

Examination and comparison of the EEG based Attention Test with CPT and T.O.V.A.

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Attention as a focusing and concentrating ability have great importance in doing daily tasks precisely and adequately; furthermore, it is a significant factor in the learning process. In this paper, besides some attention and concentration measuring methods, an innovative EEG-based measuring and examination technique of continuous attention will be demonstrated. The results of these different methods have been compared and evaluated in this research. The most significant advantage of the EEG-based attention measuring method is the possibility of time continuous examination that can shortly provide information about the actual mental state of the test subject. This information can be useful in teaching and applying the most convenient method of sharing and acquiring knowledge; therefore, it can virtually improve the result of learning.

Mobile EEG-based signal processing

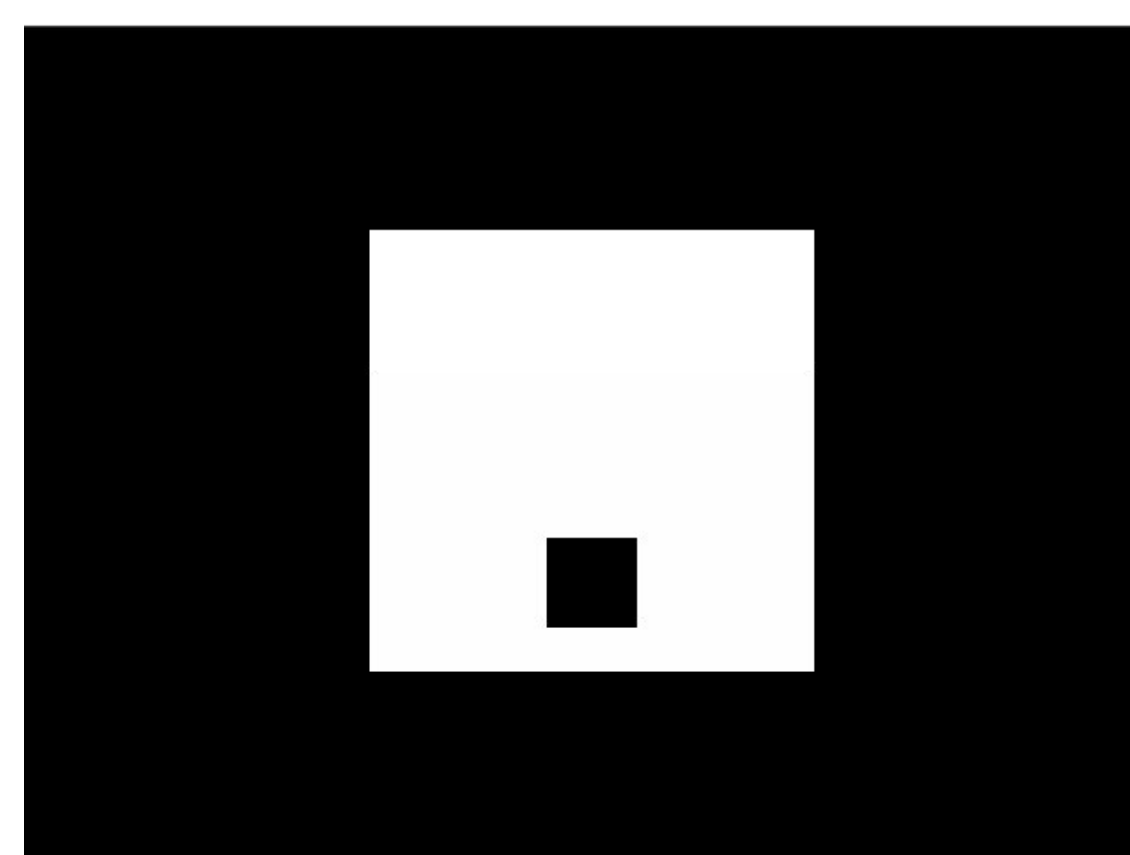
In the past few years, cheap and mobile EEG-based signal processing devices have become available and result of these the electric signals generated in the brain can be measured and processed in real time. The evaluation of information determined by the spectrum of brain signals ensures the examination of the mental state of the brain and the extent of attention or concentration, which are both important in learning. These innovative examination methods can result in applications of new research areas.

The computer-based methods in attention examination

During learning, the human brain can be examined as a system, in which the changes remain for a long time. The adaptive change in the brain, the change in the operation of the system means the transformation of the network formed by the connections of brain cells and it results in better human functions. Numerous methods have been developed to examine attention, of which the computer-based examinations are widely applied, for instance the Continuous Performance Test (CPT) and the Test of Attentional Vigilance (T. O. A. V.).



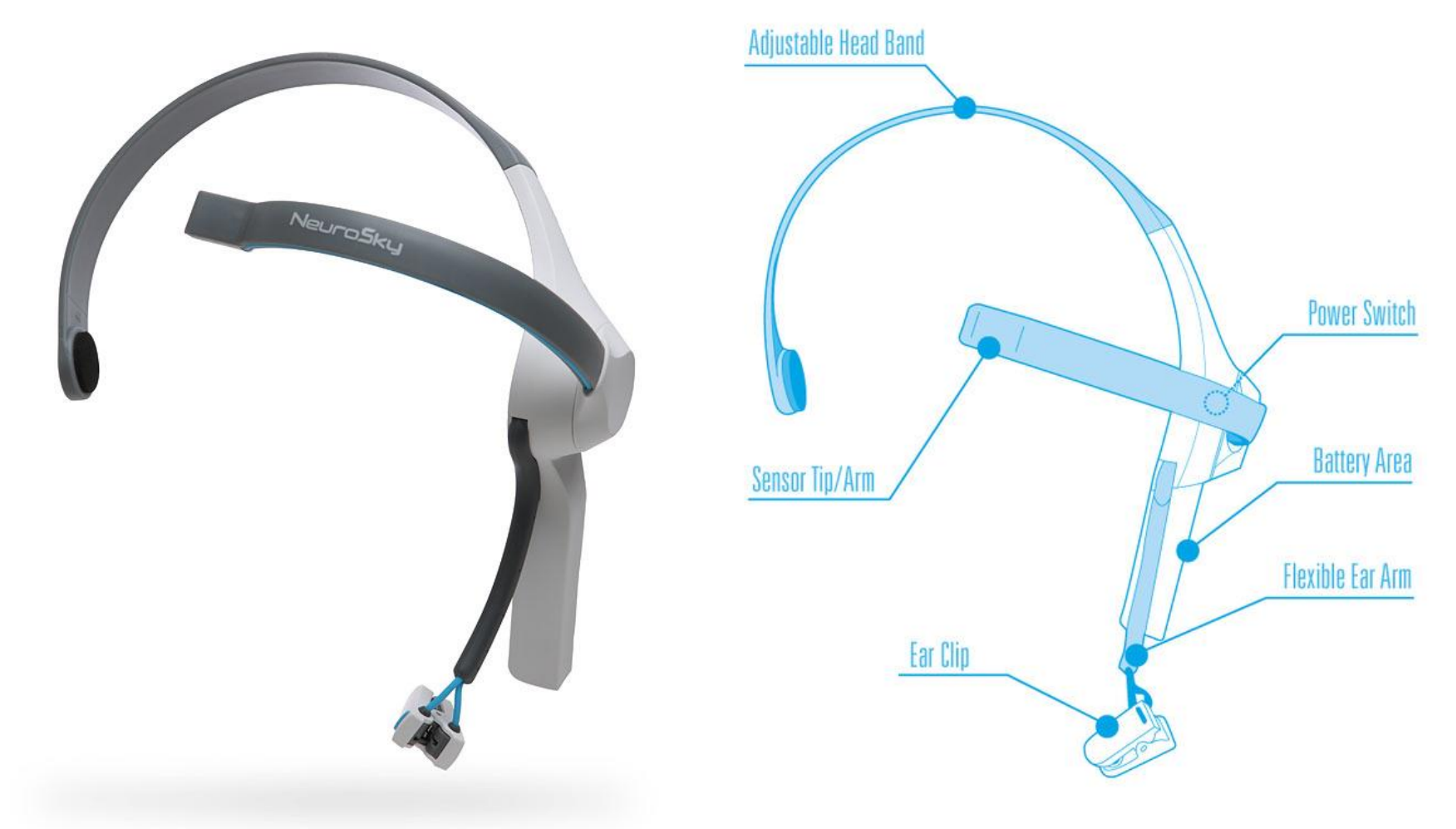
The Continuous Performance Test (CPT)



T.O.V.A. test

The computer-based methods in attention examination

The MindWave EEG headset is not a new device and beside the fact that it is user-friendly, it is also simple to use, comfortable and applicable of further research. It applies wireless communication (not a standard WiFi or Bluetooth) and a dry type, passive sensor. It was originally designed to improve brain functions and abilities but nowadays it is widely used to improve learning and the quality of life. Its chip was developed by Neurosky based on ThinkGear technology and it determines the value of attention, meditation value, blinking and brain wave values in 0.5-50 Hz. Its power is provided by an AAA type battery. This device can measure the electric signals of brain activity with sensors located on the frontal lobe in comparison with the reference points connected on the ear. It can also determine the intensity of brain waves and the value of attention with the algorithm running on the built-in microcontroller. It can also process data in real time, which is also used in several data procession and control systems.



MindWave EEG headset

THE COMPARISON OF METHODS FOR ASSESSING ATTENTION

The CPT was applied at first which was followed by the TOAV. The value of average attention measured by the EEG headset was continuously evaluated while doing both tests. The table illustrates the value of attention measured by the EEG headset after the TOAV of a test subject. According to the results seen in the tables, it can be claimed that the values in a more vigilante state, larger attentional state measured by the applied attention examination methods are higher. Furthermore, the results of the tests done in tired state are worse, which fact is also confirmed by the lower attention level measured by the EEG. These different attention examination test methods can be applied as an alternative method for the examination of attention depending on the mental state of the test subject. The advantage of the EEG-based attention examination method is that it does not require a test task, it can continuously monitor the level of attention during an actual brain activity, for instance during the process of learning as well.

Attention Tests	Total Trials	Average of Correct Trials	Average of Acc. Rate/Attention Level	Standard Deviation
CPT	324	319	98,5%	0,56
EEG			51,9%	3,67
TOAV	640	636	99,4%	0,49
EEG			52,6%	3,51

RESULTS OF ATTENTION TESTS
TEST: A HIGH MENTAL STATE

Attention Tests	Total Trials	Average of Correct Trials	Average of Acc. Rate/Attention Level	Standard Deviation
CPT	324	309	95,4%	0,72
EEG			45,9%	3,81
TOAV	640	619	96,7%	0,67
EEG			46,3%	3,78

RESULTS OF ATTENTION TESTS
TEST B: LOW MENTAL STATE

Conclusion

In this paper, some attention examination methods have been described. The results of CPT and TOAV tests show that the level of attention was lower in test B compared to test A. The attention level decrease between test A and B is consonant with the results of the EEG-based attention examination method. It can be stated that the results of the different methods to measure attention are similar; therefore they are good alternatives to observe attention. The applied attention measuring methods have been test-based so far, i.e. the answers given to the stimuli in the test were examined and evaluated. For real-time examination of attention, these test-based attention measuring methods are not applicable, though. In contrast, the EEG-based attention examination method ensures continuous examination in time, so continuous information can be gained about the actual mental state of the test subject. This information can be used in teaching to choose, modify the right knowledge sharing method or break, which could finally improve the results of learning. If attention becomes low, the information processing ability of the brain decreases as well and it negatively affects the procession of new information and connection besides memorising.