoing fluctuations in neural excitability and in network-wide activity patterns before stimulus onset have been proposed to underlie variability in near-threshold stimulus detection paradigms, i.e. whether an object is perceived or not. Here, we investigated the impact of pre-stimulus neural fluctuations on the content of perception, i.e. whether one or another object is perceived. We recorded neural activity with magnetoencephalography before and while participants briefly viewed an ambiguous image, the Rubin face/vase illusion, and required them to report their perceived interpretation on each trial. Using multivariate pattern analysis, we showed robust decoding of the perceptual report during the post-stimulus period. Applying source localization to the classifier weights suggested early recruitment of V1 and ~160 ms recruitment of category-sensitive FFA. These post-stimulus effects were accompanied by stronger oscillatory power in the gamma frequency band for face vs vase reports. In pre-stimulus intervals, we found no differences in oscillatory power between face vs. vase reports in V1 nor in FFA, indicating similar levels of neural excitability. Despite this, we found stronger connectivity between V1 and FFA prior to face reports for low-frequency oscillations. Specifically, the strength of pre-stimulus feedback connectivity (i.e. Granger causality) from FFA to V1 predicted not only the category of the upcoming percept, but also the strength of post-stimulus neural activity associated with the percept. Our work shows that pre-stimulus network states can help shape future processing in category-sensitive brain regions and in this way bias the content of visual experiences.

4* Rhythmic suppression of task-irrelevant distractors

Wöstmann, M.[1], Kreitewolf, J.[1], Naujokat, M.[1], Obleser, J.[1]

[1]Department of Psychology, University of Lübeck, Lübeck, Germany

Recent research has shown that attention samples target stimuli in a rhythmic fashion, characterized by waxing and waning target detection at frequencies in the theta range (~3–8 Hz). Beyond the prioritized processing of targets, a key role of attention is the suppression of task-irrelevant distractors. To investigate whether this suppressive component of attention is also rhythmic in nature, we here test the oscillatory dynamics of behavioural and neural distractor suppression. We combined data of six experiments with an overall sample of N = 209 human participants. In different adaptations of the Irrelevant-Sound Task', participants retained the serial order of numbers in working memory while being distracted by different auditory stimuli, including speech, amplitude-modulated noise, and stationary noise. We varied the temporal occurrence of the distractor to test whether task accuracy and neural responses would fluctuate over distractor onsets. Behavioural results revealed that number-recall accuracy was modulated by distractor onset at 1–4 cycles per second, with slower modulation for speech compared to noise distractors. To investigate the neural basis of distractor suppression, we analysed the event-related potential (ERP) in the electroencephalogram in a sub-sample of N = 23 participants. The amplitude of the N1 ERP component was modulated in sync with task accuracy: Distractor onsets accompanied by larger N1 amplitudes proved later more detrimental to behavioural accuracy. Our findings suggest that the human attentional filter suppresses task-irrelevant distractors in a rhythmic fashion. This surfaces as a synchronous waxing and waning of neural distractor encoding and, thus, of behavioural distraction.

5* Deficient Decision-Making in Pathological Gamblers correlates with Gray Matter Volume in Medial Orbitofrontal Cortex

Freinhofer, D.[1], Wurst, F. M.[2], Thon, N.[2], Tschernegg, M.[1], Schwartenbeck, P.[1,3], Eigenberger, T.[4], Kronbichler, M.[1,3]

[1]Centre for Cognitive Neuroscience and Department of Psychology, University of Salzburg, Salzburg, Austria; [2]Institute for Interdisciplinary Addiction and Drug Research (ISD), Association for Interdisciplinary Addiction and Drug Research (FISD e.V.), Hamburg, Germany; [3]Neuroscience Institute, Christian-Doppler-Klinik, Paracelsus Medical University Salzburg, Salzburg, Austria; [4]Department of Psychiatry, Psychotherapy and Psychosomatics, Christian-Doppler Medical Centre, Paracelsus Medical University, Salzburg, Austria

Individuals suffering from pathological gambling (PG) show impaired decision making, but it is still not clear how this impairment is related to other traits and neuroanatomical characteristics. In this study we investigated how decision making in PG patients (1) is connected to different impulsivity facets and (2) how it is related to gray matter volume (GMV) in various brain regions. Twenty-eight diagnosed patients with PG and 23 healthy controls completed the cups task, to measure decision making in the context of risk advantageous and risk disadvantageous choices. A delay discounting task and the Barrant Impulsiveness Scale were applied to assess impulsivity facets. In addition, structural magnetic resonance images were acquired. As predicted, in comparison to the control group PG patients demonstrated dysfunctional decision making, indicated by less sensitivity for the difference between risk advantageous and risk disadvantageous choices and they also showed increased impulsivity. Results revealed (1) a significant positive correlation between decision making impairments and non-planning impulsivity, but no relation to any other impulsivity facet. Although there were no GMV differences between PG patients and controls, (2) larger medial orbitofrontal GMV was connected to lower decision making abilities in PG patients. Our findings suggest that (1) an association between decision making and impulsivity is also present in PG patients and that (2) dysfunctional decision making – particularly the component of risk evaluation - is related to decreased GMV in the medial orbitofrontal cortex, a brain region concerned with processing of rewards.

6 Speech production rate modulates syllable perception

Assaneo, M. F.[1], Rimmele, J. M.[2]

[1]New York University; [2]Max Planck Institute for Empirical Aesthetics, Frankfurt/Main

Recent studies suggest that auditory perception relies on temporal predictions from the motor system to increase its performance (see Rimmele et al. 2018). However, there exists little behavioral evidence for this conjecture in the speech domain. In order to test this prediction, we designed a behavioral protocol capable of testing the influence of rhythmic speech production on speech perception. In line with previous results (Assaneo et al., 2019), we hypothesize that individual differences in the degree of audio-motor coupling could modulate the strength of behavioral effects. Thus, we first measured and subsequently classified participants into two groups according to the strength of their spontaneous audio-motor synchronization (high or low). Next, during the main experiment participants were instructed to produce rhythmic sequences of syllables. Immediately following speech production offset, a syllable was presented, embedded in noise, and participants performed a syllable discrimination task. Using a decoding approach, we assessed whether task performance was modulated by the phase of the syllable presentation with regard to the motor rhythm. The motor rhythm was derived from the oscillation generated by the produced speech envelope. We show that only for individuals with high audio-motor coupling performance is modulated by the speech production rhythm; i.e., participants' perceptual performance is predicted by stimulus occurrence with respect to motor production phase.

7 Alpha power as a neural signature of involuntary attention?

Weise, A.[1], Hartmann, T.[1], Parmentier, F.[2], Ruhnau, P.[3], Weisz, N.[1]

[1]CCNS and Division of Physiological Psychology, University of Salzburg, Salzburg, Austria; [2]Department of Psychology, Institut Universitaris de Recerca, University of the Balearic Islands, Palma, Spain; [3]Department of Neurology, Otto-von-Guericke University Magdeburg, Magdeburg, Germany

Neural oscillations with a particular emphasis on alpha power have become a popular tool to investigate voluntary attention. It is well known that guiding participants' attention to a certain location (left or right) modulates oscillatory alpha power, which correlates with behavioral performance. Here, we examine whether alpha power also serves as a neural signature of involuntary spatial attention. In a cross-modal distraction paradigm to-be-categorized (left/right) visual targets were preceded by task-irrelevant sounds. These sounds were presented binaurally in 80% of trials (standard condition) and lateralized (left or right) on the remaining trials, distributed randomly across the task (deviant sounds). Critically, the deviant could appear at the congruent or at an incongruent location with respect to the target. As expected, our paradigm resulted in clear behavioral distraction by the deviants: i.e. when deviants (vs. standards) preceded targets participants responses were slower. Interestingly, when deviants and targets occured at congruent (vs. incongruent) locations responses were faster, suggesting that deviants captured spatial attention involuntarily. Importantly, alpha power to lateralized deviants was modulated in a spatially selective manner: It was lower in the right hemisphere over fronto-central areas when a left (vs. right) deviant preceded the target, while it was higher in the left hemisphere over central and parieto-occipital areas. Our data strongly suggest that alpha power qualifies as a neural signature of involuntary attention.

8 Do sleep slow waves modulate information processing along the visual pathway?

Vossen, A. Y.[1], Dalal, S. S.[1]

[1]Center of Functionally Integrative Neuroscience, Aarhus University

Cortical slow waves generated during deep sleep reflect alternating phases of heightened and depressed cortical excitability which respectively permit or block sensory information processing ("sensory gating"). Accordingly, it has been shown that the magnitude of the brain's response to acoustic and somatosensory stimulation during NREM sleep depends on whether stimuli arrive during Up or Down states. The visual system has not yet been examined. We therefore sought to investigate if the phase of sleep slow waves also modulates the response to visual stimuli, and if such modulation happens early (in the retina) or late (in the cortex) along the visual pathway. Whether humans have cortico-retinal feedback connections is controversial; however, retinal response modulation would provide evidence supporting their existence. Sixteen healthy adult volunteers were stimulated with alternating monocular light flashes (ISI 1-2s) overnight while sleeping. Following one night of habituation to experimental setting and stimuli, cortical and retinal responses were measured on the second night using EEG and electroretinography (ERG). All volunteers were able to sleep and only mildly to moderately disturbed by the flash stimulation, although sleep onset was generally delayed and more frequently interrupted. Preliminary analyses confirm the presence of visual evoked responses and slow wave activity in the EEG. Flash-evoked ERG b-waves were demonstrated throughout the night in all participants; high-frequency oscillatory potentials (100-160Hz) were observed in a subset. Analysis of the relationship of these responses to slow wave phase is ongoing. These results will inform our understanding of sensory gating in the visual system during sleep.

9 Brain activation related to individual differences in natural reading speed: A fixation-related fMRI study

Richlan, F.[1], Schuster, S.[1], Hawelka, S.[1], Kronbichler, M.[1], Hutzler, F.[1]

[1]Paris-Lodron-University of Salzburg, Department of Psychology, Centre for Cognitive Neuroscience

Learning to read requires the development of brain systems capable of integrating orthographic, phonological, and lexico-semantic features of written words. In the neuroimaging literature, to date, artificial reading tasks and unnatural presentation modes are prevailing, thus limiting the validity of the findings of these studies. Therefore, a new technique - fixation-related fMRI - has been developed, allowing the investigation of natural reading via a combined analysis of eye movement and brain activation data. The present study used fixation-related fMRI in 56 healthy adults during self-paced silent sentence reading. Individual differences in reading speed were defined as words read per minute during fMRI scanning. Brain activation related to individual reading speed was identified by using it as a predictor for the fMRI data. Sentence reading compared with fixation baseline resulted in activation of the typical reading network including bilateral occipital, parietal, temporal, and frontal language regions. Faster individual reading speed was associated with higher activation in the bilateral occipitoparietal cortex associated with visual-attentional processing, in the bilateral middle and inferior temporal cortex associated with lexico-semantic processing, and in the right temporoparietal cortex associated with phonological processing. This study is a first step in the identification of the brain systems related to natural reading speed. It extends the knowledge gained from previous studies presenting isolated reading material. Furthermore, it opens new possibilities for studying individual differences in natural reading speed in impaired readers, such as children with developmental dyslexia or neurological patients with acquired reading problems.

10* Human menstrual cycle variation in subcortical functional brain connectivity - a multimodal approach

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Behavioural, emotional and sensorimotor changes have been reported along the menstrual cycle (MC). Relatedly, increasing evidence suggests that sex steroids modulate brain connectivity. Resting-state fMRI (RS-fMRI) has been used to study brain functional connectivity in humans. Nevertheless, resting state studies on the MC are underrepresented and yield inconsistent results. We attribute these inconsistencies to the use of various methods in exploratory approaches and small samples. However, hormonal fluctuations along the MC likely elicit only subtle changes, which may have profound impact on network dynamics when affecting key brain nodes. Accordingly, a multi-modal ROI-based approach focusing on areas of high functional relevance is more appropriate to capture these changes. To that end, sixty naturally cycling women underwent RS-fMRI in three different cycle phases and scans were subjected to the following analyses: (i) group ICA to identify intrinsic connectivity networks, (ii) eigenvector centrality (EC) as a measure of centrality in the global connectivity hierarchy, (iii) amplitude of low frequency fluctuations (ALFF) as a measure of oscillatory activity and (iv) seed-based analyses to explore functional connectivity. For (ii)-(iv) we applied a hypothesis-driven ROI approach in the hippocampus, caudate and putamen. In the luteal phase, we found (i) decreased intrinsic connectivity of the right angular gyrus with the default mode network, (ii) heightened EC for the hippocampus, (iii) increased ALFF for the caudate, and (iv) stronger putamen-thalamic connectivity. In the pre-ovulatory phase, we observed stronger fronto-striatal connectivity. This hormonal modulation of connectivity dynamics may underlie behavioural, emotional and sensorimotor changes along the MC.

11 Right auditory cortex morphology as a neuroanatomical marker of language learning potential

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In the past years, research on the concept of language aptitude has flourished in many disciplines including psychology, linguistics and education. Whereas behavioural and neurofunctional research have certainly gained momentum, few studies have addressed the underlying neuroanatomical properties of foreign language aptitude. Therefore, we investigated the relationship between auditory cortex morphology (structural variation and grey matter volume in Heschl's gyrus/HG), while behaviourally exploring the links between working memory, musicality, arithmetic competence and language aptitude in German-speaking adults (N = 30; aged 20-40 years) and children/teenagers (N = 41; aged 10-16 years). On the neural level, the findings of both studies revealed a strong relationship between language aptitude and right-hemispheric auditory cortex morphology. Adults with high speech imitation skills and high musicality had more complete HGs in their right auditory cortex. Similarly, children with high language aptitude possessed multiple gyri in their right auditory cortex and had higher grey matter volumes. In the adult group, language aptitude was correlated with speech imitation, musicality and working memory, while the results of the younger population revealed strong links between language aptitude, school achievement, working memory and arithmetic competence. To conclude, our findings suggest an intricate relationship between right auditory cortex morphology and language aptitude, i.e., a higher number of HGs and higher grey matter volumes seem to present neuroanatomical markers of language aptitude. Moreover, language aptitude is not only significantly associated with working memory, but also with musicality (in adults), and arithmetic skills and school achievement (in children/teenagers).

12* Effective connectivity of large scale resting state networks as well as of individual network nodes can differentiate patients with schizophrenia from controls; a spectral DCM application on resting state fMRI data

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We applied spectral dynamic causal modelling (spDCM; Friston et al., 2014) to analyze the effective connectivity differences between (a) large scale resting state networks of 25 patients with schizophrenia and 31 healthy controls, and (b) individual network nodes (i.e. DMN, SN and DAN, plus left and right hippocampus) from the same data set. Constrained ICA using the GIFT toolbox (Rachakonda et al., 2007) was first performed to obtain 14 resting state networks (Shirer et al., 2012). At the network level, patients showed increased connectivity e.g. from the sensorimotor network to the DAN, higher visual network, and the auditory network, but decreased connectivity from the sensorimotor network to the posterior SN. At the node level, patients showed increased connectivity from the left hippocampus to the dorsal anterior cingulate cortex, right anterior insula, left frontal eye fields and right inferior parietal sulcus, as well as increased connectivity from the right hippocampus to the left and right anterior insula, right frontal eye fields and right inferior parietal sulcus. Taken together, these results support effective connectivity as a valuable approach in differentiating resting state connectivity patterns between patients with schizophrenia and controls, potentially using these differences as diagnostic biomarkers.

13* Strengthening of slow oscillation-sleep spindle coupling predicts memory consolidation improvement from childhood to adolescence

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Memory consolidation during sleep is thought to be coordinated by slow oscillation-sleep spindle coupling. Slow oscillations lock sleep spindles in a favorable timeframe where memory is supposed to be transferred into the long-term storage and potentiated. Both, slow oscillations and sleep spindles change considerably throughout brain maturation. However, it is currently unknown how their dynamic interaction is developing and whether it relates to memory consolidation. Here we address this question in healthy subjects (N = 33) with a longitudinal study design spanning from childhood (8-11 years of age) to adolescence (14-18 years of age) using ambulatory full-night polysomnography and a hippocampus dependent memory task (word pair learning task). Subjects performed better in the memory task during adolescence than during childhood ($t(32) = 6.04$, $p < 0.001$). After disentangling oscillatory from 1/f neural activity, we found frequency shifts within slow oscillation and sleep spindle frequency ranges. Based on these findings we devised an individualized cross-frequency coupling approach, and demonstrate that coupling strength between slow oscillations and spindles is not only increasing ($F(1,32) = 22.35$, $p < 0.001$) but also predicting enhanced memory consolidation from childhood to adolescence ($r(33) = 0.57$, $p < 0.001$). Our results provide evidence for the involvement of slow oscillation spindle coupling in the development of large-scale networks that support memory formation. Moreover, our findings reveal a possible neural mechanism during brain maturation that enhances memory systems by facilitating the memory transfer between hippocampus and neocortex.

14 Oscillatory signatures of the interplay between cognitive load and multisensory integration

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We constantly receive information about our environment from multiple sources and via multiple sensory modalities. To successfully navigate our environment, we need to evaluate and integrate this multisensory information in our mind. Recent evidence suggests that cognitive load affects multisensory integration. However, the neural mechanisms underlying this influence are largely unknown. The goal of this study was to explore the neural signatures associated with the influence of different levels of cognitive load on multisensory integration. To this end, we recorded high-density electroencephalography from participants performing a robust multisensory illusion paradigm, the sound-induced flash illusion (SIFI). In the SIFI a single flash, presented together with two short auditory beeps is often perceived as two flashes. An orthogonal n-back task (0- and 2-back) was used to manipulate endogenous cognitive load prior to SIFI. Illusion perception was higher in the 2-back compared to the 0-back task. Preliminary EEG data analysis showed a change of frontal theta and occipital alpha power induced by higher compared with lower cognitive load. Our findings suggest that ongoing neural oscillations, especially in the theta and alpha bands reflects cognitive load, which affects multisensory integration. This highlights the role of cognitive load in shaping multisensory perception and advances our understanding of sensory integration under high cognitive load. Our findings have crucial implications for the interpretation of multisensory research studies involving experimental conditions with different processing demands, as well as the design of complex user interfaces.

15 Actigraphy in DOC Patients - A Valid Measurement?

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Recently, actigraphy measures received increasing attention in classifying vigilance states. However, in patients with disorders of consciousness (DOC) actigraphy measures should be treated with caution as the data is confounded by external movements (e.g. nursing activities, therapies). In this study, we systematically corrected for external movements in actigraphy data of DOC patients and compared corrected with uncorrected data. Wrist actigraphy was recorded over 7 consecutive days in 30 DOC patients (19 with an unresponsive wakefulness syndrome, 11 in a minimally conscious state). By using an application, clinical staff and visitors could indicate on a tablet if the patient was moved. After cleaning the data from external movements, we computed non-parametric tests to identify differences between corrected and uncorrected actigraphy data. Results indicate that patient's mean wrist activity is significantly higher in the uncorrected than in the corrected data. Patients also show higher mean activity during day than during night in both corrected and uncorrected data with day to night differences being more pronounced in the uncorrected data. The calculation of Lomb-Scargle periodograms supports this result because patients show less deviation from a 24h rhythm in the uncorrected data as compared to the corrected data. Our findings suggest that uncorrected actigraphy data not only overestimates the amount of activity initiated by the patient but also its circadian rhythmicity. Therefore, actigraphy in DOC patients does not accurately reflect the patients' movements but is strongly influenced by external movements and thus needs to be corrected for drawing meaningful conclusions.
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16 Encoding of semantic features from speech. An MEG study

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The anterior temporal lobe (ATL) is believed to be a crucial neural hub for feature-based conceptual knowledge. Single concepts (e.g., chair, wedding, truth) seem to be represented in this region by integrating various features (e.g., shape, location, emotional value) along a ventral-to-dorsal gradient, in which the features encoded become more and more abstract. This hypothesis is supported by experiments in visual object recognition, but the evidence regarding spoken word recognition is controversial, questioning the role of amodal conceptual hub of the ATL. We set out to study the geography and the time course of feature-based semantic processing of spoken words with Magnetoencephalography (MEG). In doing so, we adopted a whole-brain approach using multiple linear regressions where both psycholinguistics (syllable frequency, word frequency, phonological neighbours) and semantic regressors (from a 64-dimensions feature-based semantic space) were assessed together in the same model. Participants listened to 438 spoken words and judged whether they were related to sensory experience (e.g., chair=yes; truth=no). The semantic principal components (PCs), extracted with dimensionality reduction from both concrete and abstract feature-spaces, were encoded ~600ms after the word-recognition point, following both syllabic (~200ms after word onset) and lexical (~200ms after the word-recognition point) features, according to a hierarchical processing framework. Source analysis localized the generators for the two PCs in the left ventral-medial ATL for concrete features and in the left dorsal ATL for abstract features. The ATL encodes feature-based integrated semantic representations also during spoken-word recognition, following a ventral-to-dorsal gradient of abstractness, in a late temporal window.

17 Identifying Resting Pattern in Stroke Using fNIRS: A Pilot Study

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Resting-state functional imaging has been used to study the functional reorganization of the brain. The practicability of functional near-infrared spectroscopy (fNIRS) to assess resting-state functional connectivity (RSFC) has already been demonstrated. This study aims to identify the difference in RSFC pattern for stroke patients from that of healthy subjects. Twenty patients with mild stroke (MRS<4), having an onset of 4 to 8 weeks and an equal number of healthy volunteers were included in the study after Ethical committee approval. The fNIRS signal was recorded bilaterally over the premotor area and supplementary motor area and over the primary motor cortex using NIRSport system (NIRx Medical Technologies LLC, Berlin, Germany). Most activated channels were identified using a finger movement task prior to the resting state acquisition. Pearson Correlation is the method used to compute RSFC. RSFC for the healthy group and patient group were computed. Connectivity matrices were fisher transformed and normalized between 0 and 1. Modularity pattern for each group was identified using Brain connectivity toolbox. Healthy subjects' data demonstrated two modules involving both hemispheric connections in each module. The community structure of Left side affected patients showed also two modules with more connections concentrated in the right hemisphere. Right side affected group showed two modules but with more connections on the left hemisphere. The difference between the left side affected and right side affected group of patients when compared to the healthy group were computed. Specific patterns were identified and modularity is found out for each group.

18 Cortical reorganization of language and theory of mind cortex in an individual born without a left temporal lobe

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The faculties of language and social cognition, especially the ability to reason about mental states, theory of mind (ToM), are deeply related in evolution and development. Yet they dissociate in adult cognition, as suggested by both clinical (e.g., autism, aphasia) and neural (distinct cortical networks) evidence. Cortical injury sustained early in life leads to neural reorganization, and studies of early brain lesions provide a window into mechanisms of cortical specialization in typical development. We present a case study of an individual, EG, with extensive perinatal injury to the left temporal lobe, including areas typically dedicated to language processing, who nonetheless has no detectable behavioral impairments on a range of linguistic and general-cognitive tasks, as well as on pragmatic tasks, thought to involve interactions between language and ToM. We examine how language is accommodated in EG's preserved neural tissue, and how reorganization impacts the relationship between language- and ToM-selective cortex. We report two deviations of functional specialization for language and ToM in EG. First, on three complementary measures of cortical specialization, EG's right temporoparietal cortex, which typically includes the most selective component of the ToM network, shows reduced dissociability of language and ToM, relative to neurotypical controls. Second, regions of medial prefrontal cortex, specialized for ToM in neurotypical adults, appear to have been "taken over" by language processing in EG, with no detectable ToM responses. These results suggest a degree of developmental interchangeability between the neural substrates of language and ToM.

19* Alpha bursts in inferior parietal cortex underlie spatiotemporal object individuation

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Current theories suggest that alpha oscillations (9-13 Hz) reflect pulsed-inhibitory neural computations that structure visual perception into discrete time frames supporting spatiotemporal object individuation. We investigated the impact of alpha oscillations in a multiple-object tracking task (MOT) while simultaneously recording whole-head magneto-encephalography (MEG). On each trial, the participants were required to track 2, 4 or 8 objects over a period of 2-3 seconds. In different blocks, they switched between an individuation task (i.e. partial report) and average object-position processing (i.e. centroid task). During MOT, we found a strong alpha power increase from pre-trial baseline in bilateral inferior parietal cortex for both tasks. By contrast, we found stronger oscillatory bursting in the alpha band for individuation vs. averaging. Oscillatory bursting captures single-trial dynamics better compared to across-trial averaged power, because it measures time- and band-limited, high-signal periods above each trial's respective pre-trial mean. Critically, the alpha bursting effect was only significant below the typically reported capacity limit (i.e. for 2 / 4 objects) and not when object-capacity was exceeded (i.e. 8 objects). This pattern was supported by behavioral performance. These results suggest that oscillatory alpha bursts underlie spatiotemporal object individuation and its capacity limits.

20 Learning about other person's personality traits relies on combining reinforcement learning with representations of trait similarities

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Humans often meet new persons who could be potential cooperation partners. For successful cooperation, it is crucial to determine with whom to cooperate and who to avoid. Personality traits provide a short summary of how persons react in various situations and can thus serve as predictors for how cooperation might unfold. However, there is a lack of neuro-computational models describing how humans learn about the traits of others. Reinforcement learning models, which entail updating on the basis of prediction errors, provide mechanistic descriptions for various types of learning. But it is unlikely that humans solely rely on prediction errors for learning about traits especially considering the various sources of information available, such as the similarities between traits and their distributions in the general population. In two behavioral experiments (n=41, n=36), participants predicted how four other persons had previously rated themselves and received immediate feedback. We compared simple reinforcement learning models to models which combine reinforcement learning with other types of information like trait similarities, self and mean ratings. Similarities and mean ratings were calculated from ratings of an independent sample (n=835). In the winning model prediction errors were scaled according to trait similarities. Additionally, applying representational similarity analysis on self-ratings in two fMRI datasets (n=27, n=30). Medial prefrontal cortex reflected the fine-grained similarities between personality traits. Overall, our findings suggest that similarities between traits constitute a crucial ingredient in neuro-computational models of learning about others.

21 Motion-related activity in the human retina elicited by moving gratings

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A multitude of studies across various species have demonstrated that motion induces synchronous activity in retinal amacrine and ganglion cell populations. However, evidence for retinal motion processing in humans is sparse and not consistent. Here, we investigate whether specific types of motion stimuli elicit motion related activity in the human retina that can be recorded using electroretinography. The participants passively viewed moving circular gratings with three different speeds, a stimuli category that has been shown to result in massive cell activity synchronization in the mouse retina. Binocular retinal activity was recorded using DTL fiber electrodes and subsequently analyzed in the time and frequency domain. Contrasting the different speed conditions showed clear effects for the fastest moving grating stimulus: this condition elicited evoked potentials with larger amplitudes than slower motions. Time-frequency analysis revealed a power increase in high frequency activity (60-120 Hz) for the high speed condition compared to slower moving gratings. Taken together, this shows retinal activity elicited by moving stimuli, possibly reflecting retinal motion processing.

22 Sex affects brain activation during clustering and switching in semantic fluency

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Sex differences in cognition have been attributed to the use of different strategies in men and women. However, the neural underpinnings of these strategies have hardly been investigated. Here we study sex differences in brain activation during different strategies in a verbal fluency task. When participants generate words belonging to a pre-defined category (semantic fluency), two distinct strategies have been observed: Clustering (i.e. generating within word categories) and switching (shifting between subcategories). The female advantage in verbal fluency tasks has been attributed to their favorable use of the switching strategy. To investigate sex differences in brain activation during these verbal fluency strategies, a silent semantic verbal fluency task was administered to a large sample (36 women, 36 men) during fMRI measurement. Participants were instructed to use either the clustering or the switching strategy. Irrespective of the strategy used, men showed stronger activation in the whole verbal fluency network compared to women, especially in frontal regions. Connectivity analyses confirm stronger intra-hemispheric connectivity in men, but stronger inter-hemispheric connectivity in women. Most importantly, we found sex and strategy to interact in the right DLPFC. Stronger activation in the right DLPFC was observed during switching as opposed to clustering in men, whereas the opposite pattern was observed in women. Findings are discussed in the light of a compensatory mechanism during the non-preferred strategy.

23 Impact of multiplication facts training on sensitivity-to-interference: a behavioral and functional magnetic resonance imaging (fMRI) study

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Single-digit multiplications are thought to be associated with different levels of interference because they show different degrees of feature overlap (i.e., digits) with previously learnt problems. Recent behavioral and neuroimaging studies provided evidence for this interference effect and showed that individual differences in multiplication are related to differences in this sensitivity to interference (STI) effect. The present study investigated whether and to what extent competence-related differences in the STI effect and its neurophysiological correlates can be modulated by multiplication facts training. Two groups of students (n = 46) that differed in their arithmetic competencies (AC; low vs. high) underwent 5-day multiplication facts training in which they intensively practiced a set of low- and high-interfering multiplication problems. Following the multiplication facts training a functional magnetic resonance imaging (fMRI) test session was conducted. During the scanning participants carried out a multiplication verification task that comprised trained and untrained problems. The results revealed a behavioral interference effect in the low AC group that could not be resolved by training. In the same group, we further found that the left supramarginal gyrus (SMG) was more activated for low-interfering multiplications compared to high-interfering ones. This finding supports the idea that students' low multiplication abilities are due to the development of insufficient memory representations as a result of STI. Further, our results indicate that learning by drill (i.e., learning the association between the operands and the result) is not the right learning strategy to help this group to reduce interference.

24 Neural substrates of different sources of motivational effects in a reward paradigm

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Introduction Mean reward rates (signalling different levels of opportunity for instrumental action) and cues (signalling impending rewards and associated with the temporal difference error TD) should have motivational effects. We used a f-MRI task to seperate the phases in which TD-error and different levels of reward are present to clarify possible neural substrates of these separate motivational processes. Methods Echo-planar imaging at 3T, N=35 healthy volunteers. Task: After a cue had announced different levels of reward 1 or 20 cents could be obtained by pressing a button when a dot appears. Results At the cue, no reward could be obtained, so mean reward levels were zero, but the TD- error reflected the different announced reward levels. At the foraging patches the mean TD- error was zero, but different reward levels were earned. Different levels of reward at the cue activated the ventral striatal area. At the foraging patch, this area was not active, consistently with the prediction of the model concerning the TD- error signal. The ventral tegmental area/substanita nigra and a brainstem region consistent with the recruitment of cholinergic nuclei were associated with higher reward levels (MNI x, y, z: 6, -20, -14, t=5.44, p=0.024, peak-level corrected for the whole brain). Conclusion Motivational processes engaged by cues correspond in current treatments to the activation of Pavlovian preparatory processes. Different levels of ‘reward opportunities’ may exert their effect on behaviour through a different class of processes, perhaps coordinated by both dopaminergic and cholinergic efferents, as in sustained attention.

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25 Oscillatory Mechanisms of Successful Memory Formation in Younger and Older Adults Are Related to Structural Integrity

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Changes in the mechanisms of memory formation contribute to age-related episodic memory decline. These mechanisms have been studied with the subsequent memory paradigm, which provided evidence for the interaction of medio-temporal and prefrontal cortical regions during successful memory formation. Importantly, these regions show pronounced structural and functional decline in normal aging. We investigated whether structural integrity of these key regions affects oscillatory mechanisms of memory formation. We therefore recorded electroencephalographic data during an associative intentional learning task in 48 younger and 52 older adults. Controlling for multiple comparisons with cluster-based permutation statistics, we found subsequent memory effects (SME) in the alpha/beta as well as the theta frequency. We used logistic mixed effect models to investigate whether interindividual differences in structural integrity of inferior frontal gyrus (IFG) and hippocampus (HC) could account for interindividual differences in the strength of SME. SME in the alpha/beta band were modulated by the cortical thickness of the IFG, in line with its hypothesized role for deep semantic elaboration. Importantly, this structure–function relationship did not differ by age group. However, older adults were more frequently represented among the participants with low cortical thickness. While structural integrity of the HC as a whole did not predict performance, exploratory analysis of HC subfields revealed age differences in the contribution of the entorhinal cortex to theta SME. Thus, our results suggest that differences in the structural integrity of the IFG and HC subfields are the basis not only for interindividual, but also for age differences in memory formation.

26* A neural mechanism for contextualizing fragmented inputs during naturalistic vision

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With every glimpse of our eyes, we sample only a small and incomplete fragment of the visual world. For understanding complex natural environments, the brain needs to contextualize these fragments and integrate them into a coherent representation. Here we show that the visual system achieves this contextualization by exploiting spatial schemata, that is our knowledge about the composition of natural scenes. In two experiments, we measured fMRI and EEG responses to incomplete scene fragments and used representational similarity analysis to reconstruct their cortical representations in space and time. We observed a sorting of representations according to the fragments' place within the scene schema, which occurred during perceptual analysis in the occipital place area and within the first 200ms of vision. More detailed analyses demonstrated that this schema-based sorting is flexible with respect to the scene's appearance, rendering it an efficient mechanism for contextualizing information across visually diverse real-world environments. First, the schema-based sorting of information was not explained by a deep neural network model of vision, although the model fully explained the fragments' categorical organization. Second, fragments from visually and conceptually dissimilar indoor and outdoor scenes were similarly sorted based on their place within the schema. Together, our findings for the first time resolve how the visual brain puts snapshots of the world into meaningful context.

27* The lexical categorization model: A computational model of left ventral occipito-temporal cortex activation in visual word recognition

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To characterize the role of the left ventral occipito-temporal cortex (lvOT) during visual word recognition in a quantitatively explicit and testable manner, we propose the lexical categorization model (LCM). In the LCM, we assume that lvOT categorizes perceived letter strings into words or non-words. This computation assures neuronal efficiency by abandoning high-level processing of meaningless letter strings in experiments and efficiently detects spelling errors and unknown words while reading. LCM simulations reproduce nine benchmark effects found with fMRI. Empirically, using fMRI, we demonstrate that LCM simulations predict lvOT brain activation that resembles the standard pattern: Consonant strings<Words<Pseudowords (N=18), but also patterns that deviate from the standard (N=35). Using electroencephalography (N=31), we show that LCM accounts for activations ~300ms after stimulus onset. Also, we found that word-likeness, the input to the LCM, is represented posterior to lvOT and before the lexical categorization. In contrast, a dichotomous word/non-word contrast, which is the assumed output of the LCM, could be localized to upstream frontal brain regions and after the lexical categorization. Thus, we propose a ventral-visual-stream processing framework for visual word recognition involving word-likeness extraction followed by lexical categorization, before accessing meaning. Finally, we implemented a lexical categorization intervention for German-language-learners resulting in a reading speed increase of 18% (N=89). Reaction times in the training showed an LCM effect, which increased with each session and, finally, we found a correlation of a person-specific estimate of this interaction and reading speed change. Hence, this evidence establishes that lexical categorization is fundamental to efficient reading.

28* Alpha-band oscillation tracks the contents of visual perception and mental imagery

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Mental imagery of objects is phenomenologically similar to veridical perception. Agreeing with phenomenology, fMRI studies showed that visual perception and imagery of objects share neural representations. However, the temporal dynamics with which these representations emerge remain elusive. To investigate this, we performed an EEG experiment, in which participants either saw one of 12 everyday objects (visual perception) or was instructed to mentally visualize the object while hearing the corresponding object name (mental imagery). We performed multivariate classification to reveal the time courses of perception and imagery. We conducted two key analyses. Firstly, using time-resolved classification, we found that object representations emerged rapidly (from around 110ms) in both visual perception and imagery. Secondly, using time-generalization analysis on oscillatory responses, we found that imagery and visual perception share content-specific representation in alpha-band oscillations (8-13Hz), which emerged in imagery at around 800ms-1800ms and in visual perception from 400ms onwards. Our results indicate that alpha-band oscillations track the contents of visual perception and imagery in a shared neural format, suggesting that mental imagery is supported by activation of oscillatory mechanisms also recruited during perception.

29 No modulation of verbal working memory task performance by fronto-parietal theta tACS

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Synchronous rhythmical activity at theta frequency in a fronto-parietal network has been suggested to be associated with working memory (WM) processes and may be directly related to WM performance. In their seminal study, Polanía et al. (2012) either coupled or de-coupled a fronto-parietal theta-network by applying in-phase (0°) or anti-phase (180° phase difference) transcranial alternating current stimulation (tACS). In-phase stimulation lead to increased performance in a WM task whereas anti-phase stimulation had detrimental effects on task performance compared to placebo stimulation. This effect has only been partly replicated (Violante et al., 2017; Kleinert et al., 2017). One reason why there might be inconsistency in findings could lie in the way the electrodes have been referenced: Using electrophysiological modeling, Saturnino et al. (2017) suggested that one shared return electrode for two in-phase stimulation electrodes over frontal and parietal sites might lead to the strongest stimulation effect under the return electrode. As an alternative, they recommend multiple close-by return electrodes for focal stimulation of the frontal and the parietal cortex. This study aimed (1) to reproduce the original findings and (2) to investigate whether focal in-phase stimulation will have at least as much of an facilitatory effect on WM performance as the original in-phase stimulation. Our results from two experiments show that compared to placebo stimulation, in-phase fronto-parietal theta tACS did not lead to increased performance and anti-phase stimulation did not lead to reduced WM performance. Similarly, focal in-phase stimulation was not beneficial for WM performance compared to placebo stimulation.

30* Rhythmic auditory stimulation guides visual perception

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Inputs to our different senses often provide complementary evidence and processing of one sensory modality, such as audition, can influence neural activity and behavioural performance in another sensory modality, such as vision. Recent electrophysiological studies proposed that such cross-modal influences between auditory and visual areas are mediated by the synchronization of ongoing neural oscillations. In a human electroencephalography (EEG, N = 30) study we investigated whether auditory rhythmic stimulation can modulate visual perception and visual cortex oscillatory activity. Participants were asked to discriminate the orientation of a Gabor grating (-45° or 45°) presented at threshold, while listening to a 3 Hz frequency-modulated (FM) with a duration of 2 seconds. Gabor gratings occurred in one of 20 equally spaced target locations around the 3-Hz FM cycle of the auditory stimulus. To investigate visual perceptual processing, we calculated both perceptual sensitivity and decision criterion across the 20 target locations. Results showed that sensitivity as well as criterion were modulated by the 3 Hz FM stimulus. While behavioural modulation was stable within each participant, there was no consistent relation across participants, suggesting that each participant has a preferred phase in which behavioural processing is optimal. Further, Fourier analysis of the EEG showed spectral peaks at 3 Hz and the 6 Hz harmonic indicating that neural oscillations were entrained by the 3 Hz FM tone. These results indicate that rhythmic auditory stimulation can be used to guide visual perceptual processing.

31 High-resolution (2.00mm/1.8mm) functional imaging at 3T

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Introduction High-resolution imaging is a promising approach for innovative techniques that attempt to reconstruct specific signals using multivariate approaches. However, high-resolution imaging has been prevalently investigating at high fields (7T or higher), which are not available to most imaging labs. Here, we report our experience with the detection of activations at 1.8/2.00 mm resolution obtained with commercially available 3T scanners. Methods To obtain images at a reasonable temporal resolution, we used a multiband EPI sequence (Siemens, scanning parameters: slice accelaration: 2; GRAPPA: 2, TR: 2.09sec; TE: 48ms, flip angle: 78, FOV: 64x64, voxel size 2.00mm isotropic, and TR 2.31, TE:50ms, flip angle: 80, FOV: 64x64, voxel size 1.8mm isotropic). The task was passive observation of a checkerboard with patches with inverting colors (inversion every 300ms, blocks of 3sec separated by 12sec during which a fixation point was shown). The colors were black/white or red/blue in alternating blocks. Preprocessing followed standard procedures for realignment and normalization. Smoothing was 3mm FWHM. Results Images taken at 2mm resolution showed good sensitivity (significance values at peak level, corrected for the whole volume) and activation predominantly localizable in the gray matter. Images taken at 1.8mm resolution showed considerable loss of sensitivity, but (perhaps surprisingly) activation in the target occipital areas was present and clear, and localized specifically to gray matter and the interface to CSF. Conclusion High resolution images presented good sensitivity and high specificity of activation. Together with opportunities to separate functional noise spatially, they are a promising technique to combine with multivariate approaches.

32 Supramodal selective attention differentially adjusts frequency and phase of entrained oscillations in primary sensory areas and the dorsal attention network

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Continuously prioritizing behaviourally relevant information from the environment for improved stimulus processing is a crucial function of attention. Low-frequency phase-locking of neural activity (entrainment) in primary sensory areas, with respect to attended/ignored features has been suggested to support top-down prioritization. Entrainment of frontoparietal regions has not been widely studied, despite general implication of these in top-down selection of information. In the current MEG study, we studied how entrained oscillatory activity of both sensory and non-sensory brain regions are differentially impacted upon by attentional focus. Participants performed an established intermodal selective attention task, where low-frequency auditory (1.6 Hz) and visual (1.8 Hz) stimuli were presented simultaneously. We instructed participants to either attend to the auditory or to the visual stimuli and to detect targets while ignoring the other stimulus stream. As expected, the strongest entrainment was observed in primary sensory regions for auditory and for visual stimulation, independent of attentional focus. We found greater differences in entrainment between attended and ignored stimulation for the visual modality. Interestingly, auditory temporal regions show small but significant attention-dependent entrainment even for visual stimulation. Extending findings from invasive recordings in non-human primates, we demonstrate an effect of attentional focus on the phase of the entrained oscillations in auditory and visual cortex. In contrast to the effects in sensory areas, attentional focus adjusted the peak frequencies in nonsensory areas. Spatially these areas show a striking overlap with core regions of the dorsal attention network. This suggests that these areas prioritize the attended modality by optimally exploiting the temporal structure of stimulation. Overall, our study complements and extends previous work by showing a differential effect of attentional focus on entrained oscillations in primary sensory areas and core areas of the dorsal attention network.

33* Decoding Endogenous Imaginative Brain Activity Through The Spatial Covariance Of MEG Signal

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Visual imagery is the ability to mentally recreate a visual percept in the absence of its corresponding sensory input. Recent fMRI studies revealed a significant spatial overlap between the neural correlates of visual imagery and visual perception. However, the temporal dynamics of visual imagery are not well understood because traditional analysis approaches suffer from the core assumption that relevant brain-states occur time-locked to a well defined temporal event. In our MEG study, we decoded imagined categories - face vs. place - without presenting subjects with template images. Rather, this \"real\" imaginative percept was completely self-determined by each subject and could not be captured by traditional time-resolved decoding approaches. However, we show that a novel decoding technique based on spatial covariance matrix representation in a Riemannian manifold of the MEG signal accurately captures the differences between conditions. Unlike time-resolved decoding, covariance-based decoding can detect mental imagery. We suggest that this occurs because imagination-related brain activity is not time-locked, i.e. not temporally aligned across different trials. Our topographies suggest that the signal recorded from occipital, temporal and parietal sensors (presumably corresponding to higher visual areas) is the most informative in order to accurately discriminate face vs. place imagery. We speculate that complex visual features play a crucial role in visual imagery.

34* Prospective action plan encoding into visual working memory

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Visual working memory supports the retention of relevant information even when it is no longer physically present, bridging past visual sensations to potential future actions. Yet visual working memory and action planning have been primarily studied in isolation. We recently showed that action plans can be accessed from working memory simultaneously with probed visual items. Here, we used electroencephalography (EEG) in healthy human volunteers to investigate whether and when prospective actions are planned during visual working memory retention, and ask whether these may be formed as early as during visual encoding. Participants performed a visual-motor working memory task, with a pre-cue directing attention to one of two lateralized visual items which were independently linked to particular actions. Through careful experimental design, we were able to isolate the neural signatures of prospective action planning. Furthermore, to separate 'action encoding' from subsequent 'action preparation', we introduced a temporal expectation manipulation whereby, in different blocks, memories would become relevant for action after either 2 or 4 seconds. Suppression of contralateral mu and beta oscillations (8-30Hz) over motor electrodes revealed encoding of the action plan, irrespective of the time of expected action use. This was followed by gradual action preparation which depended on the time of expected memory use. Together, the results show that 'output gating' in visual working memory starts as early as encoding, and that temporal expectations help fine-tune subsequent action preparation in order to support effective visual-memory-guided action.

35 Goal directed attentional allocation during naturalistic visual search creates more reliable incidental identity and location memory than explicit encoding

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We use representations and expectations formed during life-long learning to support attentional allocation and perception. In comparison to traditional laboratory investigations, real-world memory formation is usually achieved without explicit instruction and on-the-fly as a by-product of natural interactions with our environment. Understanding this process and the quality of these representations is critical to understanding how memory is used to guide attention and perception. Utilizing immersive, navigable and realistic virtual environments we investigated incidentally generated memory representations by comparing them to memories for items which were explicitly memorized. Participants either searched for objects embedded in realistic indoor environments or explicitly memorized them for follow up identity and location memory tests. We show for the first time that memory for the identity of naturalistic objects and their location in 360-degree space is higher after incidental encoding compared to explicit memorization, even though the subsequent memory tests came as a surprise to participants. Our results suggest that the active nature of guiding attentional allocation during proactive behavior allows for behaviorally optimal generation and utilization of representations. This highlights the importance for investigating cognition under ecologically valid conditions and shows that understanding the most natural processes for encoding and retrieving information is critical for understanding adaptive behavior.

36 Visual retro-cues can improve conscious perception of unattended spoken words

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The neural correlates of consciousness have now been studied for decades, yet the question of when a percept becomes conscious is still under debate. Recent studies have shed a new light on this question showing that a cue displayed after the disappearance of a target stimulus at threshold could improve its perception and retrospectively grant it access to conscious report. This phenomenon, called retro-perception, suggests that conscious perception is not time-locked to the stimulus onset per se but to a top-down reamplification of sensory information. This retro-perception effect has been demonstrated in several studies using visual cues and targets. We reasoned that if this retro-perception reflects a general property of conscious access, it should not be confined to visual perception. Using a dichotic listening paradigm, we investigated the effect of a visual cue on the perception of an unattended auditory target word. We obtained both pre-cueing and retro-cueing effects on target identification. Crucially, these cues also improved both subjective and objective report of the target, indicating a retro-perception effect of auditory stimuli. These results are in line with previous studies on retro-perception effect and extend it to auditory perception and cross-modal cueing.

37* Mechanisms of schematic selection of verbal cognitions

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Selection of cognitions is a key aspect of psychological functioning in health and in psychopathological conditions. Psychological theories attribute systematic tendencies in the selection of thoughts to the effect of preexisting schemas. However, little is known about the underlying neural mechanisms. Here, we will explore a model of schema selection and thought generation based on mechanisms of choice-making as in perceptual decisions or in preference-based decisions. To elicit schema selection, we asked participants to perform a computer-based version of the Scrambled Sentences Task (SST), previously shown to demonstrate selection of pessimistic cognitions in depression. Based on known neural correlates of decision making in the vmPFC, we present functional neuroimaging data (N=22) to show the existence of a neural signal correlated with the tendency for schema selection with the same characteristics of a signal correlated with the evidence for a decision (MNI -6, 48, -16, vmPFC, t=5.19, p=0.002, ROI-corrected). As part of this research project, we investigate if the same process underlying selection of cognitions is also active in the selection of characteristic schemas in social phobia and in dark personality types by adapting the SST to target these specific schemas. In social phobia characteristic schemas focus on themes of personal inadequacy and rejection. In dark personality types the factors which must be measured are the tendency to harm somebody and justificatory beliefs. Because of the enormous influence schemas exert on our life and personality, there is a pressing need to clarify the nature of the processes underlying schematic tendencies.

38 Auditory cortex activations while viewing still scenes of mourning

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Introduction The loss of a beloved person is one of the most painful life events. Neuroimaging studies have shown that physical and psychological pain (loss, loneliness, rejection) activate common brain areas such as the anterior insula, ACC or somatosensory brain areas. Here, we report on neural activations in auditory brain areas in a large-sample fMRI study when viewing still scenes of mourning individuals. Methods Data were acquired in 415 healthy participants, who were shown stylized drawings of scenes of mourning individuals and neutral control scenes in a block design (for further details see Labek et al. 2017, SCAN). Results The contrast mourning vs control pictures revealed extensive activations in the left primary auditory cortex in Heschl´s gyrus (area TE1.1) and TE2 (secondary auditory cortex, $t = 12.90$, $p < 0.001$, peak-level corrected for the whole brain), accompanied by similar activations on the opposite side ($t = 12.16$, $p < 0.001$). Together with activations in the precuneus, these were the strongest peaks in the whole brain. Discussion Previous studies have identified shared neuronal activations (mirror neuron mechanism in temporo-parietal areas) while executing a motor action or listening to its sound. Offspring of animals generate, when separated from their caretaker, distress vocalizations with specific locations in the auditory system and pain circuits to which their parents are *exquisitely* sensitive (Panksepp,2005). Our data suggest that this phylogenetically-specified primal form of pre-verbal communication, underlying the emotional contagion of separation/loss distress, is so important to be active when viewing still images of appropriate content.

39 Probabilistic vs. deterministic nTMS-based tractography of language tracts in brain tumor patients

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Modern neurooncological treatments place great emphasis on the preservation of language function, and one of the most novel and promising methods used for this is navigated transcranial magnetic stimulation (nTMS). Following an object-naming task, language-relevant stimulation points can be further used as seed regions for tractography. However, most published protocols make use of a deterministic fiber tracking (dFT) algorithm, and probabilistic algorithms (pFT) are rarely employed. The main purpose of this study was to evaluate the difference between the two tractography approaches. 20 patients with perisylvian space-occupying lesions received preoperative nTMS language mapping, and their respective data was integrated into our tractography software (MRtrix3). Two different FT algorithms were used: a tensor-based deterministic algorithm and a 2nd order integration over fibre orientation distributions (FOD) pFT algorithm. In each patient, the number of the reconstructed language-related tracts was evaluated, as well as the number of fibers per tract to account for the specificity of the tracking. For comparison, the fractional anisotropy, FOD amplitude and minimum fiber length were varied to determine the best visualization settings for each algorithm. Both dFT and pFT successfully tracked the language-related fiber tracts in all 20 patients. pFT was more sensitive in detecting additional fibers than dFT, but also lasted substantially longer and presented a lower specificity. These results suggest that pFT, although superior in sensitivity, may be difficult to implement in clinical practice due to lower specificity and tracking duration.

40 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.

41 ERP correlates of processing the delayed auditory consequences of own versus observed actions

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Processing auditory stimuli generated by voluntary actions (e.g. playing a piano) compared to externally-generated stimuli (e.g. piano sounds) has been associated with a reduction of the N1 and P2 event-related potential (ERP) components. N1 reduction is considered to reflect motor-based predictive mechanisms and contribute to a feeling of self-agency, while P2 modulation correlates with agency judgements. Despite evidence of motor simulation in action observation, research on processing the sensory outcomes of observed actions is limited. We have recently provided initial evidence of selective P2 reduction in action observation. The present study extends this research by testing the modulatory effect of the delay between the (observed) action and its consequences. We simultaneously recorded EEG data from couples of participants: an observer observed an actor pressing a button to generate a sound, which followed after a delay of 350 ms, 850 ms or 1250 ms. Externally-generated sounds were presented either intermixed with action-generated sounds or in a separate block. For action execution, results revealed N1 amplitude reduction for action- vs. all externally-generated sounds irrespective of delay. For action observation, no N1 reduction was observed relative to the intermixed condition but only to the separate condition. Similarly, while in action performance the P2 amplitude was attenuated compared to all externally-generated sounds, such reduction was found only relative to the separate condition in action observation. For actors and observers, the P2 reduction decreased with increasing delay. We discuss these findings in terms of internal predictive mechanisms and self versus other agency attribution.

42* Choosing pain: neuronal substrates of pain related decision making

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In social neuroscience, research on the empathy of pain investigates the neural mechanisms that allow us to understand and share other people\'s emotions. While the capacity to encode and evaluate social situations is crucial in making decisions in interaction with others, empathy for pain research has used paradigms of passive exposure to images. Here, we used a decision-making paradigm to elicit neural correlates of evidence for decisions about intensity of suffering in others. Studies of perceptual and preference-based decision making converge in showing the existence of an fMRI signal correlated with the evidence for a decision. Data were acquired by showing 23 healthy participants two pictures of hands or feet in situations of anticipated physical pain or neutral conditions (source: Jackson, Meltzoff & Decety 2004). In each trial participants were instructed to decide which situation was the most painful (24 trials painful/neutral, 12 trials painful/painful, 12 trials neutral/neutral). In the contrast eliciting activity associated with evidence for a decision (painful/neutral vs. [painful/painful + neutral/neutral]) we found activations in the vmPFC (t=4.98, p=0.008 corrected). The anterior insula was active in a cluster with the inferior and middle frontal gyrus in the opposite contrast (low evidence). In the contrast pain vs. neutral the middle insula was active, even if without reaching significance after correction. The vMPFC was identified in numerous studies of decision-making tasks of subjective value. The anterior insula was active when decisions were difficult, as in effort-based decision-making strategy involving regions more typically associated with cognitive control.

43 Natural imagery as interpreted by the retina: Do early retinal responses encode low-level stimulus features?

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To date, there are few human studies investigating the nature of early retinal responses and their impact on cortical processes. Recent animal research demonstrated a close link between retinal and cortical activity patterns in different contexts. In the present study, we investigate how retinal activity might shape cortical visual responses in humans by examining activity patterns elicited by the spatial frequency content of natural imagery. We recorded retinal and cortical responses to grayscale natural images using electroretinography (ERG) and magnetoencephalography (MEG). The natural image stimuli were either unaltered or had their high or low frequency components enhanced. Comparing the stimulus conditions revealed higher peak amplitudes for natural stimuli in the ERG response. Interestingly, these amplitude differences were also present in occipital MEG sensors, with a ~50 ms latency compared to the retinal effects. Furthermore, the different image conditions elicited distinct high frequency activity patterns in their retinal responses. Taken together, these results indicate that the retina is not only sensitive to low-level features comprising stimuli, but that this retinal sensitivity is also shaping cortical responses. These results suggest that how the retina processes stimuli could account for more of the variance seen in cortical activity, e.g., activity patterns or latencies, than previously thought.

44 Implicit and explicit timing – do they share a representation of time?

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Human observers efficiently extract temporal regularities from sensory environments to form temporal predictions. Also, time provides the structure to subjective experience, and can be apprehended devoid of sensory inputs. Thus, time is implicit and essential for cognition, but also explicit, i.e. consciously represented. Here, we asked whether implicit and explicit timing rely on shared vs. separate representations of time, using an auditory foreperiod paradigm in an M/EEG experiment. To assess implicit timing, we induced an implicit, but deliberately non-rhythmic, variation of temporal predictability in a pitch discrimination task. To measure explicit timing, we asked the same participants to perform a duration discrimination task, using the very same stimuli. Behaviorally, temporal predictability improved pitch discrimination sensitivity, confirming our previous results (Herbst & Obleser 2018). Explicit timing sensitivity did not benefit from temporal predictability, suggesting that human listeners flexibly exploit implicit temporal contingencies present in sensory inputs, but do not use them to perform an explicit timing task. To compare the neural dynamics of implicit and explicit timing, we applied time-resolved decoding to the M/EEG data, focusing on the pre-target time interval, in which participants could either predict the onset of the target (implicit timing), or were actively timing the interval (explicit timing). We found a decodable representation of implicit timing versus explicit timing during the foreperiod interval. In sum, these results suggest that there are at least partially separable representations of time for implicit and explicit timing.

45 Prediction outweighs interference in language comprehension across the lifespan

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Interference and prediction have independently been identified as crucial influencing factors during language processing. However, their interaction remains severely underinvestigated. Furthermore, despite numerous behavioral studies investigating interference during sentence processing, its neurobiological basis remains insufficiently understood. We addressed these issues with an ERP experiment that examined the interaction of interference and prediction during language processing and the influence of age and individual alpha frequency (IAF) on the underlying processes. We used the neurobiologically well-established predictive coding framework for the theoretical framing of our study. German sentence pairs were presented word-by-word, with an article in the second sentence constituting the critical word. We analyzed mean single trial EEG activity in the N400 time window with LMMs and found that interference, prediction (indicated via offline cloze probability), IAF and age (groups: 10-13 years (N=28), 18 – 35 years (N=31), 61 – 72 years (N=24)) interact. Under high predictability, no effects were observable. We assume that in the sense of predictive coding, sensory input, which matched predictions, was explained away. In contrast, under low predictability, input led to model updating, which involved memory retrieval, thus leading to the possibility of interference effects. Effects were more pronounced for high and low IAF subjects compared to medium IAF subjects. Furthermore, IAF was a more crucial factor for the sign of the effect than age. We conclude that interference should be included in predictive coding-based accounts of language and in addition, that IAF is a better predictor for the interaction of interference and prediction than age.

46* NuArch: The relationship between architectural forms and neural activity as revealed by EEG and virtual reality

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Living space profoundly impacts on our behavior and mental states. Neuroscientific discoveries demonstrated that cerebral circuits underlying cognitive and motor activations are affected by the surrounding environment. This evidence paved the way for a proficient interaction between architecture and neuroscience, in which the human body is the bridge between the brain and the environment. Building upon these findings, the aim of this study is to understand how architecture impacts on human behavior and cerebral activity. The research will be carried out in a virtual reality setting, so to present realistic stimuli combining architectural forms and expressive bodily actions. This realistic experience of architecture and movement should in turn evoke completely the neurophysiological activity responsible for our architectural perception. The explicit correlates of this experience are represented by subjective perceptual judgments reported while observing such actions, which are hypothesized to be congruent or incongruent with respect to the architectural forms in which these avatars act. Instead, the implicit dimension of perception will be investigated by means of electroencephalographic recordings to study the role of mirror mechanisms during such experience. Mirror mechanisms are fundamental to shape perception of space, as well as recognition of actions and emotions, through the engagement of the motor system. Therefore, the analysis of the corresponding electroencephalographic responses will guide to the identification of the cortical networks responsible for processing architecture in a virtual realistic context. Such knowledge could be exploited for evidence-based design to improve future architecture that will be beneficial for the overall well-being of people.

47 Subliminal stimuli modulate perception and neuronal oscillations

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The human brain receives multiple signals from the environment. However, only some of these stimuli enter conscious awareness, while many stimuli remain below perceptual threshold (i.e., subliminal). Several studies have shown that such subliminal stimuli still can elicit neuronal activity and modulate perception. For example, we demonstrated that subliminal tactile stimuli modulate perception of supraliminal (i.e. above perceptual threshold) stimuli rhythmically: perception could be improved or impaired depending on the interval between subliminal and supraliminal stimuli, alternating with a frequency of ~15 Hz (Baumgarten et al., 2017). The neuronal mechanisms that induce such behavioural patterns are elusive. Here, we measured neuronal activity with MEG while subjects performed a tactile temporal discrimination task. Additionally, we presented subliminal tactile stimuli preceding the supraliminal target stimuli with varying temporal intervals. First, we could confirm that subliminal stimuli rhythmically modulate perception of supraliminal stimuli rhythmically with a frequency of ~15-22 Hz (i.e., in the beta-band). Second, we could show that the subliminal stimuli induce distinct phase resets of neuronal oscillations in somatosensory cortex in the theta/alpha- (~5-10 Hz) and beta- (13-25 Hz) band. The results demonstrate that despite not being consciously perceived, subliminal stimuli can substantially modulate neuronal oscillations. Notably, the modulation of neuronal oscillations and the modulation of perception by subliminal stimuli occur both in the beta-bands, on group and on individual level. These results suggest a crucial role for beta-band oscillations in somatosensory cortex for tactile temporal perception. Secondly, the results suggest that subliminal stimuli modulate perception by modulating these relevant neuronal oscillations.

48 Cortical Activity Associated with Acute Tinnitus Development via Unilateral Deprivation

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The development of acute tinnitus in humans has not yet been investigated with neuroimaging methods such as magnetoencephalography (MEG), with the majority of neuroimaging studies investigating chronic tinnitus. By safely inducing temporary tinnitus in healthy hearing participants, we can investigate the time course of cortical activation patterns associated with acute tinnitus during multiple MEG measurements. Participants wore one silicone earplug in one ear for four days. The plug was inserted after the first of two MEG measurements, during which brain activity was measured during five minutes of resting state. After four days, the participant returned for the second MEG measurement, during which two resting states were recorded, both before and after earplug removal. During the experiment, a tinnitus percept that subjectively ranged between 5 and 7 kHz was experienced by the participants in the plugged ear. Preliminary results from frequency analyses on sensor space data suggest a decrease of alpha activity (8-12 Hz) during the Day 4 resting state measurement, in both the contralateral and ipsilateral auditory cortices, with a more pronounced effect contralaterally. Four days of tinnitus development led to a reduction in alpha activity in both the contralateral and ipsilateral auditory cortices. Since previous MEG studies have shown similar patterns in the alpha band in those with chronic tinnitus, these preliminary findings may point to a common neural correlate underpinning both acute and chronic percepts. Additionally, these findings corroborate the use of earplugs as a safe, noninvasive way to induce a temporary tinnitus percept for future behavioral and neurophysiological studies.

49* Data-driven classification of region-specific spectral profiles in congenitally blind and sighted individuals

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During speech comprehension, a crucial role of endogenous auditory cortex brain rhythms has been proposed, allowing to process the quasi-rhythmic acoustic signals. Interestingly, congenitally blind (CB) individuals show unique skills in speed listening, while sighted (S) individuals' comprehension fails for speech rates above 9 syllables/s. Despite the association of neural oscillations with speech comprehension, endogenous local oscillatory dynamics remain largely unknown. Here, we investigated region-specific spectral profiles of endogenous brain rhythms. First, the spectral specificity of brain areas in S and CB was assessed – the analysis in the S is a direct replication of Keitel et al. (2016). Second, differences in spectral properties between groups were compared by cross-classification to identify brain areas with diverging spectra in the CB and S; and more specifically to test whether beyond known differences in the visual cortex, brain areas involved in speech comprehension show alterations. In the MEG resting state data (S: N=23; CB: N=26), power spectra were analyzed per brain region (N=116) and clustered within and across subjects using k-means and Gaussian mixture models. Specificity of spectral profiles was tested by splitting the cohort into a test and training set and automatically classifying each region of the test set based on the training set. This classification was perfomed within and between S and CB groups. Preliminary results show high classification performance of area-specific profiles both in S and CB, suggesting specific spectral properties for anatomical regions. However, performance drops for classification between groups, interestingly, most strongly for bilateral Calcarine and Heschl's Gyri.

50 Language processing alterations in healthy aging and neurodegeneration: evidence from passive neuromagnetic responses to speech

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Assessing the brain activity related to language comprehension is required in a range of e.g. clinical or developmental situations. Particularly in cases when the subjects' cooperation with instructions cannot be guaranteed (e.g., in neurological patients), a protocol is needed that could be independent from overt attention and behavioural tasks. To address this, we designed a novel paradigm which allows quantifying a range of neurolinguistic processes in the absence of directed attention towards sound stimuli and without relying on any overt behavioural responses. This is achieved by recording the brain's responses to different speech sounds with carefully manipulated linguistic properties using magnetoencephalography (MEG) combined with individual MR images to guide the source reconstruction of the event-related brain responses. This paradigm was first tested in healthy young participants who were presented with a non-attend sequence of speech stimuli while focusing on watching a silent movie. The results of this study in healthy young participants validated the usability of our proposed paradigm for an objective assessment of a range of language functions including lexical access, referential semantics and morphosyntax. This paradigm was then applied in a group of healthy elderly participants as well as a group of patients diagnosed with Parkinson disease. The results indicated a range of effects of both aging and PD-related neurodegeneration on human cortical activations related to language processing. We will discuss implications of this approach to the study of neurolinguistics processing in healthy aging and in neurological conditions.

51 Political Orientation and Resting-State Functional Connectivity

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Given the increasing divide between liberal and conservative camps and recent developments of socio-political issues worldwide, research in the realm of political neuroscience has gained considerable traction. Some theorists propose structural and functional differences between liberal and conservative individuals. In this analysis, we follow up on literature claiming that excitability of certain brain regions and the strength of cortical networks (e.g., the conservative complex) are related to ethnocentrism and political conservatism. We analyzed functional resting-state connectivity in n = 53 right-handed participants. We used a four-point single-item indicator of conservatism to investigate differences in whole-brain connectivity. Based on their proposed differences across the political spectrum, dorsal ACC and Amygdala were chosen as seeds for whole-brain connectivity analyses. Preliminary results indicate a negative relation between conservatism and connectivity between dACC and right superior/medial temporal target regions, as well as a cluster at the frontal pole. Furthermore, conservatism was linked to weaker connectivity between the right Amygdala and left temporal regions. Ethnocentrism (the belief that one's culture is superior to others and should be protected from foreign influences) was assessed using a 10-item questionnaire. Ethnocentrism was related to increased resting-state connectivity between dACC and right postcentral regions. In sum, preliminary findings suggest that there are connectivity differences between conservative and liberal individuals, as well as between high- and low ethnocentric individuals. However, these results do not directly reflect theoretical assumptions of previous literature. We will critically discuss our results in the context of these predictions.

52 Commensurable Cognitive Neuroscience (of Language and Music)

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Cognitive neuroscience of language and music (CNLM) is a rapidly growing research niche (Peretz et al, 2015) which has provided a broader epistemological framework for the experimental exploration of a diverse range of questions regarding the structure and evolution of the underlying biological mechanisms of -human and animal- linguistic and musical processing and production, in the fashion that Kording et al (2018) have described to occur within computational neuroscience, as these niches strive towards coherent interdisciplinarity. Nonetheless, several key concepts recurrently borrowed from CNLM's composing disciplines have erroneously emerged as conceptual metaphors (Lakoff and Johnson, 1980), becoming mutually incommensurable (Kuhn, 1969; Feyerabend, 1970; Popper, 1996) and, in turn, their implicit ontological orientation and particular implementation obfuscated, leading to recurring cul-de-sacs within debates and the ongoing lack of a -completely- coherent semiotic framework. A recent example of this phenomenon is to be found in the critique by Martins and Boexkc (2019) of Berwick and Chomsky (2016); according to the former, the latest iteration of the minimalist program extrapolates what occurs at the computational level of language towards the algorithmic and implementational, carrying an ontological approach and complexity inherent to one domain of our niche into another one, in the form of a fallacy. Several more examples are to be found within the history of the cognitive sciences; particularly, since the emergence of the Theory of Embodiment.

53 The neural bases of binaural speech cue integration

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Our ability to discriminate speech sounds relies on the identification and integration of speech cues, e.g. formants. When the speech signal is split so that different cues are presented to the right and the left ear (dichotic listening), identification depends upon the extent of binaural integration. In this study, we searched for brain areas that are involved in the identification and integration of speech cues. Normally hearing individuals listened to speech stimuli during fMRI. The stimuli led either to the perception of the syllable /ga/ or /da/. Some of the stimuli required the integration of binaurally presented inputs, because they were composed of an ambiguous syllable (perceptually intermediate between /ga/ and /da/), presented to right ear, and a disambiguating acoustic cue (low or high third formant indicative of /ga/ or /da) presented to the left ear. We used representational similarity analysis to identify brain areas that contribute to listeners' perceptual discrimination, and to the integration of acoustic cues for the ambiguous stimuli. We found that the brainstem at the level of the cochlear nucleus and the superior olivary complex, the right hippocampus, and the left caudate contributed to both, perceptual discrimination and binaural integration. Our findings open the possibility that phoneme-specific coding is already detectable in the brainstem at the level of the cochlear nucleus and superior olivary complex, and that these nuclei are implicated in integration of binaurally presented speech cues

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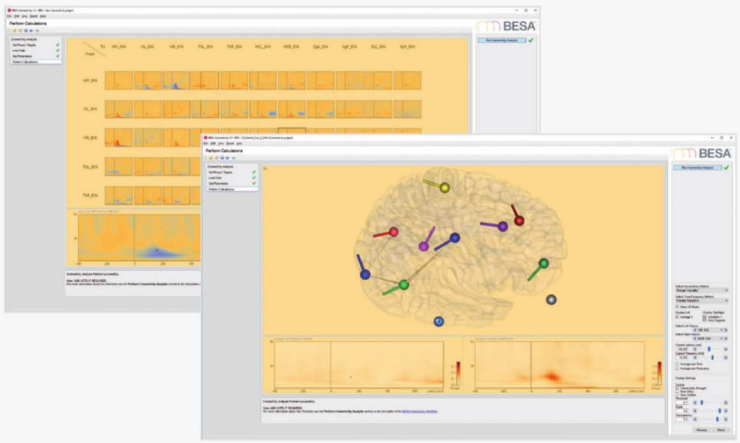

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54 Neural correlates of discourse-level comprehension for different types of texts

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The default mode network (DMN) is found to be involved in the discourse-level comprehension of narratives. However, the type of processing implemented in the DMN remains unknown (Jacoby & Evelina, 2018). The content-specific hypothesis suggests that the involvement of the DMN for narrative comprehension roots in its engagement in cognitive processes like theory of mind, self-projection, and scene construction. In contrast, the content-general hypothesis proposes that the DMN plays a specific role in integrating information over long temporal windows; thus, whenever the comprehension is at the discourse-level, the DMN should be involved. To disentangle these two hypotheses, we compared the narratives with the argumentative text, which still warrants discourse-level comprehension but lacks the narrative attributes to evoke cognitive processes like self-projection. Twenty native Italian speakers were recruited to listen to two narratives, two argumentative texts, and their sentence-scrambled version in the fMRI scanner. We employed the inter-subject correlation (ISC) method to investigate the time-locked brain activity induced by the stimuli. Replicating previous findings (Lerner et al., 2011), we found significantly stronger ISC in the DMN for the narratives than their sentence-scrambled version. However, we did not find any regions in the DMN showing stronger ISC for the argumentative texts than their sentence-scrambled version. Instead, we found the DMN showed stronger ISC for the narratives than the argumentative texts at the discourse-level. Our results indicate that the involvement of the DMN in the discourse-level comprehension is content-specific and might result from the engagement of particular cognitive processes in a time-locked fashion.

55 On the role of sigma activity for information processing during sleep

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The scientific community became captivated by recently discovered abilities of the sleeping brain, which opened the door to new fantasies going as far as the idea of learning novel information during sleep. However neural dynamics during sleep are very distinct from those observed during wakefulness, and it is unknown how this influences processing of environmental cues. To address this question, we invited 28 subjects to take a nap in an MEG scanner following a short wakefulness interval. During the entire time the participants were presented with an auditory stream of stimuli consisting of their own name and other first names, while the brain activity was simultaneously recorded with EEG and MEG. The brain at waking responded to auditory stimuli in a stereotypical way, with N1-P2 complex accompanied by theta (~4-6Hz) and gamma (~60-90Hz) synchronization. While the gamma response diminished during sleep, the theta effect persisted across all sleep stages. Most interestingly, only during sleep a prominent synchronization in the sigma frequency band (~10-20Hz) emerged after stimulus offset. Moreover, comparison of condition specific responses reveled that this exact sigma band response differentiated between the type of names being presented, with stronger synchronization for own as compared to other names (cluster p-values ≤ 0.03). This observation points towards the conclusion that processing of environmental stimuli during sleep is of a unique nature, and potentially might be related to disengagement of top-down modulatory mechanisms characteristic for wakefulness.

56 The influence of block-wise statistical regularities on trans-saccadic integration

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Our perception of the world around us appears stable and continuous despite rhythmic interruptions in the form of saccadic eye movements. One mechanism to achieve this apparent stability would be for the visual system to integrate percepts from before and after a saccade in a seamless fashion. Here, we investigated the extent to which such trans-saccadic integration is susceptible to statistical regularities. We measured trans-saccadic integration as a behavioral preview effect. Participants made cued saccades to peripheral faces. During the saccade, the face could change its orientation (upright-to-inverted/inverted-to-upright) or remain the same. Participants were better in discriminating post-saccadic face tilt when the face remained the same compared to when it changed. Crucially, this preview effect was susceptible to the distribution of valid and invalid trials across the experiment: Performing only valid compared to only invalid trials in the first (pure) part of the experiment led to a larger preview effect in the second (mixed) part of the experiment. We conclude that trans-saccadic integration adapts to regularities, perhaps based on the degree to which the environment is stable and supports prediction.

57 A sinister subject: Quantifying handedness-based recruitment biases in current neuroimaging research

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Approximately ten percent of humans are left-handed or ambidextrous (adextral). It has been suggested that, despite their sizable representation at the whole-population level, this demographic is largely avoided by researchers within the neuroimaging community. To date, however, no formal effort has been made to quantify the extent to which adextrals are excluded from neuroimaging-based research. Here we aim to address this question in a review of over 1,000 recent articles published in high-impact, peer-reviewed, neuroimaging-focused journals. Specifically, we sought to ascertain whether, and the extent to which adextrals are underrepresented in neuroimaging study samples, and to delineate potential trends in this bias. Handedness data was available for over 30,000 research subjects; only around 3% of these individuals were adextral – considerably less than the 10% benchmark one would expect if neuroimaging samples were truly representative of the general population. This observation was generally consistent across different areas of research, but was modulated by the demographic characteristics of neuroimaging participants. We posit that the observed bias carries both epistemological and ethical ramifications.

58 ERP correlates of consciousness and attention during perception of self-related stimuli

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The P3b event-related potential (ERP) — a late brain response observed over parietal electrodes — is hipothesized to constitute a neuronal correlate of consciousness (NCC). However, recent studies refute this hypothesis by showing that P3b can be evoked also by unconscious stimuli provided that these stimuli are salient. The present study was conducted to test a hypothesis that stimuli related to “self” will generate P3b potential even when presented unconsciously. Three types of stimuli were presented for 33 ms: subject’s own name, other name, or a blank (empty screen); and followed either by: a blank screen (supraliminal condition), or a backward mask (subliminal condition). In each trial participants (N=30) performed either the subjective evaluation task or a forced choice identification task. EEG (64 channels) was recorded during the performance. Analysis of the P3b component (time window: 350-550 ms) showed that, in contrast to other names, unconscious perception of the self name was related to greater P3b in the identification task ($Z = 328$, $p = 0.03$), but not during the subjective evaluation task ($t(29) = 0.97$ $p = 0.17$). Preferential processing of consciously presented self name resulted in higher amplitude of P3b in both, the identification task ($Z = 378$, $p < 0.001$) and the subjective evaluation task ($t(29) = 3.45$, $p < 0.001$). Therefore, by demonstrating that unconscious stimuli can influence P3b amplitude we falsify it\'s role as as NCC.

59 Inter-tone interval modulates tonotopic gradients and is represented orthogonally to tonotopy

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Time and frequency are two fundamental dimensions of sounds. While a functional organization of human auditory cortex for frequency (tonotopy) has been well characterized, few studies have investigated the functional organization for time. Here, we investigated spectral-temporal organizations of human auditory cortex by using functional MRI to map both spectral and temporal dimensions of sounds on human auditory cortex. We presented narrowband noise and tone clouds of four center frequencies (300, 700, 1700 and 4000 Hz) to six human listeners, and manipulated the temporal dimension by varying inter-tone intervals in the tone clouds (30, 50, 100, 300, and 500 ms). We replicated tonotopy in human core and belt auditory cortex and further found that the inter-tone interval modulated tonotopic gradients, which demonstrates that time modified the representation of spectral information. Moreover, we observed a medial-lateral functional organization of the auditory cortex for intervals – short intervals (< 100 ms) are represented in the core area and large intervals (> 100 ms) in the belt and parabelt areas. We conducted MVPA analyses on non-auditory areas and found neural sensitivities to different intervals in motor cortex. The data revealed an intertwined relationship between time and frequency, indicating that a functional organization of human auditory cortex is incomplete without time.

60 The role of hexadirectional coding in spatiotemporal integration

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Convergent evidence from single-unit recordings in non-human primates and functional MRI (fMRI) in humans suggests that the entorhinal cortex (EC) represents a grid-like map of visual space. This map is six-fold rotational symmetric (hexadirectional), a functional signature that can be assessed by fMRI when analyzing neural activity as a function of gaze direction. However, its behavioural function remains elusive. Here, we test whether it contributes to vector computations in visual space by integrating spatiotemporal task information. We designed a highly controlled visual tracking task in which participants fixated on a dot that moved on linear trajectories at different speeds within a circular boundary. Whenever the dot stopped moving, participants estimated the remaining time-to-contact (TTC), i.e. the time point when the dot would have hit the boundary if it continued moving. This design allowed us to examine TTC estimates as a function of gaze direction for a variety of motion speeds. Behavioural responses replicate typical temporal context effects on TTC responses. Preliminary imaging results suggest that entorhinal activity was indeed modulated by gaze movement direction in a hexadirectional fashion. We further address whether and how this hexadirectional signal relates to the participants' behavioural performance in the task. Our novel psychophysics approach has the potential to provide new insights into how space and time are processed dynamically across the visual field and could help unravel the hippocampal formation's involvement in spatiotemporal integration and prospection.

61 Cleaner MEG data through ICA on reference channels

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Many MEG systems contain a set of reference channels that are intended to measure magnetic fields from environmental sources. Typically, a weighted sum of these reference signals is subtracted from the main signals, which significantly reduces the strength of fields of non-neural origin. Nevertheless, as these are static weights, intermittent environmental noise often remains, and not infrequently this noise is strong enough to render the analysis sub-optimal, or unusable entirely. We propose a method which is highly sensitive to intermittent sources of environmental noise, and that can identify and remove them easily, while leaving the neural signal intact. Namely, an independent components analysis (ICA) is applied to the full set of channels, both reference and main, decomposing the signal into a large set of underlying, independent sources. Each source has a vector of weights which describes its distribution on the various channels. Sources with particularly heavy distribution on reference channels are removed, and the data are finally reconstructed from the remaining sources. Results from simulations confirm that the method isolates fields of external origin without erroneously selecting neural fields. Further, application of the method to a real data set showed great success in identifying and removing known sources of external noise such as trains, nearby machines, and even the heart. Any MEG system with reference channels may take advantage of it, and a preliminary version is already integrated into the developer version of MNE-Python.

62 Correlation between impulsive behavior and 27 Hz spindles and reducing it with neurofeedback training -a case study

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In nowadays neurofeedback is often used to reduce impulsive behavior in children. This case study follows a 12-year old diagnosed with ADHD and impulsivity. Through an initial neurofeedback assessment (1 channel, Cz and C4) it was noticed that he had highly increased high beta activity (20-30Hz) and clear and unusual spindles at 27 Hz. The 27 Hz spindle is very rare and not many researches dealt with it. Generally speaking, the reason why the high beta spindles occur is not clear. Scientists associated it with juvenile myoclonic epilepsy, Parkinson's disease and involuntary movement in general. It is also though it can be found in people with ADHD while sleeping, in a non-REM phase. Research showed that patients with the combination of high voltage EEG, increased beta activity and spindles in high beta range don't react to medication. The goal of this paper is to see how effective neurofeedback training will be in reducing 27 Hz amplitude and does it correlate with reduced impulsivity.

63* A backward encoding approach to recover subcortical auditory activity

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Several subcortical nuclei along the auditory pathway are involved in the processing of sounds. One of the most commonly used methods of measuring the activity of these nuclei is the auditory brainstem response (ABR). Due to its low signal-to-noise ratio, ABRs have to be derived by averaging over the activity generated by thousands of artificial sounds such as clicks or tone bursts. To date no approach exists that can be used to non-invasively investigate both auditory brainstem activity following natural sounds (e.g. speech, music) and silent periods, for example, within selective attention tasks. For several cognitive neuroscientific questions this is a severe limitation. We propose that by training a backward encoding model to reconstruct evoked ABRs from electrophysiological data, spatial filters (channel weights) can be obtained that are tuned to auditory brainstem activity. Since these filters can be applied to any other dataset (i.e. generalized) using the same spatial coverage, this could allow for the estimation of auditory brainstem activity from any continuous sensor level data. In this study, we established a proof-of-concept that by utilizing a backward encoding model generated using a click stimulation rate of 30 Hz we could predict the expected ABR activity recorded via electroencephalography (EEG) from an independent measurement, using a stimulation rate of 9 Hz. By showing that the individually predicted and measured ABRs are highly correlated (r ~ 0.67), we laid the necessary foundation to use this paradigm in more naturalistic listening situations.

64* Cortical entrainment in the alpha but not theta range predicts speech comprehension in noise

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Recent reviews and experimental evidence suggest that the current efforts to show cortical entrainment to speech have failed to prove its presence or even its importance for speech comprehension. In our EEG study (N=16), we therefore employed more realistic speech material by contrasting natural, isochronous and randomly rhythmic sentences in noise that all had a mean imposed syllable frequency of 5 Hz. First, word recognition scores were best for natural rhythms. That means in particular that no behavioral gain was observed due to higher temporal predictability in isochronous sentences but rather the inverse. Second, we show that 5 Hz brain-audio coherence is present only for isochronous sentences over central electrodes suggesting a strong acoustic byproduct. In contrast, brain-audio coherence in the alpha frequency range (10.7 Hz ±0.7 Hz) was predictive for single-trial speech comprehension over right temporal regions irrespective of the rhythmic condition. Hence, cortical entrainment as a means of speech encoding might not be a prerequisite for higher level processing.

65 Exploring the role of frontal alpha asymmetry during the Approach-Avoidance Task

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Over the last three decades, asymmetrical frontal cortical activation has been used as a marker for affective-motivational states. In particular, relative right frontal increase in alpha power (inverse of cortical activation) has been examined in response to appetitive stimuli, but only during the state of high approach motivation. The Approach-Avoidance Task (AAT) is an implicit measurement used to investigate automatic approach tendencies towards appetitive stimuli. In the current study 40 participants performed the AAT, while their frontal cortical activation was measured using electroencephalography (EEG). During the AAT, participants responded to images of appetitive food or neutral objects, which they had to approach by pressing the down arrow of the keyboard, causing an increase of the image (zoom-in), or which they had to avoid by pressing the up arrow, causing a reduction of the image (zoom-out). A behavioral approach bias towards appetitive stimuli was defined as faster reaction time (RT) in compatible responses (approach food/avoid objects) compared to incompatible responses (avoid food/approach objects). The goal of the current study was to investigate whether right frontal alpha power serves as a mediator, that explains the relationship between approach motivation, manipulated by the AAT, and an approach bias towards appetitive stimuli.

66 Are video games capable of expanding one`s awareness? The impact of training in RTS video game on the attentional blink phenomenon - an ERP study

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The attentional blink (AB) phenomenon is a transitory impairment of attention consisting in the inability of subjects to report on the second target (T2) when it is presented between 200-500 ms after the first one (T1). Current evidence suggest, however, that T2 might reach working memory - as reflected in the modulation of the P3 component (Kranczioch, Debner &Engel, 2003) - and that experience with action video games may improve T2 detection (Green & Bavalier, 2003). The aim of the present study - using Event-Related Potential (ERP) technique - was to examine whether the training in Real-Time Strategy (RTS) game influence the detection of the T2 and whether such impact is reflected on the neurophysiological level. Forty-four healthy participants (non-players) were recruited to the experiment. Twenty-one subjects were assigned to the control group training Starcraft II in static version and twenty-three subjects to the experimental group training the dynamic version of the same game. The training consisted of 30 hours of playing. The EEG recording sessions were performed before the beginning of the training and right after its end. The results indicate that the experimental group after training improved their performance, detecting significantly more T2 stimuli than did control group. Furthermore, following the training, the difference in the modulation of P3 component in response to the T2 was observed between those groups. Our results are in line with existing research showing the impact of action video games on AB phenomenon and indicate its potential reflection on the neurophysiological level.

67 Identifying differences between nouns and verbs using encoding and decoding models

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Converging evidence indicate a dissociation between nouns and verbs processing whose nature is still unclear. Studying homonyms allows for a fine grained distinction between the classes. To infer the representations underlying brain activity encoding and decoding are currently two of the major analytical approaches. But how critical is the choice of a particular method and does one approach outperform the other? In order to identify the contribution of grammatical class and semantic information to the distinction between nouns and verbs we applied both encoding and decoding strategies and compared their performance. Minimal sentences (function + content word) were visually presented to 14 subjects. 64 Italian homonyms were used as nouns and verbs for a total of 6 repetitions each. We then modeled grammatical class as 1s and 0s and semantic information using a corpus (https://fasttext.cc/). These models were tested with RSA and linear regression. MVPA was also used to classify grammatical classes and word pairs. The different analyses methods show a similar time-course, reliably distinguishing between nouns and verbs and demonstrating their comparable performance in the analysis of neuroimaging data. Their convergence speaks in favor of the reliability of the observed effect. We report grammatical class information as represented in brain activity already after 100 ms following function word presentation while semantic information is represented after 100 ms following content word presentation. We can infer that when reading a function word the brain already identifies the grammatical class of the following word, which is then further differentiated using semantic information.

68 The effects of language and emotional context on learning

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Prior research using single words has found reduced emotionality effects in a foreign language, but what happens if emotionality is conveyed throughout a longer text rather than being contained in a word? Would emotionality affect how well we remember and associate information? Participants learned new information in a native and a foreign language in two studies. In the first study, they learned new words and their descriptions (visual task) and in the second one they listened to descriptions of two invented countries and we tested how well they remembered facts about them. Participants remembered information they heard and read in positive contexts better than those learned in neutral contexts and participants performed better in their native language than in their foreign language. Importantly, there was no interaction between language and emotionality, suggesting that the decrease in emotionality in a foreign language observed in some areas might not apply to learning of new information. This means that using positive semantic contexts can aid in learning new information in a foreign language.

69 Using of functional connectivity to discriminate between unresponsive wakefulness and minimally conscious state in patients with brain injury

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The aim of the study was to reveal criteria for distinguishing between unresponsive wakefulness and minimally conscious state in patients with brain injury when clinical findings were not sufficient. EEG and ERPs were registered in 14 in-patients. The study was conducted before the rehabilitation concomitant with medication and at the end of transcranial stimulation (TMS) course. The duration of the TMS course was determined by a neurologist and did not exceed 10 sessions. In some cases, additional research was carried out after 3rd or 5th sessions of stimulation. A total of 38 studies were conducted. The study included the recording and analysis of EEG during resting state and ERPs for simple tones and naturalistic stimuli (music). The registration of biopotentials was carried out from 32 electrodes. The amplitude-temporal parameters were estimated; the analysis of wavelet synchrony was carried out; functional connectivity was calculated using the Granger method. Data analysis conducted using the Brain Connection and Brainstorm toolboxes. The obtained data were compared to the results of patients' clinical examination. It was suggested that the presence of "long" intra- and interhemispheric connections between the anterior (frontal and temporal) and posterior (parietal and / or occipital) areas of the cortex is one of the necessary conditions for restoring a higher-level consciousness and for recovering voluntary types of mental activity in patients. Patients in unresponsive wakefulness state have a lower value of wavelet synchrony in comparison to norm, whereas patients in minimally conscious state, a significantly higher. The study was supported by RFFI 18-013-00967a.

70 Modulation of auditory alpha to annoying sounds through mood induction with pictures

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Tinnitus is a condition plaguing 10-15% of the adult population, in which patients hear a phantom sound without external auditory input. It can result from noise trauma, but often emerges related to stress. Researchers looking for correlates of tinnitus in the brain have reported abnormalities in brain sites and processes of the emotion network. However, looking at chronic tinnitus patients, it cannot be known, whether those abnormalities gave rise to, or rather result from, the chronification of tinnitus. To explore the interconnection and possible influence of emotion on auditory processing in the brain, and one possible clue to understanding the development of tinnitus, we manipulated the emotional state of normal hearing participants, before exposing them to annoying sounds, recording neurophysiological responses with MEG. Subjects saw triplets of either positive-calming or negative-arousing pictures from the Nencki Affective Picture Set, followed by one of four sounds with tinnitus-typical characteristics. For each trial, they also rated the loudness and pleasantness/annoyance of the sound along with their emotional state. Analyses focus on auditory alpha as a marker of inhibition. We expect auditory alpha to be higher - and inhibition, thus, to be more successful - in the positive-calming as opposed to the negative-arousing condition. Furthermore, synchronization and connectivity of auditory alpha with active sites of the emotion network is explored, looking for up- or down-regulating mechanisms or interconnections; while correlational analyses look at the relationship of individual differences in auditory inhibition with subjects' emotion regulation abilities (assessed with a questionnaire).

71 Strategic action pre-selection influences movement observation processing in the observer's motor system

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When observing others' actions, "simulation" mechanisms are able to activate motor representations in a similar way as if the observer were about to perform (automatically imitate) the action observed. However, we do not imitate all the time when observing others' actions, even when we are required to perform movements in response to moving people (as in basketball or football).
Here, thanks to magnetoencephalography, we explored a hypothesis called "action pre-selection", according to which, only motor representations potentially useful to reach a current goal are facilitated, while all the others are inhibited. This way observing an action that is not among the pre-selected ones would not produce an overt facilitation of the corresponding motor representation because that would be already inhibited. Two hand actions and two shape changes of abstract objects were shown on the screen. After a delay, these stimuli became either blue or green. In the HAND pre-selection condition participants were asked to provide responses with their hands (similar actions compared to the ones they saw) to the color appearance, while in the FEET pre-selection condition feet movements were prepared to provide responses to the observed colors, (thus excluding any hand movement from the pre-selected set of potential actions). Analyzing the time window between the onset of the observed action and the appearance of the color cue, event-related Alpha and Beta hyper-synchronization was observed on hand-related M1 during action observation, and critically, only during feet movements pre-selection, in line with the hypothesis that not pre-selected movements are inhibited.

72 How jaw relaxation modulates sound processing in the auditory cortex and attenuates the perception of unpleasant sounds

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Growing evidence in tinnitus research shows that the motor/somatosensory system, and especially the jaw or neck musculature, modulates the perception of auditory phantom percepts. We here wanted to test if, in normal-hearing participants, unpleasant external sounds can be modulated by a strained versus relaxed state of the jaw. We therefore instructed participants to complete relaxing or straining exercises with their jaw for 3 minutes. Subsequently, participants were passively listening to tinnitus-like sounds while their brain activity was assessed by Magnetoencephalography. We hypothesize that the perception of unpleasant sounds is intensified by a strained versus relaxed state of the jaw and that this effect is accompanied by a decrease of alpha activity in the auditory cortex mediated through the motor/somatosensory system. First results show that unpleasant sounds can indeed be modulated by manipulating the jaw musculature, whereas neurophysiological data still have to be analysed. A potential modulation of auditory alpha activity mediated through the motor/somatosensory system would extend our knowledge on non-auditory influences in sound processing and advance our understanding of neurophysiological processes leading to somatosensory tinnitus.

73 Attentional modulations of ongoing cochlear activity is correlated to oscillatory alpha effects

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There is still a controversial debate regarding, where in the processing hierarchy of the central nervous system (CNS) selective attention takes effect. The auditory system can influence cochlear processes via direct and mediated (by the inferior colliculus) projections from the auditory cortex to the superior olivary complex (SOC). Studies illustrating attentional modulations of cochlear responses have so far been limited to sound evoked responses (e. g. Wittekindt et al., 2014). The aim of the present study was to investigate intermodal (audiovisual) selective attention in humans simultaneously at the cortical and cochlear level during a stimulus-free cue-target period. A trial-wise cueing paradigm was used to assess effects of selective attention on cochlear and cortical activity. It was found that cochlear activity in silent cue-target periods was intrinsically modulated by a theta-rhythmic pattern (~4 Hz). Moreover, slow modulations of cochlear activity were enhanced by auditory selective attention during the same period. For cortical activity enhanced posterior alpha activity during auditory selective attention was revealed. Interestingly, the found cochlear and 'classical' cortical posterior alpha attention effects showed a significant negative correlation. These results hint at a putative theta-rhythmic attentional sampling of the cochlea. Eventually, the correlation between cochlear and cortical attention effects suggests that participants showing the 'classical' posterior alpha modulations to a lesser extent appear to engage more strongly the efferent auditory system.

74 Listening to degraded but intelligible continuous speech enhances theta synchronization and reduces alpha power

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Understanding speech can pose a challenge, especially when speech is perceived as degraded, for example when using a hearing aid. Findings on brain dynamics involved in degraded speech comprehension are mixed. We investigated the effects of degraded continuous speech on intelligibility, theta synchronization, and alpha power. Additionally, we tested another commonly experienced degradation, namely that of blurred vision during visual speech perception (lip reading). Participants listened to unimodal auditory speech and watched unimodal visual speech with three different levels of degradation in a behavioural and an MEG experiment. In the auditory condition, intelligibility declined with declining clarity, implemented by fewer vocoding channels. Theta speech-brain synchronization increased with lower clarity in left auditory regions, while alpha power showed a widespread decrease. We assume that listening effort, which should be strongest for challenging conditions, led to both effects. The idea of a common process driving both measures is also consistent with the finding that increasing synchronization (for stronger degradation) was associated with lower alpha power, mainly in right temporal regions. In the visual condition, intelligibility declined with increasing blurriness of the speaker's face. Theta lip-brain synchronization in bilateral visual areas decreased with degradation, while alpha power did not change with degradation, indicating that the blurry visual stimulus could not be compensated for by neural mechanisms. Together, these findings illustrate multi-layered neural mechanisms of degraded auditory and visual speech comprehension and demonstrate fundamental differences between both modalities.

75 Neural taste category representations predict taste-related behavior

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The taste system provides important information about the edibility and macro-nutrient content of a food via differentiation between taste qualities. Specific receptors on the tongue are activated by chemicals signifying a taste quality before the signal is conveyed to the brain. How this peripheral signal is used by the central nervous system to encode taste quality is largely unknown. Cortical activation patterns change rapidly, within milliseconds, rendering temporal information a candidate variable for taste quality coding. In human participants, we investigated spatio-temporal properties of taste quality representations in the cortex and whether these representations are used for perceptual decisions during different tasks. Using non-invasive electrophysiological recordings, which provide a window into taste-neuronal processing with millisecond resolution, we found that large-scale neuronal response patterns carry information about taste quality at single trial level. Moreover, these neuronal response patterns carry information about which taste participants experienced and their onset predicts the timing of perceptual decisions ina task-dependent manner. Together, the data show that the information encoded in taste-related neural response patterns is also the foundation for gustatory decision-making and that the timing aligns with task-specific goals.

76 Intrinsic image memorability boost recollection rather than familiarity

Busch, N.[1], Mössing, W.[1], Broers, N.[1]

[1]Universität Münster, Institut für Psychologie

Some images of natural scenes are intrinsically memorable, i.e. they are consistently remembered by most people. Curiously, intrinsic memorability defies intuitive explanations: memorable images do not necessarily look particularly conspicuous, they are not judged as more meaningful or interesting, they do not capture more attention and do not trigger more elaborate encoding. Most previous research on intrinsic image memorability has sought to find out which image features make an image memorable. By contrast, the present study was concerned with the phenomenology of intrinsic memorability: does high memorability primarily increase general memory strength associated with a feeling of familiarity ("I have seen images like this before"), or does it boost recollection of specific image details ("I remember seeing this kitchen scene with the stylish coffee mug")? Participants were tested for their memory of previously learned scenes in a recognition task with additional confidence ratings and remember/know judgments. Recognition hit rates were strongly correlated with image memorability (quantified by an independent study). Receiver operating characteristic (ROC) curves were best fit by a dual-process signal detection model. According to this model, memorability had a much stronger effect on recollection than on familiarity. Furthermore, memorability of previously learned images increased the proportion of items recognized with a feeling of "remembering" (indicating recollection) instead of "knowing" (indicating familiarity). This was not the case for false alarms for new items. In sum, the results suggest that intrinsic image memorability boosts recollection of specific image details rather than the feeling of familiarity.

77 A decoding approach to temporal integration windows

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[1]University of Salzburg

Perceiving the world as a continuous temporal flow is crucial for precisely adapting to and interacting with our environment. In order to integrate discrete patterns of neuronal firings to different sensory inputs into a continuous percept of presence, or nowness, the brain has to rely on an “internal clock”, driven by neuronal oscillations in different frequency ranges. Such temporal segregation/integration of events can happen at time scales (“temporal integration windows” (TWs)) from tens of milliseconds up to 2-3 s (Poeppel, 1997, 2009) If two stimuli happen within the TW then they are “fused” into a single conscious percept, otherwise if they fall in different windows they are perceived as separate, allowing for dynamic changes independent of ‘what’ is processed and thus continuous perception. In a recent paper of our group (Demarchi et al., 2019), we noticed that the off diagonal time generalization (TG) decoding maps of auditory stimulation sequences, with different entropy/order of presentation of the stimuli, has dramatically different features with respect to the “standard” diagonal. In this study we manipulated the rate of presentations of the tones (2 vs 3 Hz), and our idea is to use the anti diagonal of the entropy level TG decoding to probe for a stable frequency component at ~ 0.3Hz, that is independent of stimulation rate, suggesting the existence of temporal integration windows in this time scale.

78 Increasing regularity of tone sequences leads to stronger priors during anticipation in individuals with tinnitus

Partyka, M.[1], Demarchi, G.[1], Süß, N., Roesch, S.[2], Weisz, N.[1]

[1] Salzburg Brain Dynamics Lab, Centre of Cognitive Neuroscience, Division of Physiological Psychology, University of Salzburg, Austria; [2] Department of Otorhinolaryngology–Head and Neck Surgery, The Paracelsus Private Medical University of Salzburg, Salzburg, Austria

According to the predictive coding framework, perception rests upon generative internal models of sensory input. Recently, predictive processing models have been developed to explain tinnitus, a common, simple auditory hallucination that emerges mostly due to hearing damage and becomes chronic in a subset of population. They suggest that default prediction of silence shifts to a prediction of sound. Extending this notion, we propose that individuals that develop tinnitus may generally rely more strongly on their internal models as compared to the actual auditory evidence. This would be a predisposing factor to shift their default prediction towards tinnitus following e.g. a hearing damage. In the current study, we implement our recently developed MEG paradigm, which combines a regularity modulation and sound omission, allowing to uncover prediction processes in auditory system. Previously, using an MVPA approach, we showed that predictions in the auditory system are carrier-frequency specific. In the present study, we applied this paradigm to individuals with tinnitus. Our results show strong differences in anticipatory periods, with brain activity in the Tinnitus group containing a stronger pitch-specific information with increasing regularity of the sound sequence. Since no differences between groups were observed in the general decoding of carrier-frequency in random sound sequences, our effects point clearly to an altered processing of statistical regularities in tinnitus. These results support our notion of an increased reliance on internal models in auditory processing of individuals with tinnitus. However, more work will be needed to establish this process as a factor that predisposes tinnitus.

INFORMATION

The SAMBA-Meeting takes place at the *Naturwissenschaftliche Fakultät* (NAWI)

University of Salzburg
Naturwissenschaftliche Fakultät (NAWI)
Hellbrunner Straße 34
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. Turn left in the *Friedensstraße*. Turn right in the *Hellbrunner Straße* after about 500 m.

Parking areas at or nearby the venue (with costs)

- Tiefgarage Zentrum Herrnau *(Alpenstraße 48 + 48A, 5020 Salzburg)*
- Parkplatz Akademiestraße (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

- Faistauergasse (6-minute-walk)
- Michael-Pacher-Straße (directly in front of the NAWI, only bus line 22)

From the main train station

Take the trolley bus line 3 *(in the direction of Salzburg Süd)* until the exit *Faistauergasse* (14 min, 8 intermediate stops). The NAWI is ~550 m walking distance.

From the airport

Option 1: Take the trolley bus line 10 *(in the direction of Sam)* until the exit *Ferdinand-Hanusch-Platz* (17 min, 10 intermediate stops). Then take trolley bus line 3 *(in the direction of Salzburg Süd)* or 8 *(in the direction of Salzburg Süd)* until the exit *Faistauergasse* (6 min, 4 intermediate stop). The NAWI is in ~550m walking distance.

Option 2: Take the bus line 2 *(in the direction of Obergnigl)* until the exit *Salzburg Aiglhof LKH West* (11 min, 6 intermediate stops). Then take bus line 8 *(in the direction of Salzburg Süd)* until the exit *Faistauergasse* (16 min, 10 intermediate stops). The NAWI is in ~550m walking distance.

Local Supply

Nearby spots for lunch:

- Mensa
- Yamas *(Michael-Pacher-Straße 21, 5020 Salzburg)*
- Zentrum Herrnau *(Alpenstraße 48, 5020 Salzburg):*
  - Raschhofer Herrnau
  - Resch (bakery)
  - MyIndigo
  - La Cantinetta

Bars / Restaurants

Some places we recommend to have a good Austrian meal:

- Bärenwirt *(city centre, Muellner Hauptstraße 8, 5020 Salzburg)*
- Kastners Schenke *(city centre, Schallmooser Hauptstraße 27, 5020 Salzburg)*
- Restaurant Stieglkeller *(city centre, Festungsgasse 10, 5020 Salzburg)*
- Raschhofer Herrnau *(7-minute-walk from the venue, Alpenstraße 48, 5020 Salzburg)*
- Gasthof Überfuhr *(10-minute-walk from the venue, Ignanz-Rieder-Kai 43, 5026 Aigen-Salzburg)*
- Zwetler's *(Kaigasse 3, 5020 Salzburg)*
- Pauli Stubn *(Herrengasse 16, 5020 Salzburg)*

To have a drink after the meeting we recommend:

- Soliman`s Bar *(Sigmund-Haffner-Gasse 4, 5020 Salzburg)*
- Mentor`s Bar *(Gstaettengasse 3, 5020 Salzburg)*
- The Dubliner Irish Pub *(Kaigasse 8, 5020 Salzburg)*
- Whiskey Museum *(Lederergasse 6, 5020 Salzburg)*
- Darwin`s *(Steingasse 1, 5020 Salzburg)*
- Schnaitl Bier + Bar *(Bergstraße 5 -7, 5020 Salzburg)*
- Beffa Bar *(Bergstraße 13, 5020 Salzburg)*
- Enoteca Settemila *(Bergstraße 9, 5020 Salzburg)*
- Lackners Bar & Cafe *(Badergaeßchen 2, 5020 Salzburg)*

Hotels / Hostels

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

- Via Roma *(Nonntaler Hauptstraße 47, 5020 Salzburg)*
- Arcotel Castellani *(Alpenstraße 6, 5020 Salzburg)*
- Motel One Alpenstraße *(Alpenstraße 92, 5020 Salzburg)*
- Austria Classic Hotel Hölle *(Dr.-Adolf-Altmann-Straße 2, 5020 Salzburg)*
- A&O Salzburg Hauptbahnhof *(Fanny-von-Lehnert-Straße 4, 5020 Salzburg*
- Eduard-Heinrich Haus *(hostel, Eduard-Heinrich-Straße 2, 5020 Salzburg)*

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 (nonntal@colibri-print.at)
- copypoint (office@copypoint.at)
- we copy (office@we-copy.at)

SOCIAL EVENT

When:

Friday, July 12th 2019, 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”?

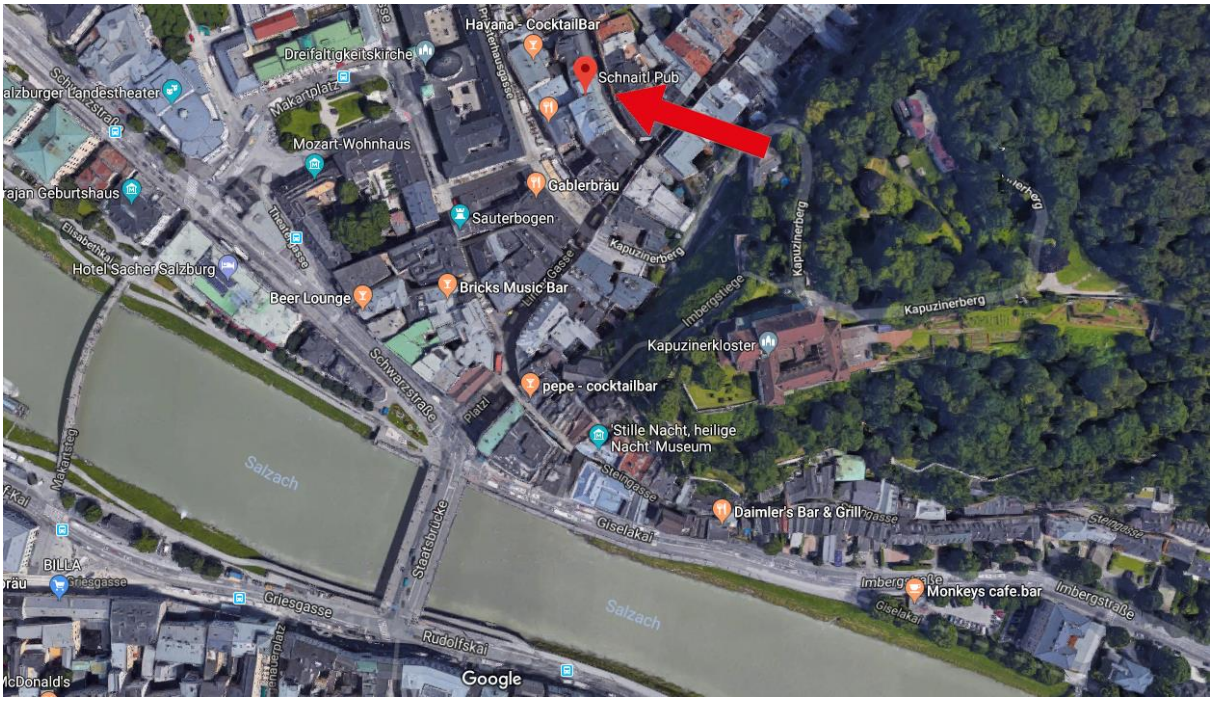
Please bring your name badge with you as it serves as an entry ticket!

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 12th 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: samba

PW: pMut2wnzvz

Find us online at

University of Salzburg

SAMBA

CCNS

Salzburg Brain Dynamics Lab

@Salzburg_SAMBA