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# Self-Automated Vs. Self-Motivated Finger Tapping Movements Using Novel Single-Frequency Filtering applied to EEG Data

## ABSTRACTS

The brain is continually changing and forming new functional connections, a concept termed as neuroplasticity, leading to the ability to rewire the functioning of its parts possibly inactivated due to an injury or brain-stroke. The aim of this study is to build a model of motor movements from EEG activations in a standard finger-tapping paradigm and in a game application. In the gaming paradigm, electrodes show a negative correlation with the scores. This study can be beneficial in post-stroke cases and helps to understand the brain's functional connectivity.

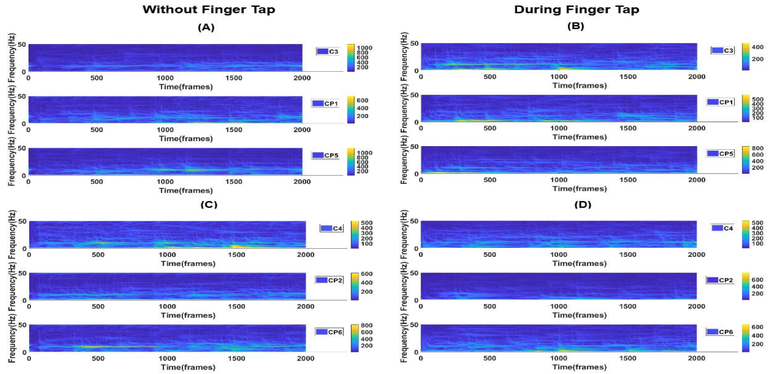


**Fig. 1: Time-frequency representation of the contralateral and the ipsilateral electrodes of the motor cortex.** *(A)* Without finger tap*: Spectrogram of the contralateral electrodes of the* motor cortex*. (B)* During finger tap*: Spectrogram of the contralateral electrodes of the* motor cortex*. (C)* Without finger tap*: Spectrogram of the ipsilateral electrodes of the* motor cortex*. (D)* During finger tap*: Spectrogram of the ipsilateral electrodes of the* motor cortex.

## OBJECTIVE

This research involves a systematic study to compare the activation generated in the brain via standard finger tapping and game-involved finger tapping experiments


**Fig.2 Motor Paradigm Design.**
*After relaxation, participants were asked to perform ten recurring finger taps from each hand. EEG data corresponding to each tap was recorded.*

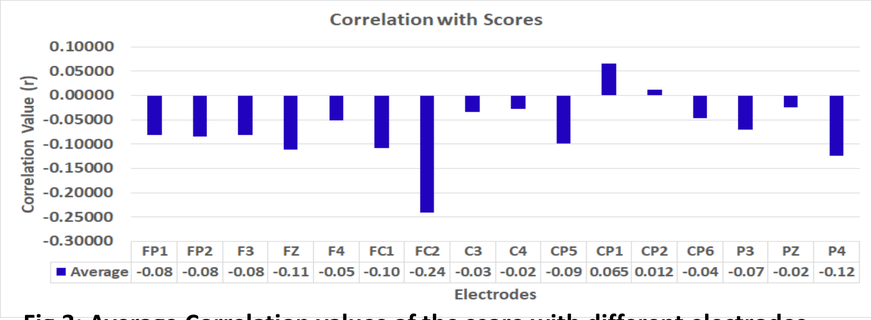


**Fig.3: Average Correlation values of the score with different electrodes**
Activation energy is negatively correlated with the scores of the participants.

## METHOD

The study was conducted in two parts, and therefore, the EEGs were recorded in two halves. The first half includes a self-automated paradigm that involves elementary upper-limb movements. For the second half, participants were asked to play a game where they have to perform a finger tap as per the gaming paradigm.

**Participants:** Twelve healthy subjects (age: mean = 24.25 yrs.; SD = 3.96 yrs.; range = 18-30 yrs.) participated in the study, and for each subject, electroencephalography (EEG) data was collected independently for the two paradigms. From twelve EEG data samples, ten most artifact-free samples were selected for further analysis. For the first half, participants were asked to perform a rhythmic finger tap according to the self-automated motor paradigm designed on the OpenSesame software. Hence, for each participant, EEG data corresponding to 10 taps was recorded from each hand. For the subsequent half, an interactive game was designed on the Unity3D game engine in which subjects have to perform a finger tap as per the gaming paradigm. The theme of the game was based on a well-known outdoor game, 'Seven stones. The aim is to throw a ball at a pile of stones to knock them over. In the gaming paradigm, we fixed the pile of stones, and the ball hovers around the stones like a pendulum of a clock. It is a kind of action game where the goal is to maximize the number of stones that fell off. To increase the engagement, subjects were rewarded scores based on the accuracy of their hits.

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