

## **Synchronizing brain and heart through decelerated respiration – An EEG-ECG study investigating the effects of paced breathing**

### **ABSTRACT:**

#### **Background**

Numerous methods for enhancing consciousness and well-being emphasize the role of breathing. We have investigated the link between body rhythms and brain dynamics during paced breathing.

#### **Aims**

Investigating correlations between EEG parameters and heart rate at different various breathing frequencies.

#### **Method**

About 40 participants conducted paced breathing sessions with respiration rates (RR) from 6 to 14 s/cycle for 7 min each task. Measures of respiration, heart rate variability (HRV), skin conductance and 64 channels EEG as well as subjective ratings were recorded and results at various RR were compared with each other. An additional hand movement task controlled for task-dependent EEG changes.

#### **Results**

Both, the respiratory sinus arrhythmia of the HRV and the slow cortical potentials (SCPs) of the EEG correlated with the respiration cycle, however the highest correlations were observed at a RR of 10 s/cycle most predominantly for the SCPs. A strong positive voltage deflection during inhalation is followed by a negative variation during exhalation (20 $\mu$ V pp). In contrast, during RR of 6s/cycle SCP changes remained below 5 $\mu$ V and during 10s/cycle control task below 3 $\mu$ V. Subjectively, participants rated this RR as the most relaxing one. Brain oscillations from Delta to Gamma correlated only weak with the course of respiration.

#### **Conclusions**

This study demonstrates the importance of the speed of breathing on the brain dynamics, especially on SCPs. This decelerated breathing rhythm matches the frequency of the baroreceptor sensitivity, leading to synchronization between breath, HRV, baroreceptors and the brain. Future applications might help us understanding the role of breath for altering states of consciousness.

#### **Keywords**

Paced breathing, Slow cortical potentials, Heart rate variability, Synchronization body rhythms

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