

16th CONGRESS OF THE EUROPEAN SLEEP RESEARCH SOCIETY

Reykjavik, June 3-7, 2002

Top of Abstract

EVENT-RELATED BRAIN DYNAMICS DURING SLEEP ONSET: PHASE RESETTING OF ONGOING BRAIN ACTIVITY

Luca A. Finelli^{1,3}, Scott Makeig^{1,3}, Bradley Schnierow⁴, Kenneth B. Campbell⁵, and Terrence J. Sejnowski^{1,2,3}

1. Institute for Neural Computation, University of California, San Diego, CA, USA
2. Howard Hughes Medical Institute
3. Computational Neurobiology Laboratory, The Salk Institute, San Diego, CA, USA
4. Department of Psychiatry, University of California, San Diego, CA, USA
5. School of Psychology, University of Ottawa, Ottawa, Canada

Objectives: The transition from wakefulness to sleep is characterized by alterations of attention level and sensory awareness. To assess how brain processes might evolve with behavioral changes in attention and sensory awareness observed during the wake-to-sleep transition period, new statistical and signal processing methods (1) were applied to single-trial event-related electroencephalographic responses in an auditory 'odd-ball' task at sleep onset.

Methods: We analyzed the electroencephalogram (EEG) of 10 healthy subjects (6 female, 4 male, mean age 23.7 y) recorded from 29 derivations during repeated task presentation in sleep onset periods. A series of 1000 Hz 'standard' tone pip stimuli (96%) was presented, while a 1500 Hz 'target' stimulus was presented infrequently (4%). The subjects were asked to press a button upon detection of the 'target' stimulus. Event-related potential (ERP) analysis of these data has been reported by Cote *et al.* (2). We applied new statistical and signal processing methods including spectral, time-frequency and independent component analyses (ICA), computing individual EEG power maps, event-related spectral perturbations (ERSPs), inter-trial coherence (ITC), event-related 'ERP images', independent components and their topographies. To determine common results across subjects, we performed cluster analyses.

Results: The frequency spectrum and the scalp topography of the single-trial ERP showed dependence on sleep stage, as expected by EEG mapping studies (3). In contrast to conventional signal averaging methods, our approach showed that event-related potentials were mainly generated by stimulus-induced partial phase resetting of multiple electroencephalographic processes whose spectral signature differed between waking and different sleep stages (1). With the progression from wakefulness to sleep the spectral perturbation plots showed changes in the time-frequency dynamics, not directly represented in ERP features. Separation of the signals by ICA revealed several common domains or epicenters of neural synchrony contributing to the averaged ERPs. Our analyses demonstrated that ERP averaging reveals only a portion of the event-related brain dynamics occurring in single EEG trials, and that these dynamics differed across wake/sleep states.

Conclusions: Changes in auditory stimulus-locked ERPs during wake-to-sleep transitions can be attributed to event-related alterations in ongoing brain activity.

References:

- (1) Makeig, S., Westerfield, M., Jung, T.-P., Enghoff, S., Townsend, J., Courchesne, E., Sejnowski, T. J. Dynamic brain sources of visual evoked responses. *Science*, 2002, 295: In press.
- (2) Cote, K. A., de Lugt, D. R. and Campbell, K. B. Changes in the scalp topography of event-related potentials and behavioral responses during the sleep onset period. *Psychophysiology*, 2002, In press.
- (3) Finelli, L. A., Borbely, A. A. and Achermann, P. Functional topography of the human nonREM sleep electroencephalogram. *Eur. J. Neurosci.*, 2001, 13:2282-2290.

Keywords: event-related potentials, sleep onset, EEG, information processing

Submitting Author: Luca A. Finelli

Address for correspondence: Computational Neurobiology Laboratory, The Salk Institute, 10010 N. Torrey Pines Rd., La Jolla CA 92037, USA

Tel. ++ (858) 453 4100 x1215

Fax ++ (858) 587 0417

e-mail lfinelli@salk.edu

To be completed by submitting Author

(see „Abstract Preparation Guidelines“)

ESRS Member as per March 2002

Yes No

Abstract category B-1

Poster presentation

Oral Presentation

Young scientist Symp.

For office use only

Abstract No. 226

Reviewer Rating

Oral

Poster

Reject