SAN2011 | 5-8 MAY | THESSALONIKI | GREECE

SOCIETY OF APPLIED NEUROSCIENCE

CONFERENCE PROGRAM

AND

BOOK OF ABSTRACTS

SAN2011 MEETING

Editors

Panagiotis D. Bamidis, Manousos A. Klados
Ana B. Vivas, Costas Pappas and John H. Gruzelier

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Welcome Note

The Society of Applied Neuroscience (SAN) has pleasure in welcoming you to its 3rd biennial meeting, 5-8th May, 2011, held in Greece's second, and ancient coastal city Thessaloniki. The meeting is hosted by Professor Panagiotis Bamidis of the Aristotle University of Thessaloniki and Dr Ana Vivas of the South-East European Research Centre, Greece. The meeting has the support of the Northern Greece Psychological Society, the Hellenic Society of Biomedical Engineering, and the Hellenic Society of Neurophysiology.

SAN is a nonprofit membership organization devoted to advancing neuroscientific knowledge and its innovative applications by empowering both scientists and practitioners in serving the public by optimising self-regulatory brain function. It promotes an integrated approach involving neural, cognitive and behavioural levels of analysis. In advancing integrative neuroscience, novel applications include neurofeedback (EEG, fMRI, NIRS), autonomic nervous system biofeedback, brain-computer interface (BCI), neuro-rehabilitation, transcranial magnetic stimulation (rTMS), virtual reality feedback, vagus nerve stimulation, electro-cranial stimulation, audio-visual stimulation, etc.

Thus its foremost scientific aim is to foster and educate an integrative approach across the range of methodologies in applied neuroscience, rather than focussing on a single methodology. For the practitioner ,application domains cover clinical treatment, education and optimal performance. SAN promotes evidence-based practice in order to optimise functions in both health and disease. The previous two meetings in Swansea and Seville were held in collaboration with the E U COST B27 initiative Electrical Neuronal Oscillations & Cognition, as was a workshop in Dubrovnik. This ENOC action has now ended and this is the first meeting solely under SAN's auspices.

It is also the first meeting that fulfils SAN's aims of offering a wide range of applications and methodologies in applied neuroscience, coming together in a three-track programme, and so denotes the growing maturity of the Society. It remains for me to thank and congratulate you for the excellent calibre of the science in the response to the call for presentations, and to thank most sincerely my Greek hosts and colleagues, and to wish you a most enjoyable meeting.

John Gruzelier

President, Society of Applied Neuroscience.

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Ana B. Vivas
John Gruzelier

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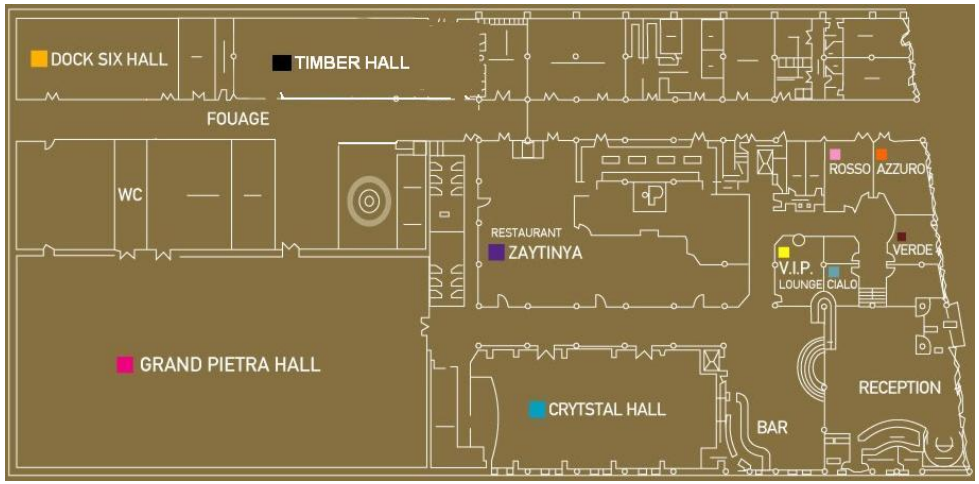

Keynotes

Phantom perceptions: the analogy between pain and tinnitus.

Dirk De Ridder

BRAI²N Belgium

Phantom perception refers to the conscious awareness of a percept in the absence of an external stimulus. Based on basic neuroscience on perception and clinical research in consciousness, phantom pain and phantom sound, a heuristic model for their origin can be developed. Phantom percepts result from sensory deafferentation and only reach awareness when increased gamma band neuronal activity in the primary sensory cortex is connected to a larger co-activated 'self-awareness' or 'global workspace' brain network, involving medial and lateral frontal and parietal areas. This could hypothetically be related to theta-gamma coupled activity, with the theta carrier wave binding distributed gamma activity through phase synchronization or coherence. Activity in a salience network consisting of the dACC and anterior insula is required for the percept to reach consciousness. When associated with rightsided temporoparietal activity this could lead to priority in conscious perceptual processing. The salience network overlaps with a predominantly right-sided central autonomic control system, and also influences limbic-auditory and –somatosensory interactions which are essential for maintaining the percept into consciousness. This involves the subgenual anterior cingulate, nucleus accumbens and amygdala, modulating the reticular nucleus of the thalamus and thereby induces and/or maintains thalamocortical dysrhythmia. Memory mechanisms play a role in the persistence of the awareness of the salient phantom percept, as well as in the reinforcement of the associated distress. Through the involvement of associative learning, the phantom percept becomes associated to distress, which in turn is reflected by a simultaneously co-activated non-specific distress network consisting of the parahippocampal area, anterior cingulate cortex, anterior insula and amygdala. Based on this pathophysiological analogy, it is not surprising that phantom sound and phantom pain share clinical and functional neuroradiological similarities, as well as similar treatment approaches. Neuromodulatory treatments based on this pathophysiological knowledge should not be limited to auditory and sensorimotor cortex neuromodulation, but should try to target hubs critically linking these different overlapping networks. This can be based on network science theories or a better understanding of the different networks involved in phantom percepts.

Applications of EEG-based Brain Computer Interfaces for the control of electronic devices

Fabio Babiloni

Dept. Physiology and Pharmacology University of Rome Sapienza

Introduction: Brain Computer Interface (BCI) is a technology that allows to the users the capability to interact with devices by using the voluntary modulation of the brain activity.
Objectives: The aim of this paper is to analyze whether the use of the cortical activity estimated from non invasive EEG recordings could be useful to detect mental states and how this technology could be useful in clinical applications. It will review the 12 years of experience of the laboratory of Rome in BCI field.
Methods: Estimation of cortical activity was performed on high resolution EEG data related to the imagination of limb movements and detection of P300 gathered in a group of normal healthy subjects by using realistic head models. Cortical activity was estimated in Region of Interest associated with the subject's Brodmann areas by using depth-weighted minimum norm solutions. Comparisons between surface recorded

EEG and the estimated cortical activity were performed. Subjects are asked to interact with different electronic devices of common use by using such BCI system.
Results: With the proposed methodology healthy users are able to drive several mechanical and electronic devices by modulating their EEG activity related to motor imagery. BCI-based P300 is found a methodology easier to use for patients than motor imagery for driving devices. Rehabilitation tasks in patients involving motor imagery could be checked by using BCI system.
Conclusions: EEG recordings can be used to drive electronic and mechanical devices in healthy and in a group of patients. The presented approach could extend the possibility for a use of BCI system into the rehabilitation path for certain class of patients.

Brain Plasticity Based Training Programs - Theory, Data, and Practice

Henry W. Mahncke, Ph.D.

Posit Science

Advances in the basic science of brain plasticity over the past three decades have revealed that the brain retains the fundamental ability to reorganize structurally, functionally, and chemically from childhood through adulthood and into old age. At the same time, advances in the study of perception and cognition in aging have demonstrated that the speed and accuracy of information processing is deeply related to cognitive function, and that decline in such information processing abilities are a significant contributor to age-related cognitive decline. These twin realizations, coupled with advances in computerized training technologies, have led to the development of "brain-plasticity-based" cognitive training programs that employ specific sets of stimuli and exercises designed to improve basic information processing abilities and thus improve cognitive function and overall quality of life in normally aging individuals. Such programs offer a novel, safe, and effective way for older individuals to maintain or improve their cognitive function as they age. Here we will discuss the basic science of such approaches, recent clinical data from large-scale randomized controlled trials demonstrating the significant effects of such training programs on cognitive and quality of life measures, and issues arising in driving real-world use of such programs in various settings

Invited Speakers

Multimodal Virtual Reality and enhancement of human performance

Miriam Reiner

Technion - Israel Institute of Technology

This talk will present findings on neural correlates and motor performance in virtual reality and their implications to human enhancement. Three studies are presented: The first suggests enhancement in motor responses via two types of mechanisms: multisensory integration and their underpinning neural mechanisms. The second suggests enhancement of responses through the virtual hand illusion, a replica of the rubber hand illusion. The third deal with neurofeedback and reports two studies recently completed: the first reports of a neurofeedback protocol that showed enhancement of motor performance and the second suggests a neurofeedback protocol that showed increased levels of insights problem solving. The methodology for all the above studies is based on immersive presence of participants in a surrounding touch enabled virtual environment. While performing tasks in the virtual world, the participants are connected to an EEG system, SGR, heart rate variability, respiration, eyetracker for measures of pupil dilation/ fluctuations. The virtual reality system enables 'touch' of virtual objects. Touch is enabled by a robotic arm held by the participant. A major advantage of the virtual reality is full control of the stimuli in the virtual setting, and fine grain measures with a resolution, hard to achieve otherwise. Results suggest that: human response can be enhanced, i.e. increase speed and accuracy of responses to multimodal stimuli, relative to unimodal. EEG analysis show as early as 30 milisec interactions. The interaction becomes even more immersive when the well known rubber-hand-illusion is used to create projection of the body on a virtual hand, so that the participants act as if the virtual hand is her own hand. Functionality, performance and learning have been found to be improved. The neurofeedback studies show improved speed and accuracy after neuroffedback, as compared to a control group. Implications for rehabilitation will be discussed.

Current interpretation of electroencephalogram alpha activity.

Olga Bazanova

NIIMBB Russian Federation

No else EEG rhythm has such functional significance as alpha-band range– this conclusion was made from numerous empirical data, theoretical computations and results of correlation investigation of fMRI, PET and EEG. The recent identification of specific brain signatures involved in optimal cognitive and psychomotor functioning (peak performance) demonstrate an association with so called "alpha status". We review the emerging literature and take stock of several long-standing theories and widely held beliefs about alpha-activity indices of cognitive and psychomotor functioning. However great number of information about alpha oscillations role in processing mechanisms and neurophysiologic control creates terminological problems in establishing correspondence between described alpha phenomena mechanisms and term "Alpha-rhythm EEG" itself. Despite different aspects of alpha activity, which have been known since Berger's time, it is not clear which quantities characterize "alpha status": increasing or decreasing alpha amplitude and frequency, event related synchronization or desynchronization. Moreover till recent time there are deep gaps in our knowledge of experimental molecular-cellular mechanisms of alpha waves generations and alpha –activity appearance on the EEG. The enlightenment attempt of alpha activity phenomena and current its interpretation was made with reference of 94 literature origins. Taken together, alpha activity does

not appear to critically depend on any single EEG range or brain region, and it is not especially associated with occipital area as sometimes hypothesized. At least three EEG features determine alpha activity: individual alpha frequency in eyes closed resting, amplitude suppression in response to eyes open and autorythmicity appeared as alpha bursting segments of EEG.

Real-time EEG-based Personalized Digital Experience

Olga Sourina
School of Electrical and Electronic Engineering, Nanyang Technological University

EEG-based immersion is a new direction in research and development on human computer interfaces. It has attracted recently more attention from the research community and industry as wireless portable EEG devices became easily available on the market. EEG-based technology has been applied in anesthesiology, psychology, serious games or even in marketing. As EEG signal is considered to have a fractal nature, we proposed and developed a novel spatio-temporal fractal based approach to the brain state quantification. We discuss the real-time algorithms of emotion recognition and concentration level recognition and its integration in human-computer interfaces of EEG-enable applications. The experiments on evoking emotions by music and sound stimuli are described. Models and algorithms of quantification of brain responses to external stimuli are discussed. The algorithms of the brain state quantification including emotion recognition would advance research on human computer interaction bringing the quantification methods and algorithms as new tools in medical, entertainment, and even digital art methodology applications, and allowing us an integration of the brain state quantification algorithms in the human computer interfaces. EEG-enable applications such as serious games, emotional avatar, music therapy, music player, storytelling, etc are demonstrated.

Memory in the lower senses

Per Møller
Department of Food Science, Sensory Systems, Life Science Faculty, University of Copenhagen, Denmark

Introspection suggests that we can remember stimuli and events in the lower "lower" senses (all but vision and audition). Whether these memories are genuinely "sensory" or whether they are rather of a verbal nature is not so obvious. In the presentation I will present recent data that show that genuine sensory olfactory memory systems do exist and I will argue that olfactory (and taste and flavour) memories have different properties than visual and verbal memory. Incidental learning, as opposed to intentional learning, is rather the rule for lower sense memories and the distinction turns out to be important for the properties of lower sense memory. I will review results which show that (non-semantic) incidentally learned stimuli are remembered as well by elderly people as by young. This is in sharp contrast to most explicit visual and verbal memory results and resembles what is often found for implicit memory. These results might suggest why food preferences seem to be rather constant with age, despite dramatic changes in the perception of smell and flavour with age and further, that memory might play a much more dynamic role for perception and appreciation in the lower senses, than it does in vision and audition. Smelling is much less constrained than a spatio-temporally varying visual stimulus and memories and expectations might therefore play a relatively larger role for olfactory perception than for, e.g., visual perception. I will present a number of results which strongly suggest that vision and olfaction have different functional structures. We have demonstrated a double dissociation between memory and discrimination for vision and olfaction. Even though subjects discriminate better between a set of visual stimuli than between a set of olfactory stimuli, they remember them less well than they remember the olfactory stimuli. Furthermore, memories in the lower senses seem to rely much more on correct rejections than on hits: You remember what you have not encountered previously! "Novelty detection", thus, seems to be particularly important in the lower senses, which makes ecological sense, since the lower senses serve as protective systems with only a very limited behavioral repertoire: inhale or don't.

Finally, I will present recent data which suggest that there is also a "working memory" system in human olfaction.

Arousal regulation as a pathogenetic factor in affective disorders

Ulrich Hegerl, Peter Schönknecht, Tilman Hensch, Sebastian Olbrich, Michael Kluge, Hubertus Himmerich, Christoph Sander

Department of Psychiatry and Psychotherapy, Universitätsmedizin Leipzig, Germany

A recently presented vigilance regulation concept suggests that the hyperactivity and sensation seeking observed during mania is an autoregulatory attempt to stabilize vigilance (central nervous arousal) by increasing external stimulation. Similar behavioural patterns are observed in overtired children and in patients with attention deficit hyperactivity disorder. Correspondingly the withdrawal and sensation avoidance in major depression is interpreted as a reaction to a state of tonically high vigilance (1,2). Indeed, under quiet resting conditions, both patients with ADHD and mania show an unstable vigilance regulation with rapid drops to lower vigilance stages (e.g. assessed by an EEG-algorithm of vigilance, VIGALL) whereas an hyperstable vigilance regulation is found in unmedicated patients with major depression (3). In both ADHD and mania, sleep deficits aggravate the dysregulation of vigilance as well as the symptomatology. In depression, sleep deprivation reduces the hyperstability of vigilance which explains it´s antidepressant effects. Among the far reaching consequences of this concept is the question whether psychostimulants have similar beneficial effects in mania as observed in ADHD. There is scattered but surprisingly strong evidence that psychostimulants are not detrimental in acute mania but might have similar rapid therapeutic effects as observed in ADHD (4). The therapeutic role of methylphenidate in acute mania will be studied in an international controlled trial.

References:

1. Hegerl et al 2010, Current Opinion in Psychiatry 23: 1-7
2. Hegerl et al 2009, Pharmacopsychiatry 42: 169-1474
3. Hegerl et al 2011, World J Biol Psychiat (in press)
4. Schönknecht et al 2011, Biol Psychiatry (in press)

Learning Theory Principles in Neurofeedback

Leslie Sherlin

Neurofeedback is a process where the electrical activity of the brain is recorded, quantified and then presented back to the individual in the form of visual, auditory or tactile stimuli. An a priori determination of the characteristics of the EEG are set as thresholds and when the EEG activityfalls within these thresholds the feedback is presented to the individual as a reward signal. Details of how to apply rewards and the frequency to apply are not the only considerations involved in this complex learning process. The reward given when the EEG reaches threshold follows the principles of operant conditioning and was first demonstrated as early as 1941 (Jasper & Shagass). Since that time it has been established that many learning theory principles (classical conditioning, shaping, generalization, placebo, etc) are involved in the application known as neurofeedback. This talk is aimed to elaborate on the learning theory principles involved in the effective application of neurofeedback.

References:

1. Jasper, H., & Shagass, C. (1941). Conditioning the occipital alpha rhythm in man. Journal of Experimental Psychology, 28(5), 373-87.

Behavioral And Physiological Changes Following Eeg Biofeedback (EEGBF)

Andrew Hill, Whitney Eriksen and Eran Zaidel

Psychology and Brain Research Institute, UCLA,USA

INTRODUCTION. We conducted a double blind, placebo controlled study of a short course of EEGBF. We measured the changes in the behavioral and physiological correlates of hemispheric attention, as well as changes in the ERP and in the spectral correlates of the biofeedback reward signal.

METHODS. Participants received one of 4 biofeedback protocols (C3-A1 SMR, C4-A2 SMR, C3-A1 Beta or Sham biofeedback) over five training sessions. Veridical feedback included a brief tone and visual reward of a progressing image display. Dense array (64-channel) EEG was recorded during biofeedback training and during a lateralized test of hemispheric attention (LANT; Lateralized Attention Network Test). The LANT was administered before biofeedback training and after 3 and 5 consecutive training sessions over 5 days. We predicted that lateralized training protocols would have asymmetric effects on the behavior and on the cortical neurophysiology of the two cerebral hemispheres.

RESULTS. (1) Behavioral: The biofeedback training protocols produced different behavioral effects on attention in the two hemispheres. Accuracy to targets proceeded by invalid cues yielded a significant interaction: Protocol (Sham, C3 SMR, C4 SMR, C3 Beta) x Session (1, 3, 5) x Visual Field (LVF, RVF); $p < .025$. (2) Physiological: Reward signals evoked by the training stimulus were characterized by a P50, an N100, and an early P300 ERP component. Training had a selective effect on the P300 component. Frequency reward bands also produced selective enhancements measured at the same scalp region.

CONCLUSION. We demonstrated for the first time that specific EEGBF protocols can affect cortical physiology in specific cortical regions and modulate information processing in specific functional modules. In particular, lateralized EEG biofeedback can have selective effects (1) on behavior (attention) in one cerebral hemisphere, (2) on the physiological signature of the reward signal at the training site, and (3) on the amplitude of the rewarded frequency band in electrodes around the training site.

References:

1. Greene, D.J., Barnea, A., Herzberg, K., Rassis, A., Neta, M., Raz, A., Zaidel, E. (2008). Measuring attention in the two hemispheres: the lateralized attention network test (LANT). Brain & Cognition, 66 (21-31).

Workshops

Single Cases & Integrative Therapy
[FRI 1:50-3:30 TIMBER HALL A]

Organiser:
Rien Breteler

Three Single Case studies

Peter Van Nunen

The first is about a 47 year old woman, who came to us with complaints about poor attention, memory loss, sleeping problems and migraine attacks. It turned out that her frequent awakenings during the night were due to the hot flashes she experienced during the day and at night. When we treated her attention and sleeping problems with NF her hot flashes also diminished dramatically.

The second case is about a young man (17) who suffers from epilepsy. His EEG showed frequently paroxysmal typical 4 Hz absence seizures. Although literature suggests that you can't threat absence epilepsy with NF, he learned to recognize the symptoms of an oncoming seizure and learned to prevent them. Follow up six months later showed that he was still seizure free.

The third case is about a 59 year old man, diagnosed with Asperger's syndrome. He had complaints about racing thoughts, unable to concentrate properly and being impulsive. His QEEG showed that his brain was extremely active with increases in nearly all frequency bands (ranging from 2-7 Hz frontally and 8-22 Hz overall). NF not only calmed down his brain, but a lot of the typical 'autistic behavior' wasn't seen anymore. Not only his wife and children noticed this dramatic change, but he was reemployed in his old job which he had lost years before because of his Asperger e.g. his inability to interact with his boss and co-workers.

Neurofeedback treatment in a patient with ADHD and ODD

Dianne Winklemolen

An 11 year old girl diagnosed with ADHD and ODD presented for neurofeedback. The diagnostic interview demonstrated she met criteria for ADHD (combined type) and criteria for ODD. Before neurofeedback treatment, she was assessed on a QEEG which demonstrated a low voltage QEEG, with very little alpha activity and excess relative theta in the 6-8 Hz range. Due to the problems with concentration and impulsivity, we focused the training on theta-beta neurofeedback; 5-8 Hz down and 15-24 Hz up, at Fz. The neurofeedback treatment focused specifically on treating the ADHD, and maybe it had also an effect on the ODD. In addition during sessions psychotherapy/coaching was performed. After 31 neurofeedback sessions, treatment was finished. On the ADHD questionnaire, the scores were decreased and she didn't met the criteria for ADHD anymore. The behavior of the girl was totally changed. The teachers on school told her parents and her that she worked really hard and her concentration was much improved. She could work very well on her assignments. Her parents noted that she was much calmer in her behavior and she could be quiet. She was no longer hyperactive and tense and the impulsivity was much less. At outtake the girl didn't met the criteria for ODD anymore, according to our diagnostic interview. Whether this improvement is due to the neurofeedback treatment or the coaching, or to the combination of these two is

not know at present and will be discussed in more detail during the presentation. The psychotherapy didn't take place every session and were usually more coaching than intensive therapy. So, maybe neurofeedback treatment could mean something for children with ODD? This was a single case where we had a good result on both ADHD and ODD. Further controlled research is necessary to investigate the effects of neurofeedback treatment in ODD. Pre- and post QEEG and neuropsychology data will also be presented.

Tinnitus treatment with Neurofeedback: a case study.

Ronald Verment

Neurobics Netherlands

Tinnitus is a severe disorder that is more widespread than known. An estimate of 6% of the adult population suffers from this disorder. In the past logically tinnitus was thought of to be caused by mechanical facts relating to the inner ear. Nowadays tinnitus is known to originate from the brain. In short the idea is that losses in the auditory spectrum creates a phantom phenomenon. The fact that tinnitus originates from the brain opens the door to possible treatments that focus on brain-activity, from which neurofeedback is a well-known example. We present a case in which we had extremely much success. A woman age 56 suffered from tinnitus for 7 years. We trained her according to rationale and QEEG on central positions to decrease theta-activity. After 5 sessions subjective experience of tinnitus started to decline. After 20 sessions subjective experience was changed from being overwhelming to a "brook" sound on the background. After ceasing sessions the experience returned to pre-treatment level. But only several sessions were sufficient to bring the tinnitus down once again. Since than the woman trains with a sel-bought neurofeedback kit. Both subjective experience as well as QEEG showed big shifts. Theta-activity declined almost to within normal range.

Optimizing treatment efficacy

B. Reitsma

In this presentation a group discussion is encouraged on the question how to enhance treatment efficacy in neurotherapy. Taken from an overall perspective it is postulated that the efficacy of psychotherapy and neurotherapy depends on the degree to which clients or 'systems' are capable of learning. Learning can be defined as the ability of the central nervous system 'to experience'. This ability is reflected in activation of neural circuitry that may lead to long lasting changes in neural activity (reflecting neuroplasticity) caused by synaptogenesis and neurogenesis. If treatment-efficacy is in part the result of the ability to learn, then the question is how to create an optimal learning environment, designed to enhance growth of neurons and the integration of neural networks. Combining therapeutic modalities that create a more enriched learning environment may be of therapeutic value when offered alone or sequentially. Such an approach supports a more "personalized medicine" orientation in treatment. Although 'stand-alone' neurotherapy may lead for instance to a more flexible, stable and resilient 'brain' and thereby creating for instance a neurophysiologic base for change, generalizability of new behavior may be lacking due to respondent conditioning of the experienced therapeutic changes to the very physical setting in which neurotherapy is provided. Behavioral procedures, such as brief homework mindfulness assignments and training of skills which clients learn to apply in stressful daily situations, expand the learning environment in which new behaviors and private experiences are trained, thereby assisting the generalizability of the strengthening of neural circuitry and networks

Ageing brain and training: neuroscientific evidence
[SAT 9:45-12:45 TIMBER HALL A]

Organisers
Franka Gloeckner, ULM University, DE
Panos Bamidis Aristotle University ofThessaloniki GR
Winfried Schlee, ULM University, DE

Sponsored by the LLM project (http://www.longlastingmemories.eu)

Cognitive and Physical training for prevention of cognitive decline in the elderly: preliminary data of the Long Lasting Memories European project

A. Tsapanou[1], L. Margioti[1], I. Beratis[1], J. Papatriantafyllou[3] ,V. Kamtsadeli[3], A. Nika[4],G. Tsilikopoulou[1], N. Kalfakis[1], P. Sakka[4], P. Bamidis[2], S.G. Papageorgiou[1]

1. *Cognitive Neurology –Movement Disorders Unit, Department of Neurology, Eginition Hospital, University of Athens*
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3. *Day Center "Iasis"*
4. *Day Center of Athens Association of Alzheimer's Disease and Related Disorders*

Objectives: Cognitive and physical training (CT & PT respectively) are recently proposed for the prevention of cognitive decline in the elderly and as a treatment option for patients with dementia or Mild Cognitive Impairment (MCI). However, their effectiveness remains controversial.

Methods: In the present study, in the context of a research program funded by the European Commission (the Long Lasting Memories project), we have implemented a 5 week program of combined CT and PT using a computer interface. The sessions were lasting for 2 hours and were run in a 5 days/week basis and were implemented in 3 community centers.

Subjects: Nineteen community dwelling people aged over 65, with average age 75,4 years (SD =8,4) and mean educational level of 11,7 years (SD=2,7), living in Athens. Eight subjects were normal, 8 had MCI, 1 had Parkinson's Disease (PD), 1 had Primary Progressive Aphasia (PPA) and 1 had Lewy Body Dementia (LBD). Subjects were assessed before and after the intervention with a neuropsychological battery including, among other tests, the California Verbal Learning Test (CVLT), the Trail Making Test A and B (TMT-A, TMT-B) and the Digit Span forward and backwards.

Results: A mixed between-within subjects' analysis of variance, with gender as the between-subjects factor, revealed a significant main effect of the intervention program (pre-intervention/post-intervention) on three neuropsychological measures. Significant improvement was observed on the TMT-B completion time (Wiks Lambda = 0.730, F(1,17)=6.300, p= 0.022), the CVLT recognition performance (Wiks Lambda = 0.749, F(1,17)=5.682, p= 0.029), and the number of repetitions while performing the CVLT (Wiks Lambda = 0.700, F(1,17)=7.276, p= 0.015). No significant effect of the intervention program was observed for the digit span score, both for the forward and the backwards condition.

Conclusions: The present findings suggest that the application of a combined CT and PT intervention program may have a positive impact on the executive and verbal memory functions in the elderly population.

Usability of a cognitive (Gradior) and physical training program based in new software technologies in patients with mild dementia, Mild Cognitive Impairment and healthy elderly people: Long Lasting Memories preliminary findings.

M. Franco-Martín , F. González Palau, Y. Ruiz, E. Vargas, A. Solis, J. G-Mellado, J. M. Toribio, R. Losada, P. Gómez, Y. Bueno, L. Bartolomé.

INTRAS Fundation, Zamora, Spain

Introduction: Despite of the huge advance in the field of computer-based interventions, few applications have been analyzed in terms of their usability in elderly population. Long Lasting Memories (LLM) is a newly integrated ICT platform which combines cognitive exercises (Gradior specialized software) with physical activity (FitForAll platform) in the framework of advance technologies.
Objectives: To examine the usability of LLM cognitive (Gradior) and physical training applications in Spanish population.
Method: 30 elderly recruited from a residential facility (11 non-demented elderly, 9 DSM-IV Mild Cognitive Impairment, 10 dementia; mean age = 75,9 years) received 1 hour of physical training and 35 minutes of cognitive training, 3 times a week, during 12 weeks program. At 8 week intervention they were assessed trough a specifically designed questionnaire that included aspects of their perception of the platform. A descriptive study of the results was performed.
Results: 73,33 % of the participants perceived LLM platform as beneficial for them. 91,1% reported they enjoyed the sessions. 63,33% found the instructions of the software clear and understandable, but 40% of them expressed that was difficult to learn how to use LLM and 56,67% perceived the platform as difficult to use without help. Nevertheless, all the participants expressed they would be able to use the program alone if they have it at home. All the users agreed they would characterize LLM software as "warm and friendly" and 70% reported that it met their expectations.
Discussion: Primary results indicate that LLM platform could provide a stimulating and usefulness new technology method that improves

Cognitive Training, Physical Exercise and Information Technology: neuroscientific challenges & first evidence from the LLM project

P Bamidis, C Frantzidis, A Kyrillidou, A Ladas, E Grigoriadou, A Billis, E Konstantinidis, V Zilidou, C Mouzakidis, A Semertzidou, M. Karagianni, A Vivas, M Tsolaki

Medical School, Aristotle University of Thessaloniki, Greece

Recent advances in Information and Communication Technology (ICT) lead to an expansion of systems assistive to elderly's comfort, life quality, as well as, physical and mental health. Among other approaches, cognitive and physical training (CT & PT respectively) have recently been proposed for the prevention of cognitive decline of seniors as well as alternative treatment options to patients with dementia or Mild Cognitive Impairment (MCI). However, any such approach faces three major challenges: the technological burdens to make it available to a wide span of requirements, the envisaged user acceptance and its measurements, and finally the actual effectiveness both subjectively/ neuropsychologically and objectively/neuroscientifically.

In this paper, answers and evidence to the above three challenges are provided in the light of the Long Lasting Memories EC funded project (www.longlastingmemories.eu). A platform based on a web services approach integrates different components and systems promoting CT or PT thereby tackling the first challenge. User surveys are focused on measuring numerous elements which besides usual approaches confined to Usability and Satisfaction, introduces ideas associated with the affective and social intergation elements of seniors life and interaction with the CT and PT systems. Finally, a battery of neuropsychological assesments (like the California Verbal Learning Test (CVLT), the Trail Making Test A and B (TMT-A, TMT-B), the Digit Span test and other) are employed to measure the effectiveness of the combined CT and PT intervention. Analysis of results from a first iteration demonstrate that seniors maintain their mental capacity, and in most cases there seems to be an improvement between the pre- and post- neuropsychological assessments. Finally, resting-state EEG (with eyes closed) recordings are examined in different energy bands (delta, theta, alpha, beta and gamma) using computations of the discrete wavelet transform (DWT) in concert with a classification system. Preliminary comparisons in the gamma and delta bands demostrate the efficacy of the approach

Aging and dementia – first results from biomarker and intervention research

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This research was funded by the Heidelberg Academy of Sciences, Heidelberg, Germany, and the Zukunftskolleg of the University of Konstanz, Konstanz, Germany.

Pathological aging is associated with comprehensive and progressive losses of brain function causing multiple problems in daily life. Current research focuses on potential biomarkers for early detection of dementia. We analyzed an electrophysiolocical correlate of executive function, the so-called error-related negativity (ERN), in healthy young and older adults and in older adults with subjective memory complaints or mild cognitive impairment (MCI) using dense-array EEG and an adapted Eriksen Flanker paradigm. We found no difference in ERN between young and high functioning older adults. However, older adults with subjective memory complaints and MCI showed significantly impaired cognitive function and a correspondingly reduced ERN amplitude ($p<.05$). These results indicate that the ERN might function as potential biomarker in early detection of pathological aging.

Nevertheless, research also needs to focus on effective interventions for people who already suffer from multiple consequences of progressive dementia. In healthy older adults and adults with MCI, physical exercise improves overall cognitive function, especially executive function. Studies analyzing potential benefits of physical training for already institutionalized and frail patients with moderate to severe dementia still report mixed results. In a pilot study, we therefore evaluated the effect of a 10-week multimodal movement training (in mainly seated position) on nursing homes residents (n=6) compared to a usual-care-protocol (n=9). After training, participants of the intervention group showed a significant improvement in the orientation/praxis subscore of the Alzheimer Disease Assessment Scale – Cognitive Subscale (ADAS-Cog; $p<.05$). In contrast, participants of the control group showed a significant decline in the ADAS-Cog overall cognitive function ($p<.05$). These results indicate that institutionalized and frail patients with dementia still profit from physical exercise.

Development of neural functional connectivity over the lifespan

Winfried Schlee, Franka Glöckner, Iris Kolassa
Department of Psychology and Education, Ulm University, Germany.

Resting-state recordings are characterized by widely distributed networks of coherent brain activations. The development of this large-scale functional networks of the human brain across the lifespan is not well understood. Using magnetoencephalography (MEG), we investigated how age-related functional resting-state brain connectivity links to cognitive performance in healthy aging of fifty-three participants ranging in age from 18 to 89 years. A beamforming technique was used to reconstruct the brain activity in source space and the interregional coupling was investigated using partial directed coherence (PDC).
Comparison of the network size revealed that slow frequencies engage larger networks than higher frequencies and show different development over the lifespan. Networks in the delta (2-4 Hz) frequency range decrease in size, while networks in the beta/gamma frequency range (>16 Hz) increase with advancing age. Results show that the right frontal lobe and the medial temporal areas in both hemispheres are important relay stations in the expanding high-frequency networks. Furthermore, neuropsychological tests confirmed the tendency of cognitive decline with older age. The decrease in visual memory and visuoconstructive functions was strongly associated with the age-dependent enhancement of functional connectivity in both medial temporal lobes.
Using functional network analysis this study elucidates important neuronal principles underlying age-related cognitive decline that are associated with mental deterioration in the senescence.

New Neurophysiological Marker for Mild Cognitive Impairment progression to Alzheimer's Disease

Vasileios Papaliagkas[1], Magda Tsolaki[2], Vasileios Kimiskidis[2], Georgios Anogianakis[3]

1. *St Georges Hospital, United Kingdom*
2. *Third Neurological Clinic, Aristotle University of Thessaloniki*
3. *Department of Experimental Physiology, Aristotle University of Thessaloniki*

Objective: The aim of the current study is measure time changes in the major waves of auditory event-related potentials (AERP) (N200, P300, SW) and their correlation with the memory status of mild cognitive impairment patients (MCI) as assessed with neuropsychometric tests. Methods: The study group consists of a patient group of 22 MCI patients (mean±SD age = 67.4±7.8, median (interquartile range-IQR) MMSE score = 28 (27-29) and a control group of 30 age-matched controls. MCI was diagnosed according to the widely used criteria of Petersen et al. (2001). Auditory event-related potentials were elicited at baseline for both groups and for MCI patients at two follow-ups, the first after an average period of 14 ±5.2 months and the second after 23 ±3 months after the baseline measurement, using a simple discrimination task, the so-called "oddball paradigm". During this time period, 3 patients developed Alzheimer disease (AD) diagnosed according to the DSM-IV-TR criteria (American Psychiatric Association, 2000). Latencies and amplitudes of N200, P300 and Slow Wave and the N200-P300 peak-to-peak amplitudes and latencies were determined, and correlation coefficients (CC) between them and MMSE scores were calculated.
Results: P300 latency was significantly increased and N200 amplitude was significantly decreased between baseline and follow up measurements. N200 latency correlated with baseline MMSE scores in the group of MCI patients (r_s=-0.488, p=0.021), whereas P300 and SW latencies correlated significantly with age (for P300 r_s=0.606, p=0.003 and SW r_s=0.710, p<0.001).
Conclusions: Since the N200 latency and the P300 amplitude did not vary with time, changes in the N200 amplitude and the P300 latency are best reflected by the N200-P300 (N2-P3) inter-peak index (IPI), defined as the ratio between (N2+P3)amplitude and (P3-N2)latency. This neurophysiological index roughly represents the voltage gradient in the latency window between N200 and P300 and it is suggested by the authors that it can adequately describe the gradual progress of MCI and its transition to AD.

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Effective Connectivity Analysis of EEG
[SAT 9:45-3:25 TIMBER HALL B]

Organiser:
Dimitris Kugiumtzis

Using bivariate surrogates to lateralize the epileptic focus

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Epilepsy is related to hyper-synchronous activity of networks of neurons. While acute epileptic seizures are the most extreme manifestation of this hyper-synchronous activity, an elevated level of interdependence of neuronal dynamics is thought to persist also during the seizure-free interval. In multichannel recordings from brain areas involved in the epileptic process, this interdependence can be reflected in an increased linear cross-correlation but also in signal properties of higher order. Bivariate signal analysis comprises a variety of approaches, each with different degrees of sensitivity and specificity for interdependencies reflected in lower- or higher-order properties of pairs of simultaneously recorded signals. We here review our results of [1] where we studied which approach is best suited to detect putatively elevated interdependence levels in signals recorded from epileptic brain areas. For this purpose, we used the linear cross-correlation that is sensitive to lower-order signatures of interdependence, a nonlinear interdependence measure that integrates both lower- and higher-order properties, and a surrogate-corrected nonlinear interdependence measure that aims to specifically characterize higher-order properties. We analyzed intracranial electroencephalographic recordings of the seizure-free interval from 29 patients with medial temporal lobe epilepsy. All three approaches detect higher levels of interdependence for signals recorded from the brain hemisphere containing the epileptic focus as compared to signals recorded from the opposite hemisphere. For the linear cross-correlation, however, these differences are not significant. For the nonlinear interdependence measure results are significant but only of moderate accuracy with regard to the discriminative power for the focal and non-focal hemisphere. The highest significance and accuracy is btained for the surrogate-corrected nonlinear interdependence measure.

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Estimation of the Cortical Activity from Simultaneous Multi-subject EEG Recordings during social interactions

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One of the most challenging questions open in Neuroscience today is the characterization of the brain responses during social interaction. A major limitation of the approaches used in most of the studies performed so far is that only one of the participating brains is measured each time. The "interaction" between cooperating, competing or communicating brains is thus not measured directly, but inferred by independent observations aggregated by cognitive models and assumptions that link behavior and neural activation. In this paper, we present the results of the simultaneous neuroelectric recording of 26 couples of subjects engaged in cooperative games (EEG hyperscanning). The simultaneous recordings of couples of interacting subjects allows to observe and model directly the neural signature of human interactions in order to understand the cerebral processes generating and generated by social cooperation or competition.

Estimating true brain connectivity from EEG/MEG data invariant to coordinate transformations

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The imaginary part of coherency is a measure to investigate the synchronisation of brain sources on the EEG/MEG sensor level, robust to artefacts of volume conduction in the sense that it represents true interactions without relying on an inverse calculation which is not uniquely solvable. Here, we present an approach to maximize the imaginary part of coherency and to reduce the amount of multivariate information to just one number per frequency. This can be used as an explorative tool for the analysis of data in terms of connectivity, and furthermore, it can serve the purpose of multivariate feature extraction for the classification of different experimental conditions. In general terms, the proposed method provides a connectivity index between two arbitrary spaces for each frequency. These spaces can for example be defined by voxels inside the brain or groups of EEG/MEG sensors. First, virtual channels are constructed by weighting the original channels such that the imaginary part of coherence is maximized. Second, the imaginary part of coherence between the spatially filtered signals is determined and combined in a way such that a single value indicates the interaction between the predefined spaces. Remarkably, the measure is invariant to any coordinate transformation. If the two spaces are identical, the result is a global measure of true interaction observable in that space. This allows e.g. to objectively compare MEG and EEG or different types of measuring devices as the measure does not depend on how sources are mapped into sensors. Since the above constructed spatial filters occur in pairs and are only unique up to mixing within each pair, additional assumptions need to be made to identify the topographies for individual sources: we propose to maximise effective connectivity, defined here using the phase slope index (PSI). Assuming two causally connected sources in a specific band, this procedure leads to clear identification of driver and recipient of information. As an explorative investigation the method was tested and evaluated on resting state EEG data where clear rhythmic interactions could be detected in all bands. On the same data, the filters where calculated with the boundary condition of also maximizing PSI where an information flow from frontal to occipital areas can be observed in the alpha band. In simulated driving data with an auditory distraction paradigm the method was used to discriminate the distraction condition from the usual driving task. Here, a difference in the occipital

alpha connectivity with other regions could be detected. Finally, we showed how the effect of overfitting can be removed.

Investigating the impact of instantaneous causality on frequency domain connectivity measures

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One of the most popular approaches to the evaluation of brain connectivity is based on describing a set of multiple neurological time series by means of a multivariate (MV) autoregressive (MVAR) model, and then computing connectivity measures from the frequency domain representation of the model coefficients. Within this framework, the directed coherence (DC) and partial DC (PDC) are well-known connectivity measures quantifying lagged causality from one series to another in the MV representation. An open issue in MVAR-based connectivity analysis is that, although zero-lag interactions are very common in experimental time series, the model traditionally used to compute DC and PDC forsakes instantaneous effects, i.e. effects occurring within the same time lag. This study aims at investigating the impact of instantaneous causality on the evaluation of MVAR-based connectivity measures. To this end, we introduce an extended MVAR representation in which instantaneous effects are explicitly described in terms of model coefficients. The extended model allows evaluation of a generalized form of causality including instantaneous effects in addition to the lagged ones, but can be adopted also to infer lagged causality through exclusive consideration of time-delayed influences. Using theoretical examples we show that, in the presence of significant instantaneous causality, the interpretation of lagged causality may change considerably if instantaneous effects are not described. In such a case, the DC and PDC computed from the traditional MVAR model yields misleading connectivity patterns, while the correct interpretation is obtained defining the two functions from the coefficients of the extended model. Moreover, we show that extended causality may be tested in the frequency domain by incorporating both lagged and instantaneous effects into the definitions of DC and PDC. Finally, we discuss the practical application of the extended MVAR model, providing an algorithm for its full identification and showing the PDC patterns related to the propagation of alpha EEG activity assessed in normal subjects in the eyes-closed condition.

Effective connectivity in partial epilepsy: modulation by transcranial magnetic stimuli

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Background: Trancranial Magnetic Stimulation (TMS) is being increasingly used in the therapeutic management of drug-resistant partial epilepsies. Evidence from open label and small-scale controlled studies suggests that repetitive TMS exerts a modest but statistically significant beneficial effect on the frequency of seizures and interictal discharges. However, the modulatory effects of TMS on EEG connectivity patterns in patients with partial epilepsy remains unexplored.
Objective: To investigate whether TMS can modulate effective connectivity patterns in patients with partial epilepsy.
Methods: Three subjects (median age, 32 years) with drug resistant frontal lobe epilepsies characterized by particularly frequent epileptiform discharges (EDs) were studied. Seizure etiology included perisylvian

syndrome (1 case) and head trauma (2 cases). In all patients, the epileptogenic focus was located in the hemispheric convexity on the right and was easily accessible to transcranial stimulation. TMS was applied over the area of the electrographic focus with a figure of 8 coil while simultaneously recording EEG with a 60-channel TMS-compatible EEG system (eXimia, Nexstim Ltd, Finland). TMS stimuli (trains of 1-10 stimuli at 1-3 Hz and 100% MSO stimulus intensity) were delivered at variable treatment latencies after the onset of EDs (range 0.5-10 secs). The measures to assess the connectivity patterns are the conditional Granger causality index (CGCI) and the partial directed coherence (PDC), both designed to detect direct causality effects. The measures are computed on overlapping EEG segments of duration 2 sec and for all possible pairs of 8 channels located at predefined brain areas. The setup regards epochs of three types: a) ED in the absence of TMS, b) TMS in the absence of ED, c) TMS matched with ED.

Results: The preliminary results show a change in connectivity before and after TMS as well as after ED. More results are expected from the on-going work that will allow for a better assessment of the connectivity patterns with regard to the presence of ED and TMS.

Brain connectivity in children with cognitive deficits and CSWS

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Continuous spike and wave during slow sleep (CSWS) is a clinical condition encountered in many children with cognitive impairment, such as ADHD and autism. This activity is assumed to interfere with memory consolidation and normal cognitive development and its negative effects leave their traces in adulthood, even when CSWS ceases. The working hypothesis is that changes in the brain connectivity mechanism give rise to the cognitive disturbances. To investigate this hypothesis we have applied a number of linear and nonlinear, functional and effective connectivity measures (correlation and partial correlation, conditional Granger causality index, direct directed transfer function, partial transfer entropy and mutual information from mixed embedding) to clinical datasets from children with CSWS during non REM (NREM) sleep and awake states. The objective of the study is to select the most relevant measures and assess the connectivity patterns at those states. Our results revealed the occurrence of dominant connectivity patterns that slightly enhance during the night. Further, we could estimate sites of spiking activity. These findings have been related to the spike index (SI) – a measure of the influence of the pathological activity in the brain. Overall, the results point out that the dominant connectivity during night in those affected children, persists during the day, thus altering the normal neural connectivity of the brain and thus affecting normal cognitive functioning.

Functional network analysis reveals differences in the semantic priming task

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Department of Physics, Humboldt University, Berlin.

The recent years have seen the emergence of graph theoretical analysis of complex, functional brain networks estimated from neurophysiological measurements. The research has mainly focused on the graph characterization of the resting-state/default network, and its potential for clinical application. Functional resting-state networks usually display the characteristics of small-world networks and their statistical properties have been observed to change due to pathological conditions or aging. In the present paper we

move forward in the application of graph theoretical tools in functional connectivity by investigating high-level cognitive processing in healthy adults, in a manner similar to that used in psychological research in the framework of event-related potentials (ERPs). More specifically we aim at investigating how graph theoretical approaches can help to discover systematic and task-dependent differences in high-level cognitive processes such as language perception. We will show, that such an approach is feasible and that the results coincide well with findings from neuroimaging studies.

Brain Computer Interfaces (BCI)
[SAT 9:45-3:25 DOCK SIX HALL]

Organisers:
Mathias Treder & Ali Bahramisharif

Switching Kalman filters for BCI data segmentation

Tracey Cassar, Kenneth Camilleri and Simon Fabri
University of Malta

As a subject performs a specific task for brain-computer interfacing (BCI), the task-specific cortical activity gives rise to scalp electroencephalographic (EEG) data that may be said to represent a sequence of task-related mental states. Continuous segmentation of this data into intervals, each representing a task-related mental state, and its classification is desirable. One approach that has not been extensively studied in the literature makes use of on-line switching filters that switch-in the most appropriate filter for each interval. This work investigates the application of switching Kalman filters to segment and classify EEG BCI data. This study was applied to imagined hand movement whereby each trial at least consists of a transition between a no-movement and a movement state. In (Penny & Roberts, 1999), expert models were similarly used to segment specific sleep states in EEG data. Our objective is to develop this approach making it applicable to BCI. We discuss the advantages of this approach and identify a number of issues that make this approach challenging to BCI. Our preliminary results for EEG data of Subject K3 from BCI Competition III, Dataset 3a, show that continuous-time segmentation of the data and its labelling into movement and no-movement data is obtained with at least 74% accuracy. Rather than reporting ensemble average results, as is typical in most BCI literature, we provide results on a single trial basis to specifically highlight the inter-trial.

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Wild Photoshoot: Applying Overt and Covert Attention

Danny Plass-Oude Bos[1], Bram Van De Laar[1], Matthieu Duvinage[2], Oytun Oktay[3], Jaime Delgado Saa[4], Marijn Van Vliet[5], Mannes Poel[1], Linsey Roijendijk[6], Ali Bahramisharif[6] and Boris Reuderink[1]

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We developed Wild Photoshoot, a game that uses naturally-occurring neurophysiological activity to augment the interaction in a virtual environment in an intuitive way. In this game, the user is a wildlife photographer. Besides normal movement controls (mouse and keyboard), the camera is adjusted according to where the user is looking (overt attention, OA). When the animal has been found, the user will have to use covert attention (CA) (Van Gerven et al., 2009) to take the picture, because when the user looks at the animal directly, it will flee. The mental tasks for OA and CA come naturally given the situation. Initial offline tests assessed the performance of EEG-based CA and EOG-based OA. For CA, the average accuracy was 67% (2 classes, 4 participants), with the pipeline: common average reference, band pass 8-14 Hz, whitening, covariance and logistic regression. The pipeline for OA is based on Barea et al., 2003 and Itakura and Sakamoto, 2010: band pass 0.05-20 Hz, derivation, threshold, integration, and linear regression. For horizontal eye movement the average error was 2.2cm, and for vertical eye movement 4.8cm (4 participants). Although BCIs are the last option for interaction for those patients who have no residual muscle control, there are also patients with limited control, who could benefit from a hybrid BCI setup which combines these two inputs. The naturalness of these inputs can make BCIs easy to use; an aspect that will be appreciated by both patients and healthy users.

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Common Spatial Patterns Using Analytic Signals for EEG-Based BCIs

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Brain computer interface (BCI) systems provide a control and communication means that depends solely on a user's brain activity. In particular, BCIs based on non-invasive EEG systems can provide a relatively low cost, safe and practical solution compared to other brain imaging techniques, making such systems attractive for use by locked-in patients, for prosthesis control, as well as for gaming applications. A key stage in a typical BCI architecture consists in the association of patterns of mental activity to specific user thoughts and actions. Subsequently, reliable features can be extracted from the recorded EEG signals

and through a computer these can be linked to various control and communication functions. A popular technique used to distinguish EEG recordings for a given set of tasks is the method of common spatial patterns (CSP), where spatial filters that optimally discriminate between EEG datasets are determined. In this paper we discuss our development of a variant of the CSP which addresses some limitations of conventional CSP whereby EEG signals are converted into their analytic form (Falzon, Camilleri & Muscat, 2010). Our CSP-variant – called Analytic CSP (ACSP) – explicitly takes into consideration phase relationships in the multi-channel EEG data thus allowing for disentanglement of amplitude and phase phenomena in the patterns of mental activity. Tests on simulated and real EEG data show that, compared to the standard CSP, the ACSP may improve classification performance and provide a more reliable insight into the underlying brain activity pertaining to a given mental task.

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Motion-based ERP Spellers in a Covert Attention Paradigm

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Overview: There is evidence that visual brain-computer interfaces (BCIs) using overt attention depend on eye movements, which limits their clinical applicability [1]. Besides, usual intensification types can be discomforting for the user. As a solution to these shortcomings, three spellers based on motion Visual Evoked Potentials (mVEPs) were developed and evaluated in this online study. mVEPs have favorable characteristics, i.e., low contrast and luminance requirements, low variability, high amplitudes and localized spatial distribution but are only recently employed as BCI input signal [2].
Methods: Eleven participants operated three mVEP spellers: Overt Motion Speller (OMS) (similar to [2]), Covert Motion Speller (CMS) and Motion Center Speller (MCS). They differed in attention modes: overt (OMS) and covert (CMS, MCS), and locus of motion stimulation: foveal (OMS, MCS) and peripheral (CMS). MVEPs were generated either by small moving bars (OMS, CMS) or a central moving grid-pattern (MCS), and all spellers adopted a vocabulary of 30 symbols.
Results: All participants successfully operated the spellers. Online spelling accuracies amounted to 97.5% for the Overt Motion Speller, 71.7% in the Covert Motion Speller, and the Motion Center Speller reached 92.4%. Spelling speed reached 2 characters/minute. Classification in the OMS was mainly based on N200, in the CMS on P300, and the MCS exploited both components.
Conclusion: The motion-induced N2 component is not discriminative when the stimulus is presented in the visual periphery. However, a novel gaze-independent speller using stimulation at a central location is able to exploit both N2 and P3 components during classification.

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From visual to tactile speller

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For patients suffering from locked-in syndrome, brain-computer interfaces (BCIs) constitute a way of communicating with the environment. One well-known BCI for communication is the visual speller. However, in some patients the visual modality deteriorates with disease progression. For patients whose vision impairments become too severe to use the visual speller, a solution might be to switch to a BCI that is not dependent on eye gaze. One possibility is a speller based on somatosensory stimulation. Previous studies have shown that brain responses to tactile stimuli on the waist (Brouwer & van Erp, 2010) and steady-state somatosensory stimuli on the fingertips (Müller-Putz, Scherer, Neuper & Pfurtscheller, 2006) can be used to control BCIs. In a pilot study, we stimulated the fingertips of healthy participants with short mechanical taps while measuring EEG activity. The subjects were instructed to focus attention on one of the fingers by silently counting the number of taps on that finger. An increased amplitude of the P300 ERP component was found in response to stimuli on the attended finger versus stimuli on any unattended finger. This is consistent with previous findings in visual (Farwell & Donchin, 1988) and tactile (Brouwer & van Erp, 2010) BCI experiments.
On the single trial level, classification rates of around 60% were reached. Information transfer rates were around 7 bits/minute on average, with our best subject reaching bit rates up to 27 bits/minute. Encouraged by these results, we further developed the tactile speller and evaluated its offline and online performance. Comparisons were made to the visual speller operated in both overt and covert attention conditions, taking into account classification performance as well as underlying electrophysiological responses. We assess the practical value of the tactile speller and discuss the attentional processes that may underlie its use.

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Natural stimuli for auditory BCI

Johannes Höhne and Michael Tangermann
TU Berlin

With Brain-computer interfaces (BCI), one can establish a communication pathway which solely relies on neural activity. Since visual BCI paradigms might not be suitable for users with vision impairments (e.g. patients suffering from neurodegenerative diseases) [1], auditory speller paradigms have recently been investigated [2, 3]. For any kind of BCI paradigm based on event-related potentials (ERPs), the choice of stimuli is crucial. In the PASS2D paradigm described in [2], nine auditory stimuli with varying pitch and direction were presented in random order with the task to count a target stimulus. It was found that concentrating on one out of the nine tones is possible, but very demanding: two out of twelve subjects could

not distinguish the stimuli at all and for three other subjects, the experiments could not be finished, possibly due to fatigue. In the present offline study, the use of phonemes instead of tones as auditory stimuli was investigated to reduce the workload and to improve applicability of the PASS2D paradigm. Short phonemes, such as 'ta', 'to' or 'it' were recorded from three speakers, resulting in nine different spoken stimuli (125ms each). These stimuli were used to drive a 9-class BCI in close analogy to [2]. In contrast to a BCI based on tones [2, 3], all participants (N=5) judged the phonemes as pleasant stimuli, that were easy to concentrate on. Although natural stimuli possess a diffuse temporal structure, the observed ERPs (N200 and P300 component) were very similar to those ERPs evoked by tones. Classification performance was almost equal for both types of stimuli. It can be concluded that natural stimuli can be used for driving a BCI. Phonemes stand out as a particularly suited type of stimulus for auditory ERP paradigms, due to their short duration and close relation to speech.

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The TNO tactile P300 BCI

Anne-Marie Brouwer and Jan Van Erp

TNO Human Factors - Perceptual and Cognitive Systems

P300 BCIs are usually based on visual stimuli with the user gazing at the to-be-selected item, generating a positive peak in the EEG when the item is flashed. However, visual BCIs are of limited value for users whose vision or eye movements are impaired or in use. Here, a BCI based on tactile stimuli could be useful. Additional benefits are that tactile BCIs are potentially unnoticeable to others and that tactile stimuli can intuitively map on spatial (movement) directions. We thus studied the feasibility of a P300 BCI with tactile stimuli. First, we investigated P300s in response to tactile and visual stimuli unimodally and bimodally. Tactile stimuli were delivered by successively vibrating tactors around the participant's waist. Visual stimuli were flashed discs arranged in a circle on a monitor, schematically representing the tactors. Eye fixation was always in the center of the circle. Participants attended to the vibrations and/or flashes of a target presented in a stream of standards. The P300 amplitude for visual and tactile modalities were comparable in size and depended on electrode location: tactile P300 amplitudes were larger than visual ones at Fz and Cz, but tended to be smaller at Oz. Offline classification accuracy was highest in the bimodal condition. In subsequent experiments we tested an online tactile P300 BCI, exploring the effects of the number of tactors (2, 4 or 6) and stimulus onset asynchrony (SOA). Classification performance was independent of the numbers of tactors. This makes it possible to tune the number of tactors of the BCI to the task requirements. The SOA for an optimum bitrate (around 300 ms) turned out to be close to conventional SOAs of visual P300 BCIs. We conclude that tactile P300 BCIs are feasible and may be very useful for specific situations or groups of users.

Neurofeedback and QEEG in ADHD: New developments [SAT 2:00-3:25 TIMBER HALL B]

Organisers:
Ulrich Hegerl & Martijn Arns

Mania and ADHD: Common symptoms, common pathophysiology, common therapy?

Ulrich Hegerl, Peter Schönknecht, Tilman Hensch, Sebastian Olbrich, Michael Kluge, Hubertus Himmerich, Christoph Sander

Klinik und Poliklinik für Psychiatrie und Psychotherapie, Universitätsmedizin Leipzig

Attention-deficit/hyperactivity disorder (ADHD) and mania show broad symptom overlap, and high comorbidity exists between ADHD and bipolar disorder. A recently presented vigilance regulation concept suggests that in both ADHD and mania an unstable wakefulness (vigilance) regulation is a central pathogenetic factor leading to attention deficits and, in vulnerable subjects, additionally to hyperactive, impulsive and sensation-seeking behaviour. The latter behavioural pattern is interpreted as an autoregulatory attempt to stabilize wakefulness by increasing external stimulation (1,2). Indeed, under quiet resting conditions, both patients with ADHD and mania show rapid drops to lower vigilance stages (e.g. assessed by an EEG-algorithm of vigilance, VIGALL). Interestingly, the opposite is found in patients with major depression who show a sensation avoidance behaviour (3). In both ADHD and mania, sleep deficits aggravate the dysregulation of vigilance as well as the symptomatology indicating that the unstable vigilance is not a consequence of mania or ADHD but a causal pathogenetic factor. Further lines of evidence supporting the vigilance regulation concept of ADHD and mania will be presented. The concept explains why vigilance stabilizing drugs such as psychostimulants have he therapeutic effects in ADHD. There is scattered but surprisingly strong evidence that psychostimulants are not detrimental in acute mania but might have similar rapid therapeutic effects as observed in ADHD (4). The therapeutic role of methylphenidate in acute mania will be studied in an international controlled trial.

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Neurofeedback for Adult ADHD: Investigation of Theta/Beta Training

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Objectives. Attention–deficit/hyperactivity disorder (ADHD) is one of the most common disorders of childhood and persists into adulthood for approximately 5% of the population world-wide (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007). The primary symptoms of ADHD include inattentiveness, impulsivity, and hyperactivity. EEG analysis of adults with ADHD compared to healthy controls and/or normative database populations indicate significant differences in brain activity patterns (Clarke et al., 2008; Koehler et al., 2009; Loo et al., 2009; Thompson & Thompson, 2005). Some adults with ADHD show the typical increase in Theta/Beta ratios commonly reported in childhood populations (Bresnahan, Anderson, & Barry, 1999; Bresnahan & Barry, 2002). Neurofeedback training is a treatment method that utilizes operant conditioning to reinforce specific EEG activity. In a recent meta-analysis of research focused on this treatment modality, a large effect size (ES) was found for neurofeedback on impulsivity and inattention in controlled studies and pre- and post-designs (Arns, de Ridder, Strehl, Breteler, & Coenen, 2009). However, limited research has investigated the use of Theta/Beta neurofeedback as a treatment for adult ADHD.

Methods. Continuous 19-channel EEG was acquired from 15 adult participants that met DSM-IV criteria for ADHD (combined, inattentive, or hyperactive type), without additional serious physical, neurological, or psychiatric disorders, and a full scale IQ > 80. EEG recordings were collected pre/mid/post treatment and included EO, EC, P300, and CNV tasks, as well as ADHD behavioral questionnaires. Participants received 30 sessions of neurofeedback training in which Theta (4-7Hz) activity was inhibited and Beta (13-21Hz) activity was augmented at CZ (referenced to A1, ground A2).

Results. This investigation is in progress. Changes in behavioral and neurophysiologic parameters will be presented at the time of the conference.

Conclusion. Treatment implications, study limitations, and future directions in research will be addressed.

The effects of QEEG-based Neurofeedback in ADHD

Martijn Arns [1, 2] & Pim (W.) Drinkenburg [3,]

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The application of neurofeedback in the treatment of ADHD has been well investigated and a recent meta-analysis concluded that neurofeedback has demonstrated a large effect size (ES) on impulsivity and inattention (Arns et al., 2009). Other recent studies however have failed to find an effect of neurofeedback against a 'placebo' condition (Lansbergen et al., 2010; Perreau-Linck et al., 2010). Most published studies have used a single treatment protocol for all subjects. The Monastra et al. (2002) study had to be excluded from the meta-analysis due to contributing too much to the heterogeneity of variance. They employed pre-selection of subjects based on a deviating theta/beta ratio, which resulted in a larger ES as compared to most other studies. In the present open-label study we therefore investigated the effects of

selecting and personalizing a neurofeedback protocol based on the individual QEEG of subjects, and hypothesized that this would improve treatment outcome. Twenty-one patients with a primary diagnosis of ADHD were included in this study. Diagnosis was confirmed using the MINI. At intake, every 10th session and outtake an ADHD rating scale and a sleep questionnaire (PSQI) were assessed to monitor treatment progress. For non-responders and drop-outs a last-observation carried forward procedure was used. One to two protocols were selected from five standard protocols and were personalized based on the individual QEEG. At outtake 76% patients could be considered a responder (> 50% decrease on one or more subscales of the ADHD rating scales), 14% a non-responder and 10% a drop-out. The ES on inattention was 1.78 and for Impulsivity/Hyperactivity was 1.22.
The presented results are similar to the results from Monastra et al. (2002) and substantially larger then the ES obtained in the meta-analysis. These results show promise for personalizing well-established neurofeedback protocols (such as central SMR/Theta and Fronto-central theta/beta) based on the individual EEG. However, these results require further replication employing larger sample sizes, randomization and adequate control groups.

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Symposia

CHRONIC FATIGUE SYNDROME
[THU 11:05-12:45 TIMBER HALL A]

Organisers:
Aisha Cortoos & Andreas Ioannides

Fatigue is a highly prevalent complaint in medical as well as psychiatric disorders, and is often used interchangeably with the concept of sleepiness when referring to the general condition of being 'tired'. Sleepiness is regarded as a normal physiological state reflecting the need for sleep or sleep propensity and is related to the previous amount of sleep as well as time spent awake. When it becomes pervasive (e.g. narcolepsy) or almost absent (insomnia), it can be regarded as pathological. Fatigue, on the other hand, seems a more elusive concept for which there is still no consensus on its exact definition and relationship to sleep and sleep quality. Furthermore, a distinction is often made between physical and mental fatigue, the first being related to mere physical exhaustion, while the latter is related to cognitive effort. Fatigue is the main symptom of patients suffering from Chronic Fatigue Syndrome (CFS) and is often related to sleep disruptions and

cognitive dysfunction in this patient population. Although the underlying pathophysiology still remains unclear, there have been studies suggesting an impairment of the central nervous system.
The first speaker of this symposium, Dr. Olivier Mairesse, will elaborate on the psychometric differentiation of sleepiness and fatigue, as these two phenomena are often confused in clinical practice both by clinicians as well as patients. Next, Dr. Daniel Neu will consider the relation between fatigue and non-restorative sleep, specifically in patients with chronic fatigue syndrome (CFS). His studies show clear disruptions of sleep quality reflected by increased slow-wave sleep phases characterised by EEG alpha intrusion. This phenomenon is also known as 'alpha-delta' sleep and appears to be associated with non-restorative sleep. Passing from the realm of sleep to daytime functioning, Dr. Lesley Parkinson will talk about the specifics of wake EEG abnormalities in CFS, more specifically indications of increased high frequency EEG activity. Finally, Dr. Jo Nijs, will elaborate on the relation between the hyperexcitability of the central nervous system and physical exercise. The need for specific countermeasures aiming at a desensitization of the CNS seems a future approach for which neurofeedback can be a suitable candidate.

Psychometric differentiation of sleepiness and fatigue

Mairesse, O.[1,2], Neu, D.[2], De Valck, E.[3], Cortoos, A.[1,4], Pattyn, N.[1,3], Le Bon, O.[5] and Cluydts,R.[3]

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3. *Expertimental and applied psychology, Free University of Brussels (VUB), Brussels, Belgium*
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Although fatigue and sleepiness complaints are ubiquitous in clinical practice, the semiological, and physiological confusion of both constructs largely persists. Despite their frequent co-occurrence, both complaints may require different therapeutic approaches. As such, distinguishing between both constructs remains of particular clinical relevance. From a psychometrical point of view, Classical Test Theory-based analyses do not offer sufficient means to separate both constructs. As a consequence, it remains unclear if the relationship between sleepiness and fatigue is genuine or a methodological artifact. Here, we propose a Rasch-based framework to investigate (1) if measures of similar constructs do target a common latent variable and (2) if subjective sleepiness and fatigue share that common underlying structure. For the first study, 22 adults ranging from 19 to 46 yrs old enrolled in a 36 hrs sleep deprivation experiment. Global sleepiness ratings were obtained at baseline by means of the Epworth Sleepiness Scale (ESS). Participants were subjected to 18 consecutive 20 min sleep challenges (Multiple Sleep Latency Test), spaced every two hours. Sleep onset latencies were Rasch-transformed to obtain global sleep propensity measures and compared to Rasch-calibrated ESS measures (common person equating). Results show that in roughly 70% of the cases, objective and subjective measures of sleepiness fall within a 95% CI, suggesting that both constructs are measured on a similar unidimensional latent variable. In a second study, demographics, sleep habits, affective symptoms and global subjective fatigue and sleepiness (Fatigue Severity Scale [FSS] and the ESS) from 150 subjects ranging from 18 to 65 yrs old were assessed by means of a structured computer-assisted survey. Rasch analyses showed that both the ESS and FSS measure unidimensional concepts. Common person equating suggests that, despite similar Rasch-derived ability scores, fatigue and sleepiness nevertheless designate distinct but strongly related constructs. In conclusion, common person equating shows that objective and subjective sleepiness are measured largely on a common underlying trait and that although participants might not present

adequate differentiation, fatigue and sleepiness do relate to different underlying concepts. However, the latter may only be confirmed if a gold standard for objective fatigue is accepted.

Waking Brain Rhythms in CFS: Implications For a Model of CNS Dysfunction

Lesley Parkinson[1] Tomas Ros[2]

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2. *Brainhealth, The Diagnostic Clinic, 50 New Cavendish Street, London W1G 8TL*

Objectives: To investigate the electrophysiological profiles of spontaneous brain activity in CFS at rest and during a 'fatigue-inducing' cognitive performance task, with the aim of relating the findings to an empirical database of normal (healthy) brain function. The implications of any discrepancies are explored within an existing model of brainwave patterns found in central nervous system (CNS) disorder(s).

Methods: The brain signatures of CFS screened patients (n=30) admitted to a U.K.-based clinic were assessed using a full-head 19 channel Quantitative EEG (electroencephalography) during 5 minutes of eyes open/closed at rest, and while performing a 20 minute Visual Continuous Performance Task (VCPT). Following spectral and topographical analysis the data was compared to the Russian Academy of Sciences Human Brain Institute (HBI) normative database for statistically significant differences. In addition, associations between the data and symptom severity scales were also investigated.

Results: As a first replication of preceding research in the eyes closed condition, a large proportion (>80%) of the patients presented significant slow-wave power abnormalities in the delta (2-4 Hz), theta (4-7 Hz), and alpha (8-11 Hz) wavebands. However, this was found to be intermixed with an even larger proportion (>90%) of persistent global and/or focal elevated fast-wave beta (>15 Hz) power during eyes opened and fatigue-inducing conditions, indicative of EEG hyperactivity in this waveband range. Collective evidence exists that beta hyperactivity can be brought on by stress, infection, and toxicity while also being implicated in disorders of CNS over-arousal. Moreover, it has been directly linked to sleep inefficiency during EEG sleep-stage polysomnography of disorders such as Insomnia.

Conclusion: We report findings of disrupted 'faster' (>15 Hz) brain rhythms in CFS during eyes open and induced mental fatigue conditions, suggestive of cortical hyper-arousal at both rest and during cognitive load. This may explain why cognitive dysfunction worsens with extended workload as the system 'burns out'. This may provide an early link between recent evidence of sleep dysfunction in CFS and general EEG hyperactivity, and support a 'cumulating sleep-debt model' whereby sequelae of reduced CNS sleep efficiency could directly lead to mental fatigue via disruption of synaptic homeostasis, whilst indirectly leading to physical fatigue.

Tired of being inactive: Central nervous system dysfunctions explain exercise intolerance in chronic fatigue syndrome

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Mounting evidence supports central nervous system involvement in chronic fatigue syndrome (CFS). Two major and interrelated central nervous system dysfunctions have been identified in people with CFS: the hyperexcitability of the central nervous system (termed central sensitization) and malfunctioning of the short-term (autonomic nervous system) and long-term (hypothalamus-pituitary-adrenal axis) stress response systems. Indeed, patients with CFS have generalized hyperalgesia for a variety of sensory stimuli, including electrical stimulation, mechanical pressure, heat and histamine. This generalized hyperalgesia in CFS is augmented, rather than decreased, following various types of stressors like exercise and noxious heat pain. The activation of diffuse noxious inhibitory controls (DNIC) following noxious heat application to the skin is delayed. In addition, patients with CFS have many autonomic manifestations, and the hypothalamus-pituitary-adrenal axis is characterized by mild hypocortisolism, a blunted adrenocorticotropin response to stressors, and enhanced negative feedback. These central nervous system dysfunctions explain exercise intolerance, one of the major and debilitating characteristics of CFS. In normal circumstances, pain thresholds increase during physical activity due to the release of endogenous opioids, growth factors and other strong inhibitory mechanisms ('descending inhibition') orchestrated by the central nervous system. However, endogenous inhibition is not activated in response to exercise in patients with CFS. This accounts for various types of exercise, including submaximal exercise and self-paced, physiologically limited exercise. The lack of endogenous inhibition during exercise accounts in part for postexertional malaise as typically experienced by CFS patients. In addition, autonomic dysfunctions accounts for the suppressed intramuscular pH recovery following exercise in CFS. Finally, the blunted hypothalamus-pituitary-adrenal axis response to physical activity results in a stronger post-exercise inflammatory reaction. When translating these findings to clinical practice, these central nervous system dysfunctions should be taken into account. First, rehabilitation of patients with CFS should account for these central nervous system dysfunctions to treat exercise intolerance. Second, the treatment of CFS should focus on desensitizing the central nervous system and restoring the load tolerance of the stress response system. The latter can be accomplished by (neuro- and biofeedback driven) stress management programs; the former by a multidisciplinary approach comprising of neurotechnological applications, centrally acting drugs and rehabilitation of cognitive-emotional sensitization.

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Non-restorative sleep and unrefreshing morning arousal in CFS: just tired or presenting disordered sleep?

Daniel Neu MD[1], Olivier Mairesse PhD[1], Guy Hoffmann PhD[1], Paul Verbanck MD, PhD[1], Paul Linkowski MD, PhD[2], Olivier Le Bon MD, PhD[1,2,3]

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Although being frequently confounded by clinicians, researchers and patients, sleepiness and fatigue are phenomenologically spoken very different concepts from semantic, semiological and physiological or patho-physiological points of view. Both are frequent complaints in general medical practice and in neurological disciplines in particular. In contrast to the modelization of sleepiness and its known regulation models, fatigue seems to present with greater systemic complexity and a general unifying functional description model seems elusive. The direct relationships between sleepiness and sleep can be resumed by sleep propensity, whereas fatigue, which usually needs rest not sleep to recover from, presents with unclear and certainly more indirect relations to sleep, despite the clinical fact that patients with a major fatigue complaint usually also complain of non-restorative or unrefreshing sleep. The latter refers to another major issue in clinical sleep research: the fact that in the same way that we do not really know what the final essence of fatigue is, regarding pathways, structures, mediators or functional modelization, we can also not define the complete specific characteristics of 'good' objective sleep quality or even of the unique nature of a restorative night's sleep. One possible way to increase knowledge about these issues is to study the sleep of clinical models of pure chronic fatigue like the chronic fatigue syndrome. We will discuss a series of clinical investigations aiming at a contribution to improve the description of fatigue and its relations to sleep.

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UNLOCKING CREATIVITY THROUGH NEUROSCIENCE [THU 11:05-12:45 DOCK SIX HALL]

Organisers:
Andreas Fink & John Gruzelier

fMRI/EEG

Andreas Fink

University of Graz,m Austria

Advanced neuroimaging techniques such as functional magnetic resonance imaging (fMRI) or the analysis of task- or event-related (de)synchronization of brain activity in the electroencephalogram (EEG) have yielded valuable insights into potential brain correlates underlying creative cognition. In this context, brain activity in the EEG alpha band (~ 8-12 Hz) has proven to be particularly sensitive to a broad range of different creativity-related demands. Specifically, on the basis of existing evidence in this field it can be concluded that EEG alpha activity varies as a function of creativity-related task demands (the more creative a task the higher the level of alpha activity), as a function of originality (higher originality is accompanied by more alpha), and as a function of an individuals' creativity level (more alpha in higher creative individuals; e.g. Fink et al., 2009a,b). In addition, alpha activity has also been observed to increase as a result of a verbal creativity training (Fink et al., 2006). In studies using fMRI we observed evidence that the generation of original ideas (as compared with the production of typical object characteristics) was associated with more activation in the supramarginal gyrus and stronger widespread deactivation in the inferior parietal cortex (around the angular gyri), especially in the right hemisphere (Fink et al., 2010). Taken together, our findings could be interpreted as being indicative of a state of internally driven mental activity that is less likely disturbed by interfering cognitive processes (such as bottom-up stimulation), thereby facilitating the combination or the recombination of more distantly related information.

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Neurofeedback & the performing arts

John Gruzelier

Goldsmiths, University of London,UK

We have conducted eight controlled studies of neurofeedback (NF) for enhancing creativity in the arts. The first studies with conservatoire musicians disclosed that whereas sensory-motor rhythm (SMR) and beta1 benefited anxiety as did other popular diverse interventions without impacting performance ratings of experts, alpha-theta (A/T) training benefited all three music domains – musicality, communication, technique - especially musicality to include interpretative imagination; professionally significant changes (Egner & Gruzelier, 2003). A/T was historically designed to facilitate creativity through inducing hypnagogia, a borderline waking state associated with creative insights; through putative facilitation of

neural connectivity (Gruzelier, 2009). Subsequent studies examined novice singing in conservatoire instrumentalists. A/T again benefited instrumental performance, extending to novice singing including creative improvisation. SMR had a suggestive impact on novice singing, subsequently examined with 11 year-old children with benefits on improvisation (creativity, communication); A/T benefited technique in prepared performance, creativity and communication in improvisation. Dance performance was examined contrasting A/T and heart rate variability (HRV) training. Both improved dancing in competitive university ballroom dancers compared with controls. In contemporary dancers A/T increased cognitive creativity, while HRV reduced anxiety. Finally, university actors were examined with SMR with the NF training-display depicting a rendering of an auditorium seen from the stage. The 2D laptop rendition was compared with a 3D VR version. Immersive VR was the more successful in facilitating brain rhythm control and acting. However, both were superior to control in inculcating a flow state in acting. The more successful NF outcome may follow greater immersion in performance during training with SMR via a visual representation or with A/T through imagination. Mechanisms and methods will be discussed along with pedagogical implications for the performing arts and optimal performance (Gruzelier, 2011).

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Cognitive stimulation and creativity training

Mathias Benedek

University of Graz, Austria

Creativity can be viewed as an essential aspect of cognitive ability. Neuroscientific studies on creative cognition have already helped to identify some robust neurophysiological correlates indicative of creative brain states. From a practical point of view, it is also interesting whether creativity can be trained or stimulated, and how the success of such interventions is reflected at the level of the brain. We have set up a computer-based creativity training, which requires participants to perform a large number of different divergent thinking tasks. A pretest-posttest evaluation revealed that the employed verbal creativity training proved to be effective in enhancing ideational fluency (Benedek et al., 2006). An examination of the neurophysiological correlates of this training effect revealed that the training group exhibited a stronger task-related synchronization of frontal alpha activity than the control group (Fink et al., 2006). This is in line with the notion that effective creative idea generation requires a top-down inhibition process which prevents internal processing to become disturbed by interfering bottom-up processes. More recently, we have also investigated the effect of cognitive stimulation via the exposure to the ideas of other people. This intervention is known as an effective tool for stimulation of creativity in group-based techniques such as brain storming. In an fMRI study (Fink et al., 2010), participants performed a divergent thinking task, and after a given time, they were confronted with other people's ideas. This intervention resulted in increased originality of later ideas, and was associated with brain activations suggesting a more effective bottom-up modulation of attention.

Brain maintenance of creative thinking

Maria Starchenko and Svyatoslav Medvedev
Bechtereva Institute of the Human Brain RAS , Russian Federation

In our studies of the neural basis of cognitive functions, particularly related to creative thinking, we have applied both EEG and PET. There have been almost 300 subjects studied to date with these methods using 6 task sets developed in our institute. These task sets were designed to reveal different aspects of verbal creative activity by applying corresponding control tasks. EEG power changes were observed in different frequency bands during the performing of creative task sets, thus the influence of the creative component could not be bound only with one, separate frequency band. PET correlates of creative activity were revealed in frontal, parietal and temporal regions. The results obtained with EEG and PET methods have a complementary character, and can demonstrate both topographical similarity in the results and its absence. We suggest a preliminary schema of the brain system supporting creativity. EEG power changes reflect the first level of this system, the least specific for creative activity but necessary for the realization of any aspect of creativity. The second level is activation of certain brain areas, which are sensitive to different aspects of the verbal creative process.

SCHIZOPHRENIA
[FRI 9:40-10:30 TIMBER HALL A]

Organiser:
John Gruzelier

The heterogeneity of schizophrenia: the inconvenient truth.

John Gruzelier

Schizophrenia is a late 19th century construct Kraepelin evolved to encompass disparate entities of hebephrenia, catatonia and paranoia, termed dementia praecox – a deteriorating process beginning in adolescence - later termed schizophrenia by E. Bleuler referring to a splitting of psychic functions; finding a contemporary counterpart in a disconnection of neural circuitry (Gruzelier, 1991). From the outset attempts were made to grapple with its heterogeneity and diverse therapeutic outcome: process/reactive, florid/nonflorid, good/poor premorbid-outcome, positive/negative, type I/II. Kraepelin also evolved the construct of two major psychoses - schizophrenia v affective psychosis - with separate aetiologies. Problematic in practice, further labels arose such as schizoaffective. Psychophysiology also disclosed diverse profiles in autonomic responses (Gruzelier & Venables, 1972), EEG spectra (Shagass, 1970), and ERPs. Notwithstanding, the holy grail has been the search (unsuccessful) for a specific single marker of deficit, in support of Kraepelin's premise. A different approach has concerned syndromes that may overlap, such as 3-syndrome schemas (Liddle, Gruzelier), with gender important (Flor-Henry), and which allows for a unitary psychosis model (Gruzelier, 2002). Much of this century-long trajectory of research and scholarship was shelved when with the potential of fMRI considerations of convenience prevailed in the search for sufficient patients to scan, usually a small number because of financial constraints. Turning to pharmacotherapy, 'one size does not fit all' manifestly. Thus for neurotherapy protocols will be outlined likely to facilitate degrees of improvement according to presenting symptoms; contrary to received wisdom that schizophrenia involved a

subclinical attention deficit (Steinhauer, Gruzelier, Zubin, 1991), schizophrenic patients with active symptoms could control brain rhythms (Gruzelier et al, 1999). I am open minded about the nihilistic premise of a defect state (though life-time neuroleptics may lead to irreversible side-effects), bearing in mind M.Bleuler's documenting that when fire broke out, life-long institutionalised patients responded with initiative and adaptive behavior.

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What is unique and common in physiology of schizophrenia and ADHD: the ERP study.

Kropotov Juri D.

Director of laboratory of the Institute of the Human Brain of Russian Academy of Sciences, St. Petersburg, Russia.
Professor II of Norwegian University of Science and Technology, Trondheim, Norway

The study was focused on assessment of functional organization of the human brain in the process of action selection in three groups of subjects: healthy controls, ADHD and schizophrenic patients of the same age. 19-channel Event Related Potentials (ERPs) were recorded in the cued visual GO/NOGO task. 100 healthy subjects, 100 patients with ADHD (taken from the HBI reference database) and 100 schizophrenic patients (recorded in the psychiatric clinic of the Institute of the Human Brain of Russian Academy of Sciences) participated in the study. They performed a cued visual GO/NOGO task. The application of Independent Component Analysis to the collection of ERPs produced several independent components. Each of the components was characterized by spatial distribution and temporal activation course. The components were associated with different psychological operations such processing in dorsal and ventral visual streams, sensory mismatch, action suppression and conflict monitoring operations. The action suppression component (generated in the supplementary motor cortex) was shown to be reduced in the ADHD group and was almost completely absent in the schizophrenia group. The conflict monitoring component was moderately reduced in ADHD and schizophrenia groups, whereas the sensory related independent components remained practically the same in the three groups. The data are discussed in terms of the theory of action selection (Kropotov, 1989, 2009). In the final part of the paper a methodology for constructing protocols of tDCS on the basis of comparison the individual ERP parameters with the reference data (HBI reference data base) will be presented. Recently developed methods of neurotherapy such as sLORETA-based, ERP-based neurofeedback and local source tDCS will be also introduced.

Schizophrenia and the Efficacy of qEEG-Guided Neurofeedback Treatment: A Clinical Case Series

Tanju Sürmeli, Ayben Ertem, Emin Eralp, Ismet H. Kos

Living Health Center for Research and Education Gazeteciler Mah. Saglam Fikir Sokak, No: 17 Esentepe Sisli, Istanbul 34387 Turkey

Introduction: Schizophrenia is sometimes considered one of the most devastating of mental illnesses because its onset is early in a patient's life and its symptoms can be destructive to the patient, the family and friends. Schizophrenia affects 1 in a 100 people at some point during their lives, and while there is no cure, it is treatable with antipsychotic medications. According to the Clinical Antipsychotic Trials for Interventions Effectiveness (CATIE) about 74 % of the patients who have discontinued the first medication prescribed within a year will have a relapse afterwards. This shows an enormous need for developing better treatment methods and better ways to manage the disease, since current therapies do not have sufficient impact on negative symptoms, cognitive dysfunction, and compliance to treatment. In this clinical case series we investigate the efficacy of QEEG Guided Neurofeedback (NF) treatment in this population, and whether this method has an effect on these patients, and its effect on concurrent medical treatment.
Method: Fifty two (53) subjects ranging 17-54 years old (mean: 29.93y, SD: 8.10y) were included. Most of the subjects were previously diagnosed with chronic schizophrenia, and their symptoms did not improve with medication. All 53 patients (25 Male, 28 Female) were evaluated using QEEG, which was recorded at baseline and following treatment. Before recording the QEEG all medications were discontinued and the subjects were washed out for up to 7 half lives of the medication they were on. Recorded QEEGs were analyzed using Nx-Link Neurometric analysis, which suggested a diagnosis of chronic schizophrenia for all the subjects tested. This was consistent with the clinical judgment of the author. The subjects' symptoms were assessed by means of the Positive and Negative Syndrome Scale (PANSS). Besides the PANSS, 34 out of 52 subjects were also evaluated by the Minnesota Multiphasic Personality Inventory (MMPI) and 34 were also administered the Test of Variables of Attention (TOVA), both at baseline and following treatment. Each subject was prescribed a NF treatment protocol based on their QEEG Neurometric analysis results. Each NF session was of 30 minutes duration, with 1-2 sessions administered per day. Changes in the PANSS, MMPI and TOVA measures were analyzed to evaluate the effectiveness of NF treatment. The mean number of sessions completed by the subjects was 117 sessions within 48 days to 192 days.
Results: Forty-nine (49) out of 50 schizophrenic subjects showed clinical improvement after neurofeedback treatment, based on changes in their PANSS scores. The subjects who were able to take the MMPI and the TOVA showed significant improvements on these measures as well. Three (3) out of 53 patients dropped out of treatment between 40 and 80 sessions of NF treatment and 1 out of 53 did not show response. Forty-four (44) of the subjects in this study were followed up for more than 22 months, 2 were followed for 1 year, 1 was followed for 9 months and 3 were followed for between 1 and 3 months after completion of their NF treatment. Overall NF treatment was shown to be effective in this group of subjects studied. This study provides the first evidence for positive effects of neurofeedback treatment on clinical outcome measures in schizophrenia. The results of this study encourage further research. The goal of this study was to foster further controlled studies in this methodology.

Why do people hallucinate?

Peter Woodruff, Michael Hunter and Iain Wilkinson

Background: The propensity to hallucinate represents a natural characteristic of the human brain. Hallucinations occur in health under specific conditions of waking or falling asleep. Rarely, however, do hallucinations predominate and intrude on conscious awareness except in severe neuropsychiatric conditions such as schizophrenia. In these clinical conditions, hallucinations are distressing and a significant cause of suicide. Hence, an accurate understanding of their mechanisms is important in the effort to alleviate the distress of hallucinating. Neuroimaging allows us to identify the key neural components that form the basis for psychotic experiences such as hallucinations. Investigations using structural and functional neuroimaging techniques have identified regions of cerebral cortex central to the genesis of hallucinations. Auditory verbal hallucinations, for example, involve activity in auditory and language regions. However, so far, the evidence falls short of a definitive model that explains why auditory hallucinations are perceived in the absence of an external auditory stimulus. Hence the objective is to develop a perceptual model for the genesis of auditory hallucinations that can be tested and improved.

Methods: I will review relevant studies, including some from myself and colleagues in SCANLab., that use functional magnetic resonance imaging. These studies examine 'spontaneous' activity of auditory cortex as well as between-condition contrasts using Statistical Parametric Mapping in those individuals with and without a tendency to hallucinate.
Results: A series of neuroimaging studies help us build up a workable neural model that helps explain the pathogenesis of auditory hallucinations. Within this model is a description of component perceptual processes that lead to an individual's perception of auditory hallucinations as real auditory events in the absence of external auditory signals.
Conclusion: Auditory hallucinations are perceived as real mental events that engage specific 'perceptual modules'.

SLEEP: BASICS AND BEYOND
[FRI 9:40-11:50 DOCK SIX HALL]

Organisers:
Aisha Cortoos & Andreas Ioannides

Sleep and Neurofeedback share sensitivity to frequency and localization of brain function. They can be thought as the best exemplars of how changes in frequency of activation in specific brain regions lead to profound changes in behaviour. Sleep and Neurofeedback can also be thought as opposite from a different perspective. On one side sleep (under normal conditions) is a natural process that repeats regularly every day with a distinct succession of stages that are characterized by a specificity in regional activation and the frequency content of these activations. On the opposite side, neurofeedback is an attempt to train the brain out of persistent mode where one or more brain regions are engaged in excessive or below normal requirement activity in specific frequency bands that are specific to each individual. The symposium will start with Prof. George K. Kostopoulos presentation of the sleep's macro- and micro- and dynamic structure, as this is emerging from recent studies with EEG and MEG. While the first talk will deal with sleep by normal subjects under normal conditions, the lecture by Prof. Nathalie Pattyn will introduce how sleep is modified under the taxing conditions of summer Antarctic expeditions and continuous exposure to bright light. The third lecture by Prof. Aisha Cortoos will move the spotlight to the study of a group of insomnia patients. The results from this study suggest that a deficit in de-arousal is more likely to be causing insomnia in the group of patients study rather than conditioned hyperarousal. Finally, Prof. Ioannides will draw on recent results from both neurofeedback and sleep to highlight how the underlying neuronal networks are manifested in each case, and possibly how results from one set of investigations may provide valuable clues in the other.

Sleep's macro-, micro- and dynamic structure

George K. Kostopoulos MD, PhD
Medical School, University of Patras

Sleep research faces two fundamental questions: (a) how we loose consciousness and (b) why we sleep, i.e. what is the role of particular elements of sleep microstructure. Studies of sleep microstructure (Kokkinos and Kostopoulos, 2011; Kokkinos et al., 2011) show that loss and regain of consciousness is continuously debated with tens of desynchronizing micro-arousals during each night, which are too short to fully wake us up. More numerous are the synchronizing micro-arousals appearing mainly as K-complexes (KCs). The presumably hypnagogic spindles are invariably stopped for the duration of a KC (about half a second) and are usually replaced by a short oscillation advancing from the upper theta to the lower alpha band. Upon termination of the KC spindles are usually elicited which invariably are of higher frequency (~ 16 Hz).

This sequence of robust EEG changes may be reflect a mechanism for evaluation of the saliency and risk bearing of arousing stimuli followed by hypnagogic synchronization. Studying "quiet" EEG periods (devoid of any phasic events) in both nonREM and REM sleep with MEG derived Magnetic Field Tomography (MFT) we revealed (Ioannides et al., 2004; 2009) distributed patterns of cortical and subcortical brain activations/deactivations at the mm and msec scale which can independently distinguish the sleep stages and provide clues for the mechanisms underlying sleep and dream phenomenology. We observed a robust higher than awake gamma band activation (> 25 Hz, indicative of cognition) in deep nonREM sleep. This activation was observed in dorsal medial prefrontal cortex of the left hemisphere to gradually increase from nonREM stage 2 to 3 and finally to maximize and spread laterally in REM sleep. A parallel increase was observed in precuneous. These two areas are in very close proximity to two areas of possible importance to dream content: the "default system" and the "theory of mind system". The demonstration of activity able to support cognition in the deepest nonREM sleep may be relevant to the mentation/dreams during that period. Furthermore the MFT derived images and connectivity studies revealed rich interactivity leading to or following the onset of rapid eye movements (REM). We identified an orbitofrontal-amygdalo-parahippocampal-pontine sequence of activity about 100 msec leading to the REM. This sequence testifies to the emotional activation during REM sleep. In combination, the above EEG and MEG studies demonstrate very rich dynamics in time and brain space, which suggest that in NonREM sleep consciousness is not lost because of loss of wealth of information processing, but because of loss of brain specific connectivity needed for integration.

Segregation of function in space, time and frequency in awake state and sleep: recent results and their possible relationship to Neurofeedback

Andreas A. Ioannides

Laboratory for Human brain Dynamics, AAI Scientific Cultural Services Ltd.,

Functional specialization, one of the few principles of modern neuroscience, rests on two pillars. Segregation of function is the first pillar and it is demonstrated by numerous fMRI studies, and supported by the parcellation of the brain into areas according to cytoarchitectonic and neurotransmitter receptor density criteria. The second pillar of functional specialization is the integration of activity in different areas giving rise to perception and consciousness. While the first pillar emphasizes static aspects of brain organization, the second emphasizes dynamics. Functional specialization offers many options as can be seen in the ensemble of single trial activations evoked by stimuli both at the neuron and regional levels in health and disease and involves a wide range of timescales. Events at the shorter timescales (~ milliseconds) do not usually reach conscious awareness. For the longer timescales (minutes to hours) changes of state dominate. Correlates of functional specialization can be extracted over much of the different timescales through frequency analysis of mass electrical activity. This analysis reveals a remarkable frequency specificity that can be seen in the EEG changes across different sleep stages that happen automatically every evening or even in the more simple scenario of keeping our eyes open or closed. Our tomographic analysis of MEG signals during sleep has demonstrated that the frequency specificity has distinct spatial distribution in each sleep stage. This has been recently confirmed by other methods. Brain rhythms characterize different systems in the resting brain: the Default System, the Theory of Mind (ToM) system and what can be thought of as their opposite the attentional system. Each of these neural network is composed of distinct brain areas, it operates best in specific frequencies and often works antagonistically with others. In the end all networks must somehow cooperate for normal brain function to be possible. It is easy to see how undue dominance or weakness of one or other neuronal network might lead to problems. It is then plausible to consider addressing such problems through neurofeedback: by teaching the brain how to emphasize or de-emphasize activity in specific frequency bands captured by well-placed EEG electrodes. The development of methods for "real-time scanning" of the awake and especially sleeping brain offers powerful, yet admittedly demanding ways of

grounding neurofeedback methods to basic neurophysiology through detailed exploration of the role of brain rhythms.

Sleep and Fatigue: Lessons from Antarctica

Pattyn Nathalie[1, 2], Cortoos Aisha[2,3], Olivier Mairesse[2], Sandra Pirrera[1], De Valck Elke[1], Xavier Neyt[2], Pierre-François Migeotte[2], Cluydts Raymond[1],

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The present investigation was conducted during two Antarctic summer expeditions, the BELARE (Belgian Antarctic Research Expedition) campaigns 2007-2008 and 2008-2009. 8 subjects were investigated in the first expedition. 22 subjects participated during the second campaign. Data were collected every 2 weeks for each subject in the first campaign, once or twice per subject in the second campaign. These included 48 hrs actigraphy, one night polysomnography, morning and evening Profile of Mood States and Karolinska Sleepiness Scale, morning Psychomotor Vigilance Test. Morning and evening saliva samples were taken to determine melatonin levels. Circadian rhythms profiles were determined with one 18 h cortisol sampling. First year data showed poor sleep efficiency and high sleep fragmentation, in concordance with participants' subjective evaluations. Furthermore, there was a strong correlation between sleep efficiency and active energy expenditure (Pearson's $r = 0,63$; $p = 0,015$), as well as a strong relationship between active energy expenditure and sleep fractionation. Second year polsysomnography results showed, in addition to high sleep fragmentation, both subjective and objective, a dramatic decrease in slow wave sleep and an increase in REM sleep. Cortisol rhythmicity was preserved, and remarkably synchronized among participants. Melatonin secretion however, showed a severe phase delay. There was a severe decrease in performance, as assessed through the PVT, but no effect whatsoever on mood. Results from the first campaign confirmed both our hypotheses, namely the lower sleep quality (lower efficiency and higher fractionation) during the expedition and the relationship between sleep quality and active energy expenditure. Data from the second campaign showed a desynchronisation between cortisol and melatonin secretion, which is hypothesized to explain the decrease in slow wave sleep, a severe effect on performance, compatible with the effect of sleep deprivation, and no effect on mood, which is hypothesized to be ascribable to the effect of continuous bright light exposure. These findings, and mainly the dissociation between fatigue and sleepiness as well as the effect of exercise, are discussed in the frame of potential countermeasures for fatigue.

The concept of cortical de-arousal in insomnia

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Introduction: The neurocognitive perspective on insomnia posits that conditioned hyperarousal is reflected by increased high frequency EEG activity resulting in impairment of information processing, and, as such, interfering with normal sleep onset and –maintenance processes. The presence of cortical hyperarousal can be evaluated in different ways going from the analysis of the electroencephalogram (EEG) during wake as well as sleep time, specific event-related potentials (ERP's) and even the analysis of the Cyclic Alternating Pattern (CAP) which is thought to reflect the stability of sleep. The aim of this study was to

evaluate the presence of cortical hyperarousal at different time points (during wake versus sleep) and levels, using the above techniques.
Method: 17 insomnia patients diagnosed according to DSM-IV criteria with polysomnographically verified sleep disruptions and 12 good sleepers were included in this study. A wake EEG and an ERP paradigm were performed. After standard sleep scoring, FFT and CAP analysis were performed. Delta (1-3.5 Hz), theta (4-7.5 Hz), alpha (8-12 Hz), beta1 (SMR: 12-15 Hz), beta2 (15-17.5 Hz), beta3 (18-25 Hz), and high beta (25.5-30 Hz) were the outcome variables for the FFT analysis. Furthermore, N100 and P200 mean amplitudes at Fz and Cz were analyzed as a measure of respectively general arousability and inhibition of information processing. Finally, CAP time and CAP rate were used as a measure of sleep stability.
Results: Indications of cortical arousal in the EEG were only present during the sleep onset period, reflected by a stable alpha EEG level and slower increase of delta power. In addition, decreased P200 amplitudes, but no significant differences in N100 amplitudes were observed in the evening. Finally, increased CAP time and CAP rate were found in insomnia patients compared to good sleepers.
Conclusion: These results suggest that our group of insomnia patients was not characterized by cortical hyperarousal, rather a deficit in de-arousal was observed. Indeed, decreased P200 amplitudes in combination with a lack of increased N100 suggests an impairment of inhibitory processing rather than increased arousal. The phenomenon of impaired de-arousal continues during sleep onset, as a delay in delta EEG activity in combination with the absence of a decrease in alpha EEG activity and a normal level of beta activity was observed. Finally, no significant difference in the sleep EEG was observed.

NEW METHODOLOGY
[SAT 9:50-11:05 TIMBER HALL A]

Organiser:
John Gruzelier

sLORETA Feedback in Chronic Pain

Leslie Sherlin

Since the first study in Low Resolution Electromagnetic Tomography feedback in 2004 (Congedo, Lubar & Joffe), there have been a number of studies investigating the application to a variety of populations. Recent studies have investigated memory, addictions, attention and even chronic pain (Cannon, 2005, Cannon, 2006, Ozier et. al, submitted). This brief presentation will introduce the neuromodulatory approach for chronic pain along with the clinical outcomes of the sLORETA feedback study recently completed.

References:

1. Cannon, R., Lubar, J., Thornton, K., Wilson, S., & Congedo, M. (2005). Limbic beta activation and LORETA: Can hippocampal and related limbic activity be recorded and changes visualized using LORETA in an affective memory condition? Journal of Neurotherapy, 8(4), 5-24. doi:10.1300/J184v08n04_02

2. Cannon, R., Lubar, J., Gerke, A., Thornton, K., Hutchens, T., & McCammon, V. (2006). EEG spectral-power and coherence: LORETA neurofeedback training in the anterior cingulate gyrus. Journal of Neurotherapy, 10(1), 5-31.

Loreta Neurofeedback - First Clinical Results

Susanne Schmid
Schoresch Kompetenzzentrum fuer Neurofeedback, Switzerland

This presentation reviews the first results of sLoreta based Neurofeedback (LNFB) in clinical applications in a neurofeedback practice in Switzerland. Patients were trained with 1-, 2- or 4-channel NFB with BioExplorer and had additional LNFB training on the anterior cingulate and BA 41 for tinnitus. We analysed the efficacy of LNFB while training on the anterior cingulate (BA 32) as a region that receives inputs from several sensory areas and which therefore plays a critical role in information processing, modulation of attention, executive functions, emotional control and monitoring (error detection). In addition to BA 32, patients with tinnitus were trained on primary auditory cortex BA 41. A 19 channel EEG was recorded during LNFB with Mitsar and Braintuner Software. All subjects had a QEEG at the beginning of their therapy. We compared QEEG data from the LNFB training sessions with the data from the QEEG at the beginning of therapy. Subjects: a)12-year-old boy with increased theta in frontal-central cortex, b)14-year-old boy with increased frontal midline theta, c)14-year-old boy with alpha-excess in central (mu rhythms) and parietal regions, d)57-year-old male with depression, alpha-excess over whole cortex and alpha-asymmetry, e)42-year-old female with tinnitus. Results showed a significant reduction in theta activity in subjects a) and b) and also in alpha-activity in subjects c) and d). Subject e) reported that tinnitus decreased significantly.In conclusion LNFB seems to be a very effective way for neurofeedback training. The EEG patterns showed significant changes although the training time was much shorter than in conventional neurofeedback. This makes LNFB practicable for clinical applications. The additional time needed for the montage of the full cap is counterbalanced by the shorter training time.

Online detection of error potentials increases information throughput in a brain-computer interface

Nico Schmidt, Benjamin Blankertz and Matthias Sebastian Treder
Berlin Institute of Technology, Germany

Overview. The primary task of research into brain-computer interfaces (BCIs) is to restore motor behavior and enable communication in patients with neuromuscular disorders. A major limitation of present-day BCIs is its low information throughput. Despite significant robustification of BCIs in the past decade, higher speed usually comes at the price of diminished accuracy. An alternative approach to increase information throughput is the classification of error potentials. Error potentials arise when an erroneous selection is presented to the user. The detection of error potentials speeds up communication because manual correction of an error is usually time consuming and can be prone to induce new errors.
Method. Eleven healthy participants (6 males and 5 females) used a mental typewriter called Center speller (Treder, Schmidt, & Blankertz, 2010) to spell short phrases. During the first phase of online spelling, no error potentials were detected but correct and erroneous trials were collected. Subsequently, a classifier was trained to detect error potentials and used during the second phase of the experiment. If an error potential was detected by the classifier, the selection of a symbol was vetoed and the trial was restarted.
Results. Relative to correct feedback, errors elicited a negativation at 200-300 ms after feedback presentation, followed by a prolonged positivation that is evident from about 350-800 ms. Detection of error potentials at a false alarm rate of 5-10% yielded a highly variable hit rate across participants, ranging from 40-95%. The mean AUC (area under the receiver operating curve) value for the error potential classifier was 0.89. Spelling speed amounted to 1.7 characters/minute without error classification and rose to 2.2 characters/minute when errors classification was used.
Conclusion. The presentation of erroneous feedback to the user is accompanied by a specific neural signature that can be detected by classifiers. In the present study, online detection of error potentials yielded an increase

of 30% in terms of information throughput. This demonstrates that the classification of error potentials can substantially boost the speed of BCI-based communication.

What is unique and common in physiology of schizophrenia and ADHD: the ERP study.

Kropotov Juri D.

Director of laboratory of the Institute of the Human Brain of Russian Academy of Sciences, St. Petersburg, Russia. Professor II of Norwegian University of Science and Technology, Trondheim, Norway

The study was focused on assessment of functional organization of the human brain in the process of action selection in three groups of subjects: healthy controls, ADHD and schizophrenic patients of the same age. 19-channel Event Related Potentials (ERPs) were recorded in the cued visual GO/NOGO task. 100 healthy subjects, 100 patients with ADHD (taken from the HBI reference database) and 100 schizophrenic patients (recorded in the psychiatric clinic of the Institute of the Human Brain of Russian Academy of Sciences) participated in the study. They performed a cued visual GO/NOGO task. The application of Independent Component Analysis to the collection of ERPs produced several independent components. Each of the components was characterized by spatial distribution and temporal activation course. The components were associated with different psychological operations such processing in dorsal and ventral visual streams, sensory mismatch, action suppression and conflict monitoring operations. The action suppression component (generated in the supplementary motor cortex) was shown to be reduced in the ADHD group and was almost completely absent in the schizophrenia group. The conflict monitoring component was moderately reduced in ADHD and schizophrenia groups, whereas the sensory related independent components remained practically the same in the three groups. The data are discussed in terms of the theory of action selection (Kropotov, 1989, 2009). In the final part of the paper a methodology for constructing protocols of tDCS on the basis of comparison the individual ERP parameters with the reference data (HBI reference data base) will be presented. Recently developed methods of neurotherapy such as sLORETA-based, ERP-based neurofeedback and local source tDCS will be also introduced.

APPROACHING EXECUTIVE FUNCTION DEFICITS IN CHILD AND ADOLESCENCE DEPRESSION. CLINICAL NEUROPSYCHOLOGICAL STUDIES IN ASSESSMENT, DIAGNOSIS AND REHABILITATION [SAT 9:50-11:05 TIMBER HALL B]

Organisers:

Argyris V. Karapetsas, Georgia Andreou, Nikos C. Zygouris

Emotional disorders are among the most common psychological diagnoses in both children and adolescents. It is a well established fact that this type of disorder is associated with major impairment in childhood and adverse consequences in later life. Epidemiological studies show that rates of depressive disorder in young people are higher (3-8%) and most severe to females than in children (1-3%) for both genders. The essential feature of depression is either impaired mood or the loss of interest and pleasure. The DSM – IV also describes depressed individuals as irritable and/or anxious (American Psychiatric Association, 1994). Persons experiencing depression often have significant social and interpersonal difficulties, problems with sexual functioning and impairments in executive functions. Neuropsychology research provides

a useful framework to study emotional disorders. Specifically, neuropsychologists have the ability to use instruments that measure mood (Children's Depression Inventory) as well as a wide variety of cognitive, emotional and expressive abilities. Neuropsychologists are also frequently trained to assess physiological parameters within the Central Nervous System (Event Related Potentials) and nowadays by using the principals of electromagnetic induction of an electric field in the brain can cause neurostimulation and neuromodulation (Transcranial Magnetic Stimulation) that can offer a new rehabilitation method.

Neuropsychological approach of depression.

Argyris V. Karapetsas

Professor of Neuropsychology – Neurolinguistics, Director of Neuropsychology laboratory, University of Thessaly.

Depression is characterized by prolonged, involuntary, emotion processing that may be due to deficits in frontal lobe functioning. Neurobiological models of major depression point to brain regions that are thought to be involved with emotion regulation. Although brain regions that play an important role in depression are related to cognitive functions only in recent years research has focused on the association between cognition and depression. The dorsolateral prefrontal (DLPFC) cortex is thought to be associated with goal – directed behavior. This is because the DLPFC is involved in higher order cognitive abilities. As more knowledge emerged from cognitive and behavioral neuropsychology, it gradually becomes apparent that executive functions such as attention, memory, categorization and decision making could not be properly understood without taking into consideration emotional influence on these processes (Levine, 2009). Furthermore, it has been suggested that activity in the left frontal lobe is generally associated with approach – related goals whereas activity in the right is associated with withdrawal goals. Evidence of hypoactivation in the left frontal lobe in individuals diagnosed with depression suggests a deficit in this region, which has been interpreted as being related to reduction in the ability of depressed children to experience pleasure or have appetitive goals. However, these brain regions play an important role in cognitive functions, such as language understanding. Resent evoked potential studies, for instance, suggest that amygdala and different parts of the cortex and thalamus process emotional versus non emotional stimuli. These results have uncovered subtle interactions between emotion and attention. Moreover, the interaction of prefrontal executive regions and subcortical areas (basal ganglia, thalamus and amygdala) are important not only for attention but also for decision making. This is a cognitive process wherein emotional involvement tends to be particular significant. Lastly, it is well known that amygdala is a brain region that is involved in memory. For instance, the types of episodic details tied to amygdala engagement may be those that are most important for creating a subjectively vivid memory. In our first paper the aim is to review all clinical neuropsychological theories that describe the neural networks in order to understand the reason why children and adolescence have low academic performance.

References:

1. Levine, D.S.(2009). Brain Pathways for cognitive – emotional decision making in human animal. *Neural Networks,* 22, 286 – 293.

Language impairments of the depressive brain

Georgia Andreou

Associate Professor of Linguistics, University of Thessaly.

Psycholinguistic theories have been profoundly influenced by the study of language capabilities of aphasic patients. Broca's work in the nineteenth century has been interpreted to indicate that left hemisphere exercises exclusive control over language production and comprehension or at least that the preponderance of language processing activity occurs in that hemisphere. Nowadays the neuropsychological methodology in studying hemispheric differences in language processing suggests that the right hemisphere develops its one robust vocabulary, some syntax and fairly "normal" language comprehension capabilities. However, the left hemisphere utilizes a controlled, attention driven process of meaning activation and selection, while the right hemisphere facilitates activation of numerous possible alternative word meanings thought a more passive spreading of activation. There are several studies suggesting that depressive patients have relatively less activity in left hemisphere. Moreover, this hypoactivation is displayed in left frontal lobe, a brain area that plays an important role in language understanding. Also, certain language tasks have been shown to activate brain regions that are damaged because of depression's neurobiological deficits. For instance, such regions as the inferior frontal gyrus and dorsolateral prefrontal cortex, brain regions that are responsible for verbal fluency. The aim of this paper is to present language deficits in depressive population because of dysfunctional hemispheric asymmetries and because of impairments that are caused from depression in brain regions that are thought to be involved with language processing.

Event Related Potentials in depressed children and adolescents. Prolonged P300 latency and abnormal brain asymmetry.

Nikos C. Zygouris

Dr. Clinical Neuropsychology, Neuropsychology Laboratory, University of Thessaly.

Depression in children and adolescents is a new research field combined with the use of objective electrophysiological methods. The current study aims at investigating the cognitive processes in depressed children. More specifically, P300 waveform was used in order to assess the executive functions of depressed children and compare them with their equal control group. Event Related Potentials (ERPs) are a time locked measure of electrical activity of the cerebral surface, representing a distinct phase of cortical processing. P300 waveform is a positive peak usually occurring approximately 300 ms post – stimulus. In this study the late ERP component was recorded in 16 children (8 male/ 8 female) with depression and 16 children (8 male/8 female) of the same age group (mean average 12 years) that participated in the control group. All 32 children were assessed using the Children's Depression Inventory (Kovacs, 1985), neuropsychological assessment of handedness and clinical interview in order to exclude psychopathological disorders apart from depression in the experimental group (Karapetsas & Zygouris, 2007). The EEG was recorded from 15 electrode sites (Fp_1, Fpz, Fp_2, F_3, Fz, F_4, F_7, F_8, C_3, Cz, C_4, P_3, Pz, P_4, Oz) according to the 10 – 20 International System (Jasper, 1958), plus 2 reference electrodes at the mastoids of each ear and one ground electrode at the Nz(nose) site. The control group had high significant smaller ($p<0.001$) latencies in P300 waveform of Event Related Potentials in all brain regions. Furthermore, children with depression had smaller P300 latencies and amplitudes in right brain lobes than in left side ones. This suggestion is based in a two – sample t – test that was done between the left and the right hemispheric regions. In addition, children with depression presented larger reaction time in a behavioural task. Children with depression responded at the acoustic stimuli in 429.72ms (±90.62) and children that participated at the control group 335.08 (±43.55) $p<0.05$. These findings suggest that depressed children apart from emotional disorders have to cope with executive function deficits.

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2. Jasper, H.H.(1958).The ten-twenty electrode system of the International Federation. *Electroencephalography and Clinical Neurophysiology*, 10, 371-375.
3. Karapetsas, A.V., Zygouris, N.C.(2007) Effects of nicotine on the performance of memory and on the electrophysiological modulation of P300, *Psychology (special issue dedicated to neuropsychology)*, 14 (2) 127 – 142.

The effects of slow and fast rTMS of the Dorsolateral Prefrontal Cortex (DLPFC) in Depression and neurophysiological predictors of treatment outcome

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2. *Utrecht University, Department of Experimental Psychology*
3. *Janssen Research & Development, Beerse, Belgium*

The application of rTMS in Depression has been investigated intensively over the last years. Several meta-analysis have demonstrated that compared to placebo the effects of fast rTMS (>5 Hz) to the left DLPFC has antidepressant effects (ES: 0.39; Schutter, 2009) and that slow rTMS (> 1 Hz) over the right DLPFC also has antidepressant effects (ES: 0.63; Schutter 2010). Given that previous studies have all employed double-blind placebo controlled studies and investigated the effects or rTMS as a mono-treatment, in this study we investigated the effects of fast and slow rTMS in Depression combined with psychotherapy in an open-label study in clinical practice.

Ninety patients with a primary diagnosis of depression or dysthymia were included in this study. All subjects underwent neurophysiological testing before treatment (Eyes Open and Eyes Closed EEG, Oddball ERP) and several rating scales were assessed. The BDI was used to assess response to treatment. Thirty-three patients received slow rTMS over the right DLPFC (1 Hz) and 57 patients received fast rTMS over the left DLPFC (10 Hz). The results demonstrated that 79,9% of all patients could be considered a responder (remission or >50% decrease in BDI score) to treatment after on average 20.56 sessions (responders). On average there was a 77.2% decrease in depressive symptoms after treatment (BDI) and the within subject Hedges' D ES=1.72. There was no significant difference (p=.862; F=1.477; df=1, 88) for response rates between fast rTMS (76,8%) and slow rTMS (81,8%). For 39 responders >6 month follow-up data were available demonstrating that after 6 months 61,5% of these responders could still be classified a responder. These long-term effects are likely to be mainly due to the combination of rTMS with psychotherapy, since the results of rTMS have often been found to last 3-6 months. EEG and ERP predictors for treatment response of this whole sample are currently being further analyzed and these results will be reported.

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Oral Presentations

Schizophrenia – Autism
[THU 2:25-3:40 TIMBER HALL A]

Effective connectivity of language circuitry in schizophrenia patients with auditory hallucinations

Branislava Curcic-Blake[1], Edith Liemburg[1], Ans Vercammen[2], Marte Swart[1], Rikus Knegtering[3], Richard Bruggeman[1] and Andre Aleman[1]

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2. *Neuroscience Research Australia,Australia*
3. *Lentis, Netherlands*

Auditory-verbal hallucinations or "hearing voices" are a characteristic symptom of schizophrenia. Neuroimaging studies of such hallucinations have consistently revealed activation of left superior temporal gyrus (including temporoparietal junction, or Wernicke's area) during hallucinations1. In addition a number of studies has implied activation of left inferior frontal gyrus (including Broca's area) and its homologue (i.e. corresponding area in the right hemisphere) and the right temporal cortex. These studies did not investigate connectivity, however. It has been hypothesized that a disconnection of frontal and temporal areas may underlie hallucinations in schizophrenia2. Here, we test this hypothesis for the first time using dynamic causal modelling. Of specific interest is also the role of the right inferior frontal gyrus (i.e. Broca's homologue) which was shown to be overactive in the largest fMRI study of hallucinations to date. This area may show reduced connectivity with Broca's area, thereby hampering adequate speech monitoring.
Eighteen healthy subjects and 36 schizophrenia in- or out-patients participated in the study. The diagnosis was confirmed by the Schedules for Clinical Assessment in Neuropsychiatry (SCAN 2.1) interview3. The severity of symptoms was determined by the Positive and Negative Syndrome Scale (PANSS) interview4. The patients were divided into two groups according to the hallucination item (P3) of the PANSS, the first consisting of those with Auditory Verbal Hallucinations (AVH) – scoring above 3, and the second comprised of those without AVH (NoAVH) – scoring up to 2. During an fMRI scan the patients performed a metrical stress evaluation task presented in a block design with two conditions and a baseline (fixation cross). During the relevant condition ('phonological'), which initiates phonological processing of imagined speech5, the subjects had to decide if the metrical stress was at the first or at the second syllable, and to confirm their choice by pressing a button. Four dynamic causal models6 (DCM) were created between Broca's (B) and Wernicke's (W) region and their homologues (BH and WH) in the right hemisphere to probe the strengths of interhemispheric influence. Bayesian model selection (BMS) was combined with Bayesian model averaging (BMA) to estimate the posterior distributions of connectivity parameters for each group. The difference between groups was evaluated by a bootstrapping procedure (10000 random sample differences). For the

comparison of parameters, the connectivity strengths were randomly sampled from each group and then compared between groups. A distribution of parameter differences between groups was calculated. A significant difference (Table 1) in connectivity strengths was observed between healthy subjects (n=18) and AVH patients (n=22) for the connectivity from W to B (96% of differences were positive) and from BH to B (90%), with reduced connectivity in the hallucinating patients. All the connectivity strengths in healthy subjects were positive. The connectivity strengths in NoAVH patients (n=14) for the same connections were in between the two other groups, but not significantly different (84% and 70% respectively from the healthy group and 76% and 75% from the AVH group). Our results point towards a reduced connectivity between frontal and temporal language area's in schizophrenia patients with auditory-verbal hallucinations. A reduced control of Broca's area over Wernickes' area may lead to spurious activity in this area, consistent with overactivation observed in studies that measured BOLD signal changes during hallucinations. The reduced connectivity between Broca and its homologue may be associated with the emotional content of hallucinations, as the right IFG has been implied in emotional aspects of speech. A lack of synchronisation between both areas may lead to the erroneous interpretation of emotional speech activity from the right hemisphere as coming from an external source.

Pupil size, pupil responses during visual scanning and time spent on core features of faces in Autism Spectrum disorders

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Early recognition of autism spectrum disorder is an important challenge, because early treatments are more effective in helping children to develop adaptation skills, allowing them a better level of integration into society, and reducing the intensity of the condition and the level of handicap. The purpose of this investigation using eye-tracking technology was to determine whether baseline pupil size, pupil responses during visual scanning and time spent on core features of faces could discriminate children with Autism Spectrum Disorder (ASD) from mental age-matched and chronological age-matched controls. The study was performed using stimuli consisting of still color photographs presented centrally at the participant's midline on the stimulus monitor. Each child was presented with series of neutral faces, virtual faces (avatars) and objects, separated by black slides. Mean pupil size and pupil size changes over time were obtained for each of the three categories of stimuli and during the exposure to black slides. Time spent on core features of neutral faces (eyes + nose + mouth) was examined. Fifty seven children participated in analyses (19 ASD, mean age 118 months, 19 mental age-matched controls, mean age 87 months, 19 chronological age-matched controls, mean age 118 months).Baseline pupil size and pupil responses during visual scanning and time spent on core features of faces were compared between diagnostic groups. During the presentation of slides, the mean pupil size for the ASD group was clearly smaller than for the MA-matched and CA-matched groups. The children with ASD spent less time on faces in general and in particular focus less on the eye region than MA-matched and CA-matched groups. The discriminant analysis conducted on pupil size, pupil responses and time spent on core features of faces successfully predicted group membership for 93 %of the participants. Group membership classification yielded 84% correct classification for the ASD group, 89% for the MA-matched group and 100% for the CA-matched group. These potential biomarkers may advance our understanding of neurodevelopmental differences in the brain in autism and could be used as indicators of ASD.

Early coding in visual words processing in schizophrenic patients and healthy comparison subjects

Valeria Strelets, Zhanna Garakh and Irina Marina
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Successful linguistic process requires effective coding of consequently arising signals on the sensory entrance in the time restriction conditions. Critical characteristics of schizophrenic patients is the time disintegration of mental activity, clinically being manifested as loss of internal, "psychic" unity. The work is aimed at the study of early coding in visual words processing using Evoked Potentials (EP) method to words/non-words stimuli. EPs were recorded from 19 derivations in the group of norm (30 subjects) and schizophrenics (32 patients with the first episode and predominance of positive symptoms) to 40 words and 40 non-words, presented randomly while no instructions were given to participants (passive perception). EPs early components P100 and N170 latency in patients appeared to be shorter than in the norm in some TPO (temporalis, parietalis, occipitalis) areas. P100 latency in patients was shorter in P3 area, while N170 latency – in P3, P4, O1 and O2 areas. The latency of N170 in the norm was significantly longer to words than to non-words and in patients – vice versa. The latency of N170 in all TPO areas was equal in the norm during words processing and this equality was disturbed during non-words processing. In patients the equality was disturbed but, opposite to the norm, the disturbances of equality were more expressed during words processing. Thus, the early stage of verbal information processing in schizophrenic patients is insufficient in time, this time deficit leading to defective processing of semantic information. The data also cast light on other cognitive disturbances in schizophrenia linked to visual word processing.

Affective Neuroscience
[THU 2:25-3:40 TIMBER HALL B]

Do I like what I am watching in TV?

G. Vecchiato[1,2], J. Toppi[3], L. Astolfi[1,3], F. De Vico Fallani[1,2], Francesco Bez [2], F. Cincotti[2], D.Mattia[2] and F. Babiloni[1,2]

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Nowadays, researchers are attempting to investigate the signs of the brain activity correlated with an increase of attention, memory and emotional engagement during the observation of commercial ads (Langleben et al., 2009; Vecchiato et al., 2010). This interest is justified by the possibility to correlate the particular brain activations observed with the characteristics of the proposed commercial ads in order to derive conclusions about the adequacy of such stimuli which should be emotionally engaging for the consumer. Indirect variables of emotional processing could be gathered by tracking variations of the activity of specific anatomical structures linked to the emotional processing activity in humans, such as the pre- and frontal cortex (PFC and FC respectively; Davidson and Irwin, 1999). Specifically, findings suggest that the left (right) PFC is an important brain area in a widespread circuit that mediates appetitive approach (defensive withdrawal) (Davidson, 2000, 2004). In particular, we aimed at investigating the existence of EEG frontal asymmetries in the distribution of the signals' power spectra related to experienced pleasantness of the video, as explicitly rated by the eleven experimental subjects. Maps of Power Spectral Density (PSD) showed an asymmetrical increase of theta and alpha activity related to the observation of pleasant (unpleasant) advertisements in the left (right) hemisphere. A correlation analysis revealed that the increase of PSD at left frontal sites is negatively correlated with the degree of pleasantness perceived. Conversely, the de-synchronization of left alpha frontal activity is positively correlated with judgments of high pleasantness.

Moreover, our data presented an increase of PSD related to the observation of unpleasant commercials, which resulted higher with respect to the one elicited by pleasant advertisements. In conclusion, we found out that there exists a frontal EEG asymmetry elicited by the observation of pleasant TV commercials. In particular there is a stronger activation in the left hemisphere related to pleasant ads and, conversely, an enhance of spectral power associated to unpleasant ads. Moreover, we may also affirm that the degree of the perceived pleasantness linearly correlates with the unbalance of the EEG power spectra estimated between selected right and left scalp sites.

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EEG correlates of musical harmony perception: frontal theta increase is greater for consonant than for dissonant chords

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While it is quite well established that there are musical harmony perception mechanisms working on a largely preconscious level, the cortical correlates of harmony perception are yet to be studied.

The study was aimed at exploring EEG evoked response to listening to consonant and dissonant chords. 32-channel EEG was recorded while the participants (20 young healthy non-musicians) listened to randomly presented 5-note consonant and dissonant chords and rated them in terms of pleasantness and harmony. Event-related band power changes were calculated for delta, lower and upper theta, lower and upper alpha, and gamma frequency bands. The participants rated consonant chords as both significantly more pleasant and more harmonic than dissonant chords. The difference in event-related band power changes was most prominent for lower (4-6 Hz) and upper (6-8 Hz) theta bands over mediofrontal cortical regions, where consonances yielded a much greater power increase in 100-250 ms time window than dissonances. A hemispheric asymmetry was observed for lower theta over frontal regions revealing greater power increase for consonant than for dissonant chords over left frontal cortical areas. Results confirm that harmony perception occurs at relatively early stages of stimulus processing. The data can contribute to further understanding of frontal midline theta rhythm that has previously been linked to internalized attention and harmony-related positive emotions, and support the hypothesis that frontal lower theta asymmetries play an important role as a part of an early emotion recognition system.

Emotional Theory of Rationality

Mario Garcés

DAXNATUR, Spain

This article proposes a new functional theoretical framework that provides a better understanding of emotion-cognition duality. Based on an evolutional argumentation, this paper intends to go further into the knowledge about emotions, justifying their existence, explaining how they work and linking them to superior cognitive processes, mainly attention, intelligence, decision making and consciousness. This theory tries to make sense of many different problems, partial theories, experiments and observations in several brain and behavioural models. It also could have important implications for fields such as Psychology, Economy, Social Sciences, Education, Marketing, Management, among others. Beyond the theory it has been used as a theoretical foundation for applied training courses and seminars about emotional balance, resilience, mobbing prevention, and social and profesional relationship improvement in the workplace.

Neurological
[THU 2:25-3:40 DOCK SIX HALL]

A Novel Approach to Visual Prosthetics

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The leading non-infectious causes of blindness are diseases of the eye that deprive the individual of sight yet spare the remainder of the visual system. Restoration of sight for these patients is thought to be possible through visual prosthesis devices that electrically stimulate the early visual pathway. In this presentation, we review a system which targets the lateral geniculate nucleus of the thalamus (LGN), the relay station between the retina and visual cortex. To answer important questions about prosthesis utility, a virtual reality simulation has been developed for design exploration with sighted human subjects. We assessed the performance of potential designs using sighted human volunteers looking through a virtual reality simulator of thalamic prosthetic vision. Experiments based on the standard Snellen acuity task were conducted to address three issues: (1) what acuity is available for the range of phosphene counts anticipated in near-term thalamic designs, (2) how do acuities for centrally-weighted patterns expected from these designs compare against those for rectangular patterns from contemporary retinal designs, and (3) does task reaction time provide an understanding of perceptual modes in artificial vision? Results were as follows. (1) Centrally-weighted phosphene patterns had increasing acuity with increasing phosphene count, with 25 phosphenes in central vision for significant performance at 20/800 (Log MAR 1.6), through 370 phosphenes for 20/200 (Log MAR 1.0). (2) Centrally-weighted patterns provide significantly higher acuity than rectangular patterns for a given phosphene count. (3) Two perceptual regimes were identified base on reaction times, an identification mode at higher performance levels, and a pattern-matching mode at lower performance levels. We conclude that a reasonably small number of contacts can provide substantially useful vision, central patterns have significant advantages over rectangular ones, and post-implant therapy should include a specific emphasis on training pattern matching skills.

Bionic Eyeblink: A Preliminar

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Objectives - The idea of a bionic reanimation of a paralysed hemiface is not new (Tobey & Sutton, 1978) and the feasibility of a functional electrical stimulation of a paralysed hemiface has been assessed (Somnia et al., 2001; Kurita et al., 2010). We are also trying to design an implantable device that will electrically stimulate the paretic eyelid, when electrodes implanted into the contralateral orbicularis oculi muscle detect a normal blink activity. This device will prevent eye damage and severe facial disfiguration. To obtain a complete eyelid closure with the same cynematic of a natural blink, as a novelty a stimulation pattern including the dynamic response of motor units (Baldissera et al., 1998) was introduced.
Methods - Epicutaneous stimulation of the facial nerve branch for the orbicularis oculi muscle was performed on 10 healthy subjects. A dedicated LabView software built up and triggered the stimulation pattern. This was composed by a train of 10 pulses at a constant frequency (carrier frequency), in which the interval between the first and second stimulus had a frequency higher than the carrier itself (dynamic pulse). Muscle recruitment curves were studied and acceleration of the bionic blink was measured and compared to the natural one. The behavioral effect was recorded by a webcam and analysed.
Results - On the basis of biomechanics and behaviour, the best pattern of stimulation was custom-made for each subject. In average a good bionic blink was obtained when the carrier frequency was set at 200Hz, with a dynamic pulse at 250Hz.
Conclusions - By adding the dynamic pulse we were able to taylor a bionic blink, which was hardly distinguishable from the subject's natural one.

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Investigation of olfactory disorders : a new method based on eyes responses

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Olfactory disorders occurs in many pathologies and could be a valuable clue for the diagnosis of depression, Alzheimer's disease, Parkinson's disease, schizophrenia and autism. The current tools for detection of olfactory disorders involve active participation of the subject who has to select the correct name matching the odor in a list. But verbal ability may be impaired or unlearned in many patients and an alternative method is required. Based on the principle of multimodal convergence of primary sensory inputs through commons structures as the orbitofrontal cortex (involved in orientation of visual attention and in olfactory perception) and knowing that odor recognition is facilitated by research of visual clues, we propose to develop an objective test for evaluating odor recognition. Via an eye tracking method, we have quantify

ocular behavior (orientation of visual attention and pupilary dilatation) during presentation of olfactory stimulation simultaneously to visual stimulus in ten healthy male and female adults aged from 18 to 35 years. Odor presentation induced an increase of pupil diameter and an increase of time spent to look the target. Our preliminary results show the validity of this method. The pupil dilation is considered as an indicator of physiological response to olfactory stimulation. Increase of time spent to look the « odor image » suggests that odor stimulation conducts visual attention towards the target. This result allows us to validate the assumptions made in favor of the objectivity of this method. The validation of this method in large healthy population and in pathological population (depression, Alzheimer disease and autistic disorder) would assist diagnosis of many pathology and would also allow an earlier medical treatment.

Validation
[THU 4:10-6:15 TIMBER HALL A]

Validation of a global live z-score protocol: mechanism, within-subject results, and a randomized controlled

Thomas Collura

BrainMaster Technologies, Inc., US

The objective of this report is to present and interpret objective data which validate a global live z-score training (LZT) neurofeedback protocol. We present data for three levels of validation of a global live z-score protocol used for neurofeedback training. These are single-subject within-session, single-subject across-sessions, and a multiple-subject randomized controlled study (RCT). The results confirm the proposed mechanism of action, which is operant learning (self-regulation) of a complex set of QEEG-derived parameters, in a conventional biofeedback paradigm. The validation consists of (a) specific within-session z-score changes (N=1, 40 minutes), (b) specific across-session z-score changes (N=3, 10 sessions each), and (c) specific enhancement of cognitive processing (N=16, 8 sessions each). The RCT outcomes were measured by a battery of neuropsychological tests in a blind, randomized, sham-controlled study. Results confirm that the global live z-score protocol leads to the expected specific EEG changes, and that EEG changes are associated with expected cognitive improvement over time. Cognitive improvements were not seen in the sham-treated subjects in the RCT. These results verify that the mechanisms of LZT training operate as described, and that they can produce measurable benefits in improved brain activation and connectivity, and associated cognitive function. Clinical application, including relationships to observed phenotypes, are described. These results provide a basis for clinical application, continued studies, and further development of protocol designs.

Alpha activity training using a novel system enhances relaxation and cognition

Geert J.M. van Boxtel[1], Ad Denissen[2], Mark Jäger[2], David Vernon[3], Marian K.J. Dekker[1,2], Vojkan Mihajlovic[2] , Margriet M. Sitskoorn[1]

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Fifty healthy participants took part in a double-blind placebo-controlled study in which they were either given auditory alpha activity training, random beta training, or no training at all. A novel wireless electrode system was used for training, involving water- based electrodes mounted in an audio headset. Training was applied roughly at central electrodes, and comprised 15 sessions of three 8-min training periods each, alternated with cognitive tasks (Flanker task, Stop task, Stroop task, N-back task). Post-training measurement using a conventional full-cap EEG system revealed an increase in alpha activity at posterior sites in the alpha group only, which persisted until a follow-up three months later. About twice as many participants in the alpha training group mentioned that the training was relaxing, in comparison to the other two groups. Behavioral measures of stress and relaxation suggested effects of alpha activity training and subjective relaxation reflecting the alternation of training periods and cognitive tasks with a session was correlated with alternations in alpha power. Alpha training led to faster learning of cognitive tasks, but the end result of training was the same for all groups. Results suggest that alpha activity training using our novel system is feasible and may represent a step forward in the ease of instrumental conditioning of brain rhythms.

A comparative randomised controlled trial of the effects of Brain Wave Vibration yoga, Iyengar yoga and Mindfulness training on mood and well-being

Deborah Bowden[1], Claire Gaudry[2] and John Gruzelier[1]

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2. *International Brain Education Association, UK*

Brain Wave Vibration (BWV) is a unique kind of Korean yoga involving exercises aimed to tone up the brain-stem and rebalance the energy distribution in the brain and body to benefit mood, health and well-being. A randomised controlled trial was conducted to investigate and compare the effects of BWV, Iyengar yoga and Mindfulness training, where the Iyengar group was intended to act as a control for the physical components of BWV and the mindfulness group was designed to control for the 'mental' components. 35 healthy adults completed 10 75-minute classes of BWV, Iyengar or Mindfulness over a period of five weeks. Participants were assessed at pre and post-intervention for salivary cortisol and self-report measures of mood, sleep, health, mindfulness and absorption, and completed computerised attention and memory tests. Both the BWV and Iyengar groups showed significant improvements in overall mood following the intervention, which was most statistically reliable in the BWV group, which was the only practice which produced a significant reduction in depression. Reductions in tiredness, sleep latency and tension also followed training in BWV but not in the other groups. The BWV group also had increased vitality and reduced tension and sleep disturbance, although these benefits also followed Mindfulness training. The Mindfulness group was the only group who had an increase in calmness and in a sense of being grounded, and they had a comparatively greater increase in absorption than the other groups. All three groups had improved stress, vitality and mindfulness post-intervention, although none of the groups showed any change in salivary cortisol, attention, memory or health. In conclusion, significant improvements in well-being followed training in all three practices, although BWV was unique in its benefits to depression, tiredness and sleep latency. Further research is needed to investigate its effects, and to isolate which exercises produce them.

A randomised controlled single-blind trial of the efficacy of Reiki in benefitting mood and well-being

Deborah Bowden, Lorna Goddard and John Gruzelier

Goldsmiths, University of London, UK

This is a constructive replication of a previous trial conducted by Bowden, Goddard and Gruzelier (2010), where students who had received Reiki demonstrated greater health and mood benefits than those who received no Reiki. The current study examined impact on anxiety/depression. 40 university students - half with high depression and/or anxiety and half with low depression and/or anxiety – were randomly assigned to receive Reiki or to a non-Reiki control group. Participants experienced six 30-minute sessions over a period of two to eight weeks, where they were blind to whether non-contact Reiki was administered as their attention was absorbed in a guided relaxation. The efficacy of the intervention was assessed pre-post intervention and at five-week follow-up by self-report measures of mood, illness symptoms and sleep. The participants with high anxiety and/or depression who received Reiki showed a progressive improvement in overall mood, which was significantly better at five-week follow-up, while no change was seen in the controls. While the Reiki group did not demonstrate the comparatively greater reduction in symptoms of illness seen in our earlier study, the findings of both studies suggest that Reiki may benefit mood.

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Assessing effects of neurofeedback on emotional interference.

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Approach: 40 students received seven NFB sessions of 30 minutes each. Four conditions were trained, based on SMR neurofeedback at Cz: visual and auditive feedback (VFAF); visual feedback and auditive placebo (VFAP); visual placebo and auditive feedback (VPAF), visual and auditive placebo (VPAP). An operant response task was administered both before and after NFB sessions. In between presentations of pictures from the International Affective Picture System (IAPS) subjects were to press a keyboard with their left hand when a circle was presented and with their right hand when a square was presented.
Results: SMR and theta increased over time in a repeated measures design, no interaction effects with condition were found. SMR (5.0 and 5.7 uV) and theta (11.1 and 11.9uV) were not significantly different before and after NFB. In the operant response task, a main effect of time was found for errors in the negative-valence pictures: after NFB the number of correct responses was decreased. A condition-by-time interaction effect was found for reaction time: whereas in the VPAP condition a decrease of reaction time was found with negative-valence pictures, in the VFAF condition the decrease was smaller or the reaction time even increased. No interaction effects were found for errors.
Discussion: In spite of lack of objective support for changes in EEG, neurofeedback appears to have affected emotional interference. The increased response time may be due to a decrease in impulsivity. Another possible explanation may be increased activity of the pulvinar due to NFB, thus enhancing the affective strength of the negative-valence pictures shown. Subjects were not asked for their beliefs about the condition they were in. This leaves room for methodological factors influencing the results.

Cognitive Neuroscience
[THU 4:10-6:15 TIMBER HALL B]

Enhanced dopamine availability and response readiness. The influence of 3 doses of methylphenidate on contingent negative variation in the EEG of healthy volunteers.

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The basal ganglia play an important role in motor control, which is dependent on dopaminergic input. Preparation of a motor response has been associated with dopamine release in the basal ganglia and response readiness may therefore serve as a pharmacodynamic marker of dopamine activity. We measured response readiness using the amplitude of the contingent negative variation (CNV), a slow negative shift in the electroencephalogram. The CNV is evoked in a paradigm in which a warning stimulus (S1) signals the occurrence of the imperative stimulus (S2) 4 seconds later, to which the participant has to respond. CNV was assessed in healthy volunteers after administration of placebo or 10, 20 or 40 mg of methylphenidate, a catecholamine re-uptake blocker which primarily enhances the synaptic concentration of dopamine and to a lesser extent also noradrenaline. Episodic memory was measured using a word learning test. In addition, participants filled out two visual analog scales measuring subjective ratings of mood and alertness: Profile of Mood States (POMS) and Bond & Lader (B&L). Results indicated that methylphenidate dose-dependently increased CNV amplitude and decreased reaction times. Episodic memory performance improved. Furthermore participants reported improved mood, feeling more alert, vigorous and content and less angry and tired after methylphenidate. These results indicate that dopamine availability increases response readiness as measured by the CNV paradigm. The CNV appears to be a good candidate biomarker for assessing changes in dopaminergic function by treatments that either directly or indirectly target the dopaminergic system.

Electrophysiological correlates of the effect of age and emotions on response inhibition

Márk Molnár, Roland Boha, Brigitta Tóth and Zsófia Anna Gaál

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Response inhibition is the result of a complex decision making process the successful outcome of which serves the purpose of adaptive behavior. In event-related potential (ERP) studies it has been shown before that characteristic changes of both the N2 and that of the P3 components can be observed in the ERPs evoked by stimuli to which a response is to be inhibited. Little is known, however, how these ERP changes are modified by the emotional valence of the stimuli in question. The aim of the present study was to investigate how the process of aging interferes with the above correlations. A group of young (n=18, mean age 21.5 yrs, SD: 2.41) and old (n=10, mean age: 66.1, SD: 2.96) subjects participated in the study. Words with different valence (positive, neutral or negative) were presented (duration: 250 ms) to the subjects altogether in six different blocks in each of which only two types (e.g. neutral, negative) were shown. The subjects were instructed to respond to only one type of the words. In addition to the conventional ERP component analysis, power spectra, "complexity" features (Omega-complexity and synchronization likelihood) and network properties of the EEG-epochs were also investigated. The amplitude of the N2 component was higher in the young subjects, particularly those elicited by the negative NOGO stimuli. The power in theta and delta band

was also higher in the young especially for negative NOGO stimuli. Complexity analyses revealed decreased synchronization in the elderly although higher synchrony was observed for negative NOGO stimuli in both age groups. Correlation findings for spectral and complexity measures suggest that irrespective of emotional valence synchronization mechanisms are less efficient in elderly subjects, supported also by results of graph theoretical analysis.

An fMRI investigation of selection among competing alternatives

Ekaterini Klepousniotou and Emma Waters

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A review of the literature on language abilities after right hemisphere damage reveals abnormalities in the interpretation of lexical items that have multiple meanings and an inability to revise initial interpretations. Although the evidence from lesion studies strongly suggests the right hemisphere's involvement in the appreciation of semantic relations, its exact neural structures involved in language processing are not known. Functional neuroimaging studies typically report increased activity in the pars opercularis and pars triangularis of the left hemisphere (Brodmann's areas 44 and 45; Broca's area) during the performance of linguistic tasks, while the left inferior frontal gyrus (LIFG) has also been involved in selection among competing alternatives. The question, however, remains as to whether intrinsic meaning competition effects (i.e., those arising when a word has multiple meanings) require bilateral processing. Using an event-related fMRI design, the study examined neural activation patterns related to the processing and selection of meaning of metaphorically ambiguous words within the left and right hemispheres. Healthy young participants were scanned while performing a semantic judgment task using triplets. Metaphorically ambiguous words (e.g., star) were preceded by a context word either related to their dominant (e.g., planet) or subordinate meaning (e.g., actor); and they were followed by a target word related either to their dominant (e.g., universe) or subordinate meaning (e.g., famous), or an unrelated word (e.g., coffee). In the baseline control condition, crosses were presented instead of the context, prime and target words. Brain activity during the performance of language processing trials in which either dominant or subordinate meaning activation of ambiguous words was required was compared with brain activity during the baseline control condition. The results revealed that a specific region bilaterally, namely the ventro-lateral pre-frontal cortex (i.e., Brodmann's area 47/12), plays a central role in selection among competing alternatives.

Congruency Effect on Encoding of Words: An ERP Study

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Brain activity at the moment of first encoding of an event can predict whether this event will be remembered or not. In multiple studies it was demonstrated that for words remembered later, larger ERP positivity could be observed (Fabiani et al., 2007). This effect was called Dm (Difference based on subsequent memory) (Paller et al., 1987). The aim of this study was to evaluate effect of context on memory encoding of words. For this aim, a matching task with two words (name of category (prime) and target word from that one or another category) presented in a subsequent order was applied in the study phase. Participants were asked to decide if target word was of category denoted by prime word. An incidental memory paradigm was used in the test phase (memory test was unexpected by subjects). Trials of study phase were sorted according to congruency of words in a pair and recognition of words as `old` or `new` in test block. Thirty two adults aged 19-45 years participated in the experiment (19 men) as volunteers. For congruent words which later were recognized as old ones, RT was shorter than for words which were later forgotten. For incongruent words this memory effect was not significant. LPC congruency effect was greater for words which were later recognized. The Dm effect was observed. LPC amplitude was greater for words which were remembered later than for words which were forgotten. Thus behavioral and ERP data showed that

congruency affected encoding processes. When words are primed by name of category, representation of this category is activated which causes deeper processing of word meaning. It leads to more effective memorizing of these words. Events which take place right before word presentation along with characteristics of words could influence memory encoding. Supported by RFH Grant 11-36-00314.

ERP Assessment of Word Processing under Broadcast Bit Rate Limitations

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In telecommunication research, audio quality is typically assessed with behavioral tests. Neurophysiological data can complement these as an objective and non-intrusive measure, potentially revealing neuronal differences in quality processing below the threshold of conscious perception that might affect a user's long-term satisfaction. Recently, subconscious processing of noise in phonemes was found in event-related potentials (ERPs) [1]. The present EEG study (N=8) applies this approach to a more realistic setting. In a forced choice task, subjects had to rate whether a given word was of maximal quality or degraded. Stimuli were presented either in wideband quality (60%) or were impaired by four progressive levels of bit rate reduction, using a standard telecommunication codec [2]. The ERP analysis allowed qualifying those trials where subjects correctly indicated a loss of quality: The higher 'neural uncertainty' involved in detecting more subtle degradations is reflected in a decreased amplitude of the P3 component. Additionally, we used a linear classifier to single out trials where quality impairment was not reported, but still evoked an ERP pattern similar to when it was processed consciously (three subjects). Thus, the approach demonstrates that even if no quality impairment is noted consciously, the degradation can still be processed in the cortex. Concluding, the ERP paradigm previously developed for noisy phonemes can be transferred successfully to full words degraded by realistic broadcast limitations. This supports the potential of ERP analysis combined with machine learning not only to complement conventional methods of audio quality assessment, but also to extend their sensitivity to sub-threshold stimuli.

Acknowledgements:
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Animal Models
[THU 4:10-6:15 DOCK SIX HALL]

Use of small inhibitory RNAs to recover the structural plasticity in the adult nervous system

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University of the Basque Country, Spain

Visual deafferentiation carried out in early postnatal stages is followed by elongation of axons from afferents to the superior colliculus that grow tangentially to the collicular surface or ascend to invade more superficial layers. This structural plasticity facilitates the recruitment of neurons devoid of visual information to elaborate behaviorally relevant responses that emerge from the deep collicular layers. When the nervous system maturates (after 6-8 postnatal weeks in rodents) no axonal growth after visual deafferentiation is observed. We set out to promote postlesional axonal sprouting in adults by administration of specific small inhibitory RNAs (siRNAs) to knock down the expression of Nogo-r (receptor of the Nogo system) or RhoA (small molecule that keeps the stability of the presynaptic actin mesh-work. A 7 days siRNAs delivery from an osmotic pump inserted into the visual cortex of deafferented adult rats elicited in cortical afferents an axonal growth of 800-1200 microns, which is significant, taking into account the short period of siRNAs application. Encapsulating siRNAs in nanoparticles of biodegradable polymers like poly-lactide glycolide (PLGA), a longer siRNAs administration was achieved. Spermidine coupled siRNAs were suspended in PLGA and then sonicated to generate nanoparticles (nanosiRNAs) of 50nm size. From these nanoparticles, siRNAs are slowly released at least during 2 weeks. 5 microliter aliquots of nanosiRNAs were injected together with the anterograde tracer biotin dextran amine into the visual areas of adult animals shortly after visual deafferentiation. Cortical fibers that arrived to the superior colliculus showed a more extensive growth than after shorter osmotic pump applications. Results described here are encouraging enough to translate the applicability of nanosiRNAs to treat human pathologies in order to enhance the postlesional recovery of nervous pathways. We are going next to assay different polymers at different concentrations aimed to obtain more efficient and sustained siRNAs release.

Spike engineering with Channelrhodopsin-2

Nir Grossman, Patrick Degenaar and Konstantin Nikolic

Photostimulation technology that combines optics and genetics to interface with neural circuits is developing into one of the most important tools in neural stimulation. Using genetically encoded agents such as Channelrhodopsin-2 (ChR2), light sensitivity can be imparted onto otherwise 'blind' neuronal cells and an external light source can be used to remotely generate the action potentials. Design of various mutants of ChR2 and other light sensitive ion channels and pumps is now well within the reach of modern molecular biology. Despite the increase use of the optogenetics technique, the underlying dynamics of the ChR2-evoked spikes are still not yet fully understood. In contrary to conventional electrical stimulations, the ChR2 evoked currents are sensitive to the neural it drives. ChR2 behaves as a complex light-controlled, voltage-dependent current driver coupled to a dynamic-threshold voltage-oscillator (neuron). We developed a model that describes the response of ChR2-expressing neurons to light stimuli and use the model to explore

the light-to-spike process. We show that an optimal stimulation yield is achieved when the optical energies are delivered in short pulses. The model allows us to theoretically examine the effects of using various types of ChR2 mutants. We show that while increasing the lifetime and shuttering speed of ChR2 have limited effect, reducing the threshold irradiance by increased conductance will eliminate adaptation and allow constant dynamic range. The model and the conclusions presented in this study can help to interpret experimental results, design illumination protocols and seek improvement strategies in the nascent optogenetic field.

References:

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2. Grossman, N., Nikolic K., et al. (2011). Modeling Study of the Light Stimulation of a Neuron Cell with Channelrhodopsin-2 Mutants. IEEE Trans Biomed Eng, in-press.

Signal analysis of the effects of microlesions in the medial septal area on the dominant hippocampal rhythm in anesthetized rats

Katrien Mols, Ivan Gligorijevic, Dimiter Prodanov and Bart Nuttin

KU Leuven, Belgium

Imec, Belgium

The theta-rhythm in the rat has been implicated in attention, motivation, learning and memory. The aim of the present experiment was to establish whether electrical stimulation in the acutely lesioned medial septal area (MSA) could have an effect on the hippocampal rhythm in anesthetized animals. Adult male Wistar rats (n=6) were anesthetized with 0.5 g/kg chloral hydrate. Two Pt bipolar twisted pair electrodes were implanted in MSA (AP 0.5 ML 1.2 SD 6.2 mm 10°) and the hippocampus (AP -3.3 ML 2.2 SD 2.6 mm 10°). Local field potentials (LFPs) were recorded in the band 0.1 Hz - 3k Hz and digitized at 10 kHz using Spike2 (CED). Voltage-controlled stimulation (pulse width 1 ms) in the MSA site was performed in the range of 5 – 10V at frequencies between 4 and 50 Hz. Electrolytic lesions were made by 200 uA DC current for 15s. Post lesion stimulation was performed with the same protocol. The stimulation in MSA in the range 10 – 25 Hz was able to elicit time-locked rhythm in the hippocampus (i.e. rhythm driving). The threshold for driving was 6.03 V. The LFPs were analyzed with the Chronux package (1); and Ensemble Empirical Mode Decomposition/ Independent Component Analysis (EEMD-ICA)(1). The driving was characterized by marked peaks in the multi-taper spectrum around 10, 20 and 30 Hz. EEMD-ICA could objectively isolate the driven rhythm and reconstruct it successfully in the presence of stimulation. Components characteristic of driving were observed only during stimulation and were not part of the stimulation artifact (reconstructed by the same procedure). In such way one could determine the influence of an isolated component of interest across a wider frequency band. Preliminary results demonstrate that at the driving threshold, in 4 cases the lesions increased the component at 10Hz, in 1 case had no effect and in 1 case there was no appreciable difference between pre and post-lesion state.

Clinical Studies

[FRI 4:00-5:15 TIMBER HALL A]

EEG-Neurofeedback and Psychodynamic Psychotherapy in Adolescent Anhedonia with Substance Misuse: A Single Case Study

Human Unterrainer[1], Max Chen[2] and John Gruzelier[2]

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2. *Goldsmiths, University of London, UK*

There is substantial evidence confirming Neurofeedback as an effective training-method with applications in clinical, educational and optimal performance domains. However, a psychodynamically informed NF-approach has not been examined. A 19 year-old adolescent male, whose first college year was evidently upset after severe, 18-month, polydrug misuse, was treated with 10 sessions with a one month follow-up. Sessions consisted of a an hour-long session of Short-Tem Psychodynamic Psychotherapy and after an interval Sensory Motor Rhythm (SMR) training followed by the Alpha/Theta (A/T) protocol. At the end of each psychotherapy session the therapist completed the Brief Psychiatric Rating Scale and the Montgomery Asberg Depression Rating Scale. The student was also characterized with the Brief Symptom Inventory, the Beck Depression Inventory, the Schizotypal Personality Questionnaire, the Big Five personality Inventory and the Multidimensional Inventory for Religious/Spiritual Well-Being. Pre/Post-treatment and Follow-up assessment confirmed that levels of psychopathology dropped almost completely to zero, and this was in concert with EEG learning curves. Correlations between symptoms and EEG bands disclosed high correlations between symptoms and SMR/theta ratio with a striking contribution from theta. This was in the direction of the greater the symptoms the higher was the amplitude of theta. This relation with theta, recorded (Cz) with eyes open, was not found with theta recorded (Pz) with eyes closed in the A/T paradigm. In conclusion the combined treatment was found to be highly effective. The student learned to deal with feelings of anhedonia and alienation. Furthermore, he did not relapse during the Follow-up phase. Further randomized-controlled trial research is recommended. The relation between eyes open theta and symptoms provides a caution for training up theta amplitude.

The Effects of Neurofeedback in Autism: Results of a Blinded Randomized Trial Using a Skin Conductance Biofeedback Control Group

Mirjam Kouijzer

Radboud University Nijmegen, Netherlads

Objective – The results of a study investigating the effects of neurofeedback in autism spectrum disorders (ASD) will be presented. A blinded and randomized trial using skin conductance (SC) biofeedback as a control group was performed to prevent the outcomes of the study from attention and expectancy biases.

Method – The present study included three research groups: an EEG-biofeedback group, a SC-biofeedback group, and a waiting list control group. All participants (n=41) were pre-tested with 19-channel EEG and executive function tasks and parents and teachers filled out behavior questionnaires measuring ASD symptoms. Then, the EEG- and SC-biofeedback groups had identical sessions of EEG- or SC-biofeedback and were blinded for the type of feedback they received. The EEG-biofeedback group inhibited delta and theta power at centro-frontal scalp locations while SC was recorded. Participants in the SC- biofeedback group inhibited SC while theta power was recorded. After 40 biofeedback sessions, all participants were re-tested with 19-channel EEG and executive function tasks and parents and teachers filled out behavior questionnaires again. Six months later, a final collection of data was completed in order to investigate long term effects of the treatment.

Results – Seven out of 13 participants of the EEG-biofeedback group successfully reduced delta and theta power and were named as EEG-responders. Six out of 13 participants showed no effect in EEG, the so called EEG-non responders. In the SC-biofeedback group, eight out of 12 participants reduced SC and were named SC-responders. Four participants showed no reduction of SC and were called SC-non responders. EEG-responders furthermore showed a long term improvement in cognitive flexibility, whereas no such improvement was found in other participants. No effects were found in ASD symptoms as rated by parents or teachers. The 19-channel EEG recordings of EEG-responders showed a reduction of delta power at Pz immediately after treatment ended but not after six months.

Remote Training /Tele-Neurofeedback, Realtime Z-Score-Training, and Special Disorders – State of Minimal Consciousness – SMC and Autism Spectrum Disorders – ASD - Case Reports

Doerte Klein and Thomas Collura

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2. *BrainMaster Technologies, Inc., US*

Background: Special symptoms do need special treatments, which are often not locally available - so is with neurofeedback-therapist and treatment of patients in state of minimal consciousness (SMC – term to be disputed) and autism spectrum disorders (ASD). Tele-Neurofeedback in a setting with quality control can overcome geographical and time barriers and counterbalance the lack of a differentiated network of qualified neurofeedback therapists.
Methods: Two adult patients with SMC and 3 children with ASD are treated in a Tele-Neurofeedback setting. The training was done with 4 channel Z-Scores – to be described – in order to fulfill requirements of quality management and to have the security to not training dysfunctional options. All patients had an intitial QEEG and initial neurofeedback-treatments done by the practician – the SMC patients in their clinics, the children with ASD in the clinic of practician. Co-Trainer were trained (varying from 6 hours to several workshops), equipment was provided, and the Tele-Setting was hold at first with any session, then with any important change of training strategy, or on a 2-weeks basis, or on demand. Decisions were adapted according to treatment progress. Co-Trainer had online-tracking with questionnaires for symptoms, QEEG's were done any 3 – 6 months with appropriate adaptation of training strategies to combine QEEG-findings, specific functions and localisations.
Results: All patients could show remarkable developments in behavioral, cognitive and emotional aspects, with SMC as degree of awareness, circadian rhythm, spastism/relaxation, eye movement and eye contact, duration of vigilance, with ASD a variety of symptoms, depending on the specific age and/or disorder. The progress in any case reflected more a development with changing challenges for ongoing training than a "healing" . Especially in the case of one of the SMC patient the training effect was "frozen", when the patient was transferred to a specific home, shown by a catamnestic QEEG.
Conclusion: In these groups of disorders Neurofeedback specifically on a Tele-basis can be a fruitful "escort" for further development, which cannot be imagined on a time-limited basis but merely as an ongoing process with ongoing fractionated training/therapy.

Developmental
[FRI 4:00-5:15 TIMBER HALL B]

The Brains Of The Gifted: A Comparative Study On The Structural And Functional Features Of The Brains Of Gifted Individuals In Contrast To Individuals With An Normal Level Of Intelligence

Mehmet Fatih Varli

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The research that has been conducted so far has (at least partly) proved that the brains of gifted individuals are different from those of normal individuals in terms of both structure and function. (Jausovac, 1996,1998,2002; Jin and others, 2006; Lee and others, 2006). The results of the scientific research carried out on the subject indicate that the structural and functional differences between the brains are regional distinctions, alpha activity effect, coherence and the operation of the right hemisphere. In the research articles focusing on this subject, the gifted individuals were experimented using different types of problems (such as open-closed problems and forming hypotheses), as their EEG (electroencephalogram) records were taken and their brains were observed by brain imaging systems. The results of the experiment helped the scientist acquire further information on the brain structures and functions of the gifted.

Early Childhood Working Memory As a Predictor of Kindergarten

Fitzpatrick, C. & Pagani, L.

Université de Montréal School Environments Research Group

How children begin school is an important predictor of their eventual academic attainment. Research findings in the fields of psychology, neuroscience, education, and economics converge in suggesting that child persistence in learning represents an important determinant of academic success during the school years. Nevertheless, the developmental origins of productive learning behavior remain unknown. Indicators of executive functioning skills such as task-persistence, self-discipline, and autonomous learning are all associated with academic achievement above and beyond IQ. It would be informative to examine whether basic executive function skills in the preschool years predict learning-related behaviors that reflect classroom engagement at school entry. The present study examines how toddler working memory skills, which represent a basic function, predict subsequent kindergarten classroom engagement behaviors. Participants are 1824 children from the Quebec Longitudinal Study of Child Development. Children were individually assessed on working memory at age 29 months, using the Imitation Sorting Task. Kindergarten teachers rated classroom engagement when children were approximately 74 months of age. Multiple regression analyses revealed a prospective association between early working memory scores and later classroom engagement, $\beta = .042$, 95% CI between .012 and .072. Results were adjusted for child sex, weight for gestational age, age in months at task completion, temperament problems, hours of continuous sleep, months breastfed, maternal age and education, and family functioning and configuration. The findings propose a robust, easily accessible, and cost effective assessment method of early childhood executive function for the development of early childhood interventions that improve school readiness.

In conclusion, working memory may represent an early predictor of later engaged learning ability. A relationship between working memory and classroom engagement also suggests developmental continuity in

the development of executive functions. This study has implications for the implementation of early interventions designed to bolster school readiness in order to circumvent later academic risks.

Compelling Evidence that Child Impulsivity in Fourth Grade is Predicted by Maternal Smoking During Pregnancy

Fitzpatrick, C. & Pagani, L.

Université de Montréal School Environments Research Group

Unfavourable fetal environments can impede healthy development and increase child susceptibility to psychological disorders throughout the lifespan (Barker, 1998). Maternal prenatal smoking has been linked to child impairments in attentional control (Linnet et al., 2003). While research has established a statistical link between perinatal smoking and later ADHD symptoms, many studies have failed to rule out the competing influence of individual and family characteristics (Linnet et al., 2003).

Using a population based, prospective birth cohort, we examine whether self-reported maternal smoking during gestation predicts child impulsivity symptoms (restlessness, poor behavioral control, and inattention) in fourth grade. Participants are 2112 parents and children from the Quebec Longitudinal Study of Child Development. Gestational smoking by mothers was classified into one of three groups: No perinatal smoking; 1-9 cigarettes per day; or More than 10 cigarettes per day. Fourth grade teachers assessed child impulsivity using the Social Behavior Questionnaire (i.e., "Was easily distracted", "Has trouble sticking to any activity", $\alpha = .91$). Results from fully-controlled multiple regression analyses reveal that children who experienced heavy gestational smoking were rated as more impulsive in fourth grade than counterparts who were not exposed to gestational smoking, $\beta = .827$, 95% CI between .545 and 1.109. Results are adjusted for child sex, exposure to perinatal drinking and exposure to elicit drugs, weight for gestational age, parental involvement and responsiveness, family functioning and configuration, and socioeconomic status, and maternal depression.

The present study found a prospective association between perinatal smoking and later impulsivity, above and beyond other plausible perinatal and family risk factors that could have explained the association. Even low levels of impulsivity are costly for individuals and society. Advising public health efforts toward improving maternal health behaviors and attitudes during pregnancy may provide long-term social and economic benefits individuals and society.

Recovery of Function

[FRI 4:00-5:15 DOCK SIX HALL]

Improved bladder emptying by electrical stimulation of pudendal afferents and efferents in an animal model of spinal cord injury

Chih-Wei Peng[1,2], Yin-Tsong Lin[3], Te-Son Kuo[3], Shih-Ching Chen [1,2], Chien-Hung Lai[1,2], and Wen-Jia Fan[4]

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Subjects with spinal cord injury (SCI) are often accompanied detrusor-sphincter dyssynergia (DSD) with incomplete voiding, low efficiency of bladder emptying, and high risk of urinary tract infection. In our study, custom-made cuff electrodes were placed on sensory and motor branches of pudendal nerves (PN) in chronic SCI rats for electrical neuromodulation. Low frequency stimulation (LFS, 2-50 Hz) and high frequency blocking (HFB, above 1 kHz) currents were applied on sensory and motor branches of PN, respectively, to determine if the neuromodulation can improve the voiding efficiency in rats with DSD. Female rats (Sprague-Dawley, n=8) underwent a complete spinal cord transection at T9-T10. After a 6-week of recovery, the rats were used for LFS and HFB studies. Voiding function was calculated via cystometric measurement (0.12-0.6 ml/min, infusion rates) to determine the effects of electrical stimulation. In our results low amplitude (~0.03mA) of LFS delivered on sensory branch(es) of PN significantly increased the voiding efficiency from 10% to 30%, whereas, high amplitude current (~0.2mA) of LFS inhibited the reflexive bladder contractions. In addition, HFB (10 or 20 kHz) applied on the motor branch of PN relaxed the external urethral sphincter, and it did not cause any significant damage on the nerve tissue. Further, we proved that LFS combined with
HFB technique dramatically improved the bladder voiding function. These results raise the possibility that the pudendal neuromodulation may provide a new approach to restore efficient bladder emptying in persons with SCI.

Case Study Of Postoperative Neurocognitive Decline In Heart Failure: Improved Functioning At One Year Follow Up

Kalliopi Megari[1], Mary H. Kosmidis[1], Helena Argiriadou[2], Giorgos Karapanagiotidis[3], Evanthia Thomaidou[2], Polichronis Antonitsis[3] and Kyriakos Anastasiadis[3]

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Introduction: Bypass surgery for coronary heart disease leads to cognitive decline with moderate spontaneous improvement over time. Despite more severe cognitive decline in cases of heart failure, several preliminary reports have suggested notable improvement in cognition after cardiac transplantation. We present the case of a patient with LVAD and stem cells implant.
Method: Neurocognitive functioning of a 64-year-old male with heart failure, who had Jarvik 2000 LVAD and stem cells implant, was assessed preoperatively, at 1-, 6- and 12-month follow-up. Specifically, we examined selective attention, working memory, executive functioning, short- and long-term memory, visuospatial perception, verbal fluency and abstract reasoning. We defined neurocognitive decline as a decrease of 1 SD (based on Greek normative data) in performance on one or more neuropsychological tests.
Results: The patient's performance was generally poor with evidence of cognitive decline relative to baseline, at 1- and 6-month follow-up evaluations, in certain domains, but returned to the average range 12 months after surgery. More specifically, he showed decline relative to baseline in selective attention and long-term memory at 1- and at 6-month follow-up and semantic verbal fluency at 1-month follow-up. Selective attention and long-term memory returned to the average range, but semantic verbal fluency improved further, placing him in the high average range, 12 months after surgery. In fact, this improvement was evident earlier on semantic fluency – particularly on semantic organization (at 6-month follow-up) and on phonological fluency (at 6- and 12- month follow-up). On executive functioning and visuospatial perception his performance was in the average range and consistent over time, with no evidence of decline on the three follow-up evaluations.
Discussion: Postoperative cognitive decline in a patient with heart failure who received LVAD and stem cell implants reversed spontaneously over time, returning to the average and high average range, 12 months after surgery.

Nasal olfactory cells transplantation as a respiratory rehabilitation strategy for cervical spinal cord injury

Stamegna J.C. [1,2], Felix M.S[1,2], Roux-Peyronnet J. [1,2], Rossi V.[1,2], Féron F.[3,4], Gauthier P.[1,2] and V. Matarazzo[1,2]

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Engraftment of nasal olfactory ensheathing cells (OEC) is considered as a promising therapeutic strategy for spinal cord repair and one clinical trial has already been initiated. However, while the vast majority of fundamental studies were focused on the recovery of locomotor function, the efficiency of this cellular tool for repairing respiratory motor dysfunction, which affects more than half of para-/tetra-plegic patients, remains unknown. Using a rat model that mimics the mechanisms encountered after a cervical contusion that induces a persistent hemi-diaphragmatic paralysis, we assessed the therapeutic efficiency of a delayed transplantation (2 weeks post- contusion) of nasal OECs within the injured spinal cord. Functional recovery was quantified with respiratory behavior tests, diaphragmatic electromyography and neuro-electrophysiological recording of the phrenic motoneurons while axogenesis was evaluated using immunohistochemistry. We show that 3 months post-transplantation, nasal OECs improve i) breathing movements, ii) recovery of the ipsilateral diaphragm and corresponding phrenic nerve activity, iii) axonal sprouting in the injury site. We also demonstrate that this functional recovery is mediated by the restoration of ipsilateral supraspinal command. Our study brings further evidence that olfactory ensheathing cells could have clinical application especially in tetraplegic patients with impaired breathing movements.

Research fund: Centre National de la Recherche Scientifique (CNRS), the Institute pour la Recherche sur la Moelle Epinière et l'Encéphale (IRME), Association Française contre les Myopathies (AFM)

References:

1. Stamegna J.C et al. Nasal OEC transplantation promotes respiratory recovery in a subchronic rat model of cervical spinal cord contusion. Experimental Neurology, 2010

Clinical EEG
[FRI 5:15-6:45 TIMBER HALL A]

EEG Changes Following Theta/Beta Neurofeedback Treatment in Adult ADHD

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2. *Psychologisches Institut /Eberhard-Karls-University, Tübingen, Germany*

Objectives. Attention–deficit/hyperactivity disorder (ADHD) is one of the most common disorders of childhood and persists into adulthood for approximately 5% of the population world-wide (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007). EEG analysis of adults with ADHD compared to healthy controls and/or normative database populations indicate significant differences in brain activity patterns (Bresnahan, Anderson, & Barry, 1999; Bresnahan & Barry, 2002; Clarke et al., 2008; Koehler et al., 2009; Loo et al., 2009; Thompson & Thompson, 2005). Neurofeedback training is a treatment method that utilizes operant conditioning to reinforce specific EEG activity. Changes in trained EEG oscillations after neurofeedback training have been demonstrated in two treatment studies within childhood ADHD populations (Gevensleben, Moll, & Heinrich, 2010; Monastra, Monastra, & George, 2002). However, limited research has investigated EEG changes following Theta/Beta neurofeedback training in an adult ADHD population.

Methods. Continuous 19-channel EEG was acquired from 15 adult participants that met DSM-IV criteria for ADHD (combined, inattentive, or hyperactive type), without additional serious physical, neurological, or psychiatric disorders, and a full scale IQ > 80. EEG recordings were collected pre/mid/post treatment and included EO, EC, P300, and CNV tasks, as well as ADHD behavioral questionnaires. Participants received 30 sessions of neurofeedback training in which Theta (4-7Hz) activity was inhibited and Beta (13-21Hz) activity was augmented at CZ (referenced to A1, ground A2).

Results. This investigation is in progress and the most current findings will be presented at the time of the conference. A within subject repeated measures ANOVA of the EEG power data with factors: time (pre-post), EEG sites (19 channels), frequency band (delta, theta, alpha, SMR, beta), and condition (EO, EC) will be assessed.

Conclusion. Treatment implications, study limitations, and future directions in research will be addressed.

Low voltage EEG is associated with the BDNF Val66Met polymorphism in depression

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Low voltage alpha power is known as a highly heritable and deviating EEG (Electro-encephalography) trait (Enoch et al., 2008). Psychiatric diseases, like ADHD and alcoholism, both contain a higher prevalence of low voltage EEG (Arns et al., 2008; Bierut et al., 2002). Because of these pathological characteristics, the low voltage EEG is useful to investigate the effects of the Brain-Derived Neurotrophic Factor (BDNF) gene. BDNF Val66Met polymorphism produces the protein BDNF, which has an important role in growth and plasticity of neurons. Therefore the BDNF polymorphism has been supposed to play a role in psychiatric diseases and particularly depression (Duman, 2006). As such, the BDNF gene expression has been attenuated in depression (Chourbaji, 2011).

The BDNF polymorphism has been earlier related to EEG patterns in depression (Bulgin et al., 2008) whereas the BDNF protein directly affects neuronal activity (Bolton et al., 2000). Moreover, etiology of depression probably has been mediated via lower alpha power (Gatt et al., 2008).

The aim of the study was to compare the association between BDNF and low voltage in depressed patients (N=96) and matched healthy controls (N=100). We performed multivariate logistic regression analyses and found a strong and stable association in depression. Carriers of the Met/Met BDNF allele in depression were

more likely to exhibit a low voltage EEG in depression, compared to carriers of the Val/Val allele. In healthy subjects, we found no such association.
These findings suggest an important gene-environment interaction of the BDNF Met allele with depressive state.Future neuro-genetic research directions should focus on deviating EEG patterns and consider the gene-environment interaction with disease. Epigenetic mechanisms leading to a low voltage EEG may be of great interest for exploring BDNF effects on brain functioning and its relation to depression.

Application of machine learning techniques for classification of ADHD and Control adults

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In this research, we present a machine learning model that combines multiple classifiers for classifying adult ADHD and control groups. Classification is based on QEEG parameters such as brain-rate and power spectra, taken from 19 electrodes, using the 10-20 international system. The analyzed sample included 117 adult patients (between 18 and 50 years of age) from which 67 were diagnosed as ADHD (divided in 4 QEEG subtypes according to Kropotov's classification) and 50 controls. The QEEG measurements were taken during two resting conditions (eyes closed and eyes open) and two neuropsychological tasks (visual and emotional continuous performance tests). Because different conditions produce different parameter values for the same electrode, we divided our sample into four data sets, one for each condition. We used these data sets for training of four different classifiers. Then, we used classifier combiner that combines the outputs from each classifier and makes final decision based on these outputs. We suggested 2 types of combiners, a feed forward neural network and logical expression, and compared the results. We applied this model for our sample and the results showed in both cases that the combiner improved the classification. But, we note that the classification of ADHD patients should be seen as a multi classification problem, because of the ADHD subtypes.
The method of using classifier combiner is interesting both from IT perspective, as well as from medical perspective. The technique of using classifier combiners for improving the classification is a well known technique in the IT world, and is used in many different kinds of applications. From medical point of view, this is a novel approach, which gives some kind of relationship between the different conditions under which the EEG measurements are taken, and the impact they have on the data obtained from the measurement.

Clinical advantages of quantitative electroencephalogram (QEEG) application in general neurology practice

J. Lucas Koberda

Tallahassee NeuroBalance Center, US

Quantitative electroencephalography (QEEG) also called brain mapping has been underutilized in general neurology practice for uncertain reasons. Recent advances in computer technology have made this electrophysiological testing relatively inexpensive. Therefore, this study was conducted in order to evaluate the clinical usefulness of brain mapping in neurological practice. Over the period of approximately 6 months, 100 consecutive QEEG recordings were analyzed for potential clinical benefits. QEEG patients were divided in 5 groups based on their initial clinical presentation. The main groups included patients with seizures, headaches, head injury, cognitive problems and behavioral dysfunctions. Subsequently, patient's cases were reviewed and decision was made if QEEG analysis contributed to the diagnosis and/or further patient's treatment. Selected and representative cases from each group are presented in more detail including brain

maps with additional low resolution electromagnetic tomography analysis (LORETA) or using computerized cognitive testing. Statistical analysis showed that brain mapping analysis contributed to 95% neurological cases which indicates great potential for wider application of this modality in general neurology.
Many patients were also started with neurofeedback therapy depending on the patient's desire to be involved in this treatment modality.

Methodology
[FRI 5:15-6:45 TIMBER HALL B]

Brain Music System: Standardized Brain Music Therapy

Adrian Attard Trevisan and Lewis Jones
London Metropolitan University, UK

The paper discusses the therapeutic applications of the "Brain Music System" , a system that uses "Sonified Neurofeedback" to accurately and cost effectively convert brainwaves into "sonified music" . A standard "Brain Music Therapy" course of treatment designed specifically for every individual patient can also be possible due to the affordability and portability of the system and could be delivered both inside and even outside of a traditional clinical setting to a wide number of subjects suffering from a number of mental and neurological conditions .The results of a pilot study to test the algorithms and standard output of the Brain Music System showed a predefined pattern in the level distribution of the Alpha , Beta and Theta in normal subjects in accordance to published studies using High End equipment . Such a ranking method helps the Brain Musc System to compare its results to standard ones achieved by Clinical EEG systems and to associate standard algorithmic tasks to each of the 3 mentioned brainwave types.

Confounding factors in neurofeedback training based on fMRI of motor imagery

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Biomedizinische NMR Forschungs GmbH am Max-Planck-Institut für biophysikalische Chemie, Germany

Introduction – The utility of fMRI-based neurofeedback has been demonstrated for the regulation of cortical activity in the primary sensorimotor (SM1) areas. However, differences between right- and left-hand training as well as confounds such as age, gender, and handedness were not yet investigated.
Methods – Sixteen young healthy adults underwent a four-week-long fMRI-based neurofeedback of SM1 responsible for hand movement. Left and right SM1 were identified individually using a functional localizer task. The goal of the training was to increase the fMRI signal difference between the left and right SM1 presented back to the subjects in real time. Eleven demographically matched individuals without training served as controls. In both groups, the initial and terminal sessions included fMRI during motor imagery without feedback (baseline measurement). Training performance was defined as increase in the fMRI signal difference between the left and right SM1 that was achieved in pre- and post-training baseline measurements.
Results – The training performance was significantly higher in the training group vs the control group ($p = 0.001$ for each hand). For the right hand, females ($p = 0.028$) and older subjects ($p = 0.033$) performed better. Whole-brain analysis revealed a significantly higher increase in activation of SM1 in the training group vs the

control group for each hand. For right-hand training, increase in activation in the right SM1 (contralateral to the target ROI) and premotor area (Br6) was positively correlated with handedness, while increase in activation in the left SM1 (target ROI) and Br6 correlated with age. For left-hand training, recruitment showed a positive correlation with handedness in supplementary motor area and Br6 bilaterally.

Conclusion – Individual training performance in fMRI-based neurofeedback employing motor imagery is affected by age and gender and – despite of a symmetrical setup – may be accompanied by lateralized functional changes depending on handedness.

Acknowledgment – Financial support by the German Federal Ministry for Education and Research (BMBF) via the Bernstein Focus Neurotechnologie (BFNT) Göttingen (Grant No. 01GQ0812) is gratefully acknowledged.

Spike sorting based on noise-assisted semi-supervised learning methodologies

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Several techniques in invasive Neuroscience research involve extracellular recording of spiking activity and share the common theme of classifying neural waveforms. Typical examples range from the functional targeting of subcortical structures in Deep Brain Stimulation to the identification of neural firing rate-code in cortical interfaces. The challenging classification task to be addressed, namely spike sorting, includes the identification of the actual number of active neurons in the recording, and the extraction of a detailed time courses for the spiking activity of each one.

Background noise is considered the most influential factor regarding the success of any spike sorting algorithm. Its presence in the experimental data complicates the correct estimation of active neurons, while on the same time makes overlapping events (from co-activated neurons) difficult to resolve. So far, the assumption of a stationary Gaussian profile for the noise has dominated the developed spike-sorting methodologies. As a consequence, any deviation from stationarity and Gaussianity can lead to performance deterioration.

We have recently introduced a novel paradigm in spike sorting (Adamos et al., 2010): noise-assisted methodologies that incorporate new trends in data-learning theory, so as the spike-sorting algorithm to be self-adaptive to the particular realization of the experimental data. In this work, we present an overview of our approach and extend its application towards the daunting scenario of sparsely firing neurons. Simulated and actual data are utilized in an extensive validation scheme.

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EEG spectrum gravity as a preliminary arousal indicator and neurofeedback parameter

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The main aim of this paper is to analyze the EEG spectrum gravity (brain rate) as a preliminary indicator of mental arousal level and as a multiband neurofeedback parameter, considering the neurophysical mechanisms. The main characteristic of the integral (polychromatic) EEG spectrum is its mean frequency, weighted over the whole spectrum (brain rate - fb), defined as in (Pop-Jordanova & Pop-Jordanov, 2005).
Conducted clinical experiments show that:
Brain-rate defined with (1), can be considered as an integral brain state attribute, correlated to its electric, mental and metabolic activity.
In preliminary assessment, brain-rate may serve as an indicator of general mental arousal level, similar to heart-rate (Kaniusas, Varoneckas, Alonderis & Podlipskyte, 2007), blood pressure and temperature as standard indicators of general bodily activation.
By comparing eyes-closed and eyes-open brain-rate values the diagnoses of inner arousal can simply be achieved.
As a measure of arousal level, brain-rate can be applied to discriminate between subgroups of "mixed" disorders (e.g. ADHD, OCD) (Pop-Jordanova, 2009).
Brain-rate can be used as a multiband biofeedback parameter in mediating the underarousal or overarousal states, complementary to few-band parameters and the skin conduction.
Brain-rate training is especially suitable to reveal the patterns of sensitivity/rigidity of EEG spectrum and its frequency bands, related to permeability of corresponding neuronal circuits. Based on this information, individually adapted neurofeedback protocols can be elaborated.

Individual Differences
[FRI 5:15-6:45 DOCK SIX HALL]

Alpha EEG indices of musical performance ability in different age musicians and non musicians

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OBJECTIVES: Previous investigations showed that Individual alpha EEG activity indices were associated with fluency and creativity in musical performance (Bazanova et al 2003). Thus changes in EEG alpha activity during development may help to understand the maturation of musical performing ability.
METHODS: We used different age groups to study technique, rhythm and originality in musical performance, pitch, tactile sensitivity and individual alpha EEG activity indices (peak frequency(IAPF), band width(IABW), amplitude suppression(IAAS) with eyes open recording) in 251 healthy children and adolescents with age 3-20 years with different musical experience.
RESULTS: Pitch and the differential tactile sensitivity threshold decreased, while technique and rhythm in musical performance expert estimations, IAPF and IAAS increased with age. These changes were larger for non musicians than musicians. Originality in musical performance and IABW did not differ in different age groups.
CONCLUSION: Increases in musical performance quality, pitch and tactile sensitivity sharpen with age and were associated with increasing IAPF and IAAS, and may be interpreted in terms of a reorganization of the

EEG towards a higher frequency oscillatory scale and higher activation which reflects maturation of "top down" control.

Second to fourth digit ratio, body mass index and waist-to-hip ratio in normal

Antonia Ypsilanti, Koidou Irini, Nikos Kollias and George Grouios
Aristotle University of Thessaloniki, Greece

The ratio of 2nd to 4th digit length (2D:4D) is sexually dimorphic in humans. There is evidence that sex differences in 2D:4D arise from in utero concentrations of sex steroids - with a low 2D:4D (male typical ratio) being positively related to prenatal testosterone, while a high 2D:4D (female typical ratio) is positively associated with prenatal oestrogen - and remain constant in adulthood. If the sexual dimorphism in 2D:4D ratio is largely determined in utero, what is its connection with other sexually dimorphic traits, such as body mass index (BMI) and waist-to-hip ratio (WHR), which are largely determined at puberty? This question is the focus of the current study. To this end, 2D:4D ratios, BMI, and WHR were assessed in 32 normal and 32 overweight right-handed preadolescent girls. A significant difference was found in mean 2D:4D ratios between the two groups ($t(62)=8.534$, $p<0.01$), with individuals with normal weight having lower mean ratio (mean=0.88, SD=0.03) compared to overweight individuals (mean= 0.94, SD=0.03). A significant positive correlation between 2D:4D ratio and BMI ($r=0.685$, $p<0.01$), between 2D:4D ratio and WHR ($r=0.626$, $p<0.01$) and between BMI and WHR ($r=0.508$, $p<0.01$) was also evident. A linear regression analysis was used to determine whether 2D:4D ratio and WHR could predict our groups. The analysis indicated that only the 2D:4D ratio could significantly predict [$F(2,63)=35.838$, $p<0,01$] the groups ($b=6.073$, $p<0.05$) accounting for approximately 54% of the variability ($r2=0.54$). In addition to an activational effect of sex hormones at puberty, the present data provide suggestive and preliminary evidence of an early organizational effect of female sex hormones through the association between indices of 2D:4D, BMI and WHR. Needless to say, further studies are required to elaborate on this concept.

Are lateral preferences in mastication and tongue movement new types of sided preference in humans?

Sdravou Katerina, Koskina Christina, Antonia Ypsilanti and Grouios George
Aristotle University of Thessaloniki, Greece

The purpose of this study was to determine whether the consistent and predominant preference in masticatory (i.e., the chewing-side preference) and tongue movements for one side of the dentition are new types of lateral preference in humans, comparable with handedness. Lateral preferences in mastication, tongue movement and manual dexterity of upper limbs was tested in 36 adults (10 males, 26 females) with full healthy dentition and a mean age of 33.36 years (SD= 8.89). The data were submitted to chi square tests to examine differences in frequencies in masticatory laterality, tongue laterality and handedness. The results showed that the percentage of right handers that exhibit right masticatory laterality is significantly higher compared to non-right handers [$\chi2\ (2) = 5.69$, $p< 0.05$]. Similarly, right handers exhibited significantly higher frequency of right tongue laterality with closed mouth compared to non-right handers [$\chi2\ (2) = 4.70$, $p< 0.05$]. Further analysis documented that individuals with right masticatory laterality also exhibited increased frequency of right tongue laterality [$\chi2\ (2) = 4.94$, $p< 0.05$]. The results showed that masticatory and tongue laterality characteristics resembled the examined laterality parameters of hand. Although these data must be regarded as preliminary, they may serve as a starting point to the further study of these new types of lateral preference in humans. Further investigation is needed to clarify the clinical relevance of these findings.

Gender differences across valence and arousal

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Recent anatomical, functional, connectivity and lesion studies have attributed non-motor function to the cerebellum involving cognition and in particular to its posterior lobe involving emotion. What is its interaction by principal factors of emotional processing such as valence and arousal? Does gender play any specific role? We investigated these questions with magnetoencephalography (MEG). We recorded the MEG signal from ten healthy adults (5 females) as they passively viewed images from the International Affective Picture System (IAPS) collection. We employed a mixed visual stimuli paradigm, manipulating orthogonally valence and arousal. Neuronal sources were estimated using Synthetic Aperture Magnetometry (SAM) within the gamma band (30-100Hz). These were spatially coregistered to anatomical scans obtained from the MRI of each subject. Anatomical and functional images were spatially normalized to Montreal Neurological Institute (MNI) template space. Statistical maps for the main effects of gender, valence and arousal as well as their interactions were estimated at $P<0.001$ (uncorrected) via a factorial design. Our results indicate the activation of the cerebellum's left posterior lobe as a significant difference between genders. Cerebellum's right posterior lobe activation as the only gender by valence interaction was evident only in the 30-45Hz range. A gender by arousal interaction was localized on cerebellum's left posterior lobe. A gender by valence by arousal interaction was localized on cerebellum's left posterior lobe for the early gamma range and on the right one for the late gamma range. Cerebellum activity was associated to arousal and valence depending on gamma band range. These results support the idea that gamma band is modulated by factors of the affective stimuli as well as that of cerebellum's differential role between males and females. Moreover, they contribute on cerebellum's response on the interaction of valence and arousal by gender.

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Development – Disability
[SAT 3:50-5:30 TIMBER HALL A]

Neuropsychological Laterality Indices of Individuals with Neurodevelopmental Disorders: Methodological Issues

Antonia Ypsilanti[1], Klio Semoglou[2] and George Grouios[1]

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2. *University of Western Macedonia, Greece*

Laterality indices such as, handedness, eyedness, and footedness have been systematically used in the neuropsychological assessment of individuals with neurodevelopmental disorders. It has been demonstrated that non-right and contralateral patterns of laterality indices are more common in clinical groups such as, individuals with intellectual disability (ID). This finding has been associated with the increased prevalence of atypical cerebral lateralization in this population. Assuming that laterality indices are indirect measures of functional cerebral asymmetry it is tempting to utilize such behavioural tools in the assessment of the neuropsychological profile of individuals with ID. However, in the literature, measurement discrepancies and procedural differences have made the comparison across studies difficult. In order to evaluate the usability of laterality indices as an index of atypical cerebral lateralization in these populations, it is essential to use preference and performance measures. The aim of this paper is to discuss experimental data from individuals with intellectual disability (ID) on laterality indices using preference and performance measures. The results suggest that preference and performance procedures yield different hand eye and foot laterality patterns in individuals with ID, confirming thus the existence of a specific ACL profile in the ID group, that is depended on the laterality measure used. Possible explanations regarding the discrepancy between preference and performance measure of laterality are presented. The implications of these findings in the assessment and the use of laterality indices in neuropsychological research and practice are further discussed.

The benefits and feasibility of neurofeedback with children in school

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The feasibility of conducting neurofeedback in the school setting and effects on music performance, attention and school/home experience were examined in 11 year olds in a deprived part of London. This followed our demonstration in elite conservatoire musicians of professionally significant improvements in music performance in musicality, communication and technique, especially musicality including interpretative imagination (Egner & Gruzelier, 2003), and in attention (Egner & Gruzelier, 2001;2004). In school children, alongside rehearsed vocal or instrumental music performance, we also examined creative musical improvisation, sustained attention and ADHD levels of inattention. 33, 11 year-olds selected for musical potential and behavioural issues were randomised to alpha/theta (A/T) or sensory-motor rhythm (SMR) 10-session training or to a no-intervention control. Performances were filmed, randomised for order and group, and rated by teacher assessors for Creativity, Communication and Technique. With training T/A and SMR/beta ratios were increased but not SMR/theta. Improvements were seen in prepared music performance with A/T: Technique - vocal quality, diction, pitch, instrument control; Communication - confidence, posture, engagement, enjoyment; and in creative improvisation with both A/T and SMR: Creativity - imagination, well structured performance, appropriateness to title, and expression (dynamics and articulation): Communication - engagement with audience, enjoyment. In attention there was a highly significant improvement in the global attention index d' following A/T, and a tendency with SMR. 19/33 were in the ADHD range. On a structured questionnaire 19/22 trained children reported improved well-being at school or home, and carry-over to the classroom - 8 SMR and 6 A/T including science, maths, physical education, performing arts and English. Logistical, methodological and pedagogic implications will be discussed together with the value of neurofeedback as an integral part of curriculum planning. Thanks to NESTA and ARK for support.

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Brain connectivity in children with cognitive deficits and CSWS

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2. *University of Oslo, Norway*
3. *Aristotle University of Thessaloniki, Greece*

Continuous spike and wave during slow sleep (CSWS) is a clinical condition encountered in many children with cognitive impairment, such as ADHD and autism. This activity is assumed to interfere with memory consolidation and normal cognitive development and its negative effects leave their traces in adulthood, even when CSWS ceases. The working hypothesis is that changes in the brain connectivity mechanism give rise to the cognitive disturbances. To investigate this hypothesis we have applied a number of linear and nonlinear, functional and effective connectivity measures (correlation and partial correlation, conditional Granger causality index, direct directed transfer function, partial transfer entropy and mutual information from mixed embedding) to clinical datasets from children with CSWS during non REM (NREM) sleep and awake states. The objective of the study is to select the most relevant measures and assess the connectivity patterns at those states. Our results revealed the occurrence of dominant connectivity patterns that slightly enhance during the night. Further, we could estimate sites of spiking activity. These findings have been related to the spike index (SI) – a measure of the influence of the pathological activity in the brain. Overall, the results point out that the dominant connectivity during night in those affected children, persists during the day, thus altering the normal neural connectivity of the brain and thus affecting normal cognitive functioning.

Rhythms of Dyslexia

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2. *qEEG,UK*

Research reviewing the evidence for a Temporal Envelope deficit in Dyslexia is discussed and extended to the idea of a P (perceptual) centre in both speech and non-speech. This converges with other research into beat perception suggesting a more general underlying P-centre deficit That is general across all rhythmic activities affecting all sensory modalities and affecting all languages. These rhythmic oscillations may be part of a theta-phase tracking mechanism, which is amenable to Neurofeedback as well as other rhythmic interventions based on frequency, such as music. Event related potentials are suggested to be the best marker for Endophenotyping of Dyslexia, with auditory, visual and motor sub-types.

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Connectivity
[SAT 3:50-5:30 TIMBER HALL B]

EEG coherence depending on EEG power during rest state and cognitive task solving

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Lessya Ukrainka Volyn National University, Ukraine

The differences in EEG coherence values of subjects with different EEG power were studied. It was proposed that coherence values were differently influenced by the signal-to-noise ratio which should be in relation to EEG power. From the total database of 154 EEG records 19 cases were selected. The EEGs were recorded from subjects who had similar psychological characteristics: they all were male, extroverts with high IQs. All EEGs were characterized by a clear and generalized alpha-rhythm during the resting state. EEG was recorded during the resting state and cognitive tasks. According to the results of cluster analysis, subjects were divided into three groups: low, medium and high EEG power during the resting state. Theta-, alpha-band and alpha sub-band ranges were calculated in relation to the individual alpha-frequency. It was shown that in the alpha-band, and particularly in the alpha-1 sub-band persons with high EEG power had significantly lower coherence values in comparison with the other two groups. Persons with medium EEG power had higher coherence values in the beta-band than groups of persons with low and high EEG power. Those differences were observed during both the resting state and cognitive tasks and were typical mainly for interhemispheric connections. We consider that higher coherence values in the group of persons with medium EEG power in beta-band can be explained by the conditions of experiment: all EEGs were characterized by clear alpha-rhythm during the resting state. The group with high EEG power therefore must have their power spectrum shifted mainly to the alpha-band, the group with low EEG power - a more powerful spectral beta-band with a lower signal-to-noise ratio, while the group with medium EEG power has an optimal signal-to-noise ratio in the beta-band.

Dynamic changes of ICA power spectra-derived EEG functional connectivity between eyes open and eyes closed states: resting state network

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3. *Goldsmiths, University of London, UK*

Background: While a major issue for neuroscience is to map accurately the synchronization of brain areas with information processing, the identification of baseline states, e.g., a resting state network (RSN) or a default mode network (DMN), is also essential for the interpretation of brain activation. Recently independent component analysis (ICA) of EEG-fMRI studies has elucidated spatiotemporal synchronous patterns and neuronal sources at rest. However, little is known about the electrophysiological spectral power correlations arising from the change of synchronization from eyes closed (EC) to eyes open (EO), the traditional EEG baseline index.
Methods:With N = 27 participants we applied a four-step analytic approach to organizing the clustering of alpha power-related independent components (ICs) in both EC and EO states: ICA estimates, similarity measures to cluster and subgroup alpha power-related ICs, standardized low-resolution tomography analysis (sLORETA) for source localization, and spectral power within subgroups and ICs together with changes from EC to EO.
Results: We found five main statistically clustered subgroups with relevant independent components, whose sources (occipital, frontal, parietal, occipitotemporal and central subgroups) were clearly identified in 2D and 3D space. Importantly, graph analysis revealed two significant functional networks associated with frontal/parietal systems and an occipitotemporal visual system, both associated with EO. Furthermore, from the EC to EO, delta, beta2 and gamma power were significantly enhanced in frontal subgroups with a reduction of theta, alpha, SMR, beta1 and beta2 powers posteriorly in central to occipital subgroups. Increased gamma power accompanied decreased alpha power from EC to EO in the occipital area.
Conclusion: In the EO state multi-dimensional scale (MDS) plots showed a strong relationship of a frontal/parietal attentional system, and a close correlation of occipital and occipitotemporal subgroups. These results imply that independent physiological mechanisms may co-exist to sustain RSN and DMN resting states. The ICA-based RSNs of the spectral power-related clustered subgroups in the resting EC and EO states may have value in elucidating activational challenges and dysfunctional brain conditions.

Functional connectivity of the anterior insula using resting state fMRI

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The anterior insula has anatomically distinctive dorsal and ventral aspects that contribute to the processing of salient information. Task-related imaging studies have further suggested a functional differentiation for these two regions, such that the dorsal anterior insula is distinctly activated by attention tasks, whereas the ventral anterior insula is distinctly activated by the experience of emotion. Here, we used resting state functional connectivity magnetic resonance imaging (rs-fcMRI) in 31 adults (mean age = 24.2, 11 males) to investigate the hypothesis that the dorsal and ventral anterior insula are nodes in separable large-scale functional networks involved in executive control and affective experience, respectively. Our results showed that the functional connectivity patterns of the two anterior insula subdivisions are separate from each other. Low frequency blood-oxygen-level-dependent (BOLD) signal fluctuations of the dorsal anterior insula were correlated with signal fluctuations of regions implicated in cognitive control, such as frontal, parietal, and dorsal anterior cingulate cortex. In contrast, the ventral anterior insula region was functionally connected with regions known to be involved in emotion, including ventral anterior cingulate cortex, orbitofrontal cortex, and amygdala. Importantly, the strength of intrinsic functional connectivity within the dorsal and ventral anterior insula networks predicted individual differences in cognitive control and affective experience, respectively. Overall, our findings suggest that the identification and manipulation of salient information is subserved by at least two brain networks that have widely distinct large-scale topography, a dorsal anterior insula involved in cognitive control and a ventral anterior insula network implicated in affective experience.

Disorders
[SAT 3:50-5:30 DOCK SIX HALL]

Deficiency of Executive Functions in Chronic Primary Insomnia

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Objectives: Chronic insomnia is a highly prevalent sleep disorder and the second most serious health problem in the medical practice. Nocturnal sleep disturbance and impaired daytime functioning with complaints of cognitive deficits are characteristic of insomnia. The current study was conducted to evaluate executive functioning, as well as nocturnal sleep and daytime parameters in chronic primary insomnia.

Methods: The study participants were 30 non-complaining normal sleepers (26,87 ± 4,60 years old) and 30 insomnia sufferers (26,80 ± 3,96 years old). The two groups were matched for sex, education level and chronotype. Sleep quality and quantity were estimated using wrist actigraphy and sleep log data collected for 7 consecutive 24-hour periods. Neuropsychological assessment included tests of attention, working memory, verbal fluency, planning and decision making.

Results: The mean insomnia history was 122,13±89,43 months long. 90% of the insomniacs complained of difficulty falling asleep, 63,3% of maintaining sleep and 70% of early morning awakening and non-restorative sleep. No statistical differences were found in tests of excessive daytime sleepiness (EDS), while insomniacs reported more fatigue symptoms. Significant differences were observed in tests of sustained attention, the phonological loop and visuospatial sketchpad. Moreover, insomniacs had significantly lower performance in tasks of maintenance, codification and manipulation of information, inhibition of habitual but inappropriate responses and in one test during the dual task paradigm. Regarding fluency, insomniacs generated fewer words in the third task of both letter and category cues in verbal fluency tasks, whereas they generated more unacceptable designs in the design fluency task.

Conclusion: Our chronic insomniacs suffered from multiple sleep difficulties, experienced fatigue and general discomfort, but no EDS symptoms were present. Even young insomniacs present subtle neuropsychological deficiencies in fluency, owing to sustained attention deficits, and working memory, especially regarding the central executive.

Consciousness In Non-Responsive Patients: fMRI and EEG Data

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2. *Encephalos-Euromedica Diagnostic Medical Center*

Objectives: Is there a way to assess consciousness in apparently non-responsive patients? The present study attempts to address this question by measuring hemodynamic and electrical brain activity.

Methods: fMRI and EEG was recorded during verbal stimulation with motor commands ("move

your hand") vs. non-motor commands, separately for each hand, in patients with persistent vegetative state (PVS, 10 patients), or minimally conscious state (MCS, 2 patients), and in 8 healthy controls.
Results: Group analysis of 8 healthy volunteers showed significant fMRI activations in contralateral primary motor cortex, supplementary motor area, pre-motor cortex, and ipsilateral cerebellum. Patients with MCS showed partial similar activations. Patients with PVS showed sporadic activations. A common pattern of EEG responses appeared in healthy volunteers, mostly in inter-electrode coherence of the 10-12 Hz frequency. Patient data are under analysis.
Conclusions: fMRI and EEG measures of brain activity may help assess consciousness in apparently non-responsive patients. This procedure may help selection of patients for further treatment with electrical brain stimulation.

Antiretroviral CNS Penetration Effectiveness rank is associated with HIV-related peripheral sensory polyneuropathy and intraepidermal nerve fiber density

Elias Skopelitis[1], Athanasios Kontos[1], Panayiotis Kokotis[2], Kyriaki Aroni[3], George Panayiotakopoulos[4], Kyriaki Panagiotopoulou[1] and Theodore Kordossis[1]

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2. *Aeginiteion Neurology Hospital, Greece*
3. *University of Athens, School of Medicine, Dept of Pathology, Greece*
4. *University of Patras, Greece*

Objectives: A method for quantifying penetration of antiretroviral (ARV) drugs was devised and validated in the CNS HIV Anti-Retroviral Therapy Effects Research (CHARTER) study, providing a rank of combination drug regimens by algorithmically combining the individual drug rankings. The CNS penetration-effectiveness (CPE) rank was associated with CSF VL. Patients treated with regimens having lower CPE ranks showed more residual CSF viral replication than those treated with higher CPE ranks. The present study aimed to investigate whether the CPE rank was also associated with the degree of peripheral sensory polyneuropathy (PSPN).
Methods: A total of 102 consecutive HIV patients from an outpatient clinic were studied with clinical examination, electrophysiology, and intraepidermal nerve fiber density (IENFD) for the presence of PSPN. The HIV status, surrogate markers and antiretroviral history was recorded and the CPE rank of the current ARV regimen was calculated. Statistical analysis was executed using SPSS 15.0
Results: Almost 16% presented with symptomatic PSPN and another 36% demonstrated subclinical PSPN, recognized by means of electrophysiology and IENFD determination. IENFD was associated with more advanced HIV disease, lower nadir CD4 count, and exposure to NRTIs. The median CPE rank for the patient population was 1.5 (range 0-3). The CPE rank did not differ in patients with or without PSPN. Using the cutoff value of CPE = 2 the regimen was characterized as CNS effective or not effective. Patients under not CNS effective regimen had lower values of IENFD (3.36 ± 1.75 vs 6.02 ± 2.47, $p=0.02$). IENFD correlated with the CPE rank values ($r=0.31$, $p=0.045$).
Conclusions: The use of ARV therapy capable of penetrating into the CNS was associated with worse IENFD, a measure of small fiber neuropathy, even though patients with and without peripheral sensory polyneuropathy diagnosis did not differ in respect of CPE rank of their ARV regimen.

Posters

(PS-1) Method of the EEG Operant Conditioning for the Children with Learning Disabilities

Paulis Butlers

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Introduction: EEG operant conditioning (neurofeedback) has been developed and used as a form of integrative therapy particularly for children with learning disabilities. This method is based on the neuronal conditioning of specific cerebral EEG activity.

Material and methods: More than 240 EEG records were analysed from Cz, C3 and C4 scalp areas of 12 children (8 to 12 years old) with learning disabilities during 20 sessions of neurofeedback training. A standard protocol of sensorimotor SMR frequency band (12-15Hz) enhancing with concurrent reduction of theta (3-6 Hz) activity was applied. 2-chanel EEG module 2E (BrainMaster Technologies, Inc.) with standard software was used. Linear (Pearson) correlation analysis of the power of different EEG frequency bands at the same scalp area during neurofeedback training sessions for each child was performed.

Results: Correlation analysis during successful neurofeedback training (of the responders only) revealed significant ($p > 0.05$) positive correlations between the power of the SMR band and the power of the alpha2 (10-12Hz) and beta1 (15–20Hz) frequency bands. There were significant negative correlations between the SMR and low frequency (theta and delta) bands as well as nonsignificant correlations between SMR and alpha1 (8-10Hz) activities.

Conclusions:

1. Standard neurofeedback SMR training increases the peak frequency of the brain's dominant alpha rhythm. These findings suggest that different neurofeedback protocols namely SMR power or alpha peak frequency enhancing both have the similar neurophysiological correlates associated with enhancing of the cortical arousal.

2. Preliminary results of the correlation analysis during SMR neurofeedback training reveal the following new neurofeedback protocols for future approbation:

a) if there is reduced left hemisphere cortical arousal and increased right hemisphere arousal the training protocol could contain SMR or beta1 enhancement at C3 and alpha1 enhancement at C4 with concurrent suppression of theta activity;

b) if there is reduced right hemisphere arousal and increased left hemisphere arousal the training protocol could contain SMR or beta1 enhancement at C4 and alpha1 enhancement at C3 with concurrent suppression of theta activity.

(PS-2) Effects of remifentanil on processing of auditory stimuli: a combined MEG/EEG study

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Background: Remifentanil (Ultiva®) is a potent ultra-short acting mu-opioid receptor agonist used for pain treatment and anaesthesia. So far, it is not known how sensitive the cognitive processes of auditory perception elicited by the mismatch negativity (MMN) paradigm are to opioids.
Objective: The present study investigated how remifentanil modulates different stages of auditory processing as reflected in the MMN and P3a.
Methods: In 20 healthy participants we recorded electroencephalography (EEG) and magnetoencephalography (MEG) when presenting auditory stimuli. We used a six stimuli multiple deviant paradigm consisting of standard repeated stimuli (50%), four different deviant sounds (frequency, intensity, gap and duration) and novel sounds. Additionally, effects of remifentanil on psychomotor function and subjective effects were assessed.
Results: Preliminary analyses indicate that remifentanil significantly increased the dipole strength of the MMNm for the novel sounds in the left hemisphere. Moreover, remifentanil significantly delayed the dipole time of females for both the deviant and novel sounds. In the EEG, the P3a after novel sounds was significantly increased by remifentanil on the C4 electrode. No treatment effect was found for the MMN. Behaviourally, remifentanil slowed down psychomotor function and affected several subjective feelings e.g. sleepiness and nausea, albeit more so in females than in males.
Conclusions: These results suggest that while the stimulus change detection system appears to be relatively insensitive to opioids, the attentional switch caused by the change detection seems to be modulated by the opioid system. The multiple deviant paradigm including novel sounds is a promising tool for investigating pharmacological manipulation of different stages of auditory processing. Furthermore, MEG and EEG are complementary in the field of mismatch negativity. Combining the two techniques will yield more specific information about the drug effects on MMN.

(P S - 3)

Management of patients with intracerebral hemorrhage due to aneurysm rupture

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Patients who present with intracerebral hemorrhage (ICH) due to aneurysm rupture usually require urgent clot evacuation and aneurysm obliteration. It is well known that the presence of ICH after aneurysm rupture negatively influences the patient's outcome. Controversy persists regarding the optimal management of ICHs caused by aneurysm rupture.
We studied retrospectively 214 cases of ICH due to aneurysm. The patients were subjected to either urgent surgical removal of ICH and simultaneously aneurysm clipping or coiling of aneurysm was performed primarily and ICH removal after improving of patients' condition. The outcome was studied using the Glasgow Outcome Score. The patients were divided into 2 groups due to Hunt-Hess grade: 1st group (87 patients) with I-III grade, who underwent removal of ICH and aneurysm clipping and 2nd (127 patients) group with IV-V grade. In the 1st group good recovery and moderate disability were in 73.5% cases, severe disability, vegetative state – 11.5%. Lethality rate was 15%. In the 2nd group 62 patients underwent ICH removal and aneurysm clipping. 12 (19.3%) of them had vegetative state, 50 (80.7%) died. In this group in 65 cases coiling was performed primarily, after improving of condition ICH was evacuated. In these cases good recovery and moderate disability were in 53.8% cases, severe disability and vegetative state – 12.4%. Lethality rate was 33.8%.
Thus, we recommend urgent ICH evacuation and aneurysm clipping for patients with I-III Hunt-Hess grade. Patients with IV-V Hunt-Hess grade should be submitted to coiling first and ICH removal after improving of patients' condition.

(PS-4)

Management of patients with intracerebral hemorrhage due to arteriovenous malformation

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Patients who present with intracerebral hemorrhage (ICH) due to arteriovenous malformation (AVM) usually require urgent clot evacuation and resection or endovascular embolization of AVM. It is well known that ICH as a result of AVM negatively influences the patient's outcome. Controversy persists regarding the optimal management of ICH due to AVM.

We studied 137 cases of ICH due to AVM. The patients were subjected to either urgent surgical removal of ICH and simultaneously AVM resection or ICH evacuation was performed primarily and after improving of patients' condition embolization or resection of AVM was conducted.

The patients were divided into 2 groups using the Spetzler-Martin scale: 1st group (62 patients) with I-III grade, who underwent ICH removal and simultaneously AVM resection and 2nd (75 patients) group with IV-V grade. In the 1st group good recovery and moderate disability were in 64.6% cases, severe disability and vegetative state – 12.9%. Lethality rate was 22.5%. In the 2nd group 32 patients underwent ICH removal and simultaneously AVM resection. 13 (40.6%) of them had vegetative state, 19 (59.4%) died. In other 43 cases ICH removal was performed primarily, after improving of condition embolization of AVM was performed. In these cases moderate and severe disability were in 53.4% cases, vegetative state – 14.0%. Lethality rate was 32.6%.

Thus, we recommend urgent ICH removal and simultaneously AVM resection for patients with I-III Spetzler-Martin grade. Patients with IV-V Spetzler-Martin grade should be submitted to evacuation of ICH first and endovascular embolization of AVM after improving of patients' condition.

(PS-5)

Effects of Himalayan Tradition meditation during a SSVEP study

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The study of the human brain during the altered states of consciousness induced by various techniques is an important tool in the search of man for the neural correlates of consciousness. Meditation is one of the most prominent and accessible paths to achieve entering these states of consciousness in a stable and gradual manner.

In the experiment presented herein, five long-term meditators and five control subjects with no prior experience with meditation were selected. They were instructed to either meditate for half an hour or let their mind wander freely in past neutral autobiographic memories, depending on the condition chosen in each trial, and following that they were exposed to a screen flickering in various frequencies. This flickering is inducing a response of the neurons in the visual cortex at the frequency of the stimuli.

The data recorded were subjected to automated and manual filtering and preprocessing. The artifact removal process included analyzing the channels into independent components and rejecting the components that corresponded to the various artifacts. Following the preprocessing, the data were split and the analysis was carried out for the 20 Hz frequency for the external stimulus. Spectral analysis was performed for different frequency bands and parametric statistics tests, as well as random statistics tests, were run between the conditions and the groups.

An important differentiation in the total power between the two groups was observed as well as a clear amplification of the external stimulus (20 Hz) and it's subharmonic (10 Hz) which is an indication of the brainwave entrainment that occurs. An important difference in the occipital alpha and central gamma electrodes was noticed, which where explained in the basis of the difference in experience and the resulting effectiveness of meditation between the two groups.

(P S - 6)

Positive Attitudinal change in the established horizons of the health seeking behaviours of parents/care givers of children with neuropsychopathology following a standardized proffer of evidence based novel instrumentations/interventions.

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Background/Purpose: Globally, for a long time childhood neuropsycholopathologies were thought to be permanent, hence the initial pursuit of the intramurally amenable management options enthusiastically was unwelcomed. However, more recently, the formidable evidence based advances in novel instrumentations/interventions lent future to all. Previously, the benefits/ positive impacts of these novel interventions were not specifically addressed. This study examines the impact of emphasizing the importance of these novel options when proffered/reiterated in a standardized documented manner.
Methodology: This study was a nested investigation to ongoing audits of cases seen in our childs neuropsychopathology clinics following a standardized documentation of the health seeking behaviours of parents of children with symptomatic neuropyschopathology needing futher advanced evaluations at QEEG/MEG/fMRI/MRS/Repititive Transcranial electromagnetic stimulation therapy/ Sloreta/ Tractographies/ SPECT/ NIRS/ Molecular/ genetic/ Chromatographic work ups/ novel chemical chaperone ,vagal nerve stimulatory,enzyme replacement, metatone sound therapies, Audiovisual stimulations, Integrative physical/psychotherapies, EEG neuroperipheral feedbacks, nervous system computer interfaces, clinical educational/sports/optimal performance applications, rehabilitative physical therapies,other novel/complimentary evidence based interventions against those presenting ordinarily with paroxysmal events(UPE) without such needs following a physician directed /documented suggestions of novel options in the former relative to a generically parents/care givers led/driven/proffered interventional options in the latter.
Results:Relative to the control group, figures for the attitudinal alterations to the health seeking behaviours for the specifically counseled symptomatic subsets were positive/ statistically/clinically superior ,it was best for overall hospital attendances ,then eagerness to pursue investigativs,drug adherences, the exploitation of intramurally accessible assistive/augmentative devices. Acute admissions were diminutive, associated with an overall objective/subjective satisfactorily response. Parents of children with non-syndromic selective audio-vocal developmental difficulties, Idiopathic globally neurodevelopmentally delays, followed by the CPs, PDDs, ADHS, symptomatic seizures subsets and finally the syndromic aneuploidies. Importance: The key findings of this study intimates that these approach ameliorated the previous emptiness/ enhance overall positive outcomes. A combination of interventional strategies will seem to improve overall outcome.

(P S - 7)

Word learning and remembering in toddlers: An ERP & behavioural study

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The learning of a new word requires the ability to map a novel word form onto a novel referent. This ability (fast mapping) develops already between 12 and 14 months of age. Nevertheless, initial word learning appears to be a slow and time consuming process and not until the age of 18 months are children able to quickly learn new words (vocabulary spurt). However, newly acquired word representations are initially unstable and require a process of strengthening (consolidation) for later recall. The process of consolidation comes to pass off-line, during sleep, and is related to the maturation of specific brain structures: prefrontal cortex and the dentate gyrus of the hippocampus (Richmond & Nelson, 2007). It is not before 20 to 24 months of age that these structures are functionally mature. The goal of the present study was to investigate whether infants at the age of 20 and 26 months have the ability to create stable memory representations of newly acquired words. If so, is this ability reflected in specific ERP-responses during learning and are these age-dependent? During an ERP training phase, 20- and 26-month-olds were repeatedly presented with pairs of novel objects and novel words. The training phase was followed by a test phase one day later, after night-sleep, to evaluate word learning and remembering. The ERP results show different learning effects for 20- and 26-month-olds. The 26-month-olds display a frontocentral negativity (400-800 ms), whereas the 20-month-olds show an increase of the P100 and a late parietal positivity (800-1000 ms). The behavioural test results indicate successful recall only for the older group of toddlers, i.e. after maturation of the related brain structures. This leads us to the assumption that the frontocentral negativity reflects processes of efficient encoding, which is important for long-term storage of a new word and its referent.

(PS-8) Developmental regulation of spontaneous network activity in mouse cortical slices

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The cerebral cortex is intrinsically active. During quiescent brain states (e.g. non-REM sleep and anesthesia) cortical networks develop spontaneous rhythmic activity in the form of slow oscillations (SO). The cellular correlates of the SOs are sustained epochs of depolarization and increased likelihood of action potential firing (Up states), interspersed with epochs of hyperpolarization and decreased activity (Down states). Since Up/Down states develop spontaneously, in the absence of sensory inputs, and also in vitro, in brain slices, they are considered the default activity of the cortex, and thus an intrinsic network property that can serve as an endophenotype of cortical circuit function.

Despite their significance, the effect of development and ageing on cortical Up/Down states is unknown. Moreover, previous research on SO activity has been conducted in different species, ages or brain areas, leading to contradictory findings and complicating functional interpretations. Here we investigate the effects of development across different cortical regions, by monitoring spontaneous activity in vitro with simultaneous intracellular and field potential recordings. Cortical Up states are examined in animals ranging from the first postnatal week, to adult and aged animals (24 months), thus covering the entire lifespan. Two cortical regions with distinct function and cytoarchitecture are monitored: (i) the primary whisker somatosensory cortex, or barrel cortex, and (ii) the primary motor cortex. Simultaneous recordings at different layers of the same cortical column, or in different columns are obtained to assess network and cellular activity correlations. Initial results reveal systematic differences in network dynamics as a function of age and cortical region, reflecting developmental changes in the cortical circuitry. Besides providing important information on intrinsic activity as an endophenotype of cortical function we believe this work will form a useful background upon which to compare and characterize a number of mouse models of neurological and psychiatric diseases.

(PS-9) Perceived Effort Changes Reported on the 0-10 NRS Following Submaximal Isometric Fatiguing

Exercise of Elbow Flexors

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Perception of effort is often used to assess fatigue (Presland et al., 2005; Søgaard et al., 2006) but the time course of the perception changes following a short bout of fatiguing exercise has not yet been clearly established. The perception of effort changes following a fatiguing isometric elbow flexion using the effort 0–10 Numeric Rating Scale (NRS) and the neurophysiological changes accompanying fatigue were therefore examined. Twelve healthy participants (4 men and 8 women, 35±9 years old) undertook 10 minute intermittent isometric fatiguing elbow flexions at 50% of Maximum Voluntary Contraction (MVC). Perception of effort ratings recorded at 30 and 50% of individual's MVC were compared with baseline measurements. Single-pulse TMS (MagStim Co, UK) over the left motor cortex evoked potentials (MEPs) which were recorded by standard surface electromyography from right m. brachioradialis. Peripheral electrical stimulation (constant current stimulator Digitimer, DS7A, UK, range 1–100mA, duration 1ms) was used for the assessment of voluntary activation of m. biceps brachii by evoking force twitches during MVCs.

10min of isometric elbow flexion caused a 44% reduction in the MVC ($p<0.001$) accompanied by a small reduction in the EMGmax ($p=0.108$) and M-wave ($p=0.15$) of biceps and a 13% reduction ($p=0.48$) of the brachioradialis MEP amplitude. The resting twitch force decreased ($p<0.001$) while the superimposed twitches increased (more than double in size) ($p<0.001$) following the fatiguing exercise. The mean effort ratings increased significantly by 2 points on the NRS for the 50% and 1 point for the 30% of absolute MVC post exercise. They were accompanied by significant increases of the mean EMG levels of both biceps and brachioradialis at submaximal contractions.

Perception of effort remained significantly increased throughout the 30 minutes post-exercise monitoring period and it was associated with changes in both peripheral and central fatigue, indicating that the perceived effort follows the post fatigue changes in the motor neural drive.

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(PS-10)

Characteristics of EEG in Subjects with High Level of Identification of Emotions in Speech.

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In our previous study we investigated individual psychophysiological characteristics in subjects during identification of emotional intonation in speech. EEG was recorded at rest and during emotion recognition task (identification of emotions in tape-recorded samples of speech with the undertones of joy, fear, grief, anger, and indifference). This method was developed and kindly provided by Prof. V.P. Morozov. As a result of the experiment, the subjects, 61 healthy students (age 18 – 25), were divided into 2 extreme groups. Subjects with low emotion identification rates showed a significantly higher brain activation and reactivity both during the emotion identification task and at rest as compared to the subjects with high identification rates. The data revealed specific activation within the right posterior temporal cortex during the task in subjects with low identification rates.
In the present study we similarly examined a group of subjects with artistic personality (professional musicians and designers – 10 male and 11 female subjects, age 19 - 35). 48% of the participants showed high level of emotion identification (in the previous study it was 31% of the subjects). Consequently we compared EEG characteristics in groups with high level of emotion identification in 2 studies. The values of coherence in the group of "musicians" were significantly higher in the central, posterior and temporal parts in delta, theta, alpha and betha-1 frequency bands. In gamma band and the frontal sites in delta, theta, alpha and betha bands meanings of coherence were significantly higher in the group of "students". This can be interpreted as an inhibiting influence of relaxation and decrease of cognitive effort on the emotion identification process. The growth of activation and cognitive tension (attention, memory processes, which are indicated by the alpha and gamma frequency bands) disturbs successful identification of emotions in subjects with low emotion identification abilities.

(PS-11)

Individual Differences in Hippocampal Configuration Learning as Predictor of Intrusive Memories

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The revised dual-representations model of PTSD [Brewin, C. R., Gregory, J. D., Lipton, M., & Burgess, N. (2010). Intrusive Images in Psychological Disorders: Characteristics, Neural Mechanisms, and Treatment Implications. Psychological Review, 117, 210-232.] claims that traumatic events lead to reliving symptoms (e.g., intrusions, flashbacks) when highly emotional sensation-based representations are formed in the amygdala and insula while the hippocampal area fails to construct a complete context-based memory for that event. As a result, one is unable to integrate the distressing sensation-based memory with other autobiographical memories. Accordingly, we hypothesized that individual differences in the efficiency of the hippocampal area to support contextual memory formation can predict the development of intrusive memories after trauma. The present study tested this idea in a healthy undergraduate sample by assessing individual differences in implicit configuration learning using the Spatial Contextual Cueing Task, which measures the degree to which participants bind and memorize configurations of multiple visual cues and is known to rely on neuronal activation in the hippocampal area. Also, participants viewed shocking video fragments in order to induce intrusive memories. We then assessed the number and quality of intrusions during one week as well as startle eye-blink potentiation in response to pictures reminiscent of the shocking video fragments. Stable individual differences that might mediate the relationship between implicit configuration learning and intrusive memories were also measured, including self-reported emotion regulation, resilience, anxiety and depression. We will present (preliminary) results of at least 50 participants.

(PS-12)

On the extension of ordinal time series analysis for multisite recordings: a new method and its use in discriminating EEG activity during different mental tasks.

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OBJECTIVE: Analyzing ordinal patterns has recently gained high popularity among practitioners of nonlinear dynamics and currently appears as a powerful tool of Symbolic Time Series Analysis capable of revealing changes in the dynamics of EEG data [1]. In its original format, the particular approach is tailored to unidimensional timeseries, hence its straightforward application to brain signals is restricted to single-sensor measurements. The treatment of multisite recordings by analyzing the dynamics in a channelwise fashion is obviously a problematic approach, as it is equivalent to ignoring any coordinated activity patterns emerging from the coherent activation of distinct brain areas. We introduce here a vectorial version of ordinal time series analysis that can fully encompass the multidimensional character of brain's activations and covariations. By applying it to EEG-data from subjects while performing mental calculations, we show that our approach can differentiate between, otherwise, indistinguishable brain states.
METHODS: A sliding window is moving along the N-dimensional time series (each recording site treated as an individual variate). At every step, the window encloses M successive vectors on which we apply a vector-ranking operator and the resulting ranks provides the ordinal pattern associated with the particular signal-segment. This is, always, just one of the permutations of {1,2,…,M}. By simply counting the number of different ordinal patterns, which appear while traversing the whole time-series, we end up with a histogram reflecting the variations in global brain dynamics. Having established this representation, the contrast between distinct brain recordings (and hence different brain states) takes the form of a histogram comparison that can be implemented readily and in various numerical ways.
RESULTS: Based on a well-established statistical index, we measured the class-separability between EEG-activations during math calculations and EEG-activations at rest. Using surrogate data analysis, we prove the statistical significance of these measurements. In addition we were able to distinguish between different mathematical tasks. Moreover, the chanellwise approach was found of limited power.
CONCLUSIONS: The vectorised version of ordinal time series analysis offers a promising new way to study and characterize brain dynamics.

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(PS-13)

Estimating brain connectivity patterns from EEG: Performance of Granger Causality, PDC and PSI on simulated data

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Introduction One of the major challenges in electroencephalography (EEG) analysis is the determination of directed (causal) information flow between brain areas. The common definition is based on the argument, that "the cause must precede the effect", which is implemented by Granger Causality (GC), Partial Directed Coherence (PDC) and the Phase-slope Index (PSI). However, due to volume conduction in the head, the original causally-related sources are mixed into EEG channels. We conducted a realistic simulation study to investigate how volume conduction affects EEG sensor-space effective connectivity estimation.

Methods: Two interacting sources were simulated by means of a bivariate autoregressive (AR) model with all-zero coefficients A1,2(p), but nonzero A2,1(p). The source time courses were mapped to 59 EEG sensors using the realistic spread of two dipoles with tangential orientation located 3cm below electrodes C3 and C4. Simulated brain noise was added to the signal, along with white sensor noise (SNR=1). 100 experiments were conducted using different noise and source AR coefficient realizations and innovation terms. Significance of the net information flow was assessed using Student's t-test.
Results: Only PSI correctly indicated significant inter-hemispheric information flow. GC indicated significant symmetric bilateral flow from EEG channels with high SNR to channels with low SNR. The estimated connectivity pattern according to PDC was exactly opposite to that of GC, i.e., information was estimated to flow from low-SNR channels to high-SNR channels. This flow reversed when the EEG time series were normalized to unit variance. PSI and GC estimates were not affected by the normalization.
Discussion: GC and PDC are based on the consideration that knowledge of the "driver's" past increases the prediction of the "receiver's" present state, compared to only using the receiver's past. In the presence of volume conduction and sensor noise, however, this is true for all EEG channel pairs. GC, which is based on comparing prediction errors, then determines the channel with higher SNR as the net driver. PDC are derived from coefficients of a multivariate AR model, which additionally depend on the scaling of the data. PSI utilizes the imaginary part of coherence, which is unaffected by (mixed) non-interacting signals (noise). The determination of net drivers and receivers here solely depends on the relative contribution of the interacting sources per channel pair.

(PS-14) Cardiovascular risk factors to be used as markers for cognitive deficits.

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Objective: Mild cognitive impairment (MCI) is an early stage of cognitive decline that has a major risk of converting to dementia. Cardiovascular pathology appears to have a major impact in cognitive decline, and it is clear that early identification and correction of cardiovascular morbidity could have a major impact on cognitive functioning.
Subjects and methods: Our study was conducted in order to identify some cardiovascular risk factors among patients with cognitive decline (Alzheimer disease-AD or MCI) and to find if there is any correlation with the degree of cognitive decline. We evaluated the body mass index, total cholesterol, hypertension, history of smoking, alcohol consumption and diabetes mellitus in patients with MCI and AD, compared with an aged-matched control group.
Results: Regarding the body mass index, we observed a progressive decrease in patients with MCI and AD, in comparison with the control group. The same thing was observed in the case of cholesterol levels, only that post hoc analysis revealed no significantly statistical differences between MCI and AD groups. The systolic blood pressure was increased in the patients with MCI and AD. Also, as in the case of cholesterol levels, post hoc analysis revealed no significantly statistical differences between MCI and AD groups. Pearson's correlation showed significant connections between the cardiovascular risk factors and the results of the cognitive evaluation.
Conclusions: Our results bring additional evidences that cardiovascular risk factors are involved in the cognitive regression. This could have an important impact on the management of dementia.

(PS-15) A randomised double-blind trial of the effects of Reiki on the germination of Gamma-irradiated Canary seeds

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Three separate double-blind experiments were conducted to investigate whether Reiki effects the germination of radiation-damaged seeds. In each experiment different Reiki Masters each treated four dishes of gamma-irradiated canary seeds for 15 minutes per dish, whereupon the germination of the seeds was compared with irradiated control seeds that did not receive Reiki. A total of eight practitioners took part – three in each of the first and third experiments and two in the second experiment. Following treatment with Reiki, the seeds were incubated for 12 days together with the control dishes. The numbers of germinated Reiki and control seeds were monitored daily by two independent experimenters whom were blind to which dishes had received Reiki, and these data were compared at the end of the study. While overall analysis of the three experiments did not find that the germination of the Reiki and control seeds statistically differed, there was a tendency for the germination of the Reiki dishes of seeds to increase relative to their controls in accordance with the order in which the practitioners treated the dishes. The dishes treated first had significantly lower germination than their controls, the germination of those treated second did not differ from their controls, while the dishes treated third and fourth both tended to have higher germination than their control dishes. However, the germination of the control dishes of the dishes treated first was higher than the controls of the dishes treated both third and fourth, presumably by chance, suggesting that the Reiki effects found may have arisen by chance. Further research is nonetheless warranted to investigate the effects of Reiki on seed germination.

(PS-16)

Brain activity linked to the filtering of visual information under uncertain conditions

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The aim of this investigation was to assess brain activity associated with patterns of "bias" in decision-making under conditions of uncertainty. The project employed QASA, a model developed by the investigators, to track both knowledge and bias (i.e., the tendency to accept or reject information) during performance in two category formation experiments. In one study, associated brain activity was monitored in 12 participants (Ps) using 128-channel EEG (EGI) recording, with Geo-source localisation software (Loreta model) then used to indicate task specific areas of EEG activation. Visual displays were presented using E-prime software. Feedback was given to establish the target concept or category, and after this was acquired, the target category was suddenly changed. Shift in bias after target change was assessed. One study (of 47 participants) involved an "abstract" category (a visual pattern defined by a particular colour and shape, etc., such as "red and square") while the second study involved a simulated military scenario with the target being a flag on a building housing suspected terrorists (eg., "red flag with black cross") and the task being to correctly identify the suspect flag before "bombing" the building. In all cases, once the correct criterion was reached, the target was changed suddenly. The behavioural data indicate that with the change in category, Ps display either a "positive" shift in bias (i.e., more restrictive or discerning) or a "negative" shift (i.e., more lax or accepting). EEG data for the abstract category task indicate that positive bias is linked to more prefrontal activity (frontal polar or orbitofrontal regions: Brodmann areas 10 and 11 respectively) than is the case for negative bias. The results will be considered in terms of brain systems that filter stimulus-response contingencies and may account for bias patterns. The implications for real-world decision-making under uncertain conditions will be discussed.

(PS-17)

Musical training effects on statistical learning of melodies: an MEG study

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The introduction of specific processes, in which musicians differ from non-musicians, enhances our understanding of experience-driven cortical plasticity. Statistical learning is a valuable process aiming to comprehend the environmental stimuli, by extracting its structure and reliable discriminate the new events that need more processing. However, important aspects of the neural correlates of statistical learning remain unknown. The goal of this study was to assess the effect of musical training in statistical learning of tone sequences using MEG. Specifically, MEG recordings were used to investigate the neural and functional correlates of the pre-attentive ability for detection of deviance, from a statistically learned tone stream. The effect of long-term musical training in this ability was investigated by means of comparing musicians to non-musicians. Results revealed a clear mismatch negativity (MMN) response in both groups (musicians and non-musicians) with equal amplitude. Moreover, both groups revealed a significant augmentation of P50 in the deviants and this response was significantly larger in the group of musicians. The behavioral results indicated that the detection of deviance was not explicitly learned, probably due to the lack of attentional resources. The enhancement of the P50 mismatch response in the group of musicians underlies a process that was trained trough intensive, specialized and long term exercise. These findings provide valuable insights on the functional architecture of statistical learning and the use of this process for the detection of new events that need more processing.

(PS-18) The Berlin ophthalmologist Bernhard Pollack, a forgotten pioneer in neuroscience

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Based on original research, this presentation portrays the pioneering work of Bernhard Pollack (1865-1928) in neurohistology. Pollack published the first standard reference on staining methods for the nervous system in 1897. That compendium went through three German editions, English, French, Russian and Italian translations. It covered most stains known at the time for neurons, fibers and glia, dissection of the central and peripheral nervous system, macroscopic examination and tissue conservation, embedding and sectioning, changes in brain weight depending on fixative, gender, age, and hemispheric dominance, macroscopic and microscopic photographic technique. Born into a Prussian-Jewish family, Pollack was educated in Berlin, Heidelberg and Leipzig. He completed his doctorate in pathology under the supervision of Carl Weigert. Upon returning to Berlin, Pollack practiced ophthalmology as an attending physician in the Polyclinic of Paul Silex. He also worked at the First Anatomical Institute of Wilhelm Waldeyer, the Neuropsychiatric Institute of Emanuel Mendel, and the Institute for Infectious Diseases of the Nobel laureate Robert Koch, and collaborated with Max Bielschowsky and Edward Flatau. Pollack's research dealt with neuroglia and its stains, neuronal damage from botulinum toxin, the innervation of the mammalian eye, optic nerve and optic disc tumors, ocular filariasis, metastatic choroidal carcinoma, spindle cell sarcoma of the frontal sinus, Sjögren syndrome, tuberculous panophthalmitis, optic nerve damage with mental signs resulting from skull fracture, and musical memory. Pollack served on the editorial board of classic journals of neurology, psychiatry and eye diseases. In 1919 he was appointed Professor of Ophthalmology at Friedrich-Wilhelms-Universität, and became well known beyond continental Europe. Besides an acknowledged medical scholar, Pollack was a world-class pianist, pupil of the composer Moritz Moszkowski. In 1911 Pollack founded the Berlin Doctors Orchestra, who this year celebrate their centennial.

(PS-19) Christfried Jakob's late views on cortical

development, localization and neurophilosophy

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This presentation highlights the groundbreaking work of Christfried Jakob (1866-1956), a German-Argentinian neurobiologist with an extraordinary scope of interests. Considering that the utmost problem of intellectual inquiry converges in cerebral function, Jakob studied the brain from the macroscopic to the microscopic level, functionally and structurally, under the spectra of development and evolution, in normality and in pathology. In crediting Jakob as an 'early neurophilosopher' we are justified by two main facts. First, he was in all likelihood one of the first professors to formally teach neurobiology in a School of Education (at the National University of La Plata, Argentina), underscoring, almost a century ago, the inevitability of bridging the humanities to biological science. Second, the philosophical denominator, evident throughout his work, reached a zenith in the later years of his research career. He published some twenty papers in the neurophilosophy domain; their key aspect is the adoption of Kantian a priori conditions of internal intuition as a basis for a theory on cognitive development ('psychogenesis') and cortical localization. In 1941 Jakob suggested that human experience is constructed upon space, time, and causality through a process that is expressed in terms of structural changes in the cerebral cortex. Within such a framework, gnoses, praxes and symbolies, processes localizable to their constitutive elements, arise and secure the individual's orientation and active intervention in the environment. Jakob held that such functions occur both in the phylogenetic and ontogenetic scales. His theorizing further comprised topics such as the philosophical meaning of the human brain (1945), the origin of consciousness (1945), and common and diverge aspects between biology and philosophy (1946).

(PS-20) Surprising dissociations in two Greek agrammatic speakers. Evidence from wh-questions and relative clauses

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Cross-linguistic studies have shown that agrammatic speakers tend to have severe difficulties interpreting both wh-questions and relative clauses (RCs) when they involve object-extraction, but not when they involve subject-extraction. In the present behavioral study we present the case of two agrammatic speakers with different brain lesions and opposite performance on the structures under investigation. Participants: Two male Greek-speaking agrammatic speakers and a control group of 10 non-impaired participants were tested. V.A. had suffered an ischemic CVA including Broca's area, the insula, inferior and superior parietal lobules, and much of the temporal lobe. E.T. had suffered a more circumscribed ischemic CVA involving only the parietal cortex.

Materials: We conducted two comprehension tasks, one with wh-questions and one with RCs. The wh-question task consisted of 30 non-referential and 30 referential subject/object questions. Similarly, the RCs task consisted of 30 right branching and 30 center-embedded subject/object clauses. Procedure: Participants were presented with a picture while they heard a sentence orally presented to them and were asked to point to the correct agent of the action. Results: V.A.'s performance was in line with studies which attest worse

comprehension of object-extraction compared to subject-extraction. However, E.T. showed the exact opposite pattern. His performance on object-extraction was significantly better than on subject-extraction. Discussion: This may be the first report of a subject (E.T.) who performs well on such a wide range of sentences involving (long-distance) object-extraction and badly on sentences involving (short-distance) subject-extraction. Processing stories are typically premised on the assumption that object-extraction is more costly. E.T. thus presents a fascinating counterexample. Clearly, it is possible for subject-extraction to break down independently of object-extraction, which suggests that short- and long-distance movement might be processed separately.

(PS-21) The Effect of Six Months Walking Exercise and Vitamin E Supplementation on Event-Related Potentials In Older People

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The purpose of this study was to investigate the possible role of walking exercise and vitamin E supplementation on event-related potentials in older people. Fifty-seven adults aged 60-85 years were randomly assigned to one of four groups: sedentary control (C), vitamin E (V), exercise training (E) and vitamin E under training (EV). V and EV groups were received vitamin E at a dose of 900 IU/day P.O. for 6 months. Trained groups were subjected to walking exercise involved 3 sessions per week for 6 months. Walking duration was gradually increased during 8 weeks, and stayed constant until the end of training period. Participants were begun walking at % 70 heart rate reserve for 20 min/day at the first two weeks, and walking duration was increased by 5 minutes/day of each week until subjects were reached a level of 50 min/day by week 8. Latency and amplitude measurements of N1, P2 and N2 components of event-related potentials were performed on all study groups both before and after training. Data were analyzed using repeated measure's of ANOVA and expressed as ±SD, statistical significance was considered at the $p<0.05$ level. P2 and N2 latency and amplitude results were found unaltered among all groups. Although significant improvement in N1 latency and amplitude measurements were found both in Fz and Cz region in E group, unaltered values were obtained in V and EV groups. In conclusion, vitamin E supplementation has no additive effect to that of walking exercise training on N1 component of event-related potentials.

(PS-22) Applying Brain Network Activation Tool on Working Memory ERPs in a Scopolamine Model of Alzheimer's Disease

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Background: An objective and sensitive neuro-pathophysiological biomarker in conjunction with a drug model of AD in healthy subjects would be a desirable application. It would set the scene for a screening tool capable of assessing the risk of developing memory deficits, still at a pre-symptomatic stage, as well as selecting the most suitable subjects for evaluating new therapeutic entities for AD.
Objectives: 1. Use the novel Brain Network Activation (BNA) analysis to define electrical activity networks associated with scopolamine (SC)-induced memory impairment. 2. Look for similarities of the individual network in the un-drugged state to the SC-impaired network, as a potential biomarker for a pre-existing AD-like activity network.
Methods: 15 healthy subjects (18-45y) participated in a double-blind, placebo-controlled, crossover study. Following administration of SC (0.4 mg) or placebo (PBO), subjects underwent cognitive tests as well as a modified face delayed match-to-sample task while EEG was recorded from 64 channels. BNA was used to extract, in an unsupervised manner, group-common spectro-spatio-temporal networks for the ERP of both the Cue and the Probe stages.
Results: We found SC-specific encoding and retrieval networks which were significantly distinct from those following PBO. Similarity indices of individual SC-retrieval networks to the aberrant SC-retrieval group pattern correlated significantly with performance decrement in the Hopkins Verbal Learning Test Revised (HVLTR). Moreover, similarity indices of individual PBO-retrieval patterns to the same aberrant group network predicted their PBO performance in the HVLTR, affirming the contention of SC BNA network being an indicator of memory deficit.
Conclusions: These results hold promise for establishing an objective AD biomarker against which inherent susceptibility and AD-related drug development may be gauged in a rather simple and cost-effective manner.

(PS-23)

The use of EEG to identify neural markers of cognitive processing limitations throughout adult maturation

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This research examines the neural activity that underlies limitations in conflict processing at two critical transitions in the adult lifespan; the end of adolescence and the beginning of old age. It is consistently found that older adults and adolescents are more impaired than their adult counterparts on tasks requiring conflict processing. Moreover the brain undergoes several structural and functional changes during these two time points. To develop a better understanding of this cognitive limitation and how it evolves throughout adult life, the electrical activity of the brain was examined as adolescents (16-17), young adults (20-30) and older adults (45-65) preformed a Stroop task. This task was designed to isolate stimulus and/or response level processing when task irrelevant distracting information (ie word reading as opposed to colour naming) induces conflict in the brain. Adolescents, young adults and older adults performed similarly in terms of reaction time and accuracy however, the underlying brain activity was significantly different. Specifically, the P3a component was significantly larger and delayed in older adults indicating additional processing was required for reorienting attention. Additionally the onset of the P1 and N2 was significantly delayed in the adolescent group however the onset of the P3b was earliest in this group. This indicates that adolescents' visual attention had stronger processing demands and this aided subsequent stimulus categorization. Also between 420-480ms after stimulus presentation there was a negative depression (N450) which is related to response conflict. This was significantly enhanced in older adults and showed an increased left activation in adolescents indicating additional processing requirements for response conflict resolution. Overall even though adult level performance was exhibited across the three groups the underlying neural activity indicates that the brain employs different cognitive strategies to compensate for limitations at both the stimulus and response levels of processing.

(PS-24) Spontaneous blink rate as a biological marker of dopamine function in old adults with mild cognitive impairment

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In the present study we aimed at testing if Spontaneous Blink Rate (SBR) can be employed as a marker of dopamine dysfunction in old adults with Mild Cognitive Impairment (MCI). The relationship between SBR and dopamine function has been strongly supported by neuropsychological studies with Parkinson's patients (Karson, 1983; Ponder & Kennedy, 1928), pharmacological studies with monkeys (Elsworth et al. 1991; Karson, 1983) and healthy humans (Blin et al., 1990), and genetic studies (Dreisbach et al, 2005). However, it has only recently been used as a reliable predictor of performance in cognitive tasks, which seems to depend on dopamine (Colzato, et al., 2007; Dreisbach, Muller, Goschke, Strobel, Schulze, Lesch et al., 2005). We measured SBR in healthy old adults and in old adults with MCI, and compared the performance of participants with high and low SBR in cognitive tasks that relay on dopamine function. We found that MCI participants differed from the healthy adults in average SBR, and most important MCI adults with low SBR performed cognitively worse than those with high SBR. This method has ethical advantages as compared to other methods, and potentially, due to its low cost, it could open new horizons of research looking at dopamine function in neuropsychiatric disorders.

(PS-25) Neuropsychological Performance In Basket-Ball Players

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Objective: to investigate the parameters of neuropsychological performance related to focused attention, attentional set shifting, sustained attention and visual-motor coordination in basket-ball players.

Method: two teams of basket-ball players from the first basket-ball league (9 males and 12 females), aged 16-24 years were compared to 21 subjects (10 males and 11 females), aged 18-25, who did not perform any significant physical activity, no recreative, nor professional. All participants completed attention tests of the Amsterdam Neuropsychological Tasks Program (ANT): Baseline Speed (BS), Focused Attention 4 letters (FA4L), Pursuit (PU), Feature Identification (FI), Shifting Attentional Set Visual (SSV), Tracking (TR) and Sustained Attention Dots (SAD). ANT is a battery of neuropsychological tests that allows systematic evaluation of information processing capacities. Measured and analyzed parameters are: speed, speed variability and accuracy of performance.

Results: basket-ball players showed significantly shorter reaction times on baseline speed (BS), tasks regarding focused attention (FA4L and FI) and attentional set shifting (SSV), while no significant difference between groups was noted for parameters of sustained attention and visual-motor coordination. No significant differences for speed variability and accuracy (number of mistakes) of performance between athletes and non-athletes on most of the tests were found.

Conclusion: our findings show that basket-ball players are faster performers than controls because they have shorter processing time within information processing than non-athlete subjects. We suppose that the training could be the reason of better and faster reaction time as well as for better focused attention an shifting of attentional set.

(PS-26)

The Influence Of Baseline And Mean Maximum Amplitude In The Ability To Control Smr

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The exact contingencies necessary to produce successful outcomes using neurofeedback are yet to be confirmed (Vernon, 2005). Furthermore, it has yet to be established whether individual electrophysiological features can influence the ability to self-regulate electrophysiological variables. The present study aimed to investigate the role of baseline EEG and mean maximum amplitudes on the ability to self-regulate sensorimotor rhythm (SMR, 12-15Hz) as measured by the percentage of time spent above the threshold. 12 adults without any psychological or neurological disorders participated in 10 neurofeedback training sessions to increase SMR amplitude, which consisted of a 2 minute baseline recording, followed by 5 x 6 minute periods separated by 1 minute breaks. The threshold was set at 0.8 times SMR baseline mean amplitude (Ros et al., 2009). Correlations between mean baseline amplitude and mean percent time above threshold across all sessions, indicated a marginally significant correlation ($r=-0.55$, $p=0.06$). Individual analyses showed this directional relationship was true for all participants, significant for 6. Correlation between mean maximum amplitude and mean percent time above threshold was not significant ($r=0.01$, $p=0.98$). Individual analyses showed no pattern in the data. Results indicate the ability to maintain SMR above threshold is not influenced by the maximum amplitude during training. However, ability to learn to control SMR might be dependent on baseline amplitude, which has important implications regarding threshold setting. Thresholds have been decided according to baseline levels so as to adjust the degree of difficulty to the natural levels shown by the individual before each training session. The present results suggest that adjusting the threshold level according to a higher baseline, for example, might increase the difficulty in maintaining SMR amplitude above threshold. Future research could investigate baseline amplitude and its predictive value regarding self-regulation of brain activity.

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(PS-27)

Is neurofeedback able to improve behaviour and academic performance in children with Attention Deficit/Hyperactivity Disorder? A comparison with pharmacological intervention

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Neurofeeedback is a promising alternative treatment to pharmacological intervention for Attention Deficit/Hyperactivity Disorder (ADHD). We present the preliminary findings of a study that aims to analyze the efficacy of neurofeedback in the improvement of behaviour and academic performance of children with ADHD. This randomized and controlled study compares neurofeedback treatment with pharmacological standard intervention, using multiple measures at different periods of time. Neurofeedback treatment consisted of 40 sessions (2 per week) of a theta/beta training protocol. Data presented here corresponds to 8 children (7-12 years old) that were randomly assigned to neurofeedback or medication. Participants were assessed before and after the treatment by their fathers, mothers, and teachers in terms of inattention, hyperactivity, behavioral problems, negative impact of ADHD in family life, and academic performance. The assessments were collected at the folllowing periods: pre-treatment asssessment, post – treatment and 2 follow up assessments. Results show a decrease in behavioural problems and an increase in some areas of academic performance after both treatments. In the follow-up assessments we observe a small increase of the 10 measures of behavioural problems in the neurofeedback group and in the medication group as well. Additionally, academic performance decreases in 2 different areas for both treatments through the follow-ups. The results are only preliminar due to the sample size. Nevertheless, these findings suggest that Neurofeedback has a similar tendency of improvement as medication for the treatment of ADHD.

(PS-28) Attention And Learning In Medical Students With High Anxiety

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Objective: to evaluate the speed and the efficiency of the learning process in subjects with high anxiety levels.

Methods: 30 subjects with high trait anxiety (TMAS score = 33,9± 6,7) and 30 subjects with low trait anxiety (TMAS score = 7,5 ± 2,9), aged 19 to 22 years, were tested with a computerized psychological test, called Pattern Recognition Test (P-R). Taylor Manifest Anxiety Scale (TMAS), was previously used for evaluation of the levels of trait anxiety in a cohort of 176 medical students, who attended second year of Medical school.

The P-R test is a modification of the Continuous Performance Test, in which sustained attention, memory and the learning process could be evaluated. It consists of 8 patterns, comprised of different combinations of binary numbers 1and 0, divided in two classes (A and B). During the first presentation of the test objects, the subject should memorize the connection between a numerical pattern and a certain class. During next iterations, a correct recognition of the class (A or B) of the presented numerical pattern should be made. The order of the presented patterns was random. The test was completed when the subject correctly recognized all

eight patterns two times in a row. Analyzed parameters were: number of incorrect recognitions, the duration of the test and the index of the learning efficiency.
Results: students with high trait anxiety levels showed significantly higher number of incorrect recognitions, longer duration of the test and a lower index of learning efficiency then students with low levels of trait anxiety.
Conclusion: Subjects with high levels of trait anxiety show reduced learning efficiency. High levels of anxiety have negative impact on the attention and cognitive processes.

(P S - 2 9)

Brain Functions After High-Frequency Electromagnetic Field Exposure: Indirect Sar Measurement

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The aim of the study was: 1. to form a simple method of direct EEG measurement during high-frequency electromagnetic field (HF EMF) exposure in healthy and neurodefective mice, 2. to study a possible effect of acute HF EMF on the spontaneous ECoG registered simultaneously, and finally 3. to detect SAR (specific absorption rate) in exposed animals.
Results and discussion. Final evaluation and averaging of cortical activity showed a distinct shift to lower frequency components. These findings are in accordance with older and recent results but clear effect only in wild - type (healthy littermates) was observed whereas in Lurcher mutant mice gentle differences between frequency spectra were found. These relatively ambiguous findings support our idea about a significantly higher vulnerability of the CNS in Lurcher to some physical and chemical factors in comparison with controls, describing in recent studies, including ours. We suppose that thermal gradient arising between lipo- and hydrophylic structures influences ions movement through membranes of neurons and/or glial cells. So possible delicate changes could be identified rather in the brain which is already injured.
Conclusions: The experiments confirmed a possibility of direct EEG registration during exposure to HF EMF. This type of radiation influenced spontaneous cortical activity – shift towards lower frequencies was observed with significant differences between Lurcher mutant and wild type mice. Using an unique exposure chamber we can able to measure SAR values.

(P S - 3 0)

Brain oxygenation in gesture production. Differences between tool use demonstration, tool use pantomimes and body-part-as-object.

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Neuropsychological studies on patients with callosal disconnection and unihemispheric brain damage have shown different cerebral activation patterns in tool-related gesture production. Cortical regions associated with tool use skills and tool knowledge revealed networks in both hemispheres, though the left hemisphere is more activated overall [1]. Observations about impaired demonstrations with tool in hand but preserved pantomiming suggest that pantomime is represented as a different cognitive entity in the human brain [2]. In contrast to demonstrations of tool use with tool in hand, pantomiming tool use without tool in hand requires the abilities of abstraction and symbolization. Furthermore, the competence to demonstrate tool use with tool in hand tends to be represented bihemispherically, while pantomiming depends on specific left hemispheric functions [2]. Here, we investigate the differences between tool demo and tool

pantomime, and additionally introduce body-part-as-object gestures (BPO) as an experimental condition, in which the hand represents the tool (e.g., index and middle finger represent the scissors). There is evidence from split-brain patients suggesting a separate representation of BPO gestures in the right hemisphere. Therefore, the aim of this study is to identify the specific neurobiological correlates of tool use demonstration with the tool in hand, pantomiming tool use without tool in hand and BPO of tool use. Near-Infrared Spectroscopy (NIRS) is used to assess cerebral topographic and temporal oxygenation changes in response to tool use movements with or without the tool in hands. Right-handed healthy subjects are recruited and concentration-changes of oxygenated (oxy-Hb) and deoxygenated hemoglobin (deoxy-Hb) are examined during tool use movements and rest. Results of this study will provide information about topographic distribution of cerebral oxygenation during pantomime in contrast to demonstration of tool use with tool in hand and BPO. So far, first results show different activation patterns for the movement types although the same hand does the same movement. Our results will show if pantomime, tool use demonstration and BPO are different cognitive entities by its different activation patterns observed in NIRS.

(PS-31)

Voluntary regulation of enhancing sensorimotor (SMR) and inhibiting theta rhythms assisted by electrostimulation (TENs) and its effects on EEG dynamics of dorsal attention and resting state networks

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Background: Voluntary regulation of electroencephalographic (EEG) frequency components and potentials can be achieved by means of EEG biofeedback, or named neurofeedback training (NFT), in research and clinical settings. Applications include the treatment of the attention disorders, epilepsy, and even brain-computer interface (BCI) for patients with impaired motor function. These sorts of self-regulation methods suggest the possibility that participants may be able to learn to voluntarily control spatially localized regions or electrical brain activity associated with specific functions, if receiving appropriate training. However, few reports showed the changed spectral power of EEG dynamics as main results after NFT. The traditional EEG spectral analysis can't tell the difference between pre- and post-NF. The possible reason is the effect of volume conduction among EEG channels.

Methods: We applied 19 channels EEG and a four-step analytic approach to circumscribe the clustering of alpha power-related independent components (ICs) of EEG records in both pre- and post-treatment: ICA estimates, similarity measures to cluster and subgroup alpha power-related ICs, standardized low-resolution tomography analysis (sLORETA) for source localization, and spectral power within subgroups and ICs together with changes from pre- to post-treatment. With N = 36 participants, the four groups were fixed to be of equal size (N=9) in order to maximize statistical power compared. Group-AESMR consisted of 9 participants who received additional 15-mins electroacupuncture stimulation with alternating low (5 Hz) and high (100 Hz) frequencies; Group-LESMR consisted of 9 cases and received additional 15-mins electroacupuncture with only the low frequency (5 Hz); The subjects of these two groups received electrostimulation on both hands first, and then received their SMR (up)/theta (down) NFT within each session. Group-SMR consisted of 9 subjects and received NFT only; Group-NON consisted of 9 cases and received non-contingent (pseudo) SMR training only.

Results: We found five main statistically clustered subgroups (occipital, frontal, parietal, occipitotemporal and central subgroups) were clearly identified in both pre- and post-treatment. The ICA power spectra and then the time-frequency analysis of revealed ICs can offer a proper method to eliminate the volume conduction and then demonstrate the significant improvement after NFT, indicating the increased beta 1 and beta 2 power on

the frontal cortex in the groups receiving the real SMR training and NFT assisted by electrostimulation. Importantly, the enhanced SMR/theta ratio (S/T) was found in 3 NF training groups, with the significantly decreased theta during NFT session in AESMR and SMR groups. Moreover, the baseline S/T increased after NFT because of significantly decreased baseline theta after NFT in the AESMR and SMR groups, implying a possible method to monitor the prolonged training effect of NFT.

Conclusion: The current results showed the ICA-based power spectra analysis with circumscribed ICs in the resting state can eliminate the volume conduction and then demonstrate the significant results after NFT. Improvements in the beta 1 and beta 2 power on the frontal cortex in the groups receiving the real SMR training and NFT assisted by electrostimulation. Significantly decreased baseline theta after NFT in the AESMR and SMR groups showed the implication of the long-term NFT effect on attention. The method we used in the current study may have value in elucidating performance-enhanced brain training protocols.

(PS-32) An EEG Investigation of the Brain Activities in a Creative Design Task

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Background: Creativity is an essential element in Art and Design-related tasks/activities. In the field of Creative Design, however, the creativity of an individual are often judged with subjective ratings or opinions of domain experts. The lack of a more scientific measure of this essential element motivate us to look into the brain mechanisms of creativity, in particular the differences between those individuals with a higher creativity and those with less. Early EEG studies demonstrated that highly creative individuals differed from normal controls in greater activity within right parietotemporal areas and higher alpha activity during analogs of "inspiration". They are also related to increased centroparietal interhemispheric connectivity and greater right hemisphere interconnectivity (Razoumnikova 2000). A more recent study, on the other hand, finds a lower level of cortical arousal during creative problem solving and stronger alpha synchronization in centroparietal cortices associated with more original responses (Fink & Neubauer 2006). This work aims to study whether these phenomena can also be found in the individuals performing a creative design task.

Methods: We designed an icon generation task. The subjects were requested to design an icon representing a "dressing room". They were instructed to not use any text in their designs. The participants were encouraged to sketch out as more of his ideas as possible. The design process was also monitored and recorded using a digital video camera. Each subject was given 10 minutes to generate the icons.

Results, Discussion and Conclusions: So far we have carried out the experiment with four subjects recruited from the junior students in our department. They were selected based on their performance in the design sketch classes. Two of them exhibit a better sketch ability and confidence in the classes while the other two have difficulties in handling the sketch task and often find themselves struggling with the course assignments. In this preliminary report, we select each one of the two categories of subjects and perform an initial independent component analysis (ICA) of their brain activity patterns. The similar results of our initial findings and those of Fink et al are shown in our figures.

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(PS-33) Classifying Motor Imagery with FES induced EEG patterns

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Functional Electrical Stimulation (FES) is commonly used in motor rehabilitation. Also, Motor Imagery (MI) based brain computer interfaces (BCIs) have been proposed as a possible treatment by activation of the same brain areas as the ones involved in visuomotor tasks. However, to use a MI-based BCI it is necessary to perform a screening session to compute a classifier. In this work we study whether it is possible to setup a classifier with brain patterns induced by FES signals and classify MI data.
EEG was recorded in one session from 10 healthy BCI-novice users. FES was applied at 20Hz with amplitudes from 8 to 20 mA. Four electrode pairs were placed on the users' biceps and tibialis anterior. Three runs of 75 trials/run were recorded for the following conditions: MI, FES without MI, and FES with MI (MIFES, stimulation and MI were performed simultaneously). The users were instructed to perform the MI imitating the movement produced by FES.
Three classifiers were trained using simple features (log band-power) in a subject selected frequency band and time interval (Blankertz et al. 2008). Three Laplacian channels at C3, Cz, C4 were used to train a dassifier using FES with, FES without simultaneous MI (3 runs) and tested on MI data (1 run) with respective mean accuracies 75.6 ± 15.7% and 75.8± 16.5%. The mean classification accuracy training and testing on MI data using a 15-fold cross-validation was 73.7 ± 12.9%. No significant differences were found between the accuracies of any condition. Consequently, we can state that EEG data obtained during FES or MIFES can be used to classify MI without performance loss. Thus, the screening BCI session can be spared. Patients undergoing MI BCI based rehabilitation therapies who need a daily screening would clearly benefit for the reduction of time, dedicating more minutes to training than to BCI system set up.

Acknowledgments
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(PS-34) Electrophysiological Evidence For The Discriminative Abilities Of Speech Relevant Sounds In Children With Cochlear Implant

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Severely hearing-impaired children are able to (re)gain access to auditory input by receiving a cochlear implant - a neuroprosthesis that stimulates the auditory nerve. Many children implanted at a young age (12 to 48 months) do not have any hearing experience until they receive the implant. This implies a much later onset of first auditory input compared to normal hearing children. The focus of the study is on how auditory abilities develop after a considerable delay of sensory input.

Objective: This study aims at measuring the ability of children with no prior hearing experience to discriminate speech relevant auditory features and its development over time after receiving a cochlear implant.

Methods: Syllables of different vowel lengths were presented in a classical oddball paradigm. A total of nine children (age at first fitting: 1;0-3;9 years, mean: 1;6 – age at first measurement: 1;0-3;10 years, mean: 2;1) were tested electrophysiologically after first fitting of the implant and in intervals of two months, with each hearing age group (0, 2, 4, 6 months) consisting of at least five children.

Results: Preliminary data suggest that first signs of discrimination can already be seen a few days after the implant has been first turned on, with ERPs becoming more robust with increasing hearing experience. It seems that in the beginning long vowel deviants are detected easier than short vowel deviants.

Conclusion: Despite no prior auditory input with all its implications to the still developing neural pathways the implanted children seem to discriminate different vowel lengths already shortly after first fitting of the implant. With an increasing sample size there will be more evidence for whether the observed ERPs may be interpreted as mismatch negativity and P3 and how they develop with increasing hearing experience.

(P S - 3 5)

ERP Assessment of Word Processing under Broadcast Bit Rate Limitations

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In telecommunication research, audio quality is typically assessed with behavioral tests. Neurophysiological data can complement these as an objective and non-intrusive measure, potentially revealing neuronal differences in quality processing below the threshold of conscious perception that might affect a user's long-term satisfaction. Recently, subconscious processing of noise in phonemes was found in event-related potentials (ERPs) [1]. The present EEG study (N=8) applies this approach to a more realistic setting. In a forced choice task, subjects had to rate whether a given word was of maximal quality or degraded. Stimuli were presented either in wideband quality (60%) or were impaired by four progressive levels of bit rate reduction, using a standard telecommunication codec [2]. The ERP analysis allowed qualifying those trials where subjects correctly indicated a loss of quality: The higher 'neural uncertainty' involved in detecting more subtle degradations is reflected in a decreased amplitude of the P3 component. Additionally, we used a linear classifier to single out trials where quality impairment was not reported, but still evoked an ERP pattern similar to when it was processed consciously (three subjects). Thus, the approach demonstrates that even if no quality impairment is noted consciously, the degradation can still be processed in the cortex. Concluding, the ERP paradigm previously developed for noisy phonemes can be transferred successfully to full words degraded by realistic broadcast limitations. This supports the potential of ERP analysis combined with machine learning not only to complement conventional methods of audio quality assessment, but also to extend their sensitivity to sub-threshold stimuli.

Acknowledgements:
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(PS-36) Enhancement of learning with EEG Neurofeedback

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There is solid evidence that sleep improves motor performance after an initial training period. We hypothesized that consolidation of memory during sleep is associated with slow EEG waves and used neurofeedback (NF) for increasing this pattern in order to improve performance without actual sleep. 35 subjects were trained to perform a motor sequence task. Following initial training and testing, the subjects went through a Neurofeedback session, while a control group took 45 minutes of a break instead. We measured speed and accuracy before motor training, post-training, post-NF, one and two days later, and a week after training. Similar to sleep-related improvements, results of this study, showed a significant improvement in speed, following slow waves training but not in the group that took a break. This effect was found to be constant for a week.
Results of this study suggest that a single NF session of 45 minutes may support enhancement of motor learning. These findings have theoretical implications, on the role of spectral EEG and sleep in learning. Our findings also have practical implications in learning of motor tasks such as athletics and musical performance or any other procedural skill.

(PS-37) Recurrent brain states during single-trials and evoked responses

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The recent years have seen an explosion of studies reporting functional connectivity of brain activity as measured either by EEG and fMRI. In most of studies functional networks are derived from the so called "resting-state" activity of subjects performing no particular task. Here, we study functional networks at the electrode space of high-resolution EEG recordings during simple cognitive task which elicit characteristic event-related potentials. Our aim is two-fold. On the one hand we are interested in the temporal evolution of the functional networks during each individual trial in order to capture transient brain states of few miliseconds. On the other hand, we aim to recognise stable functional networks which can be related to brain states elicited by the experimental conditions. We find that during short time-scales the brain oscillates between few preferred configurations which recur after few miliseconds. We also find unique patterns of functional connectivity which ocur, trial-after-trial, only as a consequence of the experimental condition.

(PS-38) Usability, satisfaction and appearance while using lower limb prostheses: Implications for the future

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Lower limb amputees (LLA) suffer from their prosthesis until the prosthesis is being integrated in the body scheme (BS) and the weight distribution is comparable to the healthy leg (Mayer et al., 2008). For this an artificial limb device (ALD), that feels and act like real limbs, may help for faster BS integration. Previous studies have shown a way to evoke a multisensory illusion (MI) in upper limb amputees by stimulating the stump in synchrony with the hand prosthesis (Ehrsson et al., 2008). Studies describing MI in LLA are missing. An ALD may also help LLA to include the prosthesis faster in the BS. Because this is a great technical challenge we first developed a questionnaire and collected data from patients regarding their needs using lower limb prostheses for a more detailed view. 80 items, describing satisfaction, usability, appearance, pain and handling of the prosthesis in different motor situations, were generated. 29 experienced prosthesis users filled out the questionnaire. Irrespective of the prosthesis technology, the results indicate a lack of satisfaction with the prosthesis shaft, a lack of satisfaction in voluntary and postural motor functioning. Furthermore a lack in appearance, as a descriptor for subjective BS integration, was also measured. While the satisfaction with the prosthesis shaft was significantly ($p<.0001$) correlated with the satisfaction in voluntary ($r=.82$) and postural ($r=.70$) movements also the appearance was significantly ($p<.001$) correlated with the satisfaction with the prosthesis shaft ($r=.61$), the voluntary ($r=.63$) and the postural ($r=.59$) movements. Although all LLA made experiences with different prosthesis technologies, no technology seems to fulfill all user demands. The appearance as a descriptor for subjective BS integration seems to be an important factor that is associated to the conditions that deal with perception (prosthesis shaft) and action (movements). Results indicate that an ALD with the possibility to walk and to stand, may be helpful to identify factors that are directly associated with unsatisfying and interfering experiences.

(PS-39)

Observational evaluations on the intricacies, chronology and dimensions of gastroenteritic related multisystemic severe syndromes with neurological complications.

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Background/Purpose: Gastroenteritis in childhood is important given its morbidity/mortality impact. It is an antecedent to miscellaneous pathologies such as febrile seizures, LGBS, transverse myelitis, meningo-encephalitis,central pontine myelinosis, horizontal gaze palsies,acute disseminated encephalomyelitis, global neuromuscular hypotonia, floppiness, defective nuchal regulation, intense global hypotonia,regressional mile stones, adynamic paralytic ileus. Comparatively, these aspects though important were not specifically addressed previously.

Methodology: Data where acquired from the cases of relevance.

Results: Approximately 524 records of childhood diarrhoeal diseases cases requiring hospitalizations for fluid resuscitations/electrolyte were retrieved, of these 132 cases manifested significant neurological features ranging from paroxysmal events, convulsive equivalents/seizures.(n=30),convulsive seizures/ encephalopathy(n=6),encephalopathy denovo (n=5),presumptive meningoencephalitis (n=31),Acute defective nuchal regulations(n=25),(n=7) had intense insomnia, whereas (n=6) had Regressional neurodevelopmental mile stones,(n=7)were somnolent(n=8) were insomniac,(n=1)had MSBP,(n=6) talked irrationally. On follow up,(n=12) had prolonged sequelae. The shared aetiologies between GET/RTIs suggested an overlap .(n=4) had conjunctivitis/,diarrheal/ hemorrhagic cystitis compatible with an adenovirus infection, in (n=51) the GET overlapped coincidentally RTIs. Compared with children with RTI/GET/seizures or RTI/Convulsive seizures alone, children with isolated gastroenteritis related convulsive seizures had better clinical course, lesser progressions to meningo-encephalitits and less neurological sequelae. Cases with dysentery had more seizures,encephalopathies/sequelae,morbidity/mortalities , whereas in acute watery/ mucoid diarrhea were less toxic, had more defective nuchal regulations /global hypotonia which correlated with hypokalaemia/multiple electrolyte imbalances. In dysentery ,even without seizures, encephalopathies, meningo-encephalities/residual sequelae were commoner, they could benefit from transcranial repetitive electromagnetic stimulatory therapy,where as in acute atery diarrhea/electrolyte imbalances without seizures ,defective nuchal regulation was more frequentl,such cases responded satisfactorily to physiotherapy.

Conclusions: Frequent paroxysmal events noted in these subsets suggests that as much as possible,routine obligatory EEGs,should be part of the routine in patient monitoring for these subsets.The more difficult cases could be candidates for advanced neuroimaging with SPECT,Functional MRI/MEG/NIRS etc.Although RTIs/GETs aetiologies differs with overlap,their clinical course outcome/specific interventions differs remarkably than they overlap.

(PS-40)

Is the Artifact Rejection enhanced if the EOG signals are included in the ICA decomposition?

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During the last decade, many Artifact Rejection techniques, based on Independent Component Analysis (ICA), were proposed [1, 2]. One of their major drawbacks is that ICA is not able to completely separate the signals derived from the eye-movements and blinks, with the signals originated from the prefrontal cortex. This leads to the bidirection contamination phenomenon [2].
A lot of discussion has been held into various scientific fora and newsletters, suggesting that if the electrooculographic (EOG) signals are included during the decompositions procedure, then the ICA separates more properly the aforementioned signals. Despite this, until now there is not any scientific evidence supporting this practice. This study comes to shed light on this assumption, by comparing the portion of cerebral activity included in the artifactual independet components(ICs) extracted by ICA, including or not the EOG signals during the decomposition procedure. In more details the artificially contaminated dataset described in [2] was decomposed using the extended INFOMAX ICA algorithm [1] two times, one with and one without using the EOG signals. In order to quantify the portion of neural signals included into the artifactual ICs, Artifact to Signal Ratio (ASR) [2] was adopted. ASR was computed for all artifactual ICs extracted with both procedures. Then one-way ANOVA was used in order to investigate if there is a statistically significance among their mean values.Results suggested that the ASR (-4,40dB±4,58) was enhanced when the EOG signals were included in ICA, while the mean ASR for the artifactual ICs extracted without using the EOG signals is -5,19dB±5,54. Despite the ostensibly difference of the ASR values, there is not a statistically significant difference among them ($F=0,592$ p-value<0.44). So, it seems that when the EOG signals are included during the ICA decomposition, ICA separates more properly the ocular artifacts. But until now, there is not any clear evidence proposing for sure the use of EOG signals in ICA.

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(PS-41)

Audio-Visual Stimulation to Influence Alpha Brain Oscillations: An EEG study of Gender Differences.

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We focused on gender differences regarding audiovisual stimulation on the alpha activity, as measured by the EEG. The bipolar "double banana" montage was used, placing nineteen scalp electrodes according to the 10-20 System. Subjects were 30 healthy, right handed, individuals, 15 males (mean age: 23.47±3.39) and15 females (mean age: 22.8±3.74). The protocol consisted of 12 audiovisual stimuli: An 8hz binaural beat (right 450hz- left 442hz) combined with an 8hz flickering light at 4 different colours (RGBY), a 10hz binaural beat (right 450hz-left 440hz) combined with a 10hz flickering light at 4 different colours (RGBY), and 4 placebo stimuli (100hz flickering RGBY light combined with 100hz at both ears). The duration of the experiment for each subject was 653 sec. Results were analyzed using the ERD/ERS method for lower (8-10hz) and upper (10- 12hz) alpha band. Statistical analysis highlight significant gender differences concerning the stimuli' effect at P4-O2 channel at specific time intervals:

1. Lower alpha: Green 8hz (0 to 300 ms) and Placebo red (500 to 900 ms) resulted in synchronization for females and desynchronization for males. Green 10 hz synchronized (0 to 200 ms) for males and desynchronized for females.

2. Upper alpha: Placebo blue resulted in synchronization (200 to 600 ms) for females and desynchronization for males. Green 10 hz synchronized (600 to 800 ms) for males while it desynchronized for females.

(PS-42) Enhancing spatial recognition memory in five-year old children through differential outcomes

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Background: Previous studies have reported that delayed face recognition is facilitated in adults and in aging people when each face to be remembered is paired with its own unique reinforcer. In the present study, we extend this differential outcomes procedure (DOP) to five-year-old children who were asked to remember spatial locations.
Methods: Two computerized spatial working memory tasks were used. Either short (1 or 5 sec) or long (10 or 15 sec) delays were interposed between the sample and the comparison stimuli. In the differential outcomes condition each location was paired with its own outcome. By contrast, in the non-differential condition outcomes were randomly arranged.
Results: The Differential Outcomes Effect (DOE) was evident in both experiments. That is, participants showed a better terminal accuracy when differential outcomes were arranged.
Conclusions: To our knowledge this is the first demonstration that differential outcomes can enhance spatial recognition memory performance in children. This finding, along with those of Hochhalter, Sweeney, Bakke, Holub, and Overmier (2000) and López-Crespo, Plaza, Fuentes, and Estévez (2009) draw attention to the potential of this procedure as a memory aid technique.

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(PS-43) Neuropsychological assessment of semantically-

bound information processing: a case report

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Background: During the past ten years, working memory (WM) literature focused on the ability to bind information across domains in order to form integrated units (Baddeley, 2000). In particular, previous studies suggested that information binding may be supported by the hippocampal structures (Berlingeri, 2008). **Objective:** To provide insight into the process of binding semantically-related information through neuropsychological assessment of a patient with extensive damage in memory circuits. Methods & Results: ThV, aged 45, suffers from a severe amnesic disorder due to HSV encephalitis. Brain MRI scans revealed extensive damage of the temporal lobes, particularly affecting their medial parts, the insula and the orbito-frontal cortices. WM was investigated in two sequential experiments.
Experiment 1: Four tests were administered in order to assess separately the four WM components (Digit Span Forward, Corsi Span Forward, Digit Span Backwards and WMS-III- Logical Memory Immediate). Immediate prose recall was severely disturbed while performance in the other tests was normal. These results could be interpreted either in terms of an "episodic buffer" disruption or as reflecting a wide deficit in long-term memory. Accordingly, Experiment 2 was conducted in order to a) minimize the contribution of long-term memory and b) discriminate between formation and maintenance of bound information. **Experiment 2:** Three 9-word lists were constructed and administered into three different conditions: 1. Processing of semantically related-bound words. 2. Processing of semantically related – unbound words. 3. Processing of semantically unrelated words. The results revealed that while ThV's was still able to recall semantically related lists of words (span = 7), he was no longer able to create semantically bound information (condition 2, span = 5). **Conclusions:** Our data suggest that temporal and frontal lobe regions are crucial in order to form and maintain, respectively, bound information. The specific role of hippocampal structures is further discussed.

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(PS-44) Movement Related Potentials Related To Self-Paced Treadmill Walking

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Objective: Walking is a complex process that involves an accurate interaction between supraspinal centers, central pattern generators and multi-sensory peripheral sources. For gait rehabilitation purposes and the successful implication of brain-computer-interfaces, it is of great importance to

know and understand the course of movement-related cortical potentials (MRCPs) during complex movements such as human gait. In this study we were able to assess MRCPs during self-paced treadmill walking in healthy subjects.

Methods: Three men and 7 women (mean age 28.2 ± 4.1 years) participated in this study. Thirty-two channel EEG data were recorded during 20 minutes of treadmill walking. Heelstrike (HS) of the left leg was detected by a foot contact sensor. EEG data were segmented into epochs of 1000 msec around HS and averaged to one MRCP for each subject. Individual waveforms were averaged to a single grand average MRCP for each channel.

Results & Conclusion: EEG traces over the motor cortex show a slow decrease in brain potential, which starts around -240 msec in relation to HS. From this point until -140 msec prior to HS a readiness potential window can be defined, followed by a fast increase in EEG negativity (the negative slope). A plateau tendency appeared between -60 and -20 msec, indicating the motor potential window. The maximum EEG activity is reached within the first 20 msec following HS. This negative potential is rapidly followed by a positive potential, creating the movement-monitoring potential following HS. This is one of the first studies that uses EEG to define MRCPs during continuous self-paced treadmill walking. As in other motor tasks (Nascimento et al., 2005 a&b), the execution of a gait cycle is accompanied by a characteristic pattern of EEG potentials.

(PS-45)

How alcohol affects emotional responses?

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It was proposed that the impairment in cognition caused by alcohol consumption can lead to alterations in emotional responses and adaptive behavior. Twenty-eight healthy right-handed persons (14 females), free of any neurological disorder participated in our study. Each participant was exposed twice to the experimental procedure, one after alcohol consumption (vodka mixed with orange beverage), and the other one after placebo dose consumption. The alcohol dose was depending on the gender and the weight of the participants, while saliva samples were analyzed with Headspace Gas Chromatography coupled with a Flame Ionization Detector in order to assess the alcohol concentration. The two measurements (alcohol and placebo) were counterbalanced among subjects and the second measurement was at least 6 weeks later than the first one. Visual stimuli were pictures from the International Affective Picture System (IAPS), containing standardized images rated for emotional pleasure and arousal. The selected stimuli divided the pleasure-arousal 2D space by naturally forming four groups of pictures: pleasant and high arousing, pleasant and low arousing, unpleasant and high arousing and unpleasant and low arousing. The pictures were presented in random order. EEG was recorded from 57 electrodes (recording frequency 500Hz). Preliminary analysis on the Global Field Power of the EEG channels revealed significant differences between placebo and alcohol, especially on the unpleasant and high arousing visual stimuli. Our preliminary results suggest that the participants' responses, especially to unpleasant stimuli, are affected by alcohol consumption.

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(PS-46)

QEEG spectra in patients with unexplained chronic fatigue syndrome.

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The aim of this study was to investigate whether a Norwegian population with unexplained chronic fatigue, displayed deviances in their EEG spectra during resting and active conditions. About half of the participants were diagnosed with Chronic Fatigue Syndrome (CFS), while the rest were diagnosed with Idiopatic Fatigue Syndrome (ICF). 19 channel qEEG was recorded during three minutes with eyes open and three minutes with eyes closed, and during the Visual Continous Preformance Task (VCPT). Eyeblink and eye movement artefacts were removed using independent component decomposition and removal, before continous spectra analysis. Individual data was compared with an age-matched normal group. There were found significant deviances both in theta, alfa and beta range, in 75% of the participants (N=29). No clear grouping was observed, but deviances corresponded well with the participant's experienced main problem (e.g. concentration deficit, tiredness, restlessness). As the etiology of unexplained chronic fatigue still is unresolved, some heterogeneity was expected. Findings indicate that this group express deviating 'steady state' as shown through deviances in their EEG spectra. These observed deviances opens the possibility for Neurofeedback Training to alleviate some of the symptoms experienced.

(PS-47) Effects of neurofeedback training for patients with unexplained chronic fatigue.

Wenche Kjenner and Stig Hollup

NTNU, Norway

The aim of this study was to investigate whether patients with unexplained chronic fatigue, would experience symptom reduction and improved daily functioning, as a result of NeuroFeedback Training (NFT). Using Mitsar's BrainTuner system, individually adapted training protocols were given to four patients. All received attention-optimizing midline beta/theta training for the first 15-20 sessions. Thereafter a protocol adapted to the patient's unique deviance in eeg spectra was run for another 15-20 sessions.
QEEG was recorded before training initiated, before changing of protocols and after the individualized protocol. Also, the patients were interviewed about daily functioning. Improvements were noted for all participants, including daily functioning, aspects of qEEG (spectra and ERP) and behavior (reaction time). Although it is doubtful that neurofeedback training can address the core problems associated with chronic fatigue (both CFS and IFS), it seems plausible that training can lead to some functional improvement for these patients.

(PS-48) Effects of attention on emotional face processing: An ERP study

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In the present study we used an emotional prime task to assess how attention and emotion modulate different ERP components of face processing. Faces with positive, negative or neutral emotions were presented as primes and emotional laden words were presented as targets for a valence task decision. Participants had to attend and respond either to the emotion expression or to a non-emotion feature (wearing rounded vs. squared glasses) of the prime face. The amplitude of P100 component was larger and its latency shorter for the right hemisphere. P100 latency was modulated by the emotion information, being shorter for emotional than for neutral faces. The N170 component was modulated only by the emotion expression. Its amplitude was larger and its latency was longer for negative faces compared with both positive and neutral faces. These effects were more apparent in the right than in the left hemisphere. Finally, the N250 component, time-locked to words, was modulated by both emotional expressions and the prime task. Its amplitude was

larger when the prime task was to attend to the emotion information than to the type of glasses. For the right hemisphere that difference was observed for both positive and negative words and all emotion expressions of faces. For the left hemisphere, the difference between the two prime tasks was more pronounced with negative than positive words, and with angry than happy or neutral faces. These results suggest that attention does not modulate early components of face processing (P100 and N170), but it modulates the N250 component. This "recognition potential" is thought as a rudimentary semantic processing index, that is sensitive to the amount of attention allocated to the emotional information (both hemispheres), and is more apparent for the negative information of both faces and words (only right hemisphere).

(PS-49)

Detecting neurophysiological alterations during Mild Cognitive Impairment and Dementia using wavelet-based energy computation and a Mahalanobis Distance classifier

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Recently, a transitional stage, called Mild Cognitive Impairment (MCI) has been identified. Early MCI detection is of crucial importance for preventing dementia onset. The aim of this study is to provide a classification framework able to discriminate subtle alterations due to neurodegenerative processes. Primary attention was given at the MCI stage. Therefore two MCI groups were formed according the patient's performance in the Montreal Cognitive Assessment (MoCA) test; a group of 39 patient with a low cognitive decline (MCI-1; MoCA>=25), and a group of 31 patients with moderate cognitive decline group (MCI-2; MoCA <25. In addition, we tested 17 healthy control participants, and 14 mild demented patients. Participants underwent a full neuropsychologic examination.

Application of the Independent Component Analysis (ICA) and visual inspection of EEG data during resting state condition with eyes closed was initially adopted for noise rejection. Then, the energy for each frequency band was computed through discrete wavelet transform (DWT). These spectral components for 57 electrodes served as an input to a classification system employing Mahalanobis Distace. Classification results (84.16% overall accuracy) demonstrated the system's robustness and reliability. Discrimination reached 82.35% for healthy controls, 92.31% for MCI-1, 74.19% for MCI-2 and 85.71% for mild demented patients. The classification system is proposed in order to supplement the neuropsychologic examination and to correlate subtle cognitive deficits revealed by MoCA with modified neurophysiological patterns, providing thus a better understanding to the progression of neurodegenerative mechanisms.

(PS-50) Aggressive Social Environment, Stress, Depression and Formation of Killer Organisms

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Stress, pathological aggression, killer and self-killer organisms are widely manifested in developing countries. The reason of these phenomena is aggressive eco-social factors: absence of electricity, cold and social isolation. Quantitative distribution of biogenic amines in specific areas of the brain was used as the correlates for pathologically aggressive and killer organism formation. In our experiments stress was modeled for 4 weeks: the rats were maintained in individual cages (social isolation) at the 1:23 light/dark regime and 15-18°C. Control animals were kept together in one cage at the 14:10 light/dark regime.

It was found that exposure of rats for a month in darkness, cold and social isolation results in formation of pathologically aggressive killer organisms with a gradual reduction of serotonin concentration in various areas of brain. Considerable differences were found in naturally non-aggressive and aggressive rats' brain. The rate of serotonin synthesis in males was found to be 52% higher than in females.

Sex hormones were also shown to be involved in the formation of intellectually incontrollable behavior. After castration rats do not show any aggression, but injection of testosterone leads again to a manifestation of killing reactions. There is no doubt that aggression and murder are pathologies and are certainly susceptible to treatment.

We propose an effective test for the detection of aggressive organisms by lectin-binding technique. Lectin-binding and erythrocyte agglutination are substantially reduced in the erythrocyte membrane of stress-exposed rats. b-D-galactose-binding lectin agglutination of erythrocytes significantly decreases in stressed rats' brains more than 128 times in comparison to control animals.

Conclusion: Disturbances of the biological rhythm with light deprivation and social isolation, together with the low temperatures, results in stress and pathological aggression leading to the formation of killer organisms.

(PS-51) Calculation of induced currents during TMS with a hybrid numerical technique

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Transcranial magnetic stimulation (TMS) has become in the recent years a valuable tool for investigating the human brain noninvasively. Moreover, repetitive TMS (rTMS) can induce changes in brain activity and shows increased therapeutic potential in patients with neurologic and psychiatric disorders. To this aim, in the present work we introduce a hybrid numerical technique which combines the finite element method (FEM) with the impedance method (IM) in order to calculate with high spatial accuracy the induced currents inside tissues during TMS. The reason for taking the above approach is that the FEM is difficult to apply in simulations of TMS with complex tissue geometries, because the conversion of a 3D voxel grid, obtained from an imaging scanner, to a finite element discretized numerical model can be very demanding, while finite-difference and impedance-based techniques cannot handle the true geometry of the coils, since they assume thin-wire loops, instead of the thick, spirally-wound lamina used in reality. There are two steps comprising the hybrid technique; in the first one a commercially available FEM software was used to calculate the magnetic field in air from a real TMS coil. Next, the resulting magnetic field was applied on a fine-resolution anatomically realistic voxel model as the source of an in-house code using the IM; eventually, the induced current density in the tissues was calculated. The IM code had been validated against analytical results from the literature.

The results show that the hybrid technique can overcome the drawbacks of both methods, and be implemented for detailed models of the head under a realistic coil source (comprising spirally-wound lamina instead of thin-wire loops). The percentage difference in the maximum predicted current between realistic and generic sources can reach 53%. This approach is of benefit for the planning of rTMS on an individual patient basis.

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