

Signal or noise?: Using a psychophysical approach to investigate the effects of attention and neurofeedback training on electrocortical predictive anticipatory activity (PAA) to true random stimuli

ABSTRACT:

Background

In the past two decades physiological experiments have been finding changes in physiological conditions preceding randomly selected stimuli, stimuli for which a participant could have no causal method for guessing correctly, either consciously or unconsciously.

Aims

This study aimed to investigate pre-stimulus effects before randomly generated stimuli using EEG with an eventual goal of making a predictive system. The hypothesis was that post-stimulus effects would be reflected pre-stimulus but at a much smaller effect size.

Method

Data were collected from 102 participants using a 32-channel EEG system using water-based electrodes. There were two experiments: 1) 1/3 probability of each of a light stimulus, sound stimulus, and null stimulus and 2) 1/2 probability of a combined light and sound stimulus and a null stimulus, further divided into a set where the participant presses any key and a set where they do not.

Results

A borderline ($p = 0.05$) significant result was found using the Euclidean distance classifier for the experiment 1 sound stimulus versus null stimulus comparison but only before the Bonferroni multiple analyses correction.

Significant changes in 10 Hz spectral power density were found for the experiment 1 sound versus null comparison ($p = 0.021$) and the experiment 2 combined versus null comparison without key press required ($p = 0.0024$). The former was in the expected direction (decrease) while the latter was in the opposite direction (increase).

Conclusions

The strongest result was a pre-stimulus enhancement of alpha waves before a combined light-sound stimulus when compared to the null condition. However, this effect was in the direction opposite that predicted by hypothesis.

Keywords

Anticipatory activity, Precognition, EEG, Alpha wave, Euclidean distance

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