



# 2016 BACN Annual Scientific Meeting 12<sup>th</sup>-14<sup>th</sup> September



## Monday 12th September 2016

8:30 *Conference registration*

9:30 Welcome address and conference introduction in the main auditorium

9:50 Valéria Csépe (Hungarian Academy of Sciences), *Cognitive Neuroscience in Hungary*

10:25 *Tea and coffee break, with sponsor exhibits*

10:50 Tibor Nánási (Hungarian Academy of Sciences), *Multimodal oscillatory coupling and spectral features in epileptic focus localization from sleep electroencephalography recordings*

11:15 Fernanda Pérez Gay Juárez (McGill University), *Categorical perception and ERP changes induced by category learning*

11:40 Nora Bunford (University of Illinois at Chicago), *Bench to Bedside: Neural predictors of pharmaco- and psychotherapy response in pediatric and adult anxiety and depression*

12:05 Jing Cui (Université de Lausanne), *Estimation of Alzheimer's disease severity in-vivo with MRI-based measures of atrophy*

12:30 *Lunch break, with sponsor exhibits*

13:00 Poster session 1

*Symposium: Reading in the brain: From words to sentences.*

14:00 Olaf Hauk (Medical Research Council, Cambridge), *Can I have a quick word? EEG/MEG evidence for early lexico-semantic information retrieval.*

14:25 Dénes Tóth (Hungarian Academy of Sciences), *The non-trivial emergence of visual expertise for print.*

14:50 Silvia Brem (University of Zurich), *Deficient print tuning of the left occipito-temporal cortex in children reflects poor reading.*

15:15 Béla Weiss (Hungarian Academy of Sciences), *The effects of letter spacing on fixation-related EEG activity and spectral perturbations during natural reading.*

15:40 Sarah Schuster (University of Salzburg), *Words in context: The effects of length, frequency and predictability on brain responses during natural reading.*

16:05 *Tea and coffee break, with sponsor exhibits*

*Early Career Prize Lecture*

16:30 Parashkev Nachev (University College London), *Lost in translation*

17:30 *Welcome reception*

## Tuesday 13th September 2016

8:30 *Conference registration*

### Symposium: Human Brain Stimulation.

- 9:10 Elisabeth Friedrich (Ludwig-Maximilians University), *Sample size and the reproducibility of effects of transcranial direct current stimulation (tDCS).*
- 9:35 Sophia Pépés (University of Nottingham), *Brain Development in Tourette syndrome: TMS Investigations of the Resting and Acting Brain.*
- 10:00 Katherine Dyke (University of Nottingham), *Exploring the origin of GABA measured using MRS.*

10:25 *Tea and coffee break, with sponsor exhibits*

- 10:50 Elham Barzegaran (Centre Hospitalier Universitaire Vaudois and University of Lausanne), *Fine structure of posterior alpha rhythm in young and aged healthy adults*
- 11:15 Tobias Katus (Birkbeck, University of London), *Tracking the focus of spatial attention in tactile working memory.*
- 11:40 Frederike Beyer (University College London), *Beyond self-serving bias: Diffusion of responsibility reduces sense of agency and outcome monitoring.*
- 12:05 Dimitrios Kourtis (Central European University), *Representation of interpersonal configuration in joint action planning.*

12:30 *Lunch break, with sponsor exhibits*

13:00 Poster session 2

### Symposium: Bodily perception

- 14:00 Martin Edwards (Université catholique de Louvain), *Embodied space perception.*
- 14:25 Natasha Ratcliffe (University of Nottingham), *Understanding visual, spatial and temporal contributions to own-body ownership.*

### Keynote Lecture

- 14:50 Edward de Haan (University of Amsterdam), *Returning into the footsteps of Berlucchi & Aglioti: Many bodies in the brain*

15:50 *Tea and coffee break, with sponsor exhibits*

16:15 BACN Annual General Meeting

17:00 *Conference End*

18:00 *Conference Dinner*

## Wednesday 14th September 2016

9:00 *Conference registration*

Symposium: Motivation, effort and reward in decision making.

10:00 Alexandre Zenon (Univerité catholique de Louvain), *The neurobiology of mental effort and mental fatigue*

10:25 Tom Verguts (University of Gent), *Effort processing in anterior cingulate cortex: A computational approach*

Mid-Career Prize Lecture

10:50 Masud Husain (University of Oxford), *Reward and effort-based decision making in health and disease.*

12:00 *Lunch break, with sponsor exhibits*

13:00 Katie Groves (University of Essex), *Eating disorder symptoms in women are associated with rapid early visual processing and gender-selective encoding of the human body form.*

13:25 Howard Bowman (University of Kent), *Biased and unbiased ERP window selection: The aggregated grand average (of trials) approach.*

13:50 Hilmar Sigurdsson (University of Nottingham), *Phonic tic severity is related to increased fractional anisotropy in Tourette syndrome: Evidence from diffusion tensor imaging*

14:15 Amy Spray (University of Liverpool), *Musical learning and micro-structural changes in the corpus callosum, a DTI study*

14:40 *Tea and coffee break, with sponsor exhibits*

Symposium: Neurocognitive background of language and music processing from a developmental perspective.

15:10 Zsófia Anna Gaál (Hungarian Academy of Sciences), *Inhibition and visual persistence in older age*

15:35 Ferenc Honbolygó (Hungarian Academy of Sciences), *Word stress representations are language specific: Evidence from event-related brain potentials*

16:00 Gábor Háden (Hungarian Academy of Sciences), *Rhythmic context affects deviant processing in newborn infants*

16:25 Orsolya Szalárdy (Hungarian Academy of Sciences), *Attentional effects on the processing of syntactic violations during listening two simultaneous speech streams*

17:00 *Conference end*

## Keynote

### **Returning into the footsteps of Berlucchi & Aglioti: Many bodies in the brain**

Edward de Haan (1)

(1) University of Amsterdam, The Netherlands

In this presentation, I will review the experimental and theoretical developments over the last twenty years on somatosensory processing. In their original paper on corporeal awareness, Berlucchi and Aglioti's (1997) already stressed the complex, multifaceted nature of how the body is represented in the brain. When Chris Dijkerman and I published our model of somatosensory processing ten years later (2007), we were more influenced by the work of Jacques Paillard, and Mel Goodale and David Milner, postulating two separate routes for processing somatosensory information: one for action planning and one for perception and recognition. These models triggered a large number of studies and somatosensory processing has now become a major field in cognitive neuroscience. So, again ten years later, it seems appropriate to take stock. In doing so, I will argue for a distributed system, as suggested by Berlucchi and Aglioti (2010), comprising several representations, such as body image and body schema but also the affective body, tactile exploration, and tactile object representation.

- [1] Berlucchi, G. & Aglioti, S. (1997), The body in the brain: Neural bases of corporeal awareness. *Trends in Neuroscience* 20, 560–64.
- [2] Goodale, M. A. & Milner, A. D. (1992), Separate visual pathways for perception and action. *Trends in Neurosciences* 15, 20–25.
- [3] Paillard, J. (1999), Body schema and body image: A double dissociation in deafferented patients. In: *Motor control, today and tomorrow*, G. N. Gantchev, S. Mori & J. Massion (Eds), Academic Publishing House, pp. 197–214.
- [4] Dijkerman, H.C. and de Haan, E.H.F. (2007), Somatosensory processes subserving perception and action. *Behavioral and Brain Sciences*, 30, 189-201
- [5] Berlucchi, G. & Aglioti, S. (2010) The body in the brain revisited. *Experimental Brain Research*, 200, 25–35.

**Lost in translation**

Parashkev Nachev (1,2)

(1) Senior Clinical Research Associate, Institute of Neurology, UCL, UK

(2) Honorary Consultant Neurologist, National Hospital for Neurology and Neurosurgery, UK

The last paragraph of research proposals often predicts an eventual use for the insights the foregoing promise to deliver. Yet remarkably little of the journal space cognitive neuroscience commands is devoted to practical applications, still less to reports of achieved impact on ordinary life. Since the object of clinical action is usually the individual, not the group, the knowledge that justifies it must be commensurately personalised. This—I argue—is a major structural obstacle to translation, and here I outline two paths we may take to circumvent it.

The distributed, richly multifocal organisation of the brain is increasingly acknowledged; the inferential framework it demands far less so. Any interacting, adaptive, multiparameter system is likely to have multiple optima, severely limiting the reach of the perspicuous, low-dimensional, oligovariate models that currently dominate the field. When used to predict the state or trajectory of a specific individual, such models will tend to perform poorly away from the simple distributional mean few if any individuals actually instantiate. The solution—high-dimensional multivariate modelling—is in the age of machine learning no longer computationally prohibitive, though its constitutive opacity and exorbitant demands on data-scale remain challenging. I shall discuss how adapting routine clinical data streams can achieve the necessary scale, and give examples from lesion and tissue volumetric inferences that demonstrate large-scale, high-dimensional modelling is both feasible and unavoidable if individuated prediction is our goal (e.g. [1]).

Without the grand scale needed for population inferences to be individually informative, we must fall back to studying the index individual direct. I shall describe a framework for silently embedding rich behavioral capture within a routine clinical pathway—the evaluation of patients with intracranial cortical and subcortical electrodes—and illustrate its use in conjunction with disruptive electrical stimulation to generate functional anatomical models intelligible at the single subject level (e.g. [2]). Finally, I shall suggest how inferences at these extremes of scale can be felicitously combined.

[1] Mah, Y-H., Husain, M., Rees, G., Nachev, P. (2014), Human brain lesion-deficit inference remapped. *Brain*, 164. doi:10.1093/brain/awu164.

[2] Nachev, P., Lopez-Sosa, F., Gonzalez-Rosa, J.J., Galarza, A., Avecillas, J., Pineda-Pardo, J.A, et al. (2015), Dynamic risk control by human nucleus accumbens. *Brain*, 285. doi:10.1093/brain/awv285.

**Reward and effort-based decision making in health and disease**

Masud Husain (1)

(1) University of Oxford, UK

What makes us act? Why do we do the things we do? Motivation to pursue goals varies enormously among healthy people. It can also be pathologically disturbed across a range of brain disorders, ranging from neurodegenerative conditions and focal brain lesions through to anhedonia in major depression and the negative symptoms of schizophrenia. Here I am going to present a neurobiological framework to understand apathy. My focus will be on frontostriatal brain mechanisms underlying motivation in the context of reward and effort-based decision-making, in healthy individuals as well as in people with brain pathology.

A key aspect of behavior is deciding whether a particular potential reward is worth the physical effort [1]. By using tasks that parametrically vary incentives on offer contingent on varying levels of effort required to obtain them, we can probe how different people weigh up such choices. Our findings show that this evaluation may be disrupted in healthy people who lack motivation. Functional imaging reveals both medial frontal and ventral striatal involvement in such decision making, with altered structural and functional frontal connectivity in people who are more apathetic [2].

In neurological patients with pathological apathy, there is evidence of severely reduced sensitivity to reward on the same decision making task. In Parkinson's disease, reward sensitivity indexed by pupillary responses is also blunted more in people with apathy [3]. Importantly, on reward for effort-based decision making tasks, patients' choices are significantly altered modulated by dopamine such that they become more sensitive to reward and are prepared to allocate more effort [4]. Dopamine can also ameliorate clinical apathy in some individuals. These results and others suggest that there might be core biological mechanisms underlying diminished motivation – apathy – in health and disease.

- [1] Manohar SG, Chong TTJ, Apps MAJ, Batla A, Stamelou M, Jarman PR, Bhatia KP, Husain M (2015) Reward pays the cost of noise reduction in motor and cognitive control. *Current Biology* 25:1707-16.
- [2] Bonnelle V, Manohar S, Behrens T, Husain M. Individual Differences in Premotor Brain Systems Underlie Behavioral Apathy (2016) *Cerebral Cortex* 26:807–19.
- [3] Muhammed K *et al.* Reward sensitivity deficits modulated by dopamine are associated with apathy in Parkinson's disease. *Brain* (in press).
- [4] Chong TTJ, Bonnelle V, Manohar S, Veromann K, Muhammed K, Tofaris GK, Hu M, Husain M (2015) Dopamine enhances willingness to exert effort for reward in Parkinson's disease. *Cortex* 69: 40-46.

**Can I have a quick word?  
EEG/MEG evidence for early lexico-semantic information retrieval**

Olaf Hauk (1)

(1) MRC Cognition and Brain Sciences Unit, University of Cambridge, UK

We can retrieve the meaning of printed words with remarkable ease and speed. Only EEG and MEG can resolve the underlying brain dynamics non-invasively and in real-time. Neural and behavioural data suggest that lexical and semantic retrieval processes begin in parallel around 200 ms after word presentation [1]. The task modulation of early brain responses indicates that these retrieval processes are best described as flexible rather than automatic [2,3]. It is a matter of debate whether the retrieval of semantic information at this early stage is supported by sensorimotor areas of the brain. In an EEG/MEG study using movement priming [4], we found that preactivation of hand and foot motor areas led to differential brain activation for hand- and foot-related words, respectively. Congruency between prime-effector and word type led to lower activation in hand motor cortex as well as in posterior superior temporal gyrus. However, we did not observe behavioural priming effects. These results suggest a neural link between motor and language systems, but the relevance of this link for behaviour is still unclear.

- [1] Hauk, O., Coutout, C., Holden, A., & Chen, Y. (2012). The time-course of single-word reading: Evidence from fast behavioral and brain responses. *NeuroImage*, 60, 1462–77.
- [2] Chen, Y., Davis, M. H., Pulvermüller, F., & Hauk, O. (2013). Task modulation of brain responses in visual word recognition as studied using EEG/MEG and fMRI. *Frontiers in Human Neuroscience*, 7.
- [3] Chen, Y., Davis, M. H., Pulvermüller, F., & Hauk, O. (2015). Early visual word processing is flexible: Evidence from spatiotemporal brain dynamics. *Journal of Cognitive Neuroscience*, 1–14.
- [4] Mollo, G., Pulvermüller, F., & Hauk, O. (2016). Movement priming of EEG/MEG brain responses for action-words characterizes the link between language and action. *Cortex*, 74, 262–276.

**The non-trivial emergence of visual expertise for print**

Dénes Tóth (1), Vera Varga (1) and Valéria Csépe (1)

(1) Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Hungary

Reading requires fast and efficient visual recognition of familiar orthographic units (letter strings) compared to unknown visual stimuli (e.g., pseudoletter strings). The left-lateralized N170 component of the event-related potential is an early electrophysiological marker of this form of visual expertise. We developed an implicit perceptual matching task to



investigate the development of the N170 effect in beginning readers and its potential deviance in (adult) dyslexic readers. In a developmental study, we aimed to test whether the letter-string specific N170 effect 1) is present in young readers (even in first graders), 2) develops further until grade three, and 3) is driven by grapheme-phoneme mapping, hence it is not the result of a purely visual learning process. Stimulus pairs (strings of familiar latin letters or unfamiliar Armenian letters) were presented visually and later audiovisually to the participants who had to detect the rare (10%) physically different (bold font) stimuli. Even though this task did not require reading, the analysis of non-target pairs revealed that both groups of children showed strong N170 effects. This strengthens the view that reading acquisition leads to rapid emergence of brain processes devoted to the automatic recognition of letter strings. Furthermore, parallel auditory presentation of pseudowords clearly enhanced the N170 effect. Thus, it was sensitive the possibility of phonological recoding, providing strong support for the phonological mapping hypothesis. However, the development of automatic visual processing of letter strings is not restricted to the early phase of reading acquisition and to the N170 component. This was demonstrated in the second study conducted with adult readers (with and without dyslexia).

### **Deficient print tuning of the left occipito-temporal cortex in children reflects poor reading**

Silvia Brem (1,2)

(1) Department of Child and Adolescent Psychiatry and Psychotherapy, Psychiatric Hospital, University of Zurich, Switzerland

(2) Neuroscience Center Zurich, University of Zurich and ETH Zurich, Switzerland

Reading acquisition critically extends the language network in the brain. Specific parts of the left ventral occipito-temporal cortex (lvOT) start to adopt a crucial role in processing print efficiently with ongoing practice. Children with developmental dyslexia show severe difficulties in fluent reading. Regarding these difficulties, print processing is an important underlying factor with the most robust neural deficits found in the lvOT. Here, fMRI data on visual print processing of a European multicenter study (NEURODYS) with more than 100 children aged  $10 \pm 1.3$  years and preliminary results of an ongoing study in young beginning readers ( $n=36$ ,  $7.4 \pm 0.3$  years) will be presented. In both studies, the fMRI analyses focused on print tuning, i.e. the differential response between words and symbols. To address the impact of dyslexia, categorical contrasts between reading groups and dimensional analyses of severity using reading fluency as a regressor were conducted. For older children, print tuning in the lvOT was modulated by the severity of the reading deficits and the reduced print tuning seen in poor readers was driven by less suppression for the irrelevant symbol condition. In younger children, an inverted print tuning effect with enhanced lvOT activation to the symbol condition characterized poor readers. The strongly increased BOLD response to symbols as compared to print in young poor readers may reflect an absent or delayed decrease in the response to a nonrelevant visual category. This indicates deficient or delayed specialization processes resulting in diminished print specialization later on. Together, these results indicate that tuning deficits of visual print processing increase with severity of dyslexia and confirm central role of the vOT regions from the very beginning of reading acquisition.

## **The effects of letter spacing on fixation-related EEG activity and spectral perturbations during natural reading**

Béla Weiss (1) and Zoltán Vidnyánszky (1,2)

- (1) Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary
- (2) Department of Cognitive Science, Budapest University of Technology and Economics, Budapest, Hungary

Reading is a unique human ability that plays a pivotal role in the development and functioning of our modern society. However, its neural basis remains poorly understood since previous research was focused on reading words with fixed gaze. We developed a methodological framework for single-trial analysis of fixation onset-related EEG activity (FOREA) and spectral perturbations (FORSP) that enabled us to investigate visual information processing during natural reading. To reveal the effect of reading skills on orthographic processing during natural reading, we measured how altering the configural properties of the written text by modifying inter-letter spacing affects FOREA [1] and FORSP. We found that orthographic processing is reflected in FOREA in three consecutive time windows (120–175 ms, 230–265 ms, 345–380 ms after fixation onset) and the magnitude of FOREA effects in the two later time intervals showed a close association with the participants' reading speed: FOREA effects were larger in fast than in slow readers. Furthermore, these expertise-driven configural effects were clearly dissociable from the FOREA signatures of visual perceptual processes engaged to handle the increased crowding (155–220 ms) as a result of decreasing letter spacing. Considering FORSP results no significant expertise-driven configural effects were found, while crowding was reflected in the power of theta oscillations that increased with the decrease of letter spacing. Strongest theta effects occurred 200 ms after the onset of fixations. Our findings revealed that effects of visual expertise and crowding can be dissociated from each other during natural reading, and that with increased reading skills orthographic processing becomes more sensitive to the configural properties of the written text.

- [1] Weiss, B., Knakker, B., & Vidnyánszky, Z. (2016). Visual processing during natural reading. *Scientific Reports*, 6, 26902.

## **Words in context: The effects of length, frequency and predictability on brain responses during natural reading**

Sarah Schuster (1,2), Stefan Hawelka (1,2), Florian Hutzler (1,2),  
Martin Kronbichler (1,2,3) and Fabio Richlan (1,2)

- (1) Centre for Cognitive Neuroscience, University of Salzburg, Salzburg, Austria
- (2) Department of Psychology, University of Salzburg, Salzburg, Austria
- (3) Neuroscience Institute, Christian-Doppler Klinik, Salzburg, Austria

Word length, frequency and predictability count among the most influential variables during reading. Their effects are well-documented in eye movement (EM) studies, but pertinent

evidence from neuroimaging primarily stem from single-word presentations. We investigated the effects of these variables during reading of whole sentences with simultaneous eye-tracking and functional magnetic resonance imaging (fixation-related fMRI). Increasing word length was associated with increasing activation in occipital areas linked to visual analysis. Additionally, length elicited a U-shaped modulation (i.e., least activation for medium-length words) within a brainstem region presumably linked to EM control. These effects, however, were diminished when accounting for multiple fixation cases. Increasing frequency was associated with decreasing activation within left inferior frontal, superior parietal and occipito-temporal regions. The function of the latter region – hosting the putative visual word form area – was originally considered as limited to sublexical processing. An exploratory analysis revealed that increasing predictability was associated with decreasing activation within middle temporal and inferior frontal regions previously implicated in memory access and unification. The findings are discussed with regard to their correspondence with findings from single-word presentations and with regard to neurocognitive models of visual word recognition, semantic processing and EM control during reading.

## Symposium 2: Human Brain Stimulation

### **Sample size and the reproducibility of effects of transcranial direct current stimulation (tDCS)**

Elisabeth Friedrich (1), Tamas Minarik (1), Barbara Berger (1) and Paul Sauseng (1)

(1) Department of Psychology, Ludwig-Maximilians University, Munich, Germany

Cheap, easy to apply, well-tolerable, with the potential of altering cortical excitability and testing causalities – attributes that have made tDCS a highly popular research tool in cognitive neuroscience. However, recently its effectiveness to alter cognitive performance in healthy participants and clinical populations has been called into question. Firstly, a number of studies reported no effects of tDCS on various cognitive processes. Secondly, studies showed a large variability in individual physiological and cognitive responses to tDCS. Not surprisingly recent meta-studies reported mixed findings regarding the efficacy of tDCS. One potential reason for the inconsistencies might be the often small sample size of studies. The low power could lead to weaker effects often not being detected and consequently meta-studies suggesting small or no efficacy. Conversely, a publication bias favouring studies with significant effects might lead to an inflation of the reported efficacy. To examine this issue we designed a choice reaction time task (CRT) and tested a large sample (n=75) of young, healthy volunteers either with anodal or cathodal tDCS applied to the sensorimotor cortex. As expected we found that anodal stimulation leads to faster response times than cathodal tDCS. Furthermore, to demonstrate the importance of sample size for finding the predicted effect, random samples of different sizes were drawn from the data pool and tested statistically. This way the probability of identifying the predicted effect was obtained as a function of sample size. Our results clearly demonstrate the crucial

importance of choosing an appropriate sample size to reliably detect tDCS effect, as well as being able to estimate the effect size appropriately.

**Brain Development in Tourette syndrome:  
TMS Investigations of the Resting and Acting Brain**

Sophia E. Pépés (1), Stephen R. Jackson (1) and Georgina M. Jackson (2)

(1) School of Psychology, University of Nottingham, UK

(2) Division of Psychiatry and Applied Psychology, University of Nottingham, UK

Several lines of research suggest that there is impaired cortical function in Tourette syndrome (TS). Here, in three experiments we explore the responsiveness of the motor cortex to TMS at rest, during motor preparation and whilst attending during a task in absence of motor preparation. Adolescents with TS between the age of 10.9-21.6 years (3 females) and age and gender matched controls (11.9 - 21.8 years, 3 females) took part in three TMS experiments (Experiment 1&2 (n=17(TS), 17(CS)); Experiment 3: n=11(TS), 7(CS)). Experiment 1: We collected indices of motor excitability using single-pulse (sp-)TMS over M1 at rest including MT and recruitment curves. Experiment 2: changes in CSE during motor preparation were investigated using sp-TMS during a simple Go/NoGo task. Experiment 3: changes in CSE were explored in a 2-cue Go/NoGo task over a period of sustained attention in contrast to motor preparation. The TS group had a significantly higher RMT and reduced CSE when they were stimulated at higher, comparable, intensities to controls. In experiment 2, the TS group showed reduced CSE throughout motor preparation. These differences were more marked in the younger group of TS with age, group and tic scores as the most important predictors of CSE. Experiment 3 demonstrated that baseline differences may be driving reduced CSE during motor preparation in the TS group. The results suggest a delay in the development of structural and functional brain networks in TS which contribute to tics, which may normalise with age in the majority of cases. Furthermore, a reduced CSE in the TS group is normalised during motor preparation which may allow for appropriate execution of a movement.

**Exploring the origin of GABA measured using MRS**

Katherine S. Dyke (1), Sophia E. Pépés (1), Soyoung Kim (1),  
Hilmar P. Sigurdsson (1), Chen Chen (2) and Stephen R. Jackson (1)

(1) School of Psychology, University of Nottingham, UK

(2) Sir Peter Mansfield Imaging Centre, University of Nottingham, UK

$\gamma$ -aminobutyric acid or GABA is the primary inhibitory neurotransmitter in the human brain and is critical in the regulation of neuronal excitability and the orchestration of neuronal networks. Dysfunction in GABAergic signalling has been linked to a range of neuropsychiatric conditions, including Autism Spectrum Disorders [1] and Tourette syndrome [2]. At present the two dominant methods for measuring GABA function within the brain are

Transcranial Magnetic Stimulation (TMS) and Magnetic Resonance Spectroscopy (MRS). The influence of GABA that is measured using TMS appears to be linked to GABAergic synaptic transmission [3]. However, the nature of the GABA concentrations measured using MRS is less clear. As different pools of GABA may relate to different forms of inhibition this is an important topic for investigation. This study aimed to examine directly the association between TMS and MRS measures of GABA. This was achieved by correlating MRS and TMS measures of GABA, acquired within the same individuals, consecutively, and on the same day, from the left motor cortex. In addition, the effects of administration of the drug GABA-pentin were also explored. 30 participants were recruited, which resulted in 24 usable data sets. Baseline measures were first collected for both TMS and MRS before the administration of gabapentin/placebo. After a period of 1.30-2 hours following drug/placebo administration participants were re-scanned and experienced the second session of TMS. The results revealed no correlation at baseline between TMS and MRS measures of GABA. This suggests that MRS GABA does not reflect GABA linked to synaptic function. Pharmacological manipulation also failed to significantly alter levels of MRS GABA. Findings and implications will be discussed.

- [1] Sgado, P., et al. (2011), The role of GABAergic system in neurodevelopmental disorders: a focus on autism and epilepsy. *Int J Physiol Pathophysiol Pharmacol.* 3, 223-35.
- [2] Jackson, G.M., et al. (2015), Inhibition, disinhibition, and the control of action in Tourette Syndrome. *Trends Cogn Sci*, 19, 655-65.
- [3] Ziemann, U., et al. (2015), TMS and drugs revisited 2014. *Clinical Neurophysiology*, 126, 1847-1868.

### Symposium 3: Bodily perception

#### **Embodied space perception**

Martin Edwards (1), Stéphane Grade (1), Samuel Salvaggio (1),  
Mathieu Tournadre (1) and Mauro Pesenti (1)

(1) Research Institute in Psychological Sciences, Université catholique de Louvain, Belgium

Research shows that the perception of space is derived from embodied action simulation. In this presentation, I will start by showing evidence supporting this statement, where participants made space perceptual judgements while in fMRI. This showed parietal and motor involvement in egocentric space perception, particularly for objects located in peripersonal space. I will then show evidence that a dual-task action manipulation caused disrupted peripersonal space perception, further supporting the statement. Finally, I will present research showing that manipulations to body reach capability using virtual reality caused a recalibration in the perception of space, suggesting that space is perceived using recent embodied calibration. The results will be discussed in terms of possible dynamic mechanisms of embodiment allowing for the calibration and perception of space.

## **Understanding visual, spatial and temporal contributions to own-body ownership**

Natasha Ratcliffe (1) and Roger Newport (1)

(1) School of Psychology, University of Nottingham, UK

The feeling that a body is one's own relies on the integration of bottom-up sensory signals and interpretation of these with respect to existing top-down knowledge about the body. The classic rubber hand illusion (RHI) investigates the conditions under which an external object can be experienced as part of the body. By contrast, the current studies investigate the effect of sensory manipulations applied to one's own hand using a mediated virtual reality (VR) device. In the first study, we directly compare embodiment in non VR (RHI) and a mediated VR environment, using a real-time video image of the participant's own hand which appeared either as grossly distorted or as normal. Participants reported a stronger sense of ownership and agency when viewing their own hand compared to a rubber hand, even when they viewed a distorted image of their own hand. In a second experiment, participants viewed two video representations of their own right hand, with opposing visual (normal or grossly distorted), temporal (synchronous or asynchronous) and spatial (precise real location or false location) manipulations. The results revealed differences in the effect of visual appearance for different components of perceptual experience, highlighting differences in the weighting of top-down and bottom-up information for different components of embodiment.

### Symposium 4: Motivation, effort and reward in decision making

#### **The neurobiology of mental effort and mental fatigue**

Alexandre Zenon (1)

(1) Institute of Neuroscience, Université catholique de Louvain, Belgium

Mental effort is a widely used concept but it is poorly defined and understood. Fifty years ago, a strong link between pupil size variations and mental effort was established, leading to the view, still currently held, that pupil size tracks changes in mental effort. Here I will discuss some of the theoretical bases of mental effort and will show recent results that question strongly its link to pupil size. Mental fatigue is the consequence of prolonged mental effort or can be a chronic state in some disease conditions. I will discuss recent findings from our lab suggesting that the degeneration of Locus Coeruleus in Parkinson Disease patients may be causally related to the intense fatigue experienced by these patients. I will also present a new neuroimaging study that attempted to address whether mental fatigue can be viewed as a disruption of motivational processes..

## Effort processing in anterior cingulate cortex: A computational approach

Tom Verguts (1)

(1) Department of Experimental Psychology, Ghent University, Belgium

Earlier studies have contrasted “value-based” versus “attention-based” theories of anterior cingulate cortex (ACC) and midbrain dopaminergic nuclei [2,3]. I present a reinforcement-learning-based computational framework in which the two aspects are naturally integrated [6]. The key point of the framework entails that ACC and midbrain dopaminergic nuclei jointly calculate whether it is worth investing effort in a task (or not); and based on this calculation, invest the effort (or not). This framework is applied to several tasks, including barrier-climbing [4], cognitive control [5], and working memory [1].

- [1] Bays, P. M., & Husain, M. (2008). Dynamic shifts of limited working memory resources in human vision. *Science*, *321*, 851–4. doi:10.1126/science.1158023
- [2] Croxson, P. L., Walton, M. E., O’Reilly, J. X., Behrens, T. E. J., & Rushworth, M. F. S. (2009). Effort-based cost-benefit valuation and the human brain. *Journal of Neuroscience*, *29*, 4531–41. doi:10.1523/JNEUROSCI.4515-08.2009
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Symposium 5: Neurocognitive background of language and music processing from a developmental perspective

### Inhibition and visual persistence in older age

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Age-related cognitive impairments are frequently explained with deficits of inhibitory processes. An elementary form of inhibition is a local process resulting in fast termination of perceptual activity. This process is responsible for temporal perceptual acuity, the termination of perceptual persistence. Paradoxically, impaired efficiency in this case leads

to better performance in elderly compared to young adults. 15 young ( $21.9 \pm 1.8$  years) and 15 older ( $66.6 \pm 3.5$  years) women participated in a behavioural and an event-related potential (ERP) experiment. In the behavioural study the task was to decide whether two parts of a stimulus pair formed a letter or a non-letter. The main variable was the interstimulus interval (ISI). Performance decreased as ISI increased, but age-related differences were not found. In the ERP study a passive oddball paradigm was conducted. The task was to indicate the thickening of one of the sides of a frame. Within the frame there were standard (80 %) and deviant (20%) task-irrelevant stimuli. These stimuli were either letters or non-letters. In various sequences the stimuli were presented either in one part, or in two fragments with 0, 20 or 40 ms ISI. As difference between the ERPs to the deviant and standard stimuli, visual mismatch negativity (vMMN) emerged at unitary stimulus presentation in both groups, at 0 and 20 ms ISI in older groups. The results support the possibility of age-related perceptual integration difference at the level of automatic processing. VMMN results show stronger temporal acuity in young adults at lower level. However, at behavioural level attentional processes compensate the age-related differences.

### **Word stress representations are language specific:**

#### **Evidence from event-related brain potentials**

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The aim of the present study was to investigate the language specific aspect of word stress processing. Stress is an essential first step in understanding and learning a native language in infancy, and beyond infancy it also plays a role in learning a second language. Previous studies investigating the neural background of word stress processing demonstrated that the change of stress pattern is processed in an automatic way in disyllabic words as shown by the emergence of the Mismatch Negativity (MMN) event-related brain potential component [1]. It has also been suggested that stress patterns have long-term language specific representations and are activated only by stress related acoustic features of a specific language [2]. In the present study, we investigated this assumption. In a passive oddball paradigm, Hungarian participants heard disyllabic pseudowords, while we recorded the brain's electrical activity. The pseudowords were pronounced either by a Hungarian or a German speaker, thus the phonetic realization of stress was different. Stress could be either on the first (legal stress) or on the second (illegal stress) syllable. Results showed that pseudowords stressed on the second syllable pronounced in Hungarian elicited two MMN components, one related to the first syllable, and another one related to the additional stress, while pseudowords stressed on the first syllable elicited a single MMN, related to the additional stress. The same pseudowords pronounced in German elicited both MMNs irrespective of the position of the stress. This implies that stress representations were not activated by the native illegal stress patterns or by foreign stress pattern, therefore supporting our hypothesis that the processing of stress relies on language specific long-term representations.



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### **Rhythmic context affects deviant processing in newborn infants**

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Rhythm in its simplest form is a series of stressed and unstressed regular pulses. For humans, rhythm perception is a basic and arguably automatic [1] mechanism functional from birth [2], which underlies music and possibly speech perception. We have tested whether newborns discriminate accented and unaccented positions based on contextual cues and how accentuation affects the processing of deviant stimuli at these positions. Event-related potentials were recorded from sleeping infants 2-4 days after birth while they were presented with 15-27 elements long trains of alternating piano (S1) and a harpsichord (S2) tones that had the same pitch and were delivered at the constant rate of 225 ms/sound. The train started equiprobably with either the S1 or S2 sound (“context”) making the S1 sound accented (starting on S1) or unaccented (starting on S2) throughout the short train. S1 tones were infrequently replaced by either frequency deviants (D) or stimulus omissions (O). The ERP responses to standard as well as deviant tones differed between the two contexts. This suggests that the newborns brain differentiates between accented and unaccented beats based on minimal contextual manipulation. This result provides new insights into the role of attention in beat perception [3].

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**Attentional effects on the processing of syntactic violations  
during listening two simultaneous speech streams**

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The notion of automatic syntactical analysis for linguistic stimuli received support from some event-related studies. Here we provide a stronger test of this issue by presenting to listeners two concurrent continuous speech streams and manipulating in a fully crossed design two variables that can potentially affect speech processing: the direction of attention (focused vs. divided)  $\times$  task (lexical – detecting numerals vs. syntactical – detecting syntactic violations). By recording EEG, we could thus compare between the event-related potentials (ERP) elicited by syntactic violations and numerals as targets (task-relevant events in the attended speech stream) with those for distractor (task-relevant events in the unattended speech stream) and attended and unattended task-irrelevant events with attention focused on one or divided between the two streams. Both task-relevant and task-irrelevant syntactic violations elicited the ELAN or possibly the N400 ERP component for the attended but not for the unattended speech stream, irrespective of the direction of attention. P600 was only elicited by target syntactic violations. Numeral targets elicited the N2b and P3 irrespective of the direction of attention, whereas none of the non-target numerals elicited either of these ERPs. The N2b amplitude was associated with the participant's performance in recognizing information from the speech material. The results provide no support for the notion of automatic syntactic analysis, because unattended syntactic violations failed to elicit any detectable ERP response.

Open talk presentations (Monday 12th September)

**Multimodal oscillatory coupling and spectral features in epileptic focus localization from sleep electroencephalography recordings**

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Pharmacologically intractable epilepsy is a neurological disorder that has enormous impact on the quality of life. The therapeutic workflow involves intracranial electroencephalography (iEEG) recordings and surgical removal of the resection site (RS), which ideally overlaps with the epileptogenic zone (EZ). Clinical EZ detection relies extensively on peri-ictal recordings, which have to be collected in sufficient number and quality, therefore poses heavy burden to the patients. We used previously acquired subdural grid iEEG data of five patients suffering from drug resistant focal epilepsy. Electrode positions were reconstructed from preoperative MRI and post-operative CT scans. Four 3 minute segments of sleep recordings free from any obvious epileptic activity with at least 1 hour of temporal separation from actual seizures were analyzed for each patient. Phase Amplitude Coupling (PAC) [1] and Phase Lag Index (PLI) [2] values were calculated. Then, two novel heuristic measurements, phase-synchronized phase-amplitude coupling constellations (PoP) and spectral heterogeneity (HDSE) were assessed. Node strength maps delivered from the graphs calculated by the novel measurements (PoP and its combination with HDSE) showed maximum values and higher averages inside the RS in the case of the four successful surgeries, whereas in the case of the patient with residual seizures the delivered maximum values and higher averages pointed outside the clinically applied RS. Our analysis works on seizure-free sleep iEEG data abundant in a typical clinical setting and aside from the initial frequency band definitions operates in a threshold-free manner.

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## **Categorical perception and ERP changes induced by category learning**

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Riona Morgan (1), Nicolas Botero (1) and Stevan Harnad (1,2)

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Categorical Perception (CP) occurs when categories influence our perception of similarity, making members of the same category look more alike (compression) and members of different categories look more different (separation) [1]. CP effects are well known for inborn categories (colours, phonemes, facial expressions [2-4]), but CP effects as a result of learning are of particular importance because most of our categories are learned rather than inborn. In his 2009 review, Goldstone [5] summarizes previous studies that explore the induction of CP by learning. We trained human subjects through trial and error with corrective feedback to sort samples of multidimensional visual stimuli into two categories based on the dimensions (features) that co-varied with category membership. We tested two kinds of stimuli: (a) unfamiliar black and white textures made up of distributed binary micro-features (to induce implicit learning) and (b) fish images with local binary features (to induce explicit learning). EEG was recorded during the training. Subjects made similarity judgments (SJ) for within-category and between-category pairs of stimuli before and after being trained to categorize them. Successful learners showed significant differences in both late (500-800ms) and early (150-200ms) ERP time-windows and significant within-category compression and between-category separation of rated similarity comparing after learning the categories, compared to before. These effects were absent in those who were unsuccessful in learning the categories. The results show that CP can be induced by learning based on local or distributed features and that an early (sensory) component of the ERP changes in the successful learners (only). Further studies will investigate the effect of the degree of difficulty (proportion of co-varying features) of the category learning task on the size of the ERP change and the CP effect.

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## **Bench to Bedside: Neural predictors of pharmaco- and psychotherapy response in pediatric and adult anxiety and depression**

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Anxiety and depressive disorders (ADs) are the most common psychiatric disorders across development [1,2] and are associated with functional impairment to individuals [e.g.,1] and economic burden to society [3]. Although cognitive-behavioral therapy (CBT) and pharmacotherapy are evidence-based treatments for ADs, many patients fail to respond to these treatments [e.g.,4]. Identifying which treatments work for whom may result in better response rates. To this end, examining neural predictors of treatment response is prudent, given that clinical/demographic measures are often inconsistent and weak predictors [e.g.,5]. Accordingly, we examined, in three studies, the degree to which differences in two event-related potential (ERP) components predict CBT and pharmacotherapy response among youth with anxiety (Study 1: N=35, ages 7-19-years) and adults with ADs (Study 2: N=39, Study3: N=52, Studies 2&3: ages 18-55-years). Across studies, findings indicated that, accounting for pre-treatment anxiety severity, neural reactivity to threat and to reward predicted symptom severity post- CBT and SSRI treatment such that enhanced electrocortical response to threat faces and reduced electrocortical response to monetary reward was associated with better treatment response. Implications and future directions will be discussed, including that enhanced neural engagement to threat may index insufficient down-regulation of threat reactivity and attenuated neural activation to reward may index excessive down-regulation of positive emotions; individuals with these forms of emotion dysregulation may have greater room for improvement in treatment. Further, ERPs appear to be a useful neural predictor of treatment response and may become a helpful clinical decision-making tool.

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**Estimation of Alzheimer's disease severity in-vivo with MRI-based measures of atrophy**

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The atrophy patterns detected by MR scans correlate with neurofibrillary tangles, one pathologic hallmark of the Braak staging system of Alzheimer's disease (AD) [1,2]. In this project, we propose to extract a latent variable based on atrophy pattern to quantify the disease severity for each subject by applying factor analysis. We aim to test whether the estimated severity significantly associates with clinical diagnosis at baseline and risk of clinical conversion in follow-up study. We downloaded ADNI [3] and three city study [4] (3C) T1-weighted MR scans and preprocessed them with SPM12 [5]. ADNI includes 322 cognitive normals (CN), 693 mild cognitive impairments (MCI) and 252 AD; 3C 1447 CN. The 114 grey matter regions were segmented based on neuromorphometrics atlas and the volumes were calculated. We applied factor analysis to estimate the disease severity for all subjects using regional volumes. To test our first objective, we compared the estimated disease severity distributions between 3 clinical groups of ADNI pairs-wisely by using two sample T test. To test the association between disease severity and clinical conversion, we built a proportional hazards model, adjusted for age, gender, APOE  $\epsilon$ 4 and years of education. Three clinical groups have significant different estimated severity (all  $p < 2.2e-16$ ). Disease severity significantly associates with clinical conversion: from CN to MCI in ADNI (HR=1.59, 95%CI 1.1 to 2.2,  $p=0.01$ ), to clinical AD in 3C (HR=1.58, 95%CI 1.1 to 2.2,  $p=0.007$ ); from MCI to clinical AD in ADNI (HR=1.74, 95%CI 1.5 to 2,  $p=1.04e-14$ ). Our results showed evidence that the estimated disease severity based on atrophy pattern significantly associate with clinical diagnosis and clinical conversion in the follow-up, suggesting a surrogate for quantifying disease staging in clinical practice.

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Open talk presentations (Tuesday 13th September)

**Fine structure of posterior alpha rhythm in young and aged healthy adults**

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Waking alpha rhythms (AR, 7–13 Hz) consist of several oscillatory components characterized by different scalp distribution and reactivity to sensory stimulation and movement. Collectively, the variants include central mu rhythm, temporal tau rhythm, anterior AR, and the most widespread and powerful posterior AR [1]. The latter is either considered as a unitary rhythm, or is subdivided into 2 or 3 AR components (ARC). This division is based on frequency-specific AR correlates to visual stimulation, memory and attention tasks, and other indirect findings. To reliably distinguish the ARC, we recorded high-density EEG with a portable encephalograph that offers safe and comfortable long-term EEG recording in natural environment. Each recording session consisted of several tasks intermingled with resting periods. The tasks, including haptic navigation and shape-matching, were designed to selectively affect the ARC based on assumption that they are generated by different cortical regions. Sixty 20-to-70 year-old healthy subjects participated in the 2-2.5 hours experiments. Our analysis was based on the 10-s EEG segments that allow the high frequency resolution of 0.1 Hz and provide a reliable estimation of the fine structure of AR in individual subjects. The methods included source spectral analysis followed by the AR decomposition by means of Parallel Factor Analysis (PARAFAC). In the young subjects (<45 yo), we found individually stable AR structure including 2-3 occipito-parietal and occipito-temporal ARC. In the middle-age subjects (>45 yo), the AR structure was limited to the 1-2 ARC with a clear tendency of reducing the ARC number with age. We expect that detailed knowledge of AR structure will be useful for monitoring age-related and neurodegenerative processes in the human brain.

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**Tracking the focus of spatial attention in tactile working memory**

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Recent event-related potential (ERP) studies found tactile contralateral delay activity (tCDA) during the retention of tactile information in lateralized working memory (WM) tasks. It is however not clear whether the tCDA indexes storage- or attention-related processes, as both types of processes are critical for WM operations. The evidence presented in this talk suggests that delay activity does not directly reflect the storage, but the attentional activation of information in WM, and furthermore, demonstrates that this activation process is mediated by an attentional mechanism that is shared with perception. In line with

a sensory recruitment account of tactile WM, Study 1 confirmed the load-sensitivity of the tCDA component, which was enhanced when two rather than one tactile stimuli were memorized [1]. In Study 2, we sequentially presented two tactile sample sets, and asked participants to memorize a single stimulus from each set. When the two memorized samples were located on opposite hands, the tCDA's polarity changed after the second sample set [2]. This suggests that the polarity of the tCDA marks the current focus of attention in WM. In Study 3, a perceptual attention task was performed during the retention period of a WM task, and importantly, both tasks were always performed on opposite hands. The tCDA was elicited contralateral to the currently prioritized task, indicating that this component reflects a domain-unspecific attention mechanism, and not a process that is specific to WM per se [3]. In conclusion, contralateral delay activity reflects strong functional overlap between the domains of WM and perception, as it indexes the attentional selection of perceived (external) and also mnemonic (internal) stimulus representations.

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### **Beyond self-serving bias: diffusion of responsibility reduces sense of agency and outcome monitoring**

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  - (3) SAS, University of London, UK
- \*equally contributing authors

Diffusion of responsibility has been proposed to underlie decreased helping and increased aggression in group behaviour. However, it is largely unknown by which cognitive mechanisms social context may influence behaviour and feelings of responsibility. Previous studies mostly used post-hoc reports of responsibility. Using EEG, we investigated whether the presence of others has online effects on how we process the outcomes of our own actions, and our Sense of Agency (SoA) regarding those outcomes. Participants (n=27) made costly voluntary actions. We manipulated the alleged presence of another player, who could act instead of the participant. The objective responsibility for action outcomes was unambiguous: participants always knew whether they had caused an outcome. We measured SoA judgements and the amplitude of the feedback-related negativity (FRN) in response to action outcomes. We assessed social context effects on these measures using mixed models. Compared to trials in which participants believed they were playing alone,



the alleged presence of another agent who could have acted, but did not, reduced SoA over action outcomes ( $b=-4.74$ ,  $t=-3.57$ ,  $p=0.002$ ) and reduced FRN amplitudes evoked by outcome events ( $b=1.26$ ,  $t=2.40$ ,  $p=0.017$ ). Our results showed that diffusion of responsibility is not just a post-hoc bias. The presence of a potential alternative agent was sufficient to reduce sense of agency and attenuate the online processing of current action outcomes. The presence of others may lead to diffused responsibility by modulating prospective neural computations relating actions to outcomes. Thus, boosting outcome salience could play an important role in preventing negative effects of social context on behaviour.

### **Representation of interpersonal configuration in joint action planning**

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The effective performance of a joint task is often facilitated by a person's ability to form an action plan, which includes the representation of his/her own action and the actions of others who are involved in the task. We investigated whether people represent the interpersonal configuration during joint action planning even if their own actions are not fully specified in advance. EEG was recorded from two people who were seated at opposite sides of a table and performed a choice-reaction task following visual cues that were projected on the table. The participants performed two types of arm reaching movements (palm facing inwards or outwards) towards each other in a coordinated manner. A cue specified either i) both the type of action and the interpersonal configuration ("Same" (e.g. both persons' palms facing inwards) vs. "Different"), ii) only the type of action, iii) only the configuration or iv) neither. The participants were asked to plan their actions accordingly and respond to a go-signal that was presented 1200ms after cue onset, providing full information in all cases. The participants responded faster when the type of action was specified in advance. Importantly, their responses were faster and better coordinated when the configuration was specified in advance, irrespective of their knowledge regarding the type of action. The EEG analyses showed that knowledge of configuration affected several ERPs, related to task updating and decision making (P300), structure representation (P600) and action planning and coordination (CNV and LRP). Our results suggest that when people engage in joint action, they form representations of the interpersonal configuration even if this seems to be redundant for the performance of their individual task.

Open talk presentations (Wednesday 14th September)

**Eating disorder symptoms in women are associated with rapid early visual processing and gender-selective encoding of the human body form**

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Growing evidence suggests that the brain processes bodies distinctively from other stimuli, but little research has addressed whether visual body perception is modulated by the observer's thoughts and feelings about their own body. The present study thus intended to investigate the relationship between body image and electrophysiological signatures of body perception, with the aim of identifying potential biomarkers of body image disturbances. Occipito-parietal (P1 and N1) and fronto-central (VPP) processing of body and non-body stimuli were assessed in 30 weight-restored eating disordered (ED) women and compared to 29 healthy controls. Rapid early visual processing was seen in the ED group, as the entire P1-N1 complex unfolded significantly earlier compared to controls. ED women also showed an unusually strong response to other women's bodies over N1 and VPP components. Such gender-selectivity was not evident in controls. Moreover, ERP effects correlated with scores on the Eating Disorder Inventory 2, indicating a close link between the visual analysis of human bodies and the observer's body image during very early stages of cortical processing. The temporal dynamics of body perception may therefore serve as potential neural markers for the identification of ED symptomatology in 'at risk' populations.

**Biased and unbiased ERP window selection:  
The aggregated grand average (of trials) approach**

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There has been considerable recent concern over the reliability of Psychology research [4]. While accurate replication rates remain debated [2], the central importance of sound empirical methods that do not inflate false positive (i.e. type I error) rates, has been reemphasized by concerns over reproducibility. Liberal methods for window placement in ERP analysis are likely sources of false positive inflation [1,3]. In response, we present a method for unbiased selection of analysis windows, which we show also offers high statistical power. We simulated tens of thousands of EEG data sets according to the human power spectrum, both under the null hypothesis and with condition differences. We assessed the distributional performance of a range of window placement methods on these data sets, enabling us to assess these method's false positive and hit rates. As previously reported, selecting windows from the difference wave dramatically inflated false positive

rates, indeed over 50% for narrow windows. In contrast, false positive rates were controlled at the alpha level (5%), if windows were placed according to a particular orthogonal contrast – the aggregated grand average of trials (the AGAT). Importantly, selection on the AGAT was also unbiased in the presence of trial count asymmetries between conditions, as well as being consistently more powerful than placement according to prior precedent [1]. This work shows that tailoring windows to the difference between conditions is unsound, and indeed, seemingly unnecessary, since the AGAT approach provides high statistical power (i.e. low type II error rates), without inflation of false positive (i.e. type I error) rates.

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### **Phonic tic severity is related to increased fractional anisotropy in Tourette syndrome: Evidence from diffusion tensor imaging**

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Tourette syndrome (TS) is a developmental neurological disorder that is characterised by the occurrence of motor and vocal tics and has been linked to alterations in the structure and function of key brain networks [1]. Complex phonic tics such as echolalia (imitation) and palilalia (repetition) are rare and occur in approximately 10-15% of all patients with TS (1). In this study we used diffusion tensor imaging (DTI) to investigate alterations in the microstructure of white matter (WM) pathways associated with complex phonic tics. DTI can be used to quantify and measure the integrity of WM fibre tracts noninvasively using several DTI scalars. 12 participants with TS displaying complex phonic tics were recruited for this study. 18 age-matched TS patients without complex phonic tics and 29 age-matched healthy volunteers were also recruited for comparison. Severity of complex phonic tics was measured using the Yale Global Tic Severity Scale (YGTSS) and we used tract-based spatial statistics (TBSS) to identify voxel clusters in which WM microstructure was predicted by the severity of complex phonic tics. Two novel findings emerged from our analyses. Increased severity of complex phonic tics in TS is predicted by differences in WM microstructure in widespread brain regions including the corpus callosum and the forceps minor. The presence of complex phonic tics was associated with widespread alterations in WM microstructure when compared to the group of typically developing individuals. These results demonstrate probable WM abnormalities responsible for the severity of phonic tics in TS and add to the growing literature showing irregularities in white matter in patients with Tourette syndrome.

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### **Musical learning and micro-structural changes in the corpus callosum, a DTI study**

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The structure of the corpus callosum (CC) of experienced musicians is different from non-musicians. Little is known about how these structural differences emerge and in particular the time scale of these structural adaptations. Diffusion-weighted magnetic resonance imaging (MRI) not only is sensitive in detecting alterations of the brain microstructure but also allows inferences about its nature. Therefore, microstructural changes of the CC contingent on short-term music training were quantified by diffusion-weighted MRI. Thirteen non-musicians were examined directly before and one day after a one hour polyrhythm tapping task. Both behavioural performance in the polyrhythm task and MRI diffusion properties of the corpus callosum were investigated. Diffusion properties were derived from the tensor model and included mean diffusivity (MD), axial diffusivity (AD), radial diffusivity (RD), and fractional anisotropy (FA). Following short-term music training significant reductions in MD, AD and RD were observed in the anterior and body parts of the corpus callosum. No equivalent changes in diffusivity were observed in the posterior CC. Importantly, MD strength of the CC predicted performance in the music task after training. Furthermore, the degree of MD reduction correlated with performance gains in the music task. This is the first demonstration that the special brain structure related to music expertise may be induced by training even in inexperienced adults and that changes in brain microstructure are specific to musical training. The rapid structural alterations are likely mediated by oligodendrocytes.

**Poster 01: Cognitive impairments accompanied by sucrose preference alterations in “schizophrenic” rats**

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It is well known that a large home cage with environmental enrichment enhances the learning capability of the animals. The goal of the study was to reveal the potential alterations in sucrose preference in a new substrain showing disturbances related to schizophrenia investigated in a large home cage with running wheels. Two groups of male Wistar rats were studied: naive rats without any treatment and the 23-24rd generations of selectively bred animals with social isolation and ketamine treatment at the age of 4-7 weeks. At the age of 2 months the tail-flick, the startle reflex and the simplified holeboard tests were performed. At the age of 3 months, rats were housed individually in a 3-storeyed large cage with two bottles; filled with tap water on the 2nd floor and with sucrose solution (2 %) on the 3rd floor for 4 days. Two series of experiments were performed: (1) the food amount was the double on the third as on the second floor, (2) the amount of the food was equal on both places. The new substrain showed decreased pain sensitivity, higher degree of startle reaction, reduced exploratory activity and disturbed cognitive performance. There were no significant differences in total food/ fluid intake and food preference between the groups during the test. The water intake was significantly higher in the new substrain on the 1st day, and decreased significantly by time, while an opposite trend was observed in sugar consumption. Therefore, the sucrose preference was significantly lower in the new substrain at the 1st day, but the preference ratio increased by time. Thus the animals with several cognitive and behavioral abnormalities have no anhedonia in sucrose preference test, but their learning capability was lower in this test too, suggesting that this model is not sensitive to simulate this symptom of schizophrenia.

**Poster 02: Colour reduces discomfort in migraine with aura**

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Patterns of stripes with certain spatial characteristics are generally uncomfortable to look at, but particularly so for people with migraine. When presented with gratings of progressively increasing contrast, individuals with migraine report photophobic symptoms at a lower contrast than headache-free individuals [1]. Individuals with migraine (15 with aura (MA) and 15 without (MO)) and 15 headache-free controls observed text in a colorizer (Intuitive Colorimeter) that permitted the separate control of hue and saturation at constant luminance. They found a colour that was “comfortable” and one that was “uncomfortable” for viewing the text. Under each colour, six gratings of increasing contrast

were presented until the participant experienced discomfort. The threshold contrast at which discomfort occurred differed significantly for comfortable and uncomfortable colours. Participants in the MA group chose as comfortable colours of significantly higher saturation than the other two groups. Participants with MA experienced more perceptual distortions than those in the other two groups. Individuals with MA may be more likely than those with MO to benefit from precision spectral filters.

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**Poster 03: Detecting fear appositely: The role of the context in a visual search paradigm**

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A large body of research suggest that fear-relevant stimuli (e.g. spiders, snakes, knives, guns) have an advantage in visual processing. The methodology used by these experiments is an odd-one-out visual search task: Respondents have to find the stimuli that is discrepant in category from the others displayed, for example a snake among flowers. However, this paradigm was met with criticism; Quinlan [1] claims after an exhaustive literature review that the results are mixed and this methodology does not have the capability to lead to a final conclusion, thus a new task is needed. In our view, a method used by Humphrey et al. (2) could be transferred to behavioural testing. Based on this we used real-life scenes (both evolutionary related, like a forest, and modern ones, like a street) with a fear-relevant target on it, that could also be evolutionary (e.g. snake) and modern (e.g. gun). Participants had to detect and indicate the place of the target using a touch-screen monitor. Our results show that respondents were faster to detect modern fear-relevant cues than evolutionary old ones. However, in both cases the analysis yielded a significant interaction with the background. Participants were faster to find a knife in an evolutionary context when compared to modern context or to a gun in evolutionary context. In parallel they also found spiders faster in a modern setting when compared to evolutionary context or to a snake in modern background. We believe that while a knife has evolutionary roots, compared to a gun; a spider is of most common occurrence in our industrialised cities nowadays than snakes. Thus, we claim that our results show the importance of the context in which a stimulus is presented, and support the relevance superiority effect; i.e. people tend to find the most relevant cue in a context the fastest.

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#### **Poster 04: The role of reciprocity in joint action learning**

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Many social contexts require coordination between agents. Previous studies suggest that reciprocity and task knowledge positively influence co-agents' ability to coordinate with each other [1,2], but to date little is known about the influence of reciprocal adaptation on learning how to coordinate with a partner over time. The aim of this project is to investigate the role of reciprocity in joint action learning. We developed a Joint Tracking Task in which participants were facing each other across a table and were asked to track as synchronously as possible two trajectories depicted on a glass panel between them. Participants were assigned to the Leader or Follower role: Leaders established the tempo of the tracking movement and Followers needed to adapt to this tempo to achieve coordination. Participants tracked an identical or a different (incompatible) trajectory. Given the shape of the incompatible trajectory, they had to modify their natural kinematics in order to achieve coordination (velocity profiles). We manipulated the reciprocity of information flow by creating a condition in which Leaders didn't see the Followers' movements (Unidirectional Coordination), and a condition in which both participants could see each other's movement, therefore can mutually adapt (Reciprocal Coordination). By manipulating the reciprocity of information flow we were able to test the effect of mutual adaptation on joint action learning. Our results showed that reciprocity of information flow between co-actors was crucial for joint action performance when participants had to coordinate by tracking an incompatible trajectory, i.e. when participants had to overcome individual motor constraints to achieve coordination.

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#### **Poster 05: Social cognitive dysfunction and pragmatic deficit from a neurolinguistic perspective**

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The study investigates the pragmatics of irony processing and contextual effects in schizophrenia from a neurolinguistic perspective. Relying on neuroimaging (fMRI) techniques the research reveals the brain networks involved in social cognition and non-compositional processing, and confirms theory of mind deficit, along with difficulties in irony comprehension in schizophrenia [4,5]. We also attempt to identify the area of the

Precuneus having an integrative role as the neural correlate of the hypothesized meta-module of pragmatic meaning construction [1-3]. Schizophrenic patients are known to be diagnosed with atypical Theory of Mind (ToM) mechanisms even during remission, which is believed to be responsible, or at least, to contribute to their deficit in pragmatic competence. Several studies reveal a connection between irony comprehension and ToM capacities in patients, who demonstrate difficulty in irony processing, which has been associated with their deficient mentalization skills. We examined the neural correlates of irony understanding in patients, as an indicator of ToM capacity, and evaluated how surface cues (linguistic help) affect irony comprehension. Patients and control subjects were submitted to event-related functional MRI scanning while performing three tasks: 1. irony, 2. irony with linguistic help and 3. control tasks. Results show that mentalizing skills are central for a fully-fledged pragmatic competence, and that linguistic surface cues enhance understanding of implicit content.

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### **Poster 06: Timing the senses and sensing the time**

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Evidence for a neural basis of time perception varies greatly depending on methodology and theoretical approach. While there is some support for the role of the alpha rhythm in timing behaviors the evidence has been far from consistent. Recent evidence that occipital alpha plays a key role in visual binding [1] as well as multisensory integration as a temporal gating mechanism [2] has lead us to reevaluate the role of this rhythm in the experience of time. We hypothesise that alpha gating is one element in a perceptual timing system and will present the findings of an EEG investigation utilising multiple timing tasks to address this question.



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**Poster 07: Exploration of the MI priming effect using EEG and EMG**

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In previous studies we have demonstrated that foreperiod motor imagery (MI) in a Rosenbaum-type task, generates typical patterns of congruency effects described for motor execution. Moreover, we observed a relatively stable RT difference between the congruency effect (CE) for MI and the congruency effect in motor preparation (MP) [1]. We propose that this RT difference is induced by differential processing of the priming stimulus in the MI condition. Specifically we argue that simulated properties in MI are influencing the processing of prime information by enhancing the quality (SNR) of the motor plan for response compared to MP. However it is unclear if this is mirrored by differences in motor or attention related processing, or simply if re-afferent feedback during MI could explain the RT difference. To answer this, 32-channel scalp EEG with monopolar EMG of tibialis anterior was recorded during a MP/MI lower limb priming task (n=15). Mean amplitudes of motor (CNV and foreperiod LRP) and attention related (ADAN and LDAP) ERP components were compared between conditions. Behavioural data (RT and error rate) were analysed for congruency effects in each condition, with foreperiod normalised EMG entered as a covariate. Initial analyses suggest enhanced late CNV and LDAP components during the MI foreperiod, and EMG not being a significant covariate for the priming RT effect difference. Through this approach we can delineate a pattern of neural markers of MI and its underlying mechanisms, as well as emphasising the importance of endogenously generated simulated information as a characteristic feature of MI.

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**Poster 08: The role of contingency in the representation of action-effects**

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Numerous studies suggest that in the human cognitive system actions and their sensory effects are represented together [1,2]. The various effects in such representations have,

however, different weights: task-relevant effects generally dominate in the representations. The present experiment investigated how the level of action-effect contingency affected the weights of effects in action-effect representations. Participants were instructed to pinch a force sensitive resistor from time to time, which resulted in no effects, the elicitation of a tone, or the elicitation of a tone and a light flash in separate conditions. To manipulate the level of action-tone contiguity, in two further conditions externally initiated tones were presented in addition to the self-induced tones (and light flashes). Event-related brain potentials to the self-induced tones were reduced in all conditions. In contrast with previous studies [3], however, the magnitude of the ERP attenuation did not differ between conditions. Pinch-force analyses, however, indicated that actions were influenced by the level of action-effect contingency: Participants applied more force when contingency was reduced (by intermixing externally initiated sounds), and they applied less force when contingency was increased (by adding a visual action-effect to the auditory one). This suggests that the reliability of distal effects affects the weighing of the different action-effects: more reliable effects allowed a better feedback on the success of the action, which, in turn allowed for the application of a force closer to the optimum to operate the response device.

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**Poster 09: Investigating the relationship between abnormal and functional impulsivity on rapid decision-making among school aged children**

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The study of decision-making and impulsivity is the focus of considerable research effort. Impulsivity is characterised as abnormal or functional depending on both the situation and the natural behaviour of those involved. However, there are several limitations associated with the naturalistic tasks currently used to identify abnormal decision-making. For example, although impulsive behaviour in pathological groups is frequently characterised by rapid and risky decision-making not many tasks measure this directly. Evidence also suggests that impulsivity and rapid decision-making, whilst under time pressure, differ according to age [1]. Heyes et al (2012) traffic light decision-making task indicates that younger participants demonstrate bimodal responses to decision-making, beginning with

high-risk choices, followed later by low-risk choices. In contrast, elderly individuals are said to consistently demonstrate low-risk taking strategies throughout rapid decision-making tasks. The purpose of this study was to extend the work of Heyes and colleagues in order to determine if this behaviour follows a developmental time-course. By testing children aged 4-11 years we are better able to understand both abnormal and functional levels of impulsivity during a rapid time constrained decision-making task. Performance was modelled as a race between two rise-to-threshold decision-making processes, one triggered by a green light and the other initiated prior to its appearance. Our results provide a useful measure of functional impulsivity, and rapid decision-making under risk, among children aged 4-11 years.

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### **Poster 10: An EEG study of skilled action anticipation in sports**

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The human mirror neuron system (hMNS) is believed to play a crucial role in facilitating skilled athlete's ability to anticipate the actions of an opponent. Here we used EEG to examine sensorimotor oscillatory activity in the mu (8-13Hz) and beta (15-25Hz) frequency bands, both EEG indices of hMNS activity. Skilled (N = 18) and unskilled (N = 21) tennis players observed videos of an expert player hitting groundstrokes, occluded 40ms before racket-ball contact. Following occlusion, participants anticipated ball direction. It was hypothesised that during the observation period prior to anticipation, skilled players would engage their own motor representations, represented by earlier and greater event related desynchronisation (ERD) in both frequency bands compared to unskilled participants, who lack the necessary motor representations. Behavioural results indicated only the skilled group performed significantly above chance and were more accurate than the unskilled group. In both frequency bands, the skilled group showed significantly earlier and greater ERD compared to the unskilled group. Specifically, only the skilled group showed ERD in the high mu (11-13Hz) band, whilst the unskilled group showed no ERD. These results suggest skilled players activate specific motor representations when observing an opponent, which may aid in their superior ability to anticipate.

**Poster 11: Transcranial direct current stimulation (tDCS) neuromodulation:  
A systematic review and meta-analysis of the decision-making literature**  
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Several studies have trialed the use of transcranial direct current stimulation (tDCS) brain stimulation for the enhancement of decision-making processes in gambling [1,2] and moral judgement tasks [3]. Many of the previous studies suggest that increased activity in the right dorsolateral prefrontal cortices (DLPFC) can positively enhance and influence judgement and decision making processes [4,5]. A comprehensive literature search was performed using the Wiley Online, Scopus, PloS One and Science Direct electronic databases with the criteria: “decision-making” and “tDCS” or “transcranial direct current stimulation”, “neuromodulation”, “tDCS” and “heuristic” in all fields in Science Direct and Wiley Online, and limited to articles title, abstract and keywords in Scopus, with the dates from 1966 to today / February 2016. This systematic review and meta-analysis (in preparation) of 16 studies with 543 participants in the transcranial direct current stimulation (tDCS) literature, suggests that there is an interhemispheric interaction between the bilateral DLPFCs in cognitive control when inhibiting the initial response to a problem. The analysis supports the notion that the use of tDCS neuromodulation can alter the use of decision-making strategies. This review demonstrates that neuromodulation by tDCS can have promising prospects for aiding in the treatment of clinical population such as depression and schizophrenia where cognitive control is impaired. However, more research needs to be done in on this topic to gain a clear understanding of the exact neurological substrates of cognitive control over decision making strategies.

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## **Poster 12: The parallel programming of saccade sequences**

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We move our eyes more than 150,000 times per day in a continuous sequence. Eye movements are central to our visual interaction with the world and experience. However much research in this area has examined single eye movements in isolation. As a result, we have a far less clear understanding of the extent to which information about our environment is encoded continuously to enable the construction of the sequences of eye movements we need. It is clear from existing work that the visual information that elicits a series of eye movements is partially encoded prior to their execution. What is not clear is how far this encoding extends along a set of visual targets. In order to examine the limits of visual encoding of information for eye movement sequences we manipulated the amount of prior information given about the visual sequence by varying the number of saccade targets presented at any one time. Increasing this number should allow additional information to be partially programmed prior to the execution of that saccade. In line with this, we found that as more information about the location of upcoming saccade targets was given, the number of saccades executed in the sequence decreased as did the latencies of the saccade response. This benefit did not appear to saturate up to sequences of 7 visual targets. Furthermore we found some evidence for longer amplitude 'target' driven saccades being distinct from a population of short amplitude 'corrective' saccades. We suggest that saccades are programmed much further in advance than previously thought.

## **Poster 13: Cognitive dissonance effect on user's privacy-related decisions in social networks**

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Privacy is a problem today as most users' private data are voluntarily provided to third parties. Users continuously take some privacy-related decisions in a counter-intuitive way. Users can be argued to be (seemingly) trading their private information for some required online services [1]; however, users' needs, adjusted choices and behaviour toward their private data do not always match the provided services. Indeed, major current online applications would not have paradoxically existed without realisation of certain psychological properties in users. This research explores a multidisciplinary area in Information Security and Social Cognitive Neuroscience. The research aims at proposing and investigating a "highly likely" root cause for users' decisions regarding their privacy-related actions. This research looks at whether Cognitive Dissonance in users is a contributing factor to the development and widespread usage of privacy-invasive technology (particularly in Social Networks), and discusses other plausible justifications on why users would subconsciously be willing to share private information. The findings can provide a better understanding of the overall dynamics of current online applications considering their

popularity, and provide guidelines for developing privacy-preserving products and services. Also, a sample of functional neuroimaging (fMRI) could also be reinforcingly generated during specific users' actions [2] and analysed.

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#### **Poster 14: Spatio-temporal processing of somatosensory and audiotactile stimuli in schizotypy**

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Daily interactions with people and objects involve locating stimuli in the environment, and relative to ourselves. The computation of such spatial localization is critically dependent upon coordinate transformation between several reference frames, including body-centered space and external space. In addition, it depends upon the integration of information about current body state with other external spatial information [1,2]. Empirical evidence suggests all these functions are altered in people with increased levels of schizotypy, which is thought to reflect the subclinical expression of the symptoms of schizophrenia in the general population [3,4]. However, no investigation of possible consequences of the same deficits on i) the ability to remap touch in the external space, ii) the temporal sensitivity in the discrimination of sensory cues from the body and the external environment, iii) the multisensory representation of the space immediately surrounding the body has been conducted so far. To this aim, we tested participants with low, moderate and high levels of schizotypy and compared their performance during i) crossed and uncrossed tactile Temporal Order Judgement task tasks, ii) audiotactile Temporal Order Judgement task, iii) audiotactile interaction task using approaching sounds. Stronger cross-hand deficit, larger audio-tactile window of integration and more extended boundary of the space around the body were found in participants with higher schizotypy. All in all, these results suggest a potential relationship between multisensory integration deficit in schizotypy and incoherent experience of body self and self-environment boundaries.

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**Poster 15: Biochemical and behavioral impairments observed in a  
“three-hit” rat model of schizophrenia**

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Selective breeding of rats after postweaning social isolation and subchronic ketamine treatment lead to behavioral changes related to schizophrenia. Since schizophrenic patients often suffer from impairments in working memory, and brain-derived neurotrophic factor (BDNF) and glutamate decarboxylase gene 1 (encoding GAD67) mRNA levels have been shown to be decreased in their dorsolateral prefrontal cortex, it is highly likely that these molecular-biological alterations play some role in the etiology of these neurodevelopmental disorders. The aims of the present study were: 1) the behavioral phenotyping of the new rat substrain (22nd generation) with a multiple test battery and 2) to determine the potential molecular-biological alterations in its background to strengthen the translational validity of our complex model. To assess acute heat pain sensitivity, sensory gating properties and working memory functions the tail-flick, prepulse inhibition and modified hole-board tests were applied subsequently in male rats beginning at the age of 9 weeks. After the behavioral phenotyping the in vitro RT-PCR was used to detect schizophrenia-related mRNA expressions in the prefrontal cortex. Decreased acute heat pain sensitivity, sensory gating disturbances and cognitive impairments were characteristic to the selected rats. RT-PCR studies revealed significantly lower BDNF and GAD1 mRNA expressions in the prefrontal cortex samples of the new substrain compared to control ones. The decreased expression of BDNF and GAD1 mRNA and the behavioral phenotype are similar to that described in schizophrenic patients. These results enhance the constructive validity of our complex animal model and its relevance to use it in translational researches (Grants: OTKA K 83810, TÁMOP-4.2.2.B-15/1KONV-2015-0006).

## Poster 16: The right occipital face area is involved in face-identity acquisition

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There is growing evidence that the occipital face area (OFA), thought to be involved in the construction of a low-level representation of the physical features of a face, is also necessary for the encoding of facial identity (1–4). To test if the OFA is causally involved in the learning of novel face identities, we have used a sequential sorting – face matching paradigm adapted from Andrews et al. (5), combined with transcranial magnetic stimulation (TMS). Participants sorted 30-30 images of two unknown persons (same gender, similar age, hair color and skin-tone) during the initial learning phase. Each image was presented for 200 ms with three TMS pulses administered to the rOFA or to the Vertex (control site) 100 ms before, at the onset of, and 100 ms after the stimulus presentation. In the subsequent test phase, participants had to decide if two images, presented side-by-side, were of the same person, or two different persons (same-different task). Presented here were novel images of the two training-phase identities, two novel identities, and identities not belonging to these aforementioned categories. Eleven participants in the rOFA stimulation group were matched for training phase performance to 11 volunteers in the Vertex stimulation group. While performance in the control group was better for trained than for novel identities, there was no such difference in the rOFA group. Furthermore, hit response rates for trained identities were significantly higher in the control group, indicating impaired identity acquisition if the activity of the rOFA is disturbed during learning. Our results support the hypotheses that the role of the rOFA is not limited to the processing of low-level physical features, but has a significant causal role in face identity encoding and in the formation of identity-specific memory-traces.

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**Poster 17: The AMBITUS corridor system as a valuable tool to assess cognitive function in rodents.**  
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The rodent tasks with food rewards are useful approaches to describe memory functions of animals; therefore, it is important to establish reliable and automated methods with high throughput to evaluate learning capability. Based on fact that rodents prefer narrow tunnels, a new instrument named AMBITUS system (“to go round”) was developed, which is a rectangular corridor with side-boxes. Experiments were performed to evaluate this instrument for task acquisition and learning flexibility applying different protocols. The rectangular corridor was constructed with 8-8 side-boxes containing food rewards along the inner and outer sides of each wall. Photocells at each boxes recorded the nose-poking activity, while the eating parameters were obtained offline from video records. 14 male adult Wistar rats were exposed to two types of tasks repeatedly for 5 minutes; Task-1: all of the side-boxes were baited, and Task-2: only the inside boxes were baited. The number, latency and frequency of ambulations, the number of eaten food rewards and the time required to collect all of the rice were detected. Most of the animals acquired the Task-1 and their performance improved gradually during 8 trials. The introduction of the Task-2 caused preference of the inner side, thus, a learning capability in the avoidance of unbaited boxes could be seen during the trials of Task-2, resulting in the rats’ moving less redundantly over trials. Discussion: Healthy animals can perform the simple tasks in the rectangular corridor after few repetitions; and show cognitive flexibility after introduction of a new task. The AMBITUS system is an efficient and reliable way for assessment the activity and learning capacity of rats. This work was supported by OTKA (K83810), TÁMOP-4.2.2.B-15/1/KONV-2015-0006.

**Poster 18: Value-based versus cue-based emotion perception:  
Associated brain activation and a potential role of autistic traits**

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Facial expressions of emotions are often ambiguous, and their categorization is influenced by contextual factors [1] such as personal utility. As we could demonstrate in a pilot study, individuals are more likely to interpret an ambiguous facial expression as sad when detecting another person’s sadness has higher relevance for them. However, people seem to differ in the extent to which they are influenced by changes in personal utility versus variation in facial cues. This study compares brain networks involved in these competing processing styles. We developed an adaptive signal detection model to estimate individuals’ subjective values of perceptual cues versus personal utility. Considering emerging evidence for decreased context sensitivity in autism spectrum disorder [2], we tested for a potential

role of autistic traits. Forty-five healthy adults underwent functional magnetic resonance imaging (fMRI) while completing a signal detection task using emotional stimuli morphed across an intensity spectrum. Participants repeatedly guessed the emotional outcome of a fictitious story from facial expressions of the protagonist. Utility was manipulated by changing financial payoffs, incentivising in turn more liberal or more conservative category boundaries. Results reveal a negative relationship between how individuals value perceptual cues versus changing utility contexts, and also point to a role of autistic traits. For fMRI analysis we compare brain activation of people with balanced, cue-focused, and utility-focused processing styles. Findings inform a neural model on emotion categorisation involving two competing processing styles.

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**Poster 19: Placing meta-stable states of consciousness within the predictive coding hierarchy: The deceleration of the accelerated prediction error**

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Predictive coding is one of the most prominent theories in cognitive neuroscience [1]. Exactly how it relates to theories of conscious perception, notably the Global Workspace (GW) theory [2], remains unclear. This talk will inform that question. We will present the results of a local-global task [2], which generalises the Mismatch Negativity (MMN) to two levels of irregularity. It hence, provides an excellent vehicle to explore evoked responses generated by Prediction Errors (PEs). The experiment also contains an anaesthetic manipulation, enabling us to assess the impact of a change in tonic awareness. An SPM cluster-extent analysis showed a broad profile of effects, including classic local & global responses [2], with the former corresponding to the MMN and the latter to the P3b. Importantly though, we also observed an interaction between local & global effects, whereby the coincidence of irregularities, i.e. “double surprise”, brought the P3 considerably earlier, suggesting an accelerated global PE. Additionally, sedation broadly lowered the amplitude of evoked responses and counteracted the acceleration of the global PE with double surprise. The finding of a clear local x global interaction stands against strong formulations of the GW, which suggests that the local-global task reveals two distinct modes [3] of processing, with the latter engaging the GW. The fact that sedation modulates both local & global levels and indeed, the interaction between them, also stands against a distinct

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### **Poster 20: ERP reflections of age-related changes in tone duration discrimination**

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The analysis of event-related potentials (ERPs) elicited in a tone duration discrimination task allows the delineation of various sensory, attentional and executive processes contributing to the task-behavior. Preparatory processes preceding tone onset and the time-point of the potential offset are reflected by slow negative ERP trends. The enhancement of onset-related auditory ERPs reflects the utilization of the onset as a reference point for the duration estimation. Offset-related auditory ERPs, and the closely following N2 and P3b ERP waveforms reflect the detection, and task-related evaluation of the offset. We administered a short-go, tone-duration discrimination paradigm to a young (20-24 years) and an old (61-73 years) adult group. In each condition, a random sequence of two tone durations was presented. The long tone duration was 750 ms in all three conditions, whereas short tone duration was 150, 300, or 450 ms. The performance pattern and the ERPs reflected the increase of discrimination difficulty with increasing short/long duration ratios, and the onset-related fore-period effect. Although the old adults' responses to tone offsets were slower than that of the young adults, an age-related discrimination performance loss was only found in the 450 vs. 700 ms condition. Whereas in young adults the offset-related waveform reflected mainly ERP activity time-locked to the tone offset, in old adults this waveform was dominated by an N2, which shifted with increasing response time, even at the shortest tone durations. This shows that old adults relied on supporting cognitive control processes much more than young adults. This suggests that young adults framed the task essentially as offset-detection, whereas old adults framed the task as a genuine discrimination task.

**Poster 21: Empathic readiness- Resting-state functional connectivity reflects individual difference in trait empathy**

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Emotional empathy is precursor of more complex empathic response and prosocial behavior [1]. Previous study shown that the activity of anterior default mode networks correlate to the individual difference of state empathy (pain response toward other's physical pain) [2]. Current study explored the relationship between resting state brain connectivity and individual difference of trait emotional empathy. Total 40 participants (M:20, Mean Age=29.03 (S.D.=4.64)) underwent rsfMRI scan. After scanning, participants finished two self-report trait empathy scales (Balanced Emotional Empathy Scale , Interpersonal Reactivity Scale ). Interestingly, both BEES and IRI-EC, which measures trait emotional empathy shown positive correlations with functional connectivity between left ITG and right thalamus. For IRI-EC, the functional connectivity between PSG to right thalamus, putamen, and parietal operculum were also shown significant correlation. In contrast, IRI-PD, reflects personal distress toward other's pain shown significant correlation with the connectivity between medial prefrontal default mode network and PSG, similar to previous study [2], The correlation with the connectivity between medial prefrontal DMN and right PCG, SFG, FP, FOrb and RLP default mode network were also significant. The correlation results with other subscales (PT, FS) also discussed. The ITG is part of ventral stream of visual processing and involved in perception of facial expression [3-4], and possibly semantic knowledge about the emotional state of others or oneself. Since right thalamus known to involve in the somatosensory and motor simulation of emotional state of others [5], Current study indicates that neural 'readiness' toward other's emotional expression might one of neural correlates of trait empathy.

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## Poster 22: Prefrontal oscillatory contributions to auditory oddball task

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Audition is crucial in detecting changes in the external environment. Change detection is facilitated by both top down (e.g. selective attention) and bottom up (e.g. stimulus processing) processes. In electrophysiological research, distinct event related responses are considered as correlates of automatic vs. attention-led change detection: Mismatch negativity (MMN) vs. P300. In generation of these responses, spatially distributed neural structures are rapidly recruited to form a 'functional network.' These processes require an intricate interaction between both modality dependent and modality independent structures [1,2]. To delineate network like interactions in attention led auditory change detection, we used magnetoencephalography (MEG) to study P300-like responses in source space. Participants (N=10) were instructed to mentally count auditory oddball stimuli (rare 2000-Hz tones and frequent 1000-Hz-tones). Source localisation was performed using a beamformer approach - synthetic aperture magnetometry (SAM). Statistical significance of source-localised data was determined using statistical non-parametric mapping (SnPM). The results indicate robust ( $p < 0.05$ , FDR) oscillatory responses in bilateral prefrontal areas, across trials in theta (4-8Hz) and alpha (8-13Hz) frequency bands. These findings are consistent with an MEG study [3] wherein participants responded to oddballs with button presses. In synthesis with this earlier study, our findings (obtained using mental counting task) show a presence of task independent functional network of change detection.

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## Poster 23: Brain source localization with the use of LORETA, sLORETA and swLORETA methods

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In 1994 R.D. Pascual-Marqui presented new method for localizing electric activity of human brain, based on multichannel surface electroencephalography [1]. The result is three

dimensional tomography with some dispersion of localization. It was called LORETA (Low Resolution Electromagnetic Tomography). Aim of this work is to compare sources of electrical brain activity which generate two kinds of evoked potentials (P100 as a typical visual exogenous waveform and P300 as an event related potential connected with attention), obtained by means of LORETA family algorithms. P100 was evoked in pattern reversal checkerboard experiment and P300 was evoked in oddball with standard and deviant stimuli, using 32 channel ASA-LAB (Advanced Source Analysis, ANT) system. Data were processed and analyzed with the use of LORETA as well as sLORETA (standardized Low Resolution Electromagnetic Tomography) and swLORETA (standardized weighted Low Resolution Electromagnetic Tomography), which are developments of original LORETA method. Additionally, for each technique, three kinds of input data for head modeling were used: standard files, Collin brain and MNI (Montreal Neurological brain). Source localization revealed maximum activity in occipital area for P100 waveform (visual cortex) and subcortical activation for P300. These results are in accordance with expected brain structures engaged in processing of visual stimuli. In our studies, LORETA seemed to be sufficient for source localizing for P100 waveform, however in P300 more reliable results were obtained by sLORETA and swLORETA algorithms because of existence of subcortical sources. Standard and Collin data files gave best results for head modeling in source reconstruction.

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**Poster 24: The things you do. Implicit person-models guide action predictions**

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Predictions are necessary for fluid social interactions. Here, we show that participants implicitly learn the behavioural tendencies of actors, reactivating this when the actor is re-encountered in a given situation. Different actors were presented next to objects, and participants had to report whether they acted towards or withdrew from each object. Unbeknownst to participants, we manipulated behaviour frequencies so that one actor typically interacted with one object (e.g., kicks a football) and turned from the other (e.g., a computer keyboard), and vice versa for another actor. Though not task-relevant, an actor's 'typical' actions were identified more quickly than the atypical ones, revealing a direct influence of actor identity – and the behaviour patterns associated with them – onto action identification. Furthermore, ERP recordings suggested that these truly reflect action prediction rather than mere stimulus/response learning. Here, unexpected actions elicited not only the P3b component associated with typical oddball responses, but additionally responses associated with error monitoring and prediction errors (N200/oERN). Together, they provide the first evidence for implicit person models that guide our perception of others' actions in the environment and bias them towards the actions typically expected by the people we know.

**Poster 25: The occipital face area is causally involved in the formation of identity-specific face representations**

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The occipital face area (OFA) is arguably one of the least understood face-selective regions of the cortex. Transcranial magnetic stimulation (TMS) [1] and functional magnetic resonance imaging (fMRI) experiments [2] suggest that the OFA processes face-part information at a relatively early stage of face processing, constructing an initial, low-level representation of the physical features of a face. However, there is also support for the OFA being part of a non-hierarchical, reentrant circuitry of face perception, necessary for the encoding of facial identity [3,4]. Here we investigated the role of the OFA in face identity processing, by combining state-dependent TMS [5] with a priming paradigm. Participants performed a familiarity decision task for famous and unknown target faces, preceded by a brief (200 ms) or longer (3500 ms) exposure to either the same image (IMG), a different image of the same identity (ID), an image of a different identity (DIFF) or a Fourier-randomized noise pattern (CTRL). Single-pulse TMS was delivered at target onset to the right OFA or to the vertex as control area. We observed a better performance for IMG and ID as compared to DIFF or CTRL conditions in the vertex TMS conditions for short stimulus exposures, suggesting intact identity and image priming. Strikingly, TMS over the right OFA impaired this priming effect by *enhancing* performance in DIFF. In other words, the stimulation effectively eliminated interference from a different prime *identity* for target face recognition. At the same time, *image* priming effects (i.e. the better performance for IMG as compared to ID) were not affected by TMS to the OFA. Our results suggest that the function of the right OFA is not limited to the image-dependent processing of low-level physical features, but that the OFA has a significant causal role in face identity encoding and in the formation of identity-specific memory-traces.

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**Poster 26: Attenuated neural reactivity to happy faces is associated with rule-breaking and social problems in anxious youth**

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Anxiety disorders are among the most prevalent psychiatric disorders of childhood and adolescence and are associated with psychiatric comorbidity [1], subjective distress, as well as academic, occupational, and social impairment [2]. Pediatric anxiety is further associated with comorbid externalizing behaviors and social problems, both of which exacerbate functional impairments [3] and impede treatment response [3], highlighting the importance of better understanding the association between anxiety with externalizing behaviors and social problems. One characteristic that may contribute to this association is altered emotion processing. The late positive potential (LPP), an event-related potential (ERP) component, is a neural marker of emotion processing, and there is evidence that anxious youth exhibit enhanced LPPs to threat [4]. It is unknown however, if differences in the LPP are related to externalizing behaviors and social problems co-occurring with anxiety and if these associations are driven by altered processing of threatening (angry or fearful faces) or rewarding (happy faces) socio-emotional signals. Thus, in the present study we examined, in a sample of 39 anxious youth (ages 7-17 years), the association between LPPs to socio-emotional signals and externalizing behaviors and social problems. Results indicated an association between attenuated LPPs to happy faces and greater rule-breaking and social problems. Implications and future directions will be discussed, including with regard to utility of conceptualizing constructs such as socio-emotional signal processing as cutting across disorders, with distinct aspects contributing to within-disorder-group heterogeneity and with LPPs as a sensitive index of such heterogeneity.

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**Poster 01: Inter-individual variability of TMS responsiveness on semantic processing: A combined MRS and fMRI-guided cTBS study**

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Transcranial magnetic stimulation (TMS) is a non-invasive technique to modulate cortical excitability in the human brain. One major challenge with TMS is that the response to stimulation is highly variable across individuals [1-3]. Here, we explored this inter-individual variability of the TMS effect on semantic processing. Converging evidence indicates that the human anterior temporal lobe (ATL) is a semantic representational hub. Thus, we combined functional magnetic resonance imaging (fMRI) with magnetic resonance spectroscopy (MRS) to measure the neural and neurochemical profiles of the ATL before stimulation. Then, continuous theta-burst stimulation (cTBS) was delivered at the ATL via fMRI-guided TMS neuronavigation. Participants performed a semantic task during fMRI and before/after cTBS. They were assigned into two groups (responders and non-responders) based on their semantic performance changes after the stimulation. After cTBS over the ATL, responders showed a task-specific inhibitory effect in their performance, whereas the non-responders revealed a paradoxical facilitatory effect. Non-responders compared to responders showed bigger ATL activity and stronger functional connectivity in the semantic network. For the neurochemical profile of the TMS responsiveness, we correlated the baseline GABA concentrations of the ATL with the TMS effect and found a significant correlation in responders only. However, there was no difference in the GABA concentrations between responders and non-responders. This study demonstrated that the TMS effect on semantic processing is strongly associated with ATL regional activity and semantic network connectivity. Our findings suggest that task-induced neural changes might be a critical factor to predict TMS responsiveness on semantic processing.

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**Poster 02: Event-related potentials associated with self-referential processing of another person's face: Different roles of frontal and parietal contributions to P3**

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There is a considerable evidence from behavioral and neuroimaging studies that people process their own face preferentially. Similar evidence exists in regard to other self-related information. Moreover, recent research has shown that people can rapidly incorporate neutral stimuli into their self-representation. Based on the previous behavioral studies, our research focused on the question if it is possible to detect a self-referential bias after associating a neutral face with the self. We investigated this using electrophysiological measures. We ran two EEG experiments, during which participants first learned the identity of three neutral unfamiliar faces. The faces were identified as either the participant, a friend or a stranger. After that they had to perform an associative matching task, similar to the one used by Sui et al. (1), but with a delay between two kinds of stimuli. Both experiments showed the same pattern of behavioral and electrophysiological results. Reaction times were faster if the first cue was associated with the self regardless of the modality and familiarity of the stimulus (a novel face or a known word). The self-association of the second cue did not have a facilitating effect on the response latency. Moreover self-association of the first stimuli led, first, to the stronger frontal P3 event-related component, and then to the stronger parietal P3 after presentation of the second stimulus. The association of the second stimulus did not have any effect on neither the response time, nor the parietal P3. These results suggest that activation of a self-representation leads to facilitated processing of the following stimuli, irrespective of their association.

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**Poster 03: Posterior Regions of the Primary Somatosensory cortex respond to static images of distorted finger postures: Ultra high-field fMRI data (7T) in individual subjects**

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Understanding what others experience is an important mechanism for human interaction. For example, observing body related abnormalities can lead to visceral and emotional reactions. Is there a mechanism which simulates the observed stimuli with activation of brain areas that support own somatosensory experience? Primary somatosensory cortex(S1) responses to images of distorted finger postures have been found in fMRI [1] and S1 subregions activate differentially during observation of touch and visual judgment of

roughness [2,3], with stronger responses in posterior parts of S1. Consequently, it is predicted that observing finger abnormalities will lead to activation of posterior S1. Five subjects were shown images of their own, or another's (belonging to the opposite sex) 3D modelled hands where postural distortions were applied to the fingers vs. natural fingers and presented from egocentric and allocentric perspectives. Brain activation to stimuli was measured using fMRI(7T). S1 subregions were identified using individual anatomy, and posterior regions showed a consistent pattern of activation to Distorted > Natural postures bilaterally. This contrast also elicited significant activity in lateral occipito-temporal cortex. These findings highlight that visual input can indeed lead to activity in the S1, particularly in its posterior parts, congruent with [2]. Thus, posterior S1 is not an area dedicated to one modality of stimuli, but is likely an area of sensory integration. Also, lateral occipito-temporal activity (congruent with extrastriate body area [4]) suggests that finger distortions (or body distortions in general) are processed in visual areas [5]. This implicates that faulty interaction between visual and somatosensory areas may be a contributing factor to disorders involving a visuo-somatosensory dysfunction.

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**Poster 04: A comparison of the QEEG oscillation of real and hypnotic experience of happiness in the healthy participants**

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During recent years neuro-hypnotism was focused on ERPs, EEG and fMRI studies. In this study the brain processes of real and hypnotic happiness, were assessed in healthy subjects using QEEG waves. Using SHSS C, 20 university students were selected by convenience sampling method (10 male, 10 female). Then randomly (5 male, 5 female) were placed in the hypnosis group and the other half in the actual emotion experience. A 4-minute rest signal was recorded from both groups as pre-test before performing the intervention. The

actual emotion group experienced the happiness by listening to a funny voice clip and the other group experienced it as hypnotic suggestion during which the brain waves were recorded by a 21-channel EEG. Dependent t-test showed that emotion experience as a whole had changed the brain waves of people with respect to the rest status ( $P < 0.01$ ). Also independent t-test showed that the brain waves of both groups in either actual or hypnotic happiness experience had no significant difference ( $P > 0.05$ ). Increasing in alpha waves function in the hypnotic group compared to the other group was quite significant in most channels ( $P < 0.05$ ). Emotional stimulation clearly had an effect on the brain waves in both groups and as it has been demonstrated in the other studies it represents changes in brain waves while experiencing the happiness [1]. Increasing in alpha band has been showed in previous studies during hypnosis [2]. Lack of significant difference in signal processing of both groups maybe indicates that brain has the same processes of real and hypnotic emotion. The study using rCBF [3] has shown that both processing of hypnotic auditory hallucination and real hearing are in one area of the brain and are processed as a unit.

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**Poster 06: Enhanced activation in the cognitive control network following unsuccessful response inhibition is associated with conscientiousness in adults without a history of mental illness**

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Cognitive control, conscientiousness, and behavioral inhibition are conceptually related and share empirically established correlates. Negative correlates include various psychopathologies and positive correlates include social adjustment and competence (e.g., 1). Yet, little is known about the association between activation in the neural systems underlying cognitive control and conscientiousness during tasks necessitating behavioral inhibition. Accordingly, we examined, via a novel measurement framework, the association between functional magnetic resonance imaging (fMRI)-measured activation in the cognitive control network (CCN) (2) and self-reported conscientiousness in the context of performance on a parametric go-no-go task (3,4,5) as a behavioral inhibition paradigm. Participants were 45 adults ( $M_{age}=34.3$  years,  $SD=12.0$ ) without a family or personal history of psychiatric illness. Findings indicated a positive association between activation in the CCN to errors of behavioral disinhibition and conscientiousness. Implications and future

directions will be discussed, including related to concurrent validity among cognitive control measured at the level of circuits, conscientiousness measured at the level of self-report, and behavioral inhibition manipulated at the level of experimental paradigm. In addition, implications for psychopathology risk, functional outcomes, and intervention will be reviewed, e.g., in light of the explanatory hypothesis that following mistakes, conscientiousness may lead to rich engagement of the CCN, which may result in an increase in adaptive and corrective behaviors over time and thus buffer against psychopathology and functional impairment.

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**Poster 07: Neurofunctional correlates of behavioral inhibition system sensitivity during attentional control are modulated by perceptual load**

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Although the Behavioral Inhibition System (BIS) is a temperamental characteristic associated with threat-sensitivity [1,2], little is known about the neurofunctional correlates of the BIS during control over task-irrelevant threat distractors. Thirty non-clinical participants ( $M_{age}=25.67$ ,  $SD=6.98$ ), who ranged in BIS sensitivity, completed an attentional control paradigm [3-5] during functional magnetic resonance imaging (fMRI). The paradigm varied in cognitive demand with low perceptual load comprising identical target letters and high perceptual load comprising a target letter in a mixed letter string; each superimposed on threatening and neutral face distractors. Whole-brain results indicated that individuals with higher, relative to lower BIS sensitivity, exhibited enhanced dorsolateral prefrontal cortex and dorsal anterior cingulate cortex activation to threatening (vs. neutral) face distractors under low load whereas no activation differences were observed under high load. These

findings are consistent with literature indicating that the BIS, an avoidance motivational system, is involved in the modulation of cognitive control mechanisms implicated in emotional conflict detection and resolution. Implications and future directions will be discussed, including with regard to research on psychopathology and with regard to theoretical interpretations of the BIS, e.g., BIS as a temperamental trait conferring risk for pathological anxiety insofar as heightened BIS sensitivity potentially conferring risk for anxiety through, in part, its association with conflict detection and monitoring and findings being consistent with prior neural data indicating that the BIS is related to conflict detection and resolution.

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**Poster 08: Integrating prospective and retrospective cues to the sense of agency: A multi-study investigation**

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Sense of agency (SoA) refers to the feeling that we are in control of our actions and, through them, of events in the outside world. This involves integration of prospective cues, related to the fluency of action selection, as well as retrospective cues, linked to outcome monitoring. The relative contribution of these cues to SoA remains unclear. In particular, we investigated how the effects of selection fluency on SoA might change during instrumental learning. We conducted a meta-analysis of available studies on prospective cues to the SoA (N=7), using multi-level linear regression. This assessed how agency ratings were affected by three factors: one prospective – selection fluency; and two retrospective: action-outcome interval, and outcome identity. The importance of outcome identity was measured as a change in ratings across trials. Additionally, experiments differed in terms of whether participants were only instructed to attend to outcome identity (N=4), or also to the action-outcome interval (N=3). Results showed a robust effect of selection fluency on agency ratings across experiments. When participants focused only on outcome identity, there was

an increase across trials in agency ratings, as well as in the effects of selection fluency on ratings. However, when participants focused on action-outcome interval, there was no increase in ratings across trials, and the effect of selection fluency on agency ratings remained stable. Selection fluency can have a general, and consistent influence on the SoA, independent of outcome monitoring. This suggests it is used as a heuristic cue, to prospectively inform our SoA. In addition, our results show that the influence of selection fluency on SoA may also increase with the learning of action-outcome contingencies.

**Poster 09: Breakthrough of familiar faces, on the fringe of awareness, in EEG identity deception detection:**

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Through Rapid Serial Visual Presentation (RSVP), we can present a large volume of visual stimuli, on the fringe of awareness (e.g. 8 stimuli per second). The vast majority of stimuli do not get encoded into working memory, but the salient ones breakthrough into awareness, enter working memory and can be reported [1]. The inclusion of familiar (salient) stimuli amongst unfamiliar stimuli leads to the generation of a P300 component [2]. Presenting stimuli on the fringe of awareness provides an accurate and countermeasure-resistant identity deception detector, which we have named the Fringe-P3 identity detector [3]. The aim of our experiment was to investigate the recognition of familiar faces in RSVP streams, even when there is no explicit task associated with them (i.e. participants were unaware of the presence of familiar faces). In addition to famous faces (e.g. well known celebrity or politician), we have repeated this experiment with familiar faces (e.g. participant's lecturer or supervisor). The goal of the analysis was to compare EEG responses between familiar faces and unfamiliar (i.e. unknown) faces. Using randomisation (i.e. Monte Carlo Permutation) tests, we were able to infer a p-value for each participant. Our experimental findings show that famous/familiar faces, presented in RSVP streams, break into conscious awareness, and such breakthrough can be detected with electroencephalography (EEG), on a per-individual basis. These findings suggest the potential of the proposed method in forensic applications (e.g. knowledge of compatriots), and further, the Fringe-P3 method can be applied across a variety of face-related forensics settings (e.g. face composite systems/line-ups).

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**Poster 10: Comparing metacognitive awareness in students  
on the first and sixth year of medical faculty**

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Metacognition is knowledge about knowledge, thinking about thinking or "cognition about cognition". Metacognition refers to a level of thinking that involves active control over the process of thinking that is used in learning situations [1]. Our aim was to determine how higher education affects development of metacognitive skills. We compared metacognitive abilities of students on the first and sixth year of Medicine in Nis. We covered 40 students in first and 40 in the sixth year, regardless of gender or age. We used the survey "metacognitive awareness inventory". The survey consists of 52 questions that are answered with true or false and which are grouped into 8 groups. We compared the average number of positive responses by group, the number of positive answers that most students gave, and the answers by the groups. Comparing the average we found a significant difference in planning (4.825 to 4.15), information management strategies (8.65 to 7.9) and debugging strategies (4.6 to 4.075), where first year students have outperformed sixth year students. The level of education is not in directly correlation with metacognition. A decline in planning, information management and debugging strategies can even point to the negative impact of education on metacognitive abilities. Our opinion is that education is not likely to affect the metacognition, and that the first year students are probably metacognitively better at start. We think it would be good for students at the beginning and during studies to point to strategies for learning and mastering material.

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**Poster 11: Anticipatory representations of reward and threat in  
perceptual areas from preadolescence to late adolescence**

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This study examined whether changes in perceptual processes can partially account for the increase in reward-orientated behaviour during adolescence. This was investigated by examining reinforcement-dependent potentiation to discriminative stimuli ( $S^D$ ) that predicted rewarding or threatening outcomes. To that end, perceptual event-related



potentials (ERPs) that are modulated by motivationally salient stimuli, the N170 and Late Positive Potential (LPP), were recorded from 30 preadolescents (9-12 years), 30 adolescents (13-17 years), and 34 late adolescents (18-23 years) while they completed an instrumental task in which they emitted or omitted a motor response to obtain rewards and avoid losses. The LPP, but not the N170, showed age, but not gender, differences in reinforcement-dependent potentiation; preadolescents, adolescents and late adolescents showed potentiation to  $S^D$  that predicted a threat, whereas only preadolescents and adolescents showed potentiation to  $S^D$  that predicted a reward. Intriguingly, greater sensation seeking was associated with greater LPP amplitudes in preadolescent males, but smaller LPP amplitudes in late adolescent males. Significantly, these findings provide initial evidence for developmental differences in value-related coding in perceptual areas, where adolescents show enhanced perceptual biases not just to reward-related cues but also to avoidance-related cues, challenging some key assumptions about adolescent behaviour being solely modulated by reward-bias.

**Poster 12: GVS modulates the electrophysiological response during change detection**

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Galvanic Vestibular Stimulation (GVS) is a non-invasive form of neural stimulation which involves applying weak, electric current over the mastoids. The therapeutic potential of GVS has been documented in a number of recent studies. Perhaps most notably, studies have shown that stimulation is able to provide transient relief from symptoms of hemi-spatial neglect. Despite this, the underlying mechanisms associated with recovery remain largely unknown. The current study therefore investigated the effect of GVS on the ERP component N2pc, thought to be associated with target detection among distractors. As a preliminary study, neurologically healthy participants were used as a more homogeneous sample. EEG was recorded from 14 participants over two separate days whilst completing a change detection task. During one session, sub-sensory GVS was administered, while a sham stimulation was administered during the other. N2pc amplitude was compared for active versus sham stimulation, as well as comparing hit and missed targets. Relative to a sham condition, N2pc amplitude for missed targets was significantly increased during active GVS. Additionally, while N2pc amplitude in the sham condition was significantly different for hit and missed targets, this difference was removed when participants received active GVS. This may suggest that GVS increases the ERP amplitude for missed targets so that they more closely approach a sensory threshold at which conscious, visual awareness is possible. Interestingly, while a clear directional focus of attention was demonstrated during sham stimulation, this was removed during active GVS. Our results may therefore provide the first tentative evidence that low levels of Galvanic Vestibular Stimulation can suppress underlying mechanisms usually associated with directional focus of attention.

### **Poster 13: EEG indices relate to fear and anxiety self report**

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The objective was to identify functional links between frequency specific EEG coherence and power on one hand, and self report measures of neuroticism, fear and trait anxiety on the other. Sixty-three participants completed three tasks; two were designed to induce internal rumination (nominal rumination, i.e. ruminating about a prescribed problem; and personal rumination, i.e. ruminating about a personally meaningful problem) and one was a baseline counting task. EEG was recorded from 12 regions of interest and considered across a range of wavebands. Participants also completed questionnaires including the Eysenck Personality Questionnaire-Revised [1], the Fear Survey Schedule [2] and the State Trait Anxiety Inventory [3]. Factor analyses (for coherence and power separately) was used to create a series of virtual variables, each representing composite waveband specific EEG coherence or power activity for each of the task conditions. These were regressed with scores for neuroticism (EPQ-R), total fear (FSS) and trait anxiety (STAI) revealing important differences between power and coherence data across frequencies. The clearest findings were linked to EEG coherence. Across most frequencies, total fear and trait anxiety relate to coherence; specifically, fear is related to nominal rumination and anxiety to personal rumination, the sign of which indicate that coherence is reduced in high fear and anxiety participants respectively. These findings point to important functions of fear and anxiety, the latter being a form of personal 'fear', whereas fear can be impersonal and not related directly to personal factors.

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### **Poster 14: Investigating visual prior entry:**

#### **The effect of emotional face stimuli on temporal order perception**

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Temporal recalibration is a phenomenon by which the brain minimises asynchrony between linked stimuli. Hence, repeated delayed action-feedback (during an adaptation phase) accelerates the processing of the feedback stimulus during a subsequent testing phase, measured by temporal order judgments. We investigated whether adaptation to delayed action-feedback using neutral oval stimuli would be differentially transferred between

fearful faces and the same oval at testing phases. Fearful faces were judged as appearing significantly earlier than ovals. Therefore, the transference of temporal recalibration effect between neutral and emotional stimuli with the same shape is greater than that of two identical neutral stimuli. Furthermore, fearful faces were judged as appearing significantly earlier than neutral faces. Accelerated processing of fearful faces was not associated with autonomic arousal, measured using skin conductance responses. We suggest that increased attention to fearful faces produces an acceleration effect, due to their biological significance for communicating threat.

**Poster 15: An ERP investigation into the effect of playing violent video games on the deployment of attention to emotional stimuli**

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Playing video games has become a common pastime and the psychological effect of playing video games has become the subject of considerable research, with a particular focus on the potential negative effect on emotional processing that violent games may have. To date, despite several reports providing evidence that playing violent video games, even for as little as 20 minutes, alters socio-emotional processing, little research has investigated how playing a violent video game leads to changes in the way that we process social emotional stimuli. The current study attempts to fill this gap by investigating how the playing of violent video games affects adults' neurophysiological response to socio-emotional stimuli. 40 participants were recruited to take part in an ERP oddball task where participants responded, via keypress, to the appearance of emotional faces (happy and fearful) presented in a stream of emotionally neutral facial stimuli, prior to, and after, playing either a violent video game (first person shooter), or a non-violent action game (racing game) for 20 minutes. Of interest were the electrophysiological responses associated with face processing, the N170, and to attentional deployment to the rare emotional faces, the P3. The results of the event-related potential response revealed an enhanced response in the N170 to the happy emotional faces after playing the violent video game, and an overall change in P3 deployment post-game play, but this response was not dependent on game type. These results shed light on the effect that playing violent video games has on adult socio-emotional processing.

**Poster 16: Testing the implicit rapid processing of learned information in older adults**

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Relational memory refers to the ability to link items in memory; an ability that typically deteriorates in old age. Imaging studies show the Medial Temporal Lobes (MTLs, especially the hippocampus) play a central role in relational processing, as atrophy in the MTLs (assessed by MRI) is correlated with performance on verbal learning tasks. The connection of MTL integrity with behaviour suggests that a sensitive behavioural measure could reveal the state of the MTLs without expensive medical imaging. Based on the propositions that: 1) priming provides an implicit measure of processing and 2) Paired Associate Learning (PAL) is the best test of relational memory, we developed a test for older participants using a PAL task and masked priming. In this first test of the procedure, to facilitate priming, we used semantically-related word pairs, small learning blocks, etc, and tested older ( $n = 38$ ,  $Mage = 70$ ) and younger adults ( $n = 36$ ,  $Mage = 30$ ). Equal-sized priming was found for both groups, showing that these older adults were able to rapidly access newly learned memory links. These promising findings provide the basis for developing the test to provide reliable individual data and to test semantically unrelated pairs. An individual version of the experiment has been constructed and results will be presented.

**Poster 17: The neural correlates of goal conflict and anxiety:**

**An EEG study of Reinforcement Sensitivity Theory**

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Reinforcement sensitivity theory (RST) is primarily concerned with the neurological processes behind approach and avoidance behaviours. One component of RST, the behavioural inhibition system, (BIS) is concerned with resolving conflict when approach and avoidance are equally weighted. BIS studies often use goal conflict tasks (GCTs) which prompt participants to activate (approach) and inhibit (avoid) response simultaneously; studies have shown neo-cortex wide activity in multiple frequency bands (for EEG power & coherence) backed up with EMG recordings [1,2]. Recently, Neo, Thurlow and McNaughton [3] improved on previous GCT research by using a task that allowed for calibration of participant-specific goal conflict delay. However, their findings were limited as only theta activity in an isolated area of the frontal cortex were reported. Here, we will adopt the task used by Neo et al., but using a more comprehensive EEG approach. Scalp-wide EEG activity (32 channels) and EMG hand activity will be recorded from 35 participants; the EEG data will be subject to both power and coherence spectra analysis (4-30Hz). Preliminary results for EEG power (3 participants) are encouraging. The data show increased theta power during goal conflict ( $M = 2.66\mu V^2$ ) in the right frontal cortex compared to approach ( $M = 0.96\mu V^2$ ); this is in line with Neo et al.'s findings. However, increased theta was also observed in the central/left frontal, central-parietal and occipital regions suggesting the involvement of other brain regions. The full dataset will be reported at the Conference, including a detailed

description of coherence and power spectra covering 4-30Hz; the EMG findings will also be reported. We will also consider the influence of personality type measured using a range of questionnaires (EPQ; BIS/BAS scales; STAI) on the EEG.

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### **Poster 18: Effects of TMS over the Supramarginal gyrus while reaching and grasping tools for use**

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Tool use is a ubiquitous part of human behaviour. In a left-lateralized brain network facilitating tool use [1], two processes must be integrated: manipulation control (related to fronto-parietal regions [2]) and knowledge of tool purpose (related to the temporal lobe [3]). It is thought that integration of these processes occurs in the parietal lobe [4]. To investigate this, we applied TMS (110% rMT, double pulse 100ms inter-pulse interval) over the supramarginal gyrus (SMG) while right handed subjects (n=15) made reaching movements to grasp tools for use. Subjects had to use the left hand to increase difficulty and were encouraged to reach quickly (~700ms) to allow examination of rapid online control, as the target tool was rotated by 90° forcing a correction of grasp. This defined a time period requiring integration of manipulation control and tool knowledge during which TMS was applied (onset of target rotation). Target rotation was varied to require upright vs. inverted grasp and congruence vs. incongruence between initial grasp plan and final required hand orientation. We hypothesised that TMS would disrupt the integration of tool knowledge into an action plan for use during correction of grasp. TMS over both left and right SMG interfered with correction of grasp (main effect:  $F(1, 14) = 63.83, p < .001$ ). A trend was found indicating stimulation over left SMG as more disruptive in upright congruent conditions; and stimulation over the right SMG more disruptive in inverted and incongruent conditions ( $F(1, 14) = 3.141, \text{trend: } p = .098$ ). This finding is consistent with a role of right SMG in more demanding online control in reaching and left SMG in familiar reaching and grasping tools for use.

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**Poster 19: Prediction mechanism in the visual modality: An ERP study**

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The ability to feel agency has been associated with internal forward modeling [1]. This phenomenon is considered to rely primarily on sensory predictions. Our aim was to examine prediction-related modification of visual processing by analyzing event-related potentials (ERPs) elicited by abstract (checkerboard) or ecologically relevant (hand) stimuli in two experiments. Stimuli either appeared after the participants pressed a button (movement-induced) or randomly without any keypresses (passive viewing). All the above conditions were performed in two different versions, with stimuli of either 100% or 50% predictability. Internal prediction mechanism marked by ERP amplitude decrease was detected in a very early stage of processing: visual N70 suppression was found both for checkerboard and hand stimuli. To the best of our knowledge, no ERP study reported such an early effect. However N70 suppression for abstract stimuli was present only for predictable stimuli, and restricted to movements by the dominant hand, suggesting that prediction mechanisms at this early stage are less general for non-ecological stimuli. In contrast to previous study results [2,3], an amplitude increase was found regarding the P100 component, independent of stimulus type, predictability or the laterality of hand movement, pointing to a more general and stable effect. Considering that these effects appear very early, it can be assumed that the modulation of activity of the striate/extrastriate visual cortex contributes to the feeling of agency related to the movement-related appearance of abstract and ecologically relevant stimuli.

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## **Poster 20: The effects of violent video games on adolescents – An ERP study**

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The way we spend our leisure time has changed greatly with an increasing rise in the use of video games, particularly amongst adolescents. Research suggests that playing violent video games leads to the development of undesirable socio-emotional behaviour, particularly relating to aggression [1]. Adolescence is a time of considerable neurological change [2], therefore it is important to understand the possible implications of video game play during this critical developmental period [3]. The current study examined changes in participants' behavioural and electroencephalography responses to emotional facial stimuli after playing a violent or non-violent video game. Twenty adolescents (aged 15-16 years old) participated in two experimental sessions, one session for each game type, order played was counterbalanced. Participants' history of gaming, trait levels of aggression and current mood were also measured. The results imply that playing a violent video game impacts on emotion processing as indicated by differences in the ERP P3 component, suggestive of post game specific changes in emotional face saliency. Surprisingly, no significant differences across conditions were found in the N170 component (elicited by the emotional face stimuli). These findings shed light on the effect of violent video games on socio-emotional processing in a key developmental period, and may help to guide future research on this important, yet under researched, topic.

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**Poster 21: The role of the parietal cortex in spelling and mathematics:  
An investigation of a multi-generational family with congenital brain abnormality**

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Literacy and numeracy are fundamental skills in digital-age society, and learning difficulties involving these domains can result in significant, lifelong disadvantage. At a neural level, processing of letters and numbers involves the intra-parietal sulcus (IPS) [1,2], a region postulated to support cross-modal mapping of symbols to meaning [2,3]. However, the exact organization of this region, its links with primary sensory cortices, language regions, and associated learning and cognitive performance remain unclear. One way to explore parietal function is to study brain-behaviour correlations in people with congenital brain abnormalities of this region. Both individuals and families with congenital brain abnormality and linked behavioural profiles are rare and have a huge scientific importance. They allow understanding of the link between genetics, brain structures and cognitive performance. The poster will introduce Family TG, whose members exhibit a characteristic pattern of abnormal parietal cortical development. Affected individuals demonstrate a selective deficit for either spelling or mathematics, but not both. Family TG offers a unique opportunity to investigate the functional neuro-anatomy and genetics of fundamental literacy and numeracy processes. We will review gaps in the literature with regards to spelling ability, and will summarise findings from initial behavioural, structural and neuroimaging investigation with family members.

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**Poster 22: Is brain parenchymal factor may be a biomarker of neurological deficits in relapsing-remitting MS? – Preliminary study**

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Multiple sclerosis (MS) is the most common and unpredictable inflammatory demyelinating disease of the central nervous system which progressively reduce patients quality life. The aim of our study was to estimate volume of grey matter (GM), white matter (WM) and cerebrospinal fluid (CSF) in patients with diagnosed relapsing-remitting MS during  $3\pm 1$  years of treatment interferon-beta and calculate brain parenchymal factor (BPF) in yearly intervals. 12 randomly selected persons of age ranging from 22-50 years old from a group of over 100 patients with diagnosed relapsing-remitting multiple sclerosis (RRMS) were included in the study. Brain imaging was performed with 1.5T GE scanner Signa HDxt in Helimed Diagnostic Imaging Center during the normal clinical work using FLAIR Cube sequence. Tissue classification was performed using SPM12 package. Volumes of GM, WM and CSF were estimated using script [1]. BPF was calculated as a quotient of brain parenchymal volume to intracranial volume. The results showed changes in volume of GM, WM and CSF as expected for people with MS. The calculated factors were between 0,894-0,712 depending on features-individual and progress of disease. BPF changes in the analysed period of time ranged from 0,0022 up to 0,0315. Comparing the clinical description with calculated changes of BPF suggests that changes of BPF less than 1% refer to mild form of MS, while changes more than 1% apply to progression of MS. Patient with the highest factor (0,0315) exhibited the characteristics of a clear process activity. Weak or negligible changes in time of BPF indicate a mild form of MS (30% patients) unlike the rest cases. Changes of BPF seems to substantially reflect the clinical state of patients.

[1] [www0.cs.ucl.ac.uk/staff/g.ridgway/vbm/get\\_totals.m](http://www0.cs.ucl.ac.uk/staff/g.ridgway/vbm/get_totals.m)

**Poster 23: Promoting the perception of two and three concurrent sound objects: an event-related potential study**

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The auditory environment often comprises several sound sources that are active simultaneously. While the perceptual segregation of two concurrent sounds has received some research attention [1], the perception of three simultaneous sound objects has not been studied. We conducted two experiments in which participants were presented with complex sounds containing sound segregation cues (mistuning, onset asynchrony, differences in frequency or amplitude modulation or in sound location), which were set up to promote the perceptual organization of the tonal elements into one, two or three concurrent sounds. In Experiment 1, participants were instructed to indicate whether they heard one, two, or three concurrent sounds. In Experiment 2, they watched a silent subtitled movie while EEG was recorded to extract the object-related negativity (ORN) component of the event-related potential as an indicator of concurrent sound segregation. Listeners predominantly reported hearing two sounds when the segregation cues were applied on the same tonal element. Notably, when segregation cues were applied to two different unrelated tonal elements, participants reported equally often hearing two and three sounds objects. The ORN was elicited in most conditions; amplitude- or frequency-modulation differences generated the smallest ORN amplitude. Manipulating two different tonal elements within the complex yielded numerically and often significantly smaller ORNs than the sum of the ORNs elicited when cues were applied a single tonal element. This suggests that ORN reflects the presence of the concurrent sounds, but not their number. The ORN results are compatible with the horse-race principle of combining different cues of concurrent sound segregation.

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