Opinion

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How Much Time Does Our Brain Need to Relax?

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Opinion

The human brain is one of the vital and mysterious organs of the body. It is in charge of all conscious and unconscious body movements, growth, memory, recall, etc. Challenges in brain studies, such as its well-protected structure and electro-chemical operation, restrict researches. As more studies are done more unknowns of our brain are revealed. This leads to advancements in robust learning skills, focusing, productivity, and cures for brain diseases. In short, it provides increases the quality of life. The data used in brain studies are mostly collected through four well-known data acquisition methods: Electroencephalography (EEG), Positron-Emission Tomography (PET), Functional Magnetic Resonance imaging (fMRI), and functional Magnetic Resonance Spectroscopy (fMRS). In EEG, electrical activity is recorded from the surface of the brain. These data acquisition methods can be employed in order to acquire information from subjects, who perform some given tasks. For instance, subjects may be asked to look at pictures in different categories or may be asked to perform motor-imaginary tasks as imaginary body-part movements, and mental tasks as relaxing, multiplication, letter composing, rotation, memorizing information, and recalling, etc. The databases available for researchers are recorded from subjects during a sequence of given tasks. A relaxation time is offered between tasks. Petrantonakis et al. recorded EEG signals of 16 subjects. Each subject was shown 60 emotion-related pictures in six categories; happiness, surprise, anger, fear, disgust, sadness. After a 5-second of picture display, subjects were asked to relax for 10 seconds [1]. Kim et al. performed motor imagery mental task classification using an EEG dataset of 99 subjects. In their study, tasks were imaginary movements of the left hand, right hand, both fists, and both feet. Subjects were given a 4.2 second resting period between each task [2]. There are many other similar EEG data acquisition practices in the field.

The success of the relaxation period affects the EEG signals acquired from the following tasks. One major purpose of the given relaxation time is to eliminate the influence of one task from another. In the mental task analysis studies, it is desired that the brain reaches the typical relaxation level prior to given tasks. Thus, mental tasks can be examined without the influence of the previous tasks or fatigue. So, how much time does our brain need to relax? Is offering a fixed relaxation time between mental tasks a right practice?

Teager energy given in (1) may give hints about the brain's relaxed state. $x(n)$ represents the EEG signal and N represents the frame size. We calculated the Teager energies of five mental tasks that were depicted in the Figure below. The EEG data of 23 years old male subject is used. The data was collected by Badara et al. in 2017 by using 10-20 electrode placement system [3]. The subject had three sessions on the same sitting. Sessions were separated by a 30-second relaxation time. Each session has five different scenarios consisted of: "task 1: relaxation (30 s)", "task 2: memorization of a list of ten words (15 s)", "task 3: memorization of a list of ten numbers (15 s)", "task 4: watching a set of images (60 s)", and "task 5: recalling the words and numbers memorized earlier (60 s)". The calculated Teager energies (shown in red dots in the Figure) of the EEG frames in the relaxation state shows that the brain does not reach its typical relaxation state after performing mental tasks. Teager energies of the relaxation period of the session 3 are higher than that of the session 2. Similarly, the relaxation period in session 2 has higher Teager energies than that of session 1. The brain needs longer relaxation periods between different mental tasks to reach its typical relax state.

$$TEO = \frac{1}{N} \sum_{n=1}^N [x^2(n) - x(n+1)x(n-1)] \quad (1)$$

(Figure 1)

Figure 1: Teager energies of different mental tasks and relaxation.

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Conflict of Interest

No conflict of interest.

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