GSURC 2014

Title: Altering working memory through cortical entrainment:
A study of beta-wave and theta-wave stimulation during an N-back task
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Introduction: Presentation of binaural auditory beats (BAB) can *entrain* brain rhythms, such as beta (~12-20 Hz) or theta (~4-7 Hz). For example, in a pilot study, we found that BAB stimulation in the beta range effected task-related changes in beta waves, whereas stimulation in the theta range affected theta-wave activity. The present study replicates and extends this work to examine the effect of BAB stimulation on working memory performance, as well as oscillatory brain activity.

Methods: We recorded event-related potential (ERP) responses from 256 locations on the head surface as participants complete a working memory (N-back) task. In this task, participants view a series of letters. The task is to indicate when a letter is the same as a letter that appeared N trials back (e.g., 2 trials back). BAB stimulation is delivered stereophonically through ear buds.

Results: Behavioral outcomes include accuracy of target detection and reaction time. These data indicate effects of BAB stimulation on working memory. Wavelet decomposition is used to quantify changes in amplitude of EEG activity within different frequency bands and across time. Averaged EEG, time-locked to the target, captures changes in visual attention to targets. We have three predictions: (i) the BAB procedure will induce greater levels or beta or theta (depending on condition), and (ii) entrainment of beta will affect performance on the one-back task, whereas (iii) entrainment of theta will have little or no effect.

Conclusion: Given that different brain rhythms appear to be associated with different cognitive functions, such as improved attentional focus, there is growing interest in the use of BAB stimulation to alter brain and cognitive function. In the present experiment, we test the hypothesis that beta stimulation will lead to increased beta-wave activity and improved performance in a working memory task. This study is part of a larger project that investigates the use of BAB to affect working memory and the learning and retention of new words.