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Event related Brain activation and Neurofeedback

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Abstract:

It is well known that pathologies show certain brain regions with either increased or decreased activity. For example, typical depression has an increased activation in the insula according to fMRI studies. If we show negative pictures to a person, there are specific locations in the brain that are activated as a consequence of those stimuli (Canli et al., 2002). The same concept works with standardized low-resolution brain electromagnetic tomography (sLORETA) which incorporates a mathematical inverse solution of surface EEG data to provide cortical source localization, and generating threedimensional images, similar to those produced by fMRI data (Thatcher, 2013). The negative brain activation to a stimulus often causes problems for example with patients suffering from depression, anxiety and PTSD. Based on those findings we´ve created an event related Neurofeedback-Protocol based on the stimulus and the hereby evoked brain response. Our innovative Neurofeedback-Protocol uses precisely time locked operant feedback and neurotherapy which is directly related to the given stimulus and the brain response

Introduction:

Neurofeedback may be a quite biofeedback, which teaches self-control of brain functions to subjects by measuring brain waves and providing a feedback signal. Neurofeedback usually provides the audio and or video feedback. Positive or negative feedback is produced for desirable or undesirable brain activities, respectively. In this review, we provided clinical and technical information about the subsequent issues: (1) Various neurofeedback treatment protocols i.e. alpha, beta, alpha/theta, delta, gamma, and theta; (2) Different EEG electrode placements i.e. standard recording channels within the frontal, temporal, central, and occipital lobes; (3) Electrode montages (unipolar, bipolar); (4) sorts of neurofeedback i.e. frequency, power, slow brainwave , functional resonance imaging, then on; (5) Clinical applications of neurofeedback i.e. treatment of attention deficit hyperactivity disorder, anxiety, depression, epilepsy, insomnia, white plague , schizophrenia, learning disabilities, dyslexia and dyscalculia, autistic spectrum disorders then on also as other applications such as pain management, and therefore the improvement of musical and athletic performance; and (6) Neurofeedback softwares. To date, many studies are conducted on the neurofeedback therapy and its effectiveness on the treatment of the many diseases. Neurofeedback, like other treatments, has its own pros and cons. Although it is a non-invasive procedure, its validity has been questioned in terms of conclusive scientific evidence. For example, it is expensive, time-consuming and its benefits are not long-lasting. Also, it'd take months to point out the specified improvements. Nevertheless, Neurofeedback is understood as a complementary and alternative treatment of the many brain dysfunctions. However, current research doesn't support conclusive results about its efficacy.

Objective:

Activities of cerebral neurons have rich information about neuronal activities. When neurons are activated, they produce electrical pulses. By placing electrodes on the scalp, the electrical activity of the brain, known as EEG, can be recorded. In turn, EEG is generated by a specific type of synchronous activity of neurons which are known as pyramidal neurons and the electrical output is thus reflected in the following areas of the skin where the electrodes are located. Different patterns of electrical activity, known as brain waves, could be recognized by their amplitudes and frequencies.

Different frequency components are categorized into delta (less than 4 Hz), theta (4–8 Hz), alpha (8–13 Hz), beta (13–30 Hz), and gamma (30–100 Hz) where each represents a particular physiological function. In summary, delta waves are observed in the EEG signal when a person is asleep, theta waves when a person is sleepy, alpha waves when a person is relaxed and his/her muscles are loose but he/she is awake, beta waves when a person is alert and gamma waves are observed when a person is trying to solve a problem (Table 1). However, there are differences in defining the exact range of frequency components in different studies. As soon because the sensory representation of this above-threshold brain-activity is followed by a rewarding feedback signal, the brain is in a position to memorize this distinct neural/behavioral state as a so-called internal set-point. This elicits a reward-modulated signal (such as dopamine) that supports synaptic plasticity. Subsequent feedback-loops aim at the reproduction of this set-point by using strategies during a feed forward way, thus comparing the particular state with the target state. Multiple loop-iterations (conditioning trials) will then cause further refinement of the set-point, and to a more efficient strategy for its reproduction.

Another feasible option for the belief of a lively control group could be to coach another waveband than the particular feature of interest. For instance, while the experimental group is meant to reinforce their theta activity so as to enhance executive functioning, the active control group might learn to reinforce their beta activity for which there is little evidence that it relates to executive functions. A variation could also be to base feedback on a special waveband for each new training session, which should effectively prevent strong frequency specific learning.

Conclusion:

In neurofeedback, EEG is usually recorded, and various brain-activity components are extracted and feedbacked to subjects. During this procedure, subjects become aware of the changes that occur during training and are able to assess their progress in order to achieve optimal performance. Electrode placement is performed according to specific brain functions and specific symptoms. Considering information about these skull regions, the entire treatment process is simplified. There are several protocols in neurofeedback training, but alpha, beta, theta, and alpha/theta protocol are the most commonly used ones.

BCI is an EEG-based communication device. VE is a human-computer interface system with which users can virtually move their viewpoint freely in real time. The purpose of using VE is to construct a virtual environment with natural interactivity and to create a real sensation from multimodality. Three-dimensional VR is much more attractive and interesting than most of two-dimensional environments.

Biography:

Thomas F Feiner has more than 25 years' experience as an occupational therapist and neurotherapy He conducted and participated clinical research on QEEG and evoked potentials and Neurofeedback since 2006. He developed computer software for testing the auditory order threshold on regular Windows PCs and created an easy to use stimulus presentation program for research in the field of evoked potentials and other psychophysiological measures. He is the clinical director of the Center for Neurofeedback in Munich and established the

Institute for EEG-Neurofeedback in 2008 which offers professional education programs in the field of Neurofeedback, Quantitative EEG and evoked potentials. Since 2017 he conducted Research on the EEG of meditators in great study of more than 1000 subjects. He is founder and owner of Neurofeedback-Partner GmbH and published articles about event related imaging, QEEG and Neurofeedback. His focus is on research and development of integrated neurofeedback protocols, event related potentials in combination with low level brain stimulation technologies.