AUXILIARIES AND NEUROPLASTICITY

Claudio Babiloni, Ph.D.

Department of Biomedical Sciences, University of Foggia (UNIFG), Italy

UNIFG structured personnel involved

Prof. Claudio Babiloni (Coordinator), Dr. Ivano Triggiani, Dr. Anna Valenzano, Prof. Giuseppe Cibelli
Dominant resting (eyes-closed) alpha rhythms are synchronous and coherent over wide cortical areas and corresponding thalamic nuclei. For this reason, alpha sources can be estimated from EEG recorded from only 19 scalp electrodes.
High-frequency EEG rhythms (20 to 100 Hz or highest) substitute alpha during eyes opening. These rhythms are coherent over small cortical areas and corresponding thalamic nuclei, and different sub-populations show different frequencies for opening their communication channel. For this reason, EEG sources of narrow high frequencies cannot be estimated from EEG recorded from 19 scalp electrodes and using large bands (i.e. 20-30 Hz) as in our clinical studies.
When and how would you choose competing electrophysiologic methods: fluctuations of EEG rhythms (ERD) vs. impulse responses (ERPs)?

ERD reflects reduction of alpha or beta EEG rhythms **nonphase-locked** to the event.

Hidden into the EEG rhythms, **ERPs** indicate small neuronal synchronization **phase-locked** to the event.

EEG related to a voluntary finger movement.
Testing of eyes opening alpha marker in athletes during upright standing
Alpha ERD was stronger in amplitude in karate and fencing athletes than in non-athletes during quiet upright standing at eyes open reference to eyes closed condition, in line with AD-qEEG marker.

Testing of alpha marker in athletes during difficult upright standing
Alpha ERD was lower in amplitude in karate and fencing athletes than in non-athletes at central and parietal areas, during monopodalic referenced to less engaging bipodalic condition, in line with neural efficiency hypothesis.

Testing of alpha marker in athletes during complex visuomotor integration
Amplitude of alpha ERD over frontal midline and right primary sensorimotor areas was stronger in expert golfers in successful than unsuccessful putts

Claudio Babiloni, Claudio Del Percio, Francesco Infarinato, Nicola Marzano, Marco Iacoboni, Pierluigi Aschieri, Fabrizio Eusebi: Sensorimotor rhythms related to precise golf putts: a high resolution EEG study Journal of Physiology, 2009
Testing of alpha marker in athletes during voluntary (endogenous) visuospatial attention
Alpha ERD was lower in amplitude in the elite athletes than in the non-athletes over the whole scalp.

How distributed systems in the brain integrate their activity by evaluating **effective connectivity** explored by TMS-EEG.

TMS and repetitive rTMS interfere with the oscillations and information processing of the targeted cortical area of interest. The magnetic stimulation results in a quick, innocuous, and reversible knock out of the targeted cortical area.
Effective connectivity by rTMS-EEG: rTMS of IPS linking cortical attentional networks (frontal eye field or FEF; precentral or PrCe; intraparietal sulcus, IPS), alpha rhythms, and behavior to Posner’s test

Paolo Capotosto, Claudio Babiloni, Gian Luca Romani, and Maurizio Corbetta. Posterior parietal cortex controls spatial attention through modulation of anticipatory alpha rhythms. Journal of Neuroscience 2009
Testing of alpha marker in athletes during understanding of expert actions
Low- (about 8–10 Hz) and high-frequency (about 10–12 Hz) was lower in amplitude in the elite rhythmic gymnasts compared to the non-gymnasts in occipital and temporal areas (ventral pathway) and in dorsal pathway.

In the elite rhythmic gymnasts, high frequency alpha ERD (10-12 Hz) was higher in amplitude with the videos characterized by a high judgment error than those characterized by a low judgment error; this was true in inferior posterior parietal and ventral premotor areas (“mirror” pathway).

“Rehabilitation” of EEG rhythms in athletes and non-athletes for the improvement of cognitive-motor function.
An audio-visual 10-Hz stimulation induced a negative correlation between pre-stimulus alpha power and reaction time in fencing athletes and non-athletes during visuo-spatial-motor task.

Conclusions

Athletes’ brain is characterized by the modulation of sources of alpha rhythms in relevant cortical networks as a function of task demands including difficult upright standing, voluntary hand movements, complex visuo-motor integration, voluntary visuo-spatial attention, and judgment of expert action.

Balance platform, AUXILIARIES, and qEEG are useful to disclose neuroplasticity of human subjects characterized by the modulation of sources of alpha rhythms. Application to rehabilitation of cognitive and motor functions seems to be promising.
Thank you for your attention

The father of EEG: H. Berger