Altering working memory performance through cortical entrainment: An ERP study of binaural beat stimulation during a two-back memory task

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GSURC 2015 abstract:

Brain rhythms, such as beta (~12-20 Hz) or theta (~4-7 Hz) have been linked to specific mental processes, such as attention and memory encoding. This study examined whether or not inducing these brain rhythms in individuals engaged in a task would increase aforementioned cognitive performance. Presentation of binaural auditory beats (BAB) can increase, or *entrain* cortical activity to specific frequencies. In a pilot study using BAB, we found that stimulation in the beta range effected task-related changes in beta wave activity, whereas stimulation in the theta range led to increased theta-wave activity. In a follow up using the 2-back memory task, effects were seen involving attention-related event-related potentials (ERPs) in one BAB condition but not the other, indicating a possible effect on attention processes. In the same BAB condition, it was seen that reaction time had decreased as a function of baseline working-memory ability as measured by the reading span task. The present study extends the prior works using a larger dataset to examine BAB effects on working memory performance, as well as more robust ERP and wavelet analysis. We recorded brainwaves while participants viewed a series of letters and were asked to press a button when the letter on screen was the same as a letter that appeared two trials back. Each subject completed two sessions (one with beta manipulation, one with theta) using a double-blind design. Control (no BAB) blocks were presented before and after the experimental blocks in each session. Behavioral and ERP measures of target detection and suppression of "lures" (1-back trials) were examined across conditions. In addition, we used joint time-frequency (wavelet) analysis to characterize BAB effects on beta and theta bands prior to the behavioral response.

Keywords: cognition, attention, binaural beats, EEG, entrainment, working memory, performance