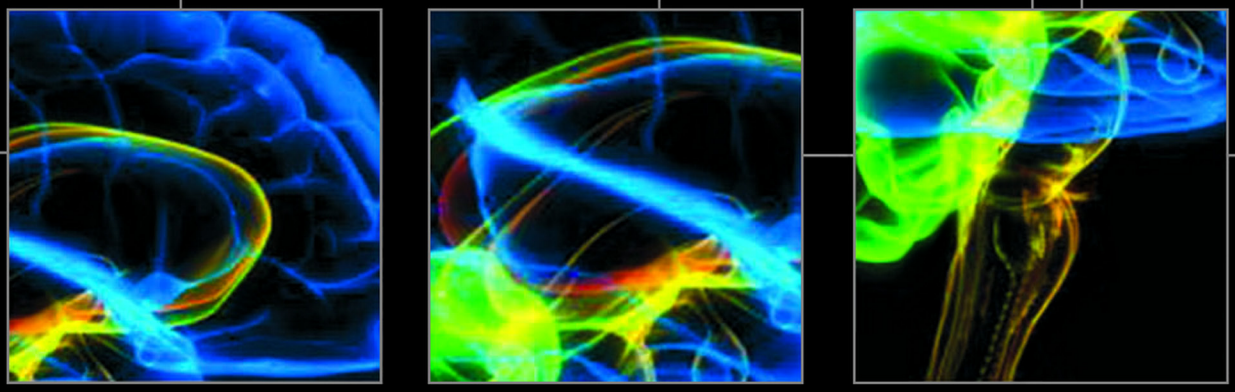


Joint COST B27/SAN Training School: Neurofeedback and ADHD & International course and conference MIND AND BRAIN VI:

Neuroplasticity of Brain and Behavior

April 16-21, 2009, Dubrovnik, Croatia

Local organizer: Selma Supek, University of Zagreb

Program directors:

Training Schools:

John Gruzelier, University of London

Silvana Markovska-Simoska, Macedonian Academy of Sciences and Arts

MIND AND BRAIN VI:

Selma Supek, University of Zagreb

Cheryl Aine, University of New Mexico

John Gruzelier, University of London

Venue: Importanne Resort Dubrovnik

www.manu.edu.mk/costb27/

www.applied-neuroscience.org/

www.brain.hr

WELCOME

It is our pleasure to invite you to the Joint COST B27/SAN Training School: Neurofeedback and ADHD, and the International Course and Conference MIND AND BRAIN VI: Neuroplasticity of Brain and Behavior that will be held April 16-21, 2009 in Dubrovnik, Croatia.

The international courses MIND AND BRAIN are focused on functional brain-imaging methods (MEG, EEG, TMS, fMRI, PET, OI) and their non-invasive insight into human brain concerning health and disease. This year's topic focuses on the neuroplasticity of the brain and behavior in normal development and aging as well as on a range of delayed or pathological developments, stress, and disease-related brain and behavior changes occurring throughout the human life span such as ADHD, PTSD, MCI, and AD. The neurofeedback track will cover topics on three domains of applications: adult clinical, child clinical/educational, and optimal performance. The ADHD training track will present neuropsychological and electrophysiological methods for the assessment and treatment of ADHD in children and adults from theoretical, research, and clinical perspectives.

The meeting should be equally stimulating for prominent senior researchers and practitioners as well as advanced graduate students and young researchers of different backgrounds. We would like to promote and increase communication between neuroscientists interested in studying neuroplasticity of the brain structure and function, and medical doctors using advanced methods for structural and functional imaging in diagnosis and in some cases treatment as well. The scientific program consists of four days of joint sessions for the COST B27/SAN Training School on Neurofeedback and ADHD which will have a course and conference profile along the lines of our series of the MIND AND BRAIN courses and conferences, and will include invited tutorial and review lectures, oral and poster presentations of the participants, as well as discussions with lecturers. The training school will include also parallel sessions with stand-alone training modules and demonstrations in smaller groups.

The Old City of Dubrovnik, a jewel of the Adriatic and currently one of the world's hottest destinations, its InterUniversity Centre, which recently celebrated its 35th anniversary, and Importanne Resort, with its excellent conference facilities and a beautiful gravel beach, should be a superb setting for our scientific, training, and social activities.

We look forward to welcoming you in Dubrovnik!

Selma Supek

Cheryl Aine

John Gruzelier

Silvana Markovska-Simoska

EU/ESF COST Action B27

Joint COST B27/SAN Training School: Neurofeedback and ADHD & International Course and Conference MIND AND BRAIN VI: Neuroplasticity of Brain and Behavior

April 16-21, 2009, Dubrovnik, Croatia

www.brain.hr

LOCAL ORGANIZER

Selma Supek, *University of Zagreb*
Department of Physics
Faculty of Science
Bijenicka cesta 32
10000 Zagreb
Croatia
Tel: 00385 1 460 5569
Fax: 00385 1 468 0336
Email: selma@phy.hr

VENUE

Importanne Resort Dubrovnik

Hotel Neptun, Hotel Ariston, Importanne Suites, Villa Elita
Kardinala Stepinca 31 20 000 Dubrovnik, Croatia
Tel. +385 20 440-100, Fax: +385 20 440-200
Web: http://www.importanneresort.com/

PROGRAM DIRECTORS

John Gruzelier*, University of London*
Silvana Markovska-Simoska*, Macedonian Academy of Sciences and Arts*
Selma Supek*, University of Zagreb*
Cheryl Aine*, University of New Mexico*

PROGRAM CONTACTS

Prof. Selma Supek
E-mail: selma@phy.hr

Fax: +385 1 468-0336
Phone: +385 1 460-5569
Mailing address: **COST B27 / SAN Training School: NF and ADHD & MIND AND BRAIN VI**
c/o Prof. Selma Supek
Department of Physics
Faculty of Science
Bijenicka 32 10 000 Zagreb CROATIA

Prof. John Gruzelier
E-mail: j.gruzelier@gold.ac.uk
Phone: +44 207 919-7635
Mailing address: **COST B27/SAN Tranining School: NF and ADHD**
c/o Prof. John Gruzelier
Goldsmiths, University of London
New Cross SE14 6NW London

Dr. Silvana Markovska-Simoska
E-mail: silvana@manu.edu.mk
Fax: +389 2 3235 423
Phone: +389 2 323-5425, +389 70 837-375

Mailing address: **COST B27/SAN Tranining School: NF and ADHD**
c/o Silvana Markovska-Simoska, MD
Neuroinformatics Division, ICEM
Macedonian Academy of Sciences and Arts
Krste Misirkov br.2, P.O. Box 428
1000 Skopje
Macedonia

AIMS

The Training School will present up to date empirical evidence forthcoming from the COST B27 Electric Oscillations and Cognition (ENOC) action working groups now in the 4th year. There will be a particular focus on the scientific basis of EEG-Neurofeedback and of ADHD. In addition the complimentary topic of brain neuroplasticity across the life span in normal and pathological development will be incorporated through collaboration with the Mind and Brain series.

Europe has led the way in establishing evidence of validation of EEG-neurofeedback over the past decade. There has been growing recognition of the importance of non-invasive neurofeedback for wide ranging applications in clinical, educational and optimal performance domains. Further this recognition is evinced by grant awards from the EU FP programmes, and from international and national Science Councils. The workshop will review the empirical basis of EEG-neurofeedback, and provide an overview of the various domains of application. Practical demonstrations will be presented in small group format of the latest technical innovations available through computer laptop, telecommunication and virtual reality technology, all designed to make neurofeedback widely applicable outside the scientific laboratory. Brain mapping, neurofeedback protocols, and instrumentation will also be demonstrated.

In parallel sessions the state of the art neuro-cognitive evidence will be provided on Attention Deficit Hyperactivity Disorder (ADHD). The outcome of collaborative projects through the COST ENOC Action will be reviewed encompassing theoretical, basic research and clinical perspectives. There will be a particular emphasis on practical demonstrations of assessment procedures from behavioural ratings to EEG brain mapping to neuropsychological testing. As ADHD has the most established evidence base of the clinical applications of EEG-neurofeedback, with a significant body of independent controlled trials, such evidence will be reviewed in joint sessions.

Fundamental to EEG-neurofeedback and to neurocognitive approaches to the treatment of ADHD is the evidence of brain plasticity. In joint sessions evidence will be reviewed of the neuroplasticity of the brain and behaviour in normal development and in aging, as well as in a range of delayed or pathological developments, stress, and disease-related brain and behaviour changes occurring throughout the human life span such as ADHD, PTSD, MCI, AD. This forms part of an established international Mind and Brain series which has focused on functional brain-imaging methods (MEG, EEG, TMS, fMRI, PET, OI) and their non-invasive insight into human brain functions in health and disease.

TRAINEES

Following the COST rules, the purpose of the Joint COST B27/SAN School and MIND AND BRAIN VI course and conference is twofold: training and dissemination of the knowledge among early stage researchers accumulated during 3 years duration of the COST Action B27 and re-training of practitioners as part of “life-long learning”. Consequently the Training School will be open for advanced PhD students, early stage researchers, and practitioners.

PROGRAM

Joint sessions

- Invited tutorial and review lectures
- Plenary sessions
- Discussions

Parallel sessions

- COST B27/SAN Training Modules on Neurofeedback
- COST B27/SAN Training Modules on ADHD
- Demonstrations in groups with tutors

Invited lecturers

Cheryl J. Aine, *School of Medicine, University of New Mexico, Albuquerque, NM, USA*
Douglas J. Bremner, *Emory University School of Medicine, Atlanta, Georgia, USA*
Adrian Burgess, *School of Life and Health Sciences, Aston University, Birmingham*
Valeria Csepe, *Hungarian Academy of Sciences, Research Institute for Psychology, HAS*
John Gruzelier, *Goldsmiths, University of London*
Jari Karhu, *University of Kuopio and Nexstim, Ltd, Helsinki*
Dragica Kozaric Kovacic, *Regional Center for Psychotrauma Zagreb, Univ. Hospital Dubrava*
Israel Liberzon, *US Veterans Medical Center, Ann Arbor, MI, USA*
Tomas Paus, *Brain and Body Centre, University of Nottingham and McGill University*
Jordan Pop-Jordanov, *Macedonian Academy of Sciences and Arts*
Hubert Preissl, *MEG Center, University of Tubingen*
Selma Supek, *Faculty of Science, University of Zagreb*

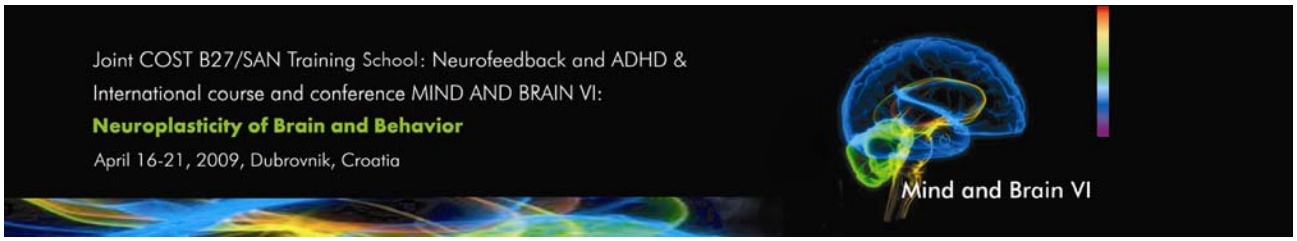
Lecturers/Trainers for Training Modules on Neurofeedback:

Adrian Burgess, *School of Life and Health Sciences, Aston University, Birmingham*
Max Chen, *Goldsmiths, University of London and Chang Gung Memorial Hospital, Taipei*
Marco Congedo, *CNRS, Grenoble*
John Gruzelier, *Goldsmiths, University of London*
Tomas Ros, *Goldsmiths, University of London*
Beverly Steffert, *Birkbeck College, University of London*
Tony Steffert, *Goldsmiths, University of London*
Petra Studer, Universtity of Erlangen

Lecturers/Trainers for Training Modules on ADHD:

Giuseppe Chiarenza, *Un. Operativa di Neuropsichiatria per l'Infanzia e l'Adolescenza*
Juri D. Kropotov, *Human Brain Institute of the Russian Academy of Sciences and Norwegian University for Science and Technology*
Andreas Müller, *Praxis für Kind, Organisation und Entwicklung, Chur*

Invited lectures: 25+5 minutes
Plenary talks: 12+3 and 15+5 minutes



EU/ESF COST Action B27

Joint COST B27/SAN Training School: Neurofeedback and ADHD & International Course and Conference MIND AND BRAIN VI: Neuroplasticity of Brain and Behavior

April 16-21, 2009, Dubrovnik, Croatia

Program at a Glance

	Wednesday **April 15**	Thursday **April 16**	Friday **April 17**	Saturday **April 18**	Sunday **April 19**	Monday **April 20**		Tuesday **April 21**
		JOINT SESSIONS				NF	ADHD	Joint Sessions
08:00-9:00		Registration						
09:00-09:30		**Opening**	**A. Burgess**	**Oral Session** General Modul I	**Oral Session** General Modul I	NF M-I	ADHD M-II	NF M-V
09:30-10:00		**J. Gruzelier**						
10:00-10:30		**V. Csepe**	**Oral Session**					
10:30-11:00		**V. Csepe**				Disc		Demonstrations
11:00-11:30		***COFFEE BREAK***						
11:30-12:00		**J P-Jordanov**	**T. Paus**	General Modul II	General Modul V	NF M-II	ADHD M-II	NF M-VI
12:00-12:30		**J. Karhu**	**T. Paus**					
12:30-13:00		**J. Karhu**	Discussion				Demos	
13:00-13:30		***LUNCH***						**Closing**
13:30-14:00								
14:00-14:30								
14:30-15:00		**S. Supek**	**D.K-Kovacic**	General Modul III	General Modul VI	NF M-III		
15:00-15:30		**C.J. Aine**	**I. Liberzon**					
15:30-16:00		**C.J. Aine**	**J. Bremner**					
16:00-16:30	**Registration**	***COFFEE BREAK***						
16:30-17:00		**H. Preissl**	ADHD M-I	**Guided Old City Tour** ***optional***	General Modul VII	NF M-IV		
17:00-17:30		**H. Preissl**						
17:30-18:00								
18:00-18:30		**Welcome CONCERT**			Discussion	Disc		
18:30-19:00								
19:00-22:00				**DINNER** ***optional***				

PROGRAM SCHEDULE

April 1, 2009, Final version

WEDNESDAY, April 15, 2009

16:00 – 19:00 **REGISTRATION**

THURSDAY, April 16, 2009 ***Conference Hall I***

08:00 – 09:00 REGISTRATION

09:00 – 09:30 **Opening remarks**
Selma Supek, Local Organizer
John Gruzelier, SAN President
Jordan Pop-Jordanov, COST B27 Chair

Session chair: James Douglas Bremner

09:30 – 10:00 **John Gruzelier:** Alpha/theta neurofeedback, creative performance enhancement, long distance functional connectivity and psychological integration
10:00 – 10:30 **Valéria Csépe:** Brain maturation and the music-language interplay
10:30 – 11:00 **Valéria Csépe:** ADHD – a challenge for cognitive and clinical neuroscience

11:00 – 11:30 *Coffee break*

Session chair: John Gruzelier

11:30 – 12:00 **Jordan Pop – Jordanov:** Nanoscopic substrate of mental activation
12:00 – 12:30 **Jari Karhu:** TMS evoked changes in EEG – measure for cortical reactivity and functional connections in congnitive studies and in clinics
12:30 – 13:00 **Jari Karhu:** Non-invasive navigated brain stimulation (NBS) in cortical mapping – what do tumor and stroke patients tell us about plasticity

13:00 – 14:30 *Lunch*

Session chair: Jari Karhu

14:30 – 15:00 **Selma Supek:** Neuromagnetic insight into cortical dynamics: Simulation and empirical studies
15:00 – 15:30 **Cheryl J Aine:** Aging and dementia: Different Strategies for Auditory Word Recognition
15:30 – 16:00 **Cheryl J Aine:** Aging: Development and Pathology in Adulthood

16:00 – 16:30 *Coffee break*

Session chair: Valéria Csépe

16:30 – 17:00 **Hubert Preissl:** Magnetoencephalographic recordings in neonates and fetuses
17:00 – 17:30 **Hubert Preissl:** Insulin sensitivity of the human brain

17:30 – 19:00 **Welcome reception and concert**

FRIDAY, April 17, 2009 ***Conference Hall I***

Session chair: Adrian Burgess

09:00 – 09:30 **Adrian P Burgess:** From the Dynamic Core to a Small World: The role of functional connectivity and cortical oscillations in the emergence of consciousness
09:30 – 11:00 **ORAL SESSION I**
09:30 – 10:00 *Karim Jerbi, Emmanuel Maby, Jeremie Mattout, Philippe Kahane, Olivier Bertrand, Jean Philippe Lachaux:* Online exploration of cerebral oscillations in human intracranial data: Towards novel BCI, neurofeedback and functional mapping strategies

10:00 – 10:20 *Tomas Ros, Moniek A.M. Munneke, Diane Ruge,John H. Gruzelier and John C. Rothwell:* Direct effects of neurofeedback on motor cortical plasticity: a TMS-EEG study

10:20 – 10:40 *Sabine de Ridder, Martijn Arns:* The usability of Tele-Neurofeedback

10:40 – 11:00 *Tony Steffert, Atsuko Inoue, Anthony Steed, Aleksander Valjamae, Ulysses Bernadet, Paul F M J Verschure and John Gruzelier:* Virtual reality and SMR neurofeedback

11:00 – 11:20 *Martijn Arns, Sabine de Ridder, Ute Strehl, Marinus Bretel and Ton Coenen:* Efficacy of neurofeedback treatment in ADHD: The effect on inattention, impulsivity and hyperactivity: A meta-analysis

11:00 – 11:30 *Coffee break*

Session chair: Cheryl J Aine

11:30 – 12:00 **Tomáš Paus:** White matter in the Adolescent Brain: Myelin or Axon?

12:00 – 12:30 **Tomáš Paus:** Prenatal Exposure to Maternal Smoking and Brain Structure and Function in Adolescent Offspring

12:30 – 13:00 Discussion

13:00 – 14:30 *Lunch*

Session chair: Tomáš Paus

14:30 – 15:00 **Dragica Kozarić-Kovačić:** Malingering posttraumatic stress disorder: diagnostic and treatment concerns

15:00 – 15:30 **Israel Liberzon:** Functional Neuroanatomy in PTSD

15:30 – 16:00 **James Douglas Bremner:** Neuroplasticity in Posttraumatic Stress Disorder

16:00 – 16:30 *Coffee break*

16:30 – 19:00 **ADHD Module I**

The neuropsychological approach to ADHD
(*prof. Giuseppe Chiarenza*)

- Theoretical models of attention
- Theoretical models of attention in ADHD
- Neuropsychological assessment of attention
- Review of literature
- The Amsterdam Neuropsychological Test
- Presentation of the tests
- Assessement and evaluation of patients

SATURDAY, April 18, 2009 ***Conference Hall I***

Session chair: Hubert Preissl

09:00 – 10:00 **ORAL SESSION II**

09:00 – 09:15 *W. Klonowski, S. Biegluk, B. Stankiewicz, P. Stepien, R. Stepien, K. Zielinski:* Peripheral biofeedback and non-spectral Neurofeedback: Basics and applications

09:15 – 09:30 *Silvana Markovska-Simoska, Nada Pop-Jordanova, Aneta Demerdzieva:* Comparison of visual and emotional continuous performance tests related to sequence of presentation, gender and age

09:30 – 09:45 *Krunoslav Stingl, Martina Guthoff, Katarína Porubská, Otto Tschritter, Naima Lahanar, Martin Heni, Hans-Ulrich Häring, Andreas Fritsche, Hubert Preissl:* Intranasal administered insulin effects, cerebral activity in lean subjects

09:45 – 10:00 *Aneta Demerdzieva, Nada Pop-Jordanova, Silvana Markovska-Simoska:* QEEG assessment in anorectic patients

10:00 – 11:30 **General Module I**

EEG Rhytms & Neurophysiology

(*prof. Juri Kropotov*)

- Slow, infra slow potentials and delta rhythms
- Alpha rhythms
- Beta rhythms
- Frontal midline theta rhythm
- Paroxysmal events
- QEEG endophenotypes

11:30 – 12:00 *Coffee break*

12:00 – 13:30 **General Module II**

EEG Rhythms & Cognition

(*prof. Adrian Burgess*)

- Introduction to time-frequency analysis
- Event-related (de)synchronisation
- Wavelet Analysis
- The Functional Significance of EEG frequency ranges
    - Alpha rhythms
    - Beta rhythms
    - Theta & frontal midline theta rhythms
    - Gamma rhytms
    - Slow, infra slow potentials and delta rhythms

13:30 – 15:00 *Lunch*

15:00 – 16:30 **General Module III**

EEG Rhythms & Recording

(*prof. Juri Kropotov*)

- Methods of analysis of background EEG
- Amplifiers, filters, impendance
- Artefacts correction
- Electrode placement
- Brain mapping
- Create Spectral analysis
- Comparison with HBI database

16:30 – 19:00 **GUIDED OLD CITY TOUR (optional)**

19:00 – 22:00 **DINNER (optional)**

SUNDAY, April 19, 2009 ***Conference Hall I***

Session chair: Juri Kropotov

09:00 – 10:00 **ORAL SESSION III**

09:00 – 09:20 *Joseph Leach and John Gruzelier:* Beneficial effects of alpha/theta neurofeedback on non-expert singing and expert instrumental performance

09:20 – 09:40 *Petra Studer:* Neurofeedback in children with attention deficit/ hyperactivity disorder (ADHD)

09:40 – 10:00 *Max Jean-Lon Chen and John H. Gruzelier:* Beneficial effects of electrostimulation contigencies on sustained attention, ERPs and EEG

10:00 – 11:30 **General Module IV**

EEG Rhythms & Dynamics Systems

(*prof. Adrian Burgess*)

- The binding problem and the nature of consciousness
- The role of cortical oscillations in functional connectivity
- Introduction to measuring functional connectivity
    - Coherence
    - Phase locking indices
    - The problem of volume conductance
    - Graph theory measures
- Applications of Functional Connectivity
    - The Dynamic Core Hypothesis & Consciousness
    - Functional Connectivity and neurological/psychiatric disease

11:30 – 12:00 *Coffee break*

12:00 – 13:30 **General Module V**

Operant Conditioning of EEG

(*dr. Marco Congendo, Tony Steffert*)

- Principles of neurofeedback
- Fast wave training
- Slow wave training
- Slow potential training
- Massed versus spaced training
- Source localisation, LORETA
- LORETA based training
- VR based neurofeed back
- fMRI neurofeedback

Demonstrations

13:30 – 15:00 *Lunch*

15:00 – 16:30 **General Module VI**

Event related potentials and brain system

(*prof. Juri Kropotov*)

- Sensory systems
- Attention networks
- Executive system
- Affective system
- Memory systems
- Methods: neuronal networks and event related potentials

16:30 – 17:00 *Coffee break*

17:00 – 18:30 **General Module VII**

Cognitive Neuroscience of ADHD

(*Petra Struder*)

- The nature of ADHD, cognitive and behavioural deficits
- Brain structure/function, psychopharmacology
- Electrophysiological markers of ADHD
- Neurofeedback treatment of ADHD
- fMRI and neurofeedback of ADHD

18:30 – 19:00 Discussion

MONDAY, April 20, 2009 ***Conference Hall I***

09:00 – 10:30 **Neurofeedback Module I**

QEEG Demonstration

(*prof Juri Kropotov, dr Beverly Steffert, dr Marco Congedo, dr Max Chen, Tomas Ros, Tony Steffert*)

- Hands on experince
- Full cap EEG
- Normative databases
- Brain maps, terminology
- Absolute, relative power
- Montage
- Bandwidths
- Asymmetry
- Dominant frequency
- Acquiring data

11:00 – 11:30 *Coffee break*

11:30 – 13:00 **Neurofeedback Module II**

Slow Wave Neurofeedback Demonstration

(*dr Beverly Steffert, dr Marco Congedo, dr Max Chen, Tomas Ros, Tony Steffert*)

- Hands on experience
- Sensor placement
- Screens
- Slow wave protocols

13:00 – 14:30 *Lunch*

14:30 – 16:00 **Neurofeedback Module III**

Optimal Performance

(*prof John Gruzelier, Tomas Ros*)

- Origins
- Anxiety reduction
- Alpha and sportsmanship
- Theta, creativity, flow
- SMR/beta attention, memory
- Micro-surgical performance
- Performing arts
- Virtual reality

16:00 – 16:30 *Coffee break*

16:30 – 18:30 **Neurofeedback Module IV**

Adult Clinical Applications

(*dr Beverly Steffert, prof John Gruzelier, prof Juri Kropotov*)

- Databases
- Epilepsy
- Anxiety, panic, PTSD
- Sleep
- Depression, bipolar disorder
- Schizophrenia
- Addiction
- Migraine, pain
- Head injury, stroke, dementia

MONDAY, April 20, 2009 ***Conference Hall II***

09:00 – 12:30 **ADHD Module II**

Systematic neurophysiological psychotheraphy in ADHD

(*dr Andreas Müller*)

- A new clinical approach
- Theoretical model
- Diagnostics
- Treatment

11:00 – 11:30 *Coffee break*

12:30 – 13:00 Discussion

13:00 – 14:30 *Lunch*

TUESDAY, April 20, 2009 ***Conference Hall I***

09:00 – 10:30 **Neurofeedback Module V**

QEEG Demonstration in Groups

(*prof Juri Kropotov, dr Beverly Steffert, dr Marco Congedo, dr Max Chen, Tomas Ros, Tony Steffert*)

- Hands on experince
- Full cap EEG
- Normative databases
- Brain maps, terminology
- Absolute, relative power
- Montage
- Bandwidths
- Asymmetry
- Dominant frequency
- Acquiring data

10:30 – 11:00 Demonstrations and discussion

11:00 – 11:30 *Coffee break*

11:30 – 13:00 **Neurofeedback Module VI**

Child Applications

(*dr Beverly Steffert, prof Juri Kropotov, Tony Steffert*)

- Controlled studies od ADHD
- ADD
- Autism
- Dyslexia
- Dysgraphia
- Behaviour disorders
- Intensive training

13:00 – 13:30 **Closing remarks**

ABSTRACTS

I. Invited lectures

Aging and dementia: Different Strategies for Auditory Word Recognition

Cheryl J. Aine
University of New Mexico, School of Medicine

We previously showed that young participants (<30 years) revealed different brain patterns compared to their elderly counterparts (>64 years) during a visual delayed-match-to-sample task with no difference in performance levels (Aine et al, 2006). Here we examine MEG brain patterns and performance of healthy elderly (>64 years) and elderly diagnosed with mild cognitive impairment (MCI) and Alzheimer's disease (AD) during an auditory incidental verbal leaning task. Results from 19 elderly and 11 MCI/AD participants indicate three dominant spatio-temporal patterns that correlate with IQ and memory tests as well as behavioral performance. Best performers utilized anterior temporal lobe in conjunction with premotor cortex. Our results also suggest that brain signals in AD or MCI in these regions often exceed the amplitudes of normal controls in initial stages of the disease.

Aging: Development and Pathology in Adulthood

Cheryl J. Aine
University of New Mexico, School of Medicine

Memory dysfunction is the most common complaint of the elderly, but this problem is difficult to study since there are a number of factors contributing to age-related changes in memory. I would like to highlight two factors in this talk that are important to consider in studies of normal aging. First, healthy age-related changes occur in the anatomy and physiology of the brain throughout the life span that mediate the unfolding of different cognitive strategies. For example, age-related changes in episodic memory seems to parallel the development of white matter connectivity, which is necessary for effective strategies (i.e., top-down processing). Middle-aged and elderly individuals use executive strategies (e.g., verbally based) more frequently for performing working memory tasks while the young tend to rely more on a visual perceptual strategy, the phylogenetically oldest representations that are dependent upon bottom-up processing. Second, two pathological processes, hypertension and type 2 diabetes, are known to target white matter connectivity in prefrontal cortex causing cognitive decline. Here, the goal is to separate healthy “successful” aging from “normal” aging since vascular and metabolic disorders, which can be controlled or prevented, are often not controlled for in aging studies.

Neuroplasticity in Posttraumatic Stress Disorder

James Douglas Bremner
Emory University School of Medicine, Atlanta, Georgia, USA

Posttraumatic stress disorder (PTSD) is associated with long-term changes in neurobiology. Brain areas involved in the stress response include the medial prefrontal cortex, hippocampus, and amygdala. Neurohormonal systems that act on the brain areas to modulate PTSD symptoms and memory include glucocorticoids and norepinephrine. Dysfunction of these brain areas is responsible for the symptoms of PTSD. Brain imaging studies show that PTSD patients have increased amygdala reactivity during fear acquisition. Other studies show smaller hippocampal volume. A failure of medial prefrontal/anterior cingulate activation with re-experiencing of the trauma is hypothesized to represent a neural correlate of the failure of extinction seen in PTSD. The brain has the capacity for plasticity in the aftermath of traumatic stress. Antidepressant treatments and changes in environment can reverse the effects of stress on hippocampal neurogenesis, and humans with PTSD showed increased hippocampal volume with both paroxetine and Phenytoin.

From the Dynamic Core to a Small World: the role of functional connectivity and cortical oscillations in the emergence of consciousness

Adrian P. Burgess
School of Life and Health Sciences, Aston University, Birmingham

The search for a neural correlate of consciousness has focused for many years on the role of cortical oscillatory activity and it has been claimed that conscious perception is associated with changes in both local oscillatory activity (e.g. gamma oscillations ~40Hz) and connectivity between different brain areas (i.e. functional connectivity). However, as both gamma activity and functional connectivity can be seen in the absence of consciousness, neither can be considered to be neural correlates of the process. To overcome this problem, it has been proposed that it is not the presence or absence of functional connectivity in any given frequency range but the pattern (i.e. the topology) of the connections that is critical. For example, Tononi & Edelman's (1998) Dynamic Core Hypothesis proposes that for consciousness to occur there must be a specific pattern of information exchange within the brain which they call Neural Complexity. The great strengths of the Dynamic Core Hypothesis are that i) Neural Complexity is explicitly mathematically defined and ii) the hypothesis makes testable predictions. In this talk I shall report a series of experiments designed to test the Dynamic Core Hypothesis and discuss the theoretical and practical limitations of the approach. I shall go on to describe new topological approaches to functional connectivity in the brain derived from graph theory (e.g. Small World Networks) that might overcome these limitations and report some preliminary results that suggest these may have a useful role to play in the search for neural correlates of consciousness.

Brain maturation and the music-language interplay

Valéria Csépe
Hungarian Academy of Sciences Budapest, Hungary

Recent comprehensive studies aim to shed light of the relationship between music and language in general and especially from the standpoint of cognitive neuroscience. Years have been passed when researchers shared a widespread belief that music and language are processed independently. Recently, multidisciplinary research on this topic grows rapidly, as scholars from various disciplines, such as cognitive psychology, linguistics, music cognition, and neuroscience are drawn to the music-language interplay as one way to explore how mental abilities especially language is allocated to brain mechanisms involved in music processing. This presentation aims to highlight recent data that show how music and language share critical neural networks, and that how multidisciplinary research provides a unique way to study cognitive and neural mechanisms underlying brain maturation and cognitive development.

ADHD - a challenge for cognitive and clinical neuroscience

Valéria Csépe
Hungarian Academy of Sciences Budapest, Hungary

ADHD is one of the challenging topics of recent research in developmental cognitive neuroscience. The presentation will highlight the neuro-cognitive background of this complex disorder, its brain correlates and the diagnostic possibilities for assessing atypical development associated with ADHD. The main topics of the talk are as follows:

- Disorders and impairments in the brain's attentional/executive system
- Frontal lobe involment in ADD and ADHD
- Cognitive profile of ADD and ADHD
- Frequent co-morbidities
- Assessment possibilities
    - Cognitive
    - Developmental
    - Neurophychological
    - Neuro-cognitive

Alpha/Theta Neurofeedback, Creative Performance Enhancement, Long

Distance Functional Connectivity & Psychological Integration.

John Gruzelier
Department of Psychology, Goldsmiths, University of London

Professionally significant enhancement of music, dance and acting performance and mood has followed training with an EEG-neurofeedback protocol which increases the ratio of theta to alpha waves using auditory feedback with eyes closed. While originally the protocol was designed to induce hypnogogia, a state historically associated with creativity, the outcome was psychological integration, while subsequent applications focusing on raising the theta-alpha ratio, reduced depression and anxiety in alcoholism and resolved post traumatic stress syndrome (PTSD). In optimal performance studies we confirmed associations with creativity in musical performance, but effects included technique and communication. We extended efficacy to dance and acting performance and well-being in socially anxious medical students. Diversity of outcome has a counterpart in wide ranging associations between theta oscillations and behaviour in cognitive and affective neuroscience: in animals with sensory-motor activity in exploration, effort, working memory, learning, retention and REM sleep; in man with meditative concentration, reduced anxiety and sympathetic autonomic activation, as well as task demands in virtual spatial navigation, focussed and sustained attention, working and recognition memory, and having implications for synaptic plasticity and long term potentiation. Neuroanatomical circuitry involves the ascending mescencephalic-cortical arousal system, and limbic circuits subserving cognitive as well as affective/motivational functions. Working memory and meditative bliss, representing cognitive and affective domains respectively, have involved coupling between frontal and posterior cortices, and exemplify the role for theta and alpha waves in mediating the interaction between distal and widely distributed connections. It is posited that this mediation in part underpins the integrational attributes of alpha-theta training in optimal performance and psychotherapy, creative associations in hypnogogia, and enhancement of technical, communication and artistic domains of performance in the arts (1). Contrasts with faster wave training will also be made (2). Gruzelier, J.H. (2009) A theory of alpha/theta neurofeedback, creative performance enhancement, long distance functional connectivity and psychological integration. Cognitive Processing, in press. Gruzelier, J.H., Egner, T., Vernon, D. (2006) Validating the efficacy of neurofeedback for optimising performance. In C. Neuper , W. Klimesch, Event-related dynamics of brain oscillations. Progress in Brain Research, 159, 421-431.

TMS evoked changes in EEG - measure for cortical reactivity and functional connections in cognitive studies and in clinics

Jari Karhu
Dept. of Physiology, University of Kuopio and Nexstim Ltd.,Helsinki, Finland

Electroencephalography (EEG) combined with TMS allows one to obtain detailed, real-time information about the state of the cortex [1]. By measuring the neuronal electrical activity elicited by TMS, it provides a new modality for functional brain imaging. Any region of the cortical mantle can be stimulated; in addition to the state of the stimulated area, the response informs us about the functional connectivity to other regions as well as about their state.
The new modality of TMS-EEG is straightforward to:
- measure and map neuronal reactivity of the cortex
- monitor how brain oscillatory activity is modulated by targeted stimulation
- measure functional connectivity between brain areas
- monitor the effects of rTMS during and after treatment

Recent sleep studies have shown the disconnection of discrete cortical areas during deep, but not REM, sleep. Another application emerging from cognitive studies is the parallel speeding up of reaction time and TMS-evoked EEG responses during acognitive-motor task. Of particular inerest is the behavior of oscillatory 10-Hz EEG activity which represents the interplay of thalamo-cortical sensory networks. The TMS-induced desynchronization/synchronization of these oscillations may provide a dosedependent index for physiological effectiveness of brain stimulation. The recent results in Alzheimer disease support the concept of diminished functional connectivity of motor cortex in neurodegenerative diseases. These advances have taken the method to the verge of routine clinical use in addition to the research applications

Non-invasive navigated brain stimulation (NBS) in cortical mapping -what do tumor and stroke patients tell us about plasticity

Jari Karhu
Dept. of Physiology, University of Kuopio and Nexstim Ltd.,Helsinki, Finland

We have evaluated Navigated Brain Stimulation (NBS) as a brain mapping method by demonstrating its ability to map the cortical representation of specific muscles by stimulating motor areas, eliciting direct corticospinal volleys, and recording the evoked muscle responses by surface EMG. Transcranial magnetic stimulation (TMS) preferentially stimulates neurons located directly beneath the coil's maximal electric field. However, it is difficult to precisely localize cortical targets with traditional TMS devices. We use real-time interactive 3D- positioning for targeting. The intracranial stimulating electric field, "dose", of NBS is also calculated and visualized in real time, taking into account individual head shape and stimulating coil shape. What distinguishes the method from all other brain imaging tools is the causality: we know, that to observe an EMG -response stimulation must activate the cortical end of a functioning corticospinal motor tract. We have observed permanent plastic changes, e.g., in figure skater's leg motor presentations. Moreover, the motor neuronal populations have now been mapped a) prior to the operation of tumors or lesions adjacent to these viable brain areas, and b) at various stages after a stroke. The mapping has provided exact information about the location of viable tissue even in the cases with prominent swelling and alterations of the anatomical structures. The non-invasively recorded locations agree very well with intracranial direct cortical stimulation (DCs). Prominent plastic changes are frequently seen in chronic stroke patients and they reflect well the functional capacity of the individual subject Navigated Brain Stimulation (NBS) localizes motor areas quickly and reliably. NBS mapping is a significant new tool in the study of plastic changes in human cortex.

Malingering posttraumatic stress disorder: diagnostic and treatment concerns

Dragica Kozarić -Kovačić
Department of Psychiatry, Dubrava University Hospital, Referral Center for Stress-related Disorders of the Croatian Ministry of Health and Social Welfare, Regional Center for Psychotrauma, Zagreb, Croatia

Posttraumatic stress disorder (PTSD) is a severe, complex, and very often chronic psychiatric illness associated with disturbances in diverse neurobiological systems. The diagnosis of PTSD may have several subtypes, including psychotic symptoms, depending upon pre-existing psychiatric disorder, trauma severity, duration of disturbance, comorbidity, post-trauma social environment, etc. PTSD has a big influence to the individual, family, and society. The prevalence of posttraumatic stress disorder (PTSD) in war veterans has been a controversial medical but also political issue. A controversial topic in this debate is the malingering of PTSD symptoms. PTSD is a diagnosis difficult to establish with certainty. Because of a fact that PTSD is diagnosed mainly on symptoms presented by the patient, as well as the comorbidity, PTSD is not hard to simulate. In the cases of compensation-related purposes and other forensic evaluations, the diagnostic problem is more sensitive. Of course, having compensation seeking motives certainly does not invalidate a PTSD diagnosis. Evenmore, it is critical to have more objective diagnosis in planning suitable treatment procedures, because the chronicity, comorbidity, and somatization can influence the course of PTSD and subsequent outcome. As factitious and malingered PTSD have negative connotation to individual and society, an unrecognized or neglected PTSD can seriously affected both the individual and his/her immediate family, contributing further to the aggravation of the problems. Our experience supports the notion that it is necessary to include many different assessment methods, such as psychiatric assessment based on diagnostic criteria and clinical evaluations and psychological assessment based on psychometric evaluation, because only then is the most objective diagnosis and appropriate therapy possible. This is especially important in situations of expert examination for forensic or compensation-related purposes. Furthermore, the evaluation of different biomarkers might facilitate a goal of the modern medicine, a proper diagnosis and treatment for an individual patient at a given stage of disease. This is especially important in PTSD, a disorder with complex clinical picture, diverse symptoms, and different comorbidities.

PTSD – beyond fear conditioning

Israel Liberzon
US Veterans Medical Center, Ann Arbor, MI, USA

Functional neuroimaging provides a powerful means to understand the mechanisms that mediate emotional processing in healthy individuals as well as the dysregulation of these processes in posttraumatic stress disorder (PTSD). Neuroanatomical models of PTSD have been traditionally based on fear conditioning, and the role of amygdala in this process. Neuroimaging studies in PTSD had been utilizing symptom provocation paradigm focusing on the amygdala and prefrontal-amygdala connectivity, in mediating symptom formation in PTSD. Newer functional neuroanatomy studies implicate medial prefrontal cortex mPFC in complex psychological processes like habituation, extinction recall; cognitive-emotional interactions; and self-related and social-emotional processing. Findings linking neurocircuitry subserving these processes to the abnormalities associated with PTSD are highlighted, suggesting that the mPFC is implicated in a number of these processes in PTSD. It is proposed that the mPFC plays a role in the "contextualization" of stimuli, and dysregulation of contextualization processes might play a key role in the generation of PTSD symptoms.

White Matter in the Adolescent Brain: Myelin or Axon?

Tomáš Paus
Brain & Body Centre, University of Nottingham, UK and Montreal Neurological Institute, McGill University, Canada

White matter occupies almost half of the human brain. It contains axons connecting spatially segregated modules and, as such, it is essential for smooth flow of information in functional networks. Structural maturation of white matter continues during adolescence, as reflected in age-related changes in its volume, as well as its microstructure. I review recent observations obtained with magnetic resonance imaging in typically developing adolescents, point out some of the known variations in structural properties of white matter vis-a-vis brain function in health and disease, and conclude by outlining possible cellular underpinnings underlying sex differences in the growth of white matter during adolescence.

Prenatal Exposure to Maternal Smoking and Brain Structure and Function in the Adolescent Offspring

Tomáš Paus
Brain & Body Centre, University of Nottingham, UK and Montreal Neurological Institute, McGill University, Canada

This presentation will provide an overview of an on-going study of long-term consequences of prenatal exposure to maternal cigarette smoking (PEMCS) on brain & behaviour: the Saguenay Youth Study. The overall goal of this study is to evaluate PEMCS effects on multiple phenotypes in two domains, namely on brain & behaviour and on cardiovascular & metabolic health, and to search for genes that may modify effects of such an adverse intrauterine environment on these phenotypes. I will focus on our findings obtained in the following areas: (1) brain morphology, as assessed with computational analysis of magnetic resonance images; (2) cognitive abilities examined by a number of standard and experimental psychological tests; and (3) anti-social and pro-social behaviour assessed with a variety of questionnaire-based measures. Our findings will be interpreted in the context of our current understanding of brain maturation and cognitive development in adolescence.

Nanoscopic substrate of mental activation

Jordan Pop-Jordanov
Macedonian Academy of Sciences and Arts, Skopje, MK

There is a well established empirical (experimental and clinical) evidence of correlation between EEG spectrum and mental activation, both non-focused (arousal) and task-related (attention). The neurofeedback training is also based on this correlation, using the corresponding spectral parameters (theta-beta, theta-alpha, brain rate etc.). The present study is an overview of our attempts toward theoretical explanation and mathematical representation of this interdependence, advancing from descriptive "how" to explanative "why". To this aim, we started from the nanoscopic substrate of mental activation, relating it to the interaction of electric field with neuronal quantum dipoles. The

obtained analytical expressions and numerical values, based on quantum transition probabilities and corresponding information entropy, appeared to be in agreement with classical empirical results for arousal and attention, including the respective sigmoid and inverted-U shapes, as well as the frequency intervals. Still, despite these encouraging results, for a deeper understanding of substrates and emergence of arousal, attention and consciousness, the subtle interplay of neurophysical, neurochemical and neurobiological correlates must be taken into account.

Magnetoencephalographic recordings in neonates and fetuses

Hubert Preissl
UAMS, Little Rock, USA; University of Tübingen, Tübingen, Germany

Investigation of functional brain activity in the early stages of development is a technical challenge. Magnetoencephalography (MEG) has several advantages compared to other well established brain imaging techniques, e.g. electroencephalography, functional magnetic resonance imaging. MEG is a completely non-invasive method and allows measurement in neonates and even fetuses. We developed a special MEG device for fetal and neonatal recordings. Most studies on fetuses and neonates are performed with auditory stimulation. It was possible to show gestational changes of the evoked auditory fields and even early discriminative capabilities, which may be a precursor of language development. In addition first clinical investigations are implemented, to investigate the effect of compromised intrauterine environment on the functional brain development. In addition visual evoked fields and spontaneous brain activity are detectable with MEG in the fetuses and neonates. In my talk I will give an overview of the current analysis approaches for fetal and neonatal MEG recordings and review the current status of MEG studies in fetuses and neonates.

Insulin sensitivity of the human brain

Hubert Preissl
UAMS, Little Rock, USA; University of Tübingen, Tübingen, Germany

Until recently insulin was regarded as a peptide primarily effective in the periphery of the human body. However after the detection of insulin receptors all over the human brain, the question arouse how insulin could affect human brain activity. In an early study we were able to show that peripheral application of insulin leads to changes in spontaneous brain activity measured by magnetoencephalography (MEG). Interestingly this effect was dependant on the body composition, e.g. it was negatively correlated with the body mass index. This relation resembles the peripheral effect of insulin and we called it cerebral insulin resistance. Recently we were able to show that this effect is also detectable in visual evoked fields during stimulation with food images. These results clearly demonstrate the importance of insulin in the human brain and lead to a very interesting questions about the development of cerebral insulin resistance and its link to peripheral insulin resitance. In my talk I will present the results of our MEG and fMRI studies related to food processing and modulation of these processes by insulin.

Neuromagnetic insight into cortical dynamics: Simulation and empirical studies

Selma Supek
Department of Physics, Faculty of Science, University of Zagreb

Neuroplasticity and in particular cognitive neurodynamics of the developing human brain are challenging and largely unknown despite significant advances in the functional and structural imaging of the human brain. Such information is not readily available even with the invasive approaches since they are typically performed on epileptic patients providing pathology related distortions. The relevance of the extraction of the neuronal activation timecourse comes from evidences that dysfunction and age related changes are often related to the interaction pathways. MEG represents a direct and real-time measure of neuronal activity and offers monitoring of the spontaneous and evoked brain responses with a millisecond resolution parallel only to the electroencephalography (EEG). In addition, it offers the possibility of identifying the underlying neuronal substrate and tracking when, where, and how the activity changes over time without knowledge of a detailed conductive geometry profile. Neuromagnetic source dynamics accuracy, however, is model and inverse procedure dependent. The results of experimental and numerical simulation studies will be presented on the spatio-temporal source discrimination as well as location and timecourse estimation accuracy of the activated cortical sources. Since functional neuroanatomy differs between individuals we will provide empirical and simulation evidences in favor of a within subject analysis in particular in the light of a lifetime neuroplasticity of the brain both in health and disease.

II. Oral presentations

Efficacy of Neurofeedback treatment in ADHD: The effects on Inattention, Impulsivity and Hyperactivity: A meta-analysis.

Martijn Arns[1,2], Sabine de Ridder[2], Ute Strehl[3], Marinus Breteler[4,5], Ton Coenen[5]
1Brainclinics Diagnostics, Nijmegen, The Netherlands
2Brainclinics Treatment, Nijmegen, The Netherlands
3University of Tuebingen, Germany
4EEG Resource Institute, Nijmegen, The Netherlands
5Radboud University, Nijmegen, The Netherlands

Since the first reports of Neurofeedback treatment in ADHD in 1976 many studies have been carried out investigating the effects of Neurofeedback on different symptoms of ADHD such as inattention, impulsivity and hyperactivity. This technique is also used by many practitioners, but the question as to the evidence-based level of this treatment is still unclear. In this study selected research on Neurofeedback treatment for ADHD was collected and a meta-analysis was performed. Both prospective controlled studies and studies employing a pre- and post-design found large effect sizes (ES) for Neurofeedback on impulsivity and inattention and a medium ES for hyperactivity. Randomized studies demonstrated a lower ES for hyperactivity suggesting that hyperactivity is probably most sensitive to non-specific treatment factors. Due to the inclusion of some very recent and sound methodological studies in this metaanalysis potential confounding factors such as small studies, lack of randomization in previous studies and a lack of adequate control groups have been addressed and the clinical effects of Neurofeedback in the treatment of ADHD can be regarded as clinically meaningful. Four randomized controlled trials have shown Neurofeedback to be superior to a (semiactive) control group, whereby the requirements for Level 4: Efficacious are fulfilled (Criteria for evaluating the level of evidence for efficacy established by the AAPB and ISNR). Three studies have employed a semi-active control group which can be regarded as a credible sham control providing an equal level of cognitive training and client-therapist interaction. Therefore, in line with the AAPB and ISNR guidelines for rating clinical efficacy, we conclude that Neurofeedback treatment for ADHD can be considered 'Efficacious and Specific' (Level 5) with a large ES for inattention and impulsivity and a medium ES for hyperactivity.

QEEG assessment in anorectic patients

Aneta Demerdzieva[1], Nada Jop-Jordanova[1], Silvana Markovska-Simoska[2]
1Pediatric Clinic, Faculty of Medicine, University of Skopje
2Bioinformatics Unit, ICEIM, Macedonian Academy of Sciences and Arts

Anorectic patients are obsessed with their weight and body shape. Abnormalities in brain structure and function are among the most common. OBJECTIVE: to investigate electroencephalographic, LORETA and brain rate characteristics in group of five patients with anorexia and to compare their results with normative data base. METHODS: QEEG was recorded by Mitsar using International 10-20 system, 250 Hz sampling rate in 0.3 – 70 Hz frequency range in the following conditions: 1) eyes opened–3 minutes, 2) eyes closed –3 minutes, and 3) a modification of GO/NOGO task –visual continuous performance task and auditory continuous performance task – for 20 minutes. Absolute and relative EEG spectra powers were computed and compared with the corresponding parameters from the Human Brain Institute normative database. For all patients the brain rate was also determined. RESULTS showed in eyes open condition statistical significant increase of theta activity in frontal regions, while in eyes closed condition theta activity was increased in the right parietal region. This could be correlated with the abnormal body-image in these patients. LORETA results for source and spectra power distribution in eyes open condition showed Brodmann's area 17 and 18 which is important for modulation of attention. LORETA results in eyes closed condition showed Brodmann's area 39 and 40 responsible for integration of information from all sensory modalities. Average brain rate in eyes closed condition was 6.62, in eyes open condition 5.61, in VCPT 5.60 and during auditory CPT was 5.60. CONCLUSIONS: EEG-power changes indicate a cortical dysfunction and deficits in somatosensory integration processing in anorexia nervosa patients. Spectral power was generally lower in the AN group in comparison to the normative database. Brain rate as indicator for general mental activity shows low values, denoting the state of underarousal in C_Z for all conditions (e.o., e.c., VCPT and ACPT). Results from QEEG assessment suggest that differences in brain dynamics might explain difficulties in the social functioning of patients with anorexia.

Online exploration of cerebral oscillations in human intracranial data: Towards novel BCI, neurofeedback and functional mapping strategies

Karim Jerbi[1], Emmanuel Maby[1], Jeremie Mattout[1], Philippe Kahane[2], Olivier Bertrand[1], Jean-Philippe Lachaux[1]

1INSERM, U821, Brain Dynamics and Cognition Laboratory, Lyon, 69500, France.
2Department of Neurology and INSERM U704, Grenoble Hospital, Grenoble, France.

A crucial step common to most online applications such as Brain Computer Interface (BCI) or neurofeedback strategies is the selection of electrophysiological signals that provide optimal decoding and that facilitate subject training. The performance of a real-time system does not only depend on the type of signal (e.g. unit recordings, local field potentials (LFPs), scalp-EEG recordings) but also on a number of properties including location of the recording site, signal quality and functional specificity of the selected signal features. For example, from a BCI perspective, the optimal anatomical structure to record from is not necessarily the primary cortical area directly involved in mediating the intended task. A large body of evidence from primate studies indicates that motor intention for instance can be decoded via multiple single-unit recordings (but also from LFPs) recorded from primary motor cortex, but also in premotor or parietal areas. In humans, reports of invasive BCI systems are less numerous and signal selection for optimal control is still poorly understood. We performed a series of studies to evaluate the possible utility of intracerebral recordings obtained via Stereo-Electroencephalography (SEEG) depth electrodes in epilepsy patients for the development of novel Brain-Computer interfaces. To test the ability of patients to control various parameters of their intracranial recordings in real-time we designed an online signal analysis system that computes and displays the power variations at various frequencies as they unfolded. Using this system with and without visual feedback to the implanted patient allows both the experimenter and the subject to explore possible relationships between behaviour and oscillatory power modulations at all electrode sites. Task-related power modulations observed with this system called Brain TV, pave the way for systematic examinations using follow-up paradigms (Lachaux et al. 2007). The advantages of this approach is that it allows for the detection of previously unsuspected correlations between the subject's behaviour and power modulations in various brain areas and that it may reveal features that the subject is able to control to a certain extent even prior to training. The insight gained from the online functional exploration procedure can then be used to guide the selection of the sites and frequency bands to be used in a translation algorithm such as the one needed for a BCI-driven cursor control. Our results show the feasibility of online functional exploration via intracranial recordings in humans and outline the benefits of this approach for invasive BCI strategies in humans. In particular, our finding suggest that efficient BCI devices can be achieved using intracranial signals recorded from multiple brain areas based on power modulations of both low (theta/alpha/beta) and high (gamma) frequency estimations and suggest that BCI performance may be improved by using signals recorded from various systems such as the oscillatory activity recorded in the motor and oculomotor systems as well as higher cognitive processes including attention, memory load and mental calculation networks (Jerbi et al. 2007, 2009a,b). Implications of our findings are discussed in the context of epilepsy, functional mapping, BCI and future implications for neurofeedback.

Peripheral Biofeedback and Non-spectral Neurofeedback - Basics and Applications

W.Klonowski, S.Biegluk, B.Stankiewicz, P.Stepien, R.Stepien, K.Zielinski

Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Sciences, Warsaw

Biofeedback for a physicist means exerting a conscious influence upon a process that normally is regulated unconsciously, based on information presented to our senses about some dynamic quantitative characteristic of the regulated process. If the visualized dynamic characteristics concerns person's EEG it is called neurofeedback. Classical neurofeedback is based on spectral characteristics of EEG-signal obtained by Fast Fourier Transform.

Human EEG is a deterministic-chaotic signal and no transformation can normalized it. Moreover, EEG is very nonstationary - even the Hamletian question "To pee or not to pee" asked in mind may induce a stress in the person who is being trained by neurofeedback and ay change spectral characteristics of the person's EEG-signal - I say this from my personal experience as a neurofeedback patient. As we have suggested, neurofeedback may be based on non-spectral characteristics, like fractal dimension of EEG-signal.

In Physics there exist well defined normal values; normal values are not independent from one another - normal boiling temperature of pure water is 100°C but only under normal atmospheric pressure 760 mm Hg. In Medicine normal values practically do not exist. The only such value seems

to be ‘normal body temperature’ - 36.6°C. It is an erroneous belief that in Medicine normal value equals population average value - ‘normative databases’ no matter how large do not give a possibility of ‘reliable comparison’ to decide if the given case is ‘normal’ or ‘abnormal’. Human organism (and human brain in particular) is a highly complex nonlinear systems, and that is why standardized approach based on ‘stiff’ protocols may lead to serious errors in diagnosis.
For a special purpose - treatment of stuttering persons - we have proposed a peripheral biofeedback based on capnographic signal i.e. on the concentration of carbon dioxide in the exhaled air. Computer game in which stuttering person’s capnographic signals controls a car on the screen in such a way that decreased stuttering makes the car to drive quicker has been implemented and is now under laboratory testing on patients for further improvement.

Beneficial effects of Alpha/Theta neurofeedback on non-expert singing and expert instrumental perfomance

Josephy Leach & John Gruzelier
Department of Psychology, Goldsmiths University of London

BACKGROUND: For millennia the sleep onset period known as hypnagogia has
been described as a condition in which novel mentation is likely to occur and can also be retained and organised in working memory. The Alpha/Theta neurofeedback protocol provides reliable markers of the EEG dynamics that occur during the sleep onset period, and hence a rationale is drawn for testing Alpha/Theta training as a facilitator for inducing creative insight. In this study creativity is measured as a component of live music performance, and especially improvisation, which is an exemplary domain in which to observe the creative process as it occurs.
METHODOLOGY: 36 music student volunteers were randomly assigned to two training groups receiving 10, 15 minutes sessions, or to a no-training control group. One group practised increasing and sustaining eyes closed, parietal EEG Theta band activity (5-8 Hz) in relation to Alpha (8-11 Hz). A second had 10 sessions in which to practice elevating eyes open sensorimotor cortex SMR band EEG (1215 Hz) in relation to Theta (5-8 Hz)and High-Beta (22-36 Hz). Outcome assessment included folk singing, solo instrumental performance, and unprepared singing from a graphical score (Stripsody). Performances were filmed pre/post intervention, and footage was rated.
RESULTS: Alpha/Theta Training produced improvements in novice singing ability including improvisation, and in support of Gruzelier & Egner [1] in expert instrumental performance in domains of Musicality, Communication and Technique.

Comparison of visual and emotional continuous performance tests related to sequence of presentation, gender and age

Silvana Markovska-Simoska[1], Nada Pop-Jordanova[2], Aneta Demerdzieva[2]
1Bioinformatics Unit, ICEIM, Macedonian Academy of Sciences and Arts, MK
2 Pediatric Clinic, Faculty of Medicine, University of Skopje, MK

The Continuous Performance Tests (CPTs) is one group of paradigms for the evaluation of attention and, to a lesser degree, the response inhibition (or disinhibition) component of executive control. The object of this study was to compare performance on a CPT using both visual and emotional tasks in 46 normal adult subjects. Particularly, we examined the effects of type of task (VCPT or ECPT), sequence of presentation, and gender/age influence on performance as measured errors of omission, errors of commission, reaction time and variation of reaction time. The results showed that there are significantly worse performance parameters for ECPT than VCPT task, with probabilistic explanation of the influence of emotional stimuli on attention and information processing and no significant effect of sequence of presentation and gender on performance. Significant differences with more omission errors for older groups were obtained, showing better attention in younger subjects.

The usability of Tele-Neurofeedback

Sabine de Ridder, Martijn Arns
Brainclinics Treatment, Nijmegen, The Netherlands

Neurofeedback training requires considerable effort of clients in terms of time, money and energy, particularly for clients who live more than an hour away from their therapy practice. Tele-Neurofeedback is an approach which facilitates the treatment process for these clients. In this

approach, the clients handle their own hardware at home, using software installed on their own computer, while being supervised in real-time by their therapist via the internet and telephone.

In this presentation, we describe the procedures that were developed in order to secure a professional treatment, based on initial face-to-face training. Furthermore, the technical details of this procedure will be explained as well as data demonstrating this approach was similarly efficacious as compared to on-site Neurofeedback. Finally, this method has also been used in a scientific study in the treatment of insomnia, demonstrating the usefulness of tele-neurofeedback in research studies.

Direct effects of neurofeedback on motor cortical plasticity: a TMS-EEG study

Tomas Ros[1], Moniek A.M. Munneke[2], Diane Ruge[3], John. H. Gruzelier[1], and John C. Rothwell[3]

1 Department of Psychology, Goldsmiths, University of London, London, U.K.

2Department of Clinical Neurophysiology, Radbound University Nijmegen Medical Centre, Nijmegen, the Netherlands.

3 Sobell Department of Motor Neuroscience and Movement Disorders, Institute of Neurology, University College London, London, U.K.

Objective: We investigated whether a standard 30-min session of EEG neurofeedback (NFB) at left motor cortex of 24 naive subjects modified corticospinal excitability and neuroplasticity. Methods: Effects on corticospinal excitability as well as intracortical inhibition (SICI) and facilitation (ICF) of either alpha (8-12 Hz) suppression or low beta (12-15Hz) enhancement NFB were assessed by single-pulse and paired-pulse transcranial magnetic stimulation (TMS) applied to both right and left hemisphere motor cortex. Immediately before and twice after (up to 25 min) the NFB session, the motor evoked potential (MEP), SICI, and ICF parameters were measured. Results: Net corticospinal excitability of the left hemisphere (right FDI) was significantly increased >20 min after the end of alpha suppression (desynchronisation), as reflected in the average magnitudes of the single-pulse MEP, together with a reduction of SICI. Importantly, MEP change was inversely correlated ($p<0.05$) with percentage of alpha power change during NFB, as well as with the ratio of pre to post alpha baseline at rest. Following low beta NFB training there was a significant enhancement of ICF, without reliable main effects in MEP amplitude. Nevertheless a significant ($p<0.05$) negative correlation was observed between the magnitude of low beta synchronisation and MEP change. In contrast, no significant alterations in TMS parameters were found in the untrained (right) hemisphere for either protocol. Conclusions: Neurofeedback supression of alpha rhythm, generally regarded as a correlate of cortical activation, is associated with prolonged potentiation of corticospinal excitability and reduced intracortical inhibition, while synchronisation of low beta rhythms, in view of their suboptimal entraining, lead to a reduction in corticospinal excitability. The current study provides the first evidence for the 'missing link' between the historically-reported but inadequately recognised effects of cumulative neurofeedback training and direct validation of neuroplastic change following an individual training session.

Virtual reality and SMR neurofeedback

Tony Steffert, Atsuko Inoue, Anthony Steed, Aleksander Valjamae, Ulysses Bernadet, Paul F M J Verschure and John Gruzelier

Department of Psychology, Goldsmiths, University of London

Department of Computer Science, University College London

Laboratory for Synthetic Perceptive, Emotive and Cognitive Systems Institute of Audiovisual Studies, Universitat Pompeu Fabra

The efficacy of an ecologically valid neurofeedback training context was examined for effects on learning, performance and presence in two studies. In one with actors, the context consisted of a theatre auditorium, with SMR learning contingent on changes in illumination and for inhibits a reduction of intrusive audience noise. This was rendered via a computer screen, or a Computer Assisted Virtual Environment (CAVE) at UCL. In line with Presence hypotheses, the greater immersion of the CAVE was predicted to have the greater benefits for creative performance than the Screen version. Participants were 15 US sophomore theatre students: 5 CAVE, 6 Screen, 4 no-training. CAVE neurofeedback produced advantages on 5/11 acting scales as rated by 3 professors. The impact on creativity was confirmed by all 3 Imagination scales showing improvements advantaging the CAVE participants, who also identified the requisite SMR state sooner. There was a parallel with the SMR learning curves which were superior in the CAVE group. Flow (Jackson & Eklund, 2004) was higher in the training groups, and the experience of flow was positively associated with acting performance improvement in all domains.

The second study involved self motion navigation contingent on SMR neurofeedback learning in a virtual and mixed reality environment (VMRE) - eXperience Induction Machine (XIM), SPECS, Barcelona. 20 participants were randomised either to XIM which provides a highly immersive visual

environment - the space is surrounded by 3 projection screens (2.25m x 5m), and 6 video projectors used for displaying ecologically valid, life-size content, or to the same scenario rendered on a computer screen. The effectiveness of NF training along with the experience of flow is compared according to the level of immersion (size of visual display) with outcome measures including VCPT and ERPs. The results of this on-going study will be presented.

Intranasal administered insulin affects cerebral activity in lean subjects

Krunoslav Stingl[1], Martina Guthoff[2], Katarína Porubská[3], Otto Tschritter[2], Naima Lahanar[1], Martin Heni[2], Hans-Ulrich Häring[2], Andreas Fritsche[2], Hubert Preissl[1,4]

1Institute of Medical Psychology and Behavioural Neurobiology, University of Tübingen, Tübingen, Germany
2Department of Internal Medicine IV, University Hospital, University of Tübingen, Tübingen, Germany
3Department Pathophysiology of Vision and Neuro-Ophthalmology, University Eye Hospital Tübingen, Tübingen, Germany
4Department of Obstetrics and Gynaecology, University of Arkansas for Medical Sciences, Little Rock, USA

Insulin is known to be an anorexigenic hormone for the central nervous system (CNS) that contributes to the termination of food-intake in the postprandial state. In obese people however, alterations in cerebral insulin action as was previously shown are implicating a “central insulin resistance” and could be a part of the pathogenesis of obesity. Intranasal administered insulin enters the brain via the olfactory never and bulb and was shown to raise insulin concentrations in the cerebrospinal fluid without relevant absorption to the systemic blood circulation. Thereby, if insulin is administrated in this way, insulin action in the brain can be monitored directly and malfunction of the blood-brain barrier as underlying cause insulin resistance can be tested. We therefore measured 10 lean and 10 obese subjects with magnetoencephalography both in the basal state and after applying insulin or placebo intranasal spray. Neuronal stimulation was performed using matched food and non-food pictures in randomized order in the one-back working memory test. We found an increase of amplitude of the root mean square value in the evoked magnetic field induced by food pictures after insulin administration in lean but not in obese subjects. This modulation was observed in the components of evoked field related to identification and categorization of incoming picture (at around 170ms post stimuli in the visual ventral stream). Intranasal insulin had no significant effect on glucose, insulin or cpeptide concentrations. In conclusion, observed effect of intranasal insulin on cerebral processing of food pictures are giving additionally strong support to the idea of a central insulin resistance in obesity but they are also rule out a malfunction of the blood-brain barrier as source of the same.

Neurofeedback in Children with Attention Deficit/ Hyperactivity Disorder (ADHD)

Petra Studer

Department of Child & Adolescent Mental Health, University of Erlangen, Germany

Attention deficit/ hyperactivity disorder is a neurodevelopmental disorder characterized by symptoms of inattention, hyperactivity and impulsivity (prevalence: ca. 5%). Cognitive, brain structural as well as functional differences compared to children without ADHD are implicated. Treatment usually comprises medication with stimulants and / or interventions based on cognitive behaviour therapy. But there is a need for further treatment options.

Neurofeedback, a neurobehavioural training, has emerged as a promising treatment module for children with ADHD. Positive effects of neurofeedback training had been described in a variety of studies. However, the significance of these studies was limited due to methodological short-comings like e.g. small sample sizes and lacking adequate control conditions. Recent studies have addressed these short-comings and provided more substantial evidence for the effectiveness of neurofeedback in ADHD. In addition, the underlying neurophysiological mechanisms are studied in order to gain insights into the processes underlying a successful neurofeedback training.

In the first part of the presentation a brief introduction to ADHD will be given providing some background information as well as explaining the rationale for neurofeedback in ADHD. The main part of the presentation will give an overview of neurofeedback studies in ADHD focusing on controlled studies. The evidence that exists up to now will be summarized and an outlook on ongoing studies will be given.

Beneficial Effects of Electrostimulation Contingencies on Sustained Attention, ERPs and EEG

Max Jean-Lon Chen, MD[1, 2] John H. Gruzelier, MA, PhD[1],

[1]Department of Psychology, Goldsmiths, University of London, [2]School of Medicine, Chang Gung University and Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital, Taiwan.

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