

# Proceedings

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### Coherence Analysis of All-Night Sleep EEG. - P. Achermann and A.A. Borbély (Institute of Pharmacology, University of Zurich, CH-8057 Zurich, Switzerland).

The interhemispheric and intrahemispheric coherence of the EEG may provide information on the functional connectivities between brain regions. The present study was designed to explore state-specific changes of EEG coherence during sleep. The nocturnal sleep EEG of 8 young healthy subjects was recorded. The power spectra (averages of five 4-s epochs) and coherence spectra (20-s epochs) between different bipolar derivations were calculated in the frequency range of 0.25-25 Hz. - Intrahemispheric anterior-posterior coherences in nonREM sleep showed distinct peaks in the frequency range of sleep spindles, in the low delta band, and in the alpha band. Coherence was low throughout the entire frequency range in stage 1 and REM sleep. - Interhemispheric coherences of corresponding sites showed an entirely different pattern. Coherence in nonREM sleep was high in the delta, theta and alpha range, and the distinct peaks of intrahemispheric coherence were also present. They were most prominent in the anterior derivations. The pattern in stage 1 and REM sleep was similar to that of nonREM sleep although the typical peaks were absent and the values in the low delta range were lower. - Our results indicate that a state-specific high coherence is limited to distinct frequencies within the low delta, alpha and sigma band.

**Effect of Inter-Target Interval on P300 Source Distribution in Young and Elderly Normal Healthy Subjects. - P. Anderer\*, H.V. Semlitsch\*, R.D. Pascual-Marqui\*\* and B. Saletu\* (\*Dept. of Psychiatry, University of Vienna, Vienna, Austria; \*\*The KEY Institute for Brain-Mind Research, University Hospital of Psychiatry,**

### Zurich, Switzerland).

According to the triarchic model, P300 amplitude depends, at given levels of global probability, stimulus meaning and information transmission, on the specific sequence of preceding stimuli. Thus, in an oddball paradigm, P300 amplitude should depend on  $1/ITI$  where ITI is the inter-target interval. - Single potentials evoked by target tone bursts ( $p=0.10$ ;  $N=31$ ), were averaged according to their occurrence in the experiment, separately for 58 normal healthy subjects aged 20-29 years, and 41 normal healthy subjects aged 60-79 years. Latencies, amplitudes and electrical activity in the brain localized by means of "low resolution electromagnetic tomography (LORETA)" were evaluated. - P300 latency was strongly related to  $1/ITI$  both in young and elderly subjects, with short latencies for long ITIs ( $r=0.91$  and  $r=0.89$  in young and elderly, respectively). On the other hand, P300 amplitude at Pz was related to  $1/ITI$  only in young subjects with high amplitudes for long ITIs ( $r=-0.75$ ), but not in elderly ( $r=-0.19$ ). - As shown previously, LORETA revealed frontal and parieto-occipital P300 generators. In young subjects the parieto-occipital source was predominant for short ITI. With increasing ITI the parieto-occipital source decreased, while the frontal increased. In elderly, however, frontal and parieto-occipital P300 sources were approximately equal in size and strength, independent of the ITI.

**Sex or Pre-Treatment Differences on EEG-Effects of Morphine in Low Concentrations? - M.J. Barbanoj\*, G. Salazar\*, R.M. Antonijuan\*, F. Jane\*, P. Anderer\*\* and B. Saletu\*\* (\*Pharmacological Research Area, Research Institute of Sant Pau Hospital, Dept. of Pharmacology and Therapeutics, U.A.B., E-08025 Barcelona, Spain; \*\*Pharmacopsychiatry Section, Sleep Laboratory, Dept. of Psychiatry, University of Vienna, Vienna, Austria).**

In contrast to the abundant findings on EEG-effects of anaesthetic doses of opiates there are scarce data reporting on low-concentrations.

differences were found in the evoked potentials from 242-414 ms post-stimulus, indicating macroscopically different neural assemblies to be active for each of the three modalities. In a further decision demanding, memory associated imagery task, the brain electrical fields differed significantly between the acoustical and the visual modality at a latency of 117 ms and returned to undistinguishable topographies at 246 ms. This indicates that the evocation and exploration of mental images for their implicit content can be performed and concluded in unexpectedly short time spans.

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**Correlation of Personality Traits with Global EEG Descriptors.** - W. Szelenberger\*, J. Wackermann\*\*, T. Piotrowski\* and M. Skalski\* (\*Warsaw Medical Academy, Dept. of Psychiatry, Warsaw, Poland; \*\*Neuroscience Technology Research Inc., Prague, Czech Republic).

The aim of the study was to find out psychological correlates for global EEG descriptors. Twenty male volunteers aged 21-53 participated in the study. The participants filled in MMPI. Manifest Anxiety Scale (MAS) and Anxiety Trait Scale (A) were calculated. All subjects performed four sessions of MSLT. EEG was recorded for 20 min from 21 derivations referred to the average reference. Artifacts were marked in 2.5 s chunks (256 data points). Global descriptors (Wackermann 1996) of complexity ( $\Omega$ ), global power ( $\Sigma$ ) and generalized frequency ( $\Phi$ ) were computed in 2.5 s intervals.  $\Sigma$  and  $\Phi$  were combined to a new variable,  $\text{LogE} = \text{Log}(\Sigma) + \text{Log}(\Phi)$ , which is assumed to represent a continuum of vigilance. All descriptors were computed for the whole field and for each hemisphere, and anterior and posterior derivations. Spearman coefficients were computed for MMPI scores and EEG descriptors for waking and sleeping separately. The 1% error level was assumed. Correlation of MAS with  $\text{LogE}$  was found at posterior and right side derivations ( $r=0.38$  and  $0.43$ , respectively). Correlation of A with  $\text{LogE}$  was also found at the right side ( $r=0.37$ ). No significant correlations were found between anxiety scores and EEG descriptors computed after sleep onset. Some significant correlations between  $\Omega$  and MMPI clinical scales were observed, which is difficult for interpretation at present.

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**Mapping for the Research of Cortical Bioelectrical Processes Organization during the Verbal Psychological Set.** - E.A. Tcheremoushkin, T.A. Vorobieva and I.A. Yakovenko (Institute of Higher Nervous Activity and Neurophysiology, Russian Academy of Sciences, Moscow, Russia).

The verbal psychological set was formed in 30 healthy adult subjects by means of successive exposition (on a screen) of 30 single pseudo-words written in Latin letters. The series of stimuli was immediately followed by a similar presentation of 36 single Russian words which consisted of the letters written in the same way as some characters of the Latin alphabet. At the beginning of the second train of stimuli all subjects began to read the well-known Russian words as senseless. In 19 subjects this effect disappeared after 1-2 Russian word presentations (non-stable set) and in 19 subjects only after 6-36 presentations (stable set). 24-channel EEG recorded before presentations was analyzed. It was used to build maps of the so-called "community coefficient" which describes each bioelectrical process at its recording point through its correlations with the other processes. Map patterns of non-stable and stable subjects groups were studied. It was found that the bioelectrical processes of correlativity were larger in the stable group at the different set stages, particularly clear in frontal areas. This brain area is very important during human purposeful behavior (A.R. Luria 1963). This predominance points to more integration in brain structures

which are involved in cognitive activity. - The spatial organization of cortical electric processes to some degree depends on the character of the current cognitive set of the subject.

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**Auditory Source Localization with MEG and EEG.** - P. Teale\*, J. Wang\*, M. Reite\*, J. Sheeder\* and P. Nunez\*\* (\*Neuromagnetism Laboratory, Dept. of Psychiatry, University of Colorado Health Sciences Center, Denver, CO, USA; \*\*Dept. of Biomedical Engineering, Tulane University, New Orleans, LA, USA).

MEG-based source localization of auditory evoked fields components has demonstrated good spatial resolution, but requires relatively expensive magnetic recording technology. EEG-based source localizations can be substantially less expensive, but their comparable accuracy remains to be determined. We compared localization coordinates of the 100 msec latency auditory component over both hemispheres using both MEG and EEG methods in 3 normal male subjects. Stimuli were 1kHz 25 msec 85 dB SPL tone pips delivered to the opposite ear. Magnetic recordings were obtained with a BTI Model 607 7 channel gradiometer sampling the area encompassing both extrema. EEG recordings used a 16 electrode "Star of David" array with 2 cm interelectrode spacing, centered over the MEG-determined source. Neuroscan SCAN<sup>®</sup> software was used for MEG and EEG data collection and processing. EEG sources were estimated using BESA<sup>®</sup> constrained to fit a bilateral pair of regional sources. MEG sources were estimated with MEG/EEG, a custom program using a single dipole in a spherical volume. Mean MEG/EEG source location differences in the lateral (X), vertical (Z) and antero-posterior (Y) directions were 0.78cm, 0.48cm, and 0.97cm respectively. EEG confidence intervals overlapped MEG confidence intervals, and EEG-based locations demonstrated a similar left-right asymmetry with sources tending to be more anterior in the right hemisphere. (Supported by USPHS MH47476).

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**Sources of Pain-Related Responses to Posterior Tibial Nerve Stimulation.** - P.J. Theuvenet\*, Z. Dunajski\*\*, M.J. Peters\*\*\* and J.M. van Ree\*\*\*\* (\*Dept. of Anesthesiology, Medical Center of Alkmaar, The Netherlands; \*\*Warsaw University of Technology, Warsaw, Poland; \*\*\*University of Twente, The Netherlands; \*\*\*\*Rudolph Magnus Institute of Neurosciences, Utrecht University, The Netherlands).

Brain responses to posterior tibial nerve stimulation were examined in patients who suffered from a proven neuropathic (traumatic) pain. The aim of this study was to learn if these responses could be used for the assessment of persistent pain and its relief in chronic pain patients. Experiments were carried out in five patients, where usual strategies had failed and spinal cord stimulation was applied. It was found that the measured evoked responses, when these patients were in pain, showed additional waves at latencies at around 110 ms and 150 ms after stimulation of the posterior tibial nerve. The magnetic field and electrical potential distributions at these latencies were dipolar and the responses at 110 ms and 150 ms could be ascribed to two equivalent current dipoles situated in two distinct areas in the brain. In patients, who underwent spinal cord stimulation, the additional wave disappeared once the patient was in a pain free condition. For this group of patients the additional waves appear to be related to the perception of pain and this may offer an objective method to assess this kind of pain and study the effects of spinal cord stimulation. Although not mentioned here, similar results were found for median nerve stimulation.

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**Process Analysis of Pattern Comparison and Concept**