RESEARCH NETWORKING PROGRAMME

EUROPEAN RESEARCH NETWORK FOR INVESTIGATING HUMAN SENSORIMOTOR FUNCTION IN HEALTH AND DISEASE (ERNI-HSF)

Scientific Report on the ERNI-HSF funded workshop,

Brain oscillations in health and disease

Budapest, Hungary, 2012.11.08-2012.11.10

Summary

The aim of the workshop was to bring together investigators working in different areas to discuss emerging ideas and approaches in the research of human neural oscillations in health and disease. Brain oscillations have been associated with diverse neural processes involved in sensory and motor functions, attention, and memory. The workshop will focus on how oscillations contribute to the neural responses within brain areas as well as to the coordination of activity between distant areas during both normal brain functioning and in disease states.

Scientific content and discussion

The meeting aimed to start an in depth discussion of the neural and cognitive mechanism of oscillatory mechanisms within healthy and pathophysiologically altered central nervous systems. First Professor Valeria Csepe, who is the Deputy General Secretary of the Hungarian Academy of Sciences welcomed the meeting, stating the importance of the field of oscillatory functions in the

human brain and briefly discussing its historical background. Next, Professor Stephen Jackson (University of Nottingham) welcomed the meeting with an introduction to ERNI-HSF program providing a broad work of European Science Foundation. Finally Professor Zoltán Vidnyánszky opened the meeting with introductory words regarding oscillations, their role in sensory, motor and cognitive functions and briefly introduced and thanked the speakers and organizers.

We arranged for the invited speakers to speak for 35 minutes each, including their responses to questions. On the first day we had three talks focusing on the neural basis of brain oscillations. The first was by Norbert Hajos (Inst. Exp. Medicine of the Hungarian Acad. Sci) about the cellular and neural network mechanisms of fast oscillations in rats. Next István Ulbert (Inst. Psychol, Hung. Acad. Sci) talked about slow-sleep oscillations, finally Robert Bodizs (Semmelweis Univ) summarized neural oscillations during sleep in healthy human subjects and connected functions to phenotypes. The discussions after the talks highlighted the importance of the research aiming at understanding how brain oscillations are generated in the brain as well as the pathology of the underlying neural processes using animal models.

Afterwards we had a coffee break at the Coffee club of the Hungarian Academy of Sciences with approximately 80 participants, including the members of the audience as well. This concluded the first day scientific program and was followed by the workshop dinner at a neighboring restaurant.

The talks during the second day were focusing on the role of brain oscillations in human sensory processing, attention and memory and the impairments of oscillatory processes found in different diseases, including dyslexia, schizophrenia, autism spectrum disorder and tinnitus. The first talk was given by Ole Jensen (Donders Inst. Nijmegen) who talked about theta, alpha and

gamma oscillations and the mechanisms of phase-coding. His intriguing theory suggesting that a similar phase coding mechanism as that found in the hippocampus and involving theta and gamma oscillations might exist in the sensory processing but involving alpha and gamma oscillations evoked a lively discussion after his talk. It was followed by Nadia Müller (CIMEC, Trento) who emphasized the functional role of alpha activity in normal auditory processing as well as in tinnitus. Finally the morning session was concluded by the talk of Karen Mullinger (Univ. Nottingham) who talked about the role of oscillations in the primary somatosensory system and also discussed the difficulties of simultaneous EEG-fMRI recordings.

After the coffee break, we started a session entitled as “Attention and memory” with the talk of Wolfgang Klimesch (Univ. Salzburg) who summarized the functional role of alpha-oscillations in attentional and mnemonic processes. His great summary lecture was followed by the talk of Satu Palva (Univ Helsinki) who gave a very comprehensive talk about the role of alpha band large-scale inter-areal synchronization processes in attentional selection. The last talk before lunch was by Zoltan Vidnyanszky (Budapest Univ. Technol and Econ) who talked about the importance of measuring brain oscillations during natural viewing conditions and summarized his results on the role of alpha oscillations in distractor suppression during reading in healthy subjects and their implications for dyslexia. The discussions after the talks were focusing on the dual function of alpha oscillation: 1. as a mechanism of active sensory inhibition and 2. its involvement in long-range synchronization processes in attention and memory.

Next we had a lunch-break at the Coffee club of the Hungarian Academy of Sciences, attended by the speakers and organizers.

After the break, Paul Sauseng (Univ. Surrey) talked about the role of phase

coding and cross-frequency coupling in working memory. His results suggested that working memory capacity depends on the efficacy of phase coding mechanisms. The next talk was given by Gregor Thut (Univ. Glasgow), who provided an excellent summary on the application of transcranial magnetic stimulation (TMS) in the research on brain oscillations in health and disease. His results convincingly demonstrated that 10 Hz TMS stimulation of the visual cortex mimics the inhibitory effect of increased alpha oscillations and thus provides a very exciting research tool for studying the effect of alpha oscillations in sensory processing and attentional selection. The last talk before the afternoon coffee-break was by Jürgen Fell (Univ. Bonn) and focused on the role of phase-synchronization in memory processes. His unique experimental approach, involving intracranial recordings using implanted electrodes in humans provided compelling evidence for the involvement of oscillatory and synchronization processes in memory functions.

After the coffee-break we had still two talks. The first was by Anne-Lise Giraud (INSERM, Paris) who presented her intriguing theory and supporting experimental results on the role of different oscillation bands (theta, alpha, beta and gamma) in the predictive coding processes during speech perception. The last talk was given by Peter Uhlhaas (Max Planck Inst. Frankfurt) who discussed his results regarding oscillatory processes in schizophrenia and related disorders as well as the important topic of application of different measures of brain oscillations as biomarkers in the field of translational medicine.

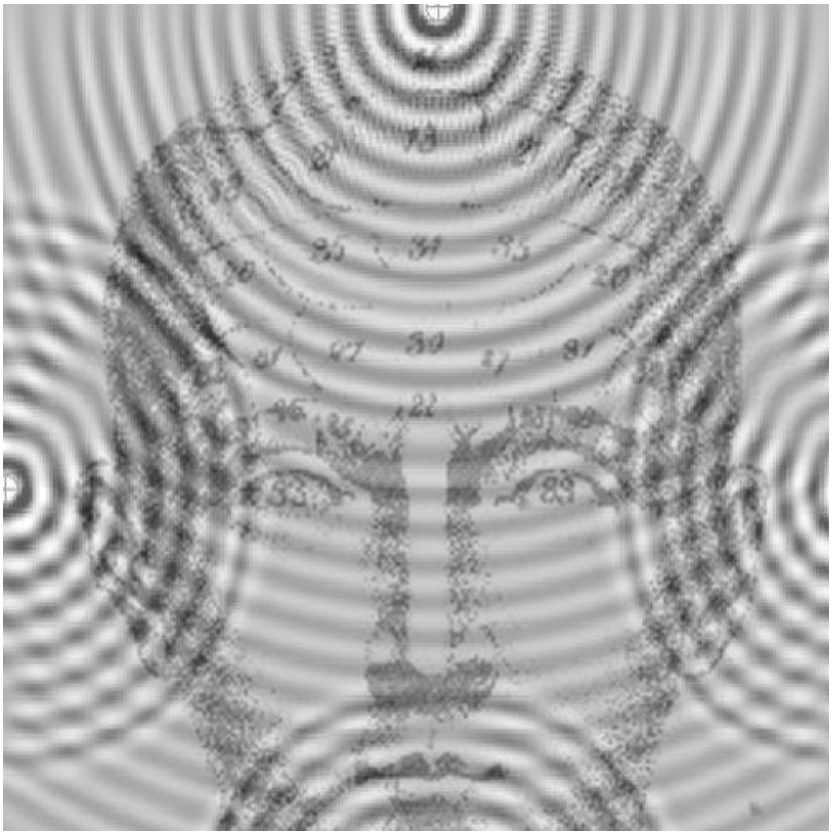
The lively discussions that arise after the talks were continued during the dinner held at the Coffee club of the Hungarian Academy of Sciences.

The third day started with the lecture by Mark Molnar (Inst. Psychol, Budapest) who talked about the investigation of the oscillation processes during emotional

word processing. His talk was followed by Jörg Hipp from Tübingen who had an excellent presentation about the frequency-band limited activity patterns in the human brain as an index of long-range neural interactions. Finally, a young colleague from the Univ Zürich, Gabor Stefanics discussed his results regarding the role of phase entrainment in the auditory processing.

The coffee-break was followed by the poster presentations. We had 12 posters covering full range of topics in brain oscillations in health and disease.

Overall, the meeting succeeded in bringing together eminent scientists in the field of brain oscillations and attracting junior scientists. It provided a state-of-the-art overview of the neural mechanisms and functions of brain oscillations and their impairment in different diseases. The workshop offered a place to discuss the issues during oral as well as poster sessions.



Brain oscillations in health and disease

2012.11.08.- 2012.11.10

Hungarian Academy of Sciences, Budapest

Organizers: Zoltán Vidnyánszky, Wolfgang Klimesch, Gyula Kovács, Stephen Jackson,

Program

Thursday, 8th November:

The neural origin of oscillations

13.00: Wellcome

13.20-13.50: *Norbert Hájos (Inst Exp Medicine, HAS):* TBA

13.55-14.25: *István Ulbert (Inst Psychol, HAS)*: Slow-sleep oscillations

14.30-15.00: Róbert Bódizs (Semmelweis Univ.) Neuronal oscillations during sleep: from functions to phenotypes

15.00-15.30: Coffee break

Dinner and social event

Friday, 9th November:

Brain oscillations in Sensory and Motor systems:

9.00-9.30: *Ole Jensen (Donders Institute, Nijmegen):* How alpha oscillations might organize a temporal phase code

9.35-10.05: *Nadia Müller (CIMeC, Trento, Italy)*: The functional role of auditory cortical alpha activity in normal and phantom perception

10.10-10.40: *Karen Mullinger* (Univ. Nottingham) Spatial temporal dynamics of the primary somatosensory system investigated with simultaneous EEG-fMRI

10.45-11.15 Coffee break

Attention and Memory:

11.15-11.45: *Wolfgang Klimesch (Univ Salzburg)*: The functional role of alpha for attention and memory

11.50-12.20: *Satu Palva, (Univ Helsinki):* Large-scale inter-areal synchrony during attention

12.25-12.55: *Zoltán Vidnyánszky (Budapest Univ Technol Econ)*: Brain oscillations during reading

13.00-14.00: Lunch

14.00-14.30: *Paul Sauseng, (Univ Surrey Guildford*): Cross-frequency oscillatory interaction as mechanism of neural gain control during working memory processes

14.35-15.05: *Gregor Thut (Univ Glasgow):* Interventions into human brain oscillations to reveal their functional roles

Brain oscillations in disease

15.10-15.40: *Juergen Fell (Univ. Bonn):* Phase synchronization in memory processes

15.45-16.15: Coffee break

16.15-16.45: *Anne-Lise Giraud (INSERM, Paris):* Speech processing: computational operations based on cortical oscillations

16.50-17.20: Peter Uhlhaas *(Max Planck, Frankfurt):* Neural Oscillations in Schizophrenia and Related Disorders: Insights from MEG

Dinner

Saturday, 10th November:

9.00-9.20 Márk Molnár *(Inst. Cog. Neurosci Psychol, HAS)* Emotional word processing: effect of aging on linear-nonlinear synchronization related to late ERP components

9.25-9.45: Joerg Hipp *(CIN, Tübingen):* Power correlation of band-limited activity as an index of neuronal interaction

09.50-10.10: Gábor Stefanics *(Univ Zurich)* Timing is essential: Entrainment of cortical oscillations to predict 'when'

10.15 -10.40: Coffee break

10.40-12.00: Student presentations

<Speakers and Participants>

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