The Impact of Trait and Mathematical Anxiety on Oscillatory Brain Activity during Lexical and Numerical Error-Recognition Tasks

Authors : Alexander N. Savostyanov, Tatyana A. Dolgorukova, Elena A. Esipenko, Mikhail S. Zaleshin, Margherita Malanchini, Anna V. Budakova, Alexander E. Saprygin, Yulia V. Kovas

Abstract : The present study compared spectral-power indexes and cortical topography of brain activity in a sample characterized by different levels of trait and mathematical anxiety. 52 healthy Russian-speakers (age 17-32; 30 males) participated in the study. Participants solved an error recognition task under 3 conditions: A lexical condition (simple sentences in Russian), and two numerical conditions (simple arithmetic and complicated algebraic problems). Trait and mathematical anxiety were measured using self-repot questionnaires. EEG activity was recorded simultaneously during task execution. Event-related spectral perturbations (ERSP) were used to analyze spectral-power changes in brain activity. Additionally, sLORETA was applied in order to localize the sources of brain activity. When exploring EEG activity recorded after tasks onset during lexical conditions, sLORETA revealed increased activation in frontal and left temporal cortical areas, mainly in the alpha/beta frequency ranges. When examining the EEG activity recorded after task onset during arithmetic and algebraic conditions, additional activation in delta/theta band in the right parietal cortex was observed. The ERSP plots reveled alpha/beta desynchronizations within a 500-3000 ms interval after task onset and slow-wave synchronization within an interval of 150-350 ms. Amplitudes of these intervals reflected the accuracy of error recognition, and were differently associated with the three (lexical, arithmetic and algebraic) conditions. The level of trait anxiety was positively correlated with the amplitude of alpha/beta desynchronization. The level of mathematical anxiety was negatively correlated with the amplitude of theta synchronization and of alpha/beta desynchronization. Overall, trait anxiety was related with an increase in brain activation during task execution, whereas mathematical anxiety was associated with increased inhibitory-related activity. We gratefully acknowledge the support from the №11.G34.31.0043 grant from the Government of the Russian Federation.
Keywords : anxiety, EEG, lexical and numerical error-recognition tasks, alpha/beta desynchronization