

# Neurofeedback as an Intervention for Brain Abilities Enhancement

Navjot Saini, Ravinder Agarwal

**Abstract-** There are a number of fields where psychological factors influence the human actions. Sports include a number of brain abilities for an athlete to excel. There is a need to provide mental training in addition to physical training to the athletes. Similarly, brain abilities enhancement is needed in the individuals' having brain disorders. Various Interventions can be employed to enhance the brain abilities of the individuals. Neurofeedback is an Intervention to enhance or inhibit certain brain waves to achieve the desired mental state. It can be used to train the persons for improving their psychological skills. Neurofeedback Intervention/training can be provided with the help of a computer system. With consistent practice over a number of Neurofeedback sessions, desired brain abilities can be enhanced.

**Keywords** — Brain abilities, Intervention, Neurofeedback, Sports.

## I. INTRODUCTION

The human brain is very complex in nature. Researchers have been trying to understand the brain mechanisms, in order to understand the human behavior and various mental disorders. There is high competition in sports. There have been a number of instances where a player is unable to perform well because of anxiety, pressure, lack of concentration and confidence. Even elite players are sometimes unable to perform well in the highly competitive competitions. Factors responsible for choking [1] in team sports have been studied by researchers. This information can be used by the coaches and sports practitioners while preparing the training schedule of the athletes.

An individual with mental disorders needs mental conditioning to lead a normal life in the society. Neurofeedback training can be provided to improve the mental abilities naturally. It is not good to use the pharmaceutical drugs and surgical techniques, as a way to

enhance brain abilities. Neurofeedback training allows a person to become aware of the mental state. Neurofeedback training has been used to improve attention in persons having attention deficit problems. A large number of subjects participated in a study [2], and improvement in attentiveness scores was found after the Neurofeedback training. Neurofeedback is being used to achieve peak performance by the individuals.

Individualized training should be given to the individuals, depending upon their requirements. If someone has learning disabilities, then appropriate procedure should be followed to enhance or inhibit the targeted brain wave frequencies. Neurofeedback studies have been explained in various fields [3] and their effectiveness has been discussed through various applications. Neurofeedback training can be used for cognitive and memory enhancement, treatment of insomnia, stroke, head injuries, stress disorders, anxiety and depression. In a study [4], the Neurofeedback training holds promise for increasing the concentration and attention, lowering the anxiety and rehabilitating the individuals with mild head injuries in sports. Neurofeedback training has also been used to improve the physical balance.

One of the studies on archery players [5], shows that after going through the Sensory Motor Rhythm (SMR) Neurofeedback training, players were able to regulate their mental status and enhance their performance. Players were asked to enhance SMR (12-15 Hz) frequency and inhibit theta (4-7 Hz) and high beta (22-26 Hz) frequencies, throughout the Neurofeedback sessions. Various kinds of Neurofeedback protocols have been studied. In Alpha (8.5-12.5 Hz) training protocol [6], the outcome of enhancing the alpha activity on short-term memory performance, has been discussed. In the same work, alpha/theta training protocol has been described, where the participants were asked to enhance their theta activity over their alpha activity. The relation of this training protocol is tested with enhancement of the creativity and well-being.

Neurofeedback treatment has been used to improve the executive functioning in the children affected by the autism spectrum disorders [7]. The treatment reduced the children's high theta/beta ratio by inhibiting the theta frequencies and enhancing the beta frequencies during the Neurofeedback sessions. Neurofeedback has positive effects for the children and adults suffering from Attention Deficit Hyperactivity Disorder (ADHD). In another work [8], the impact of theta/beta training and slow cortical potentials (SCPs)

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training Neurofeedback protocols, was assessed on resting electroencephalogram (EEG) and the association between different EEG measures and behavioral improvements was analyzed, in comparison to an attention skills training control condition.

As people age, their cognitive functions begin to decline. The population above 60 years of age is increasing. Neurofeedback training can be used to help the elderly to preserve their executive functions. It has been demonstrated that theta activity is closely associated with working memory, episodic memory and encoding new information. Attention and working memory appear to be related with frontal-midline theta activity. The results of the study [9] showed increased theta magnitude values and the training indices over the 12 sessions of the Neurofeedback training. The EEG findings provided support for the success of the frontal-midline theta uptraining protocol for the attention and working memory functions of older and younger participants.

The Neurofeedback training is an efficient method for acquiring expertise and excellence in sports. Novice players can acquire expertise with practice only. However, Neurofeedback training protocols can also be used in this context. The need to acquire and quickly master new skills is important in various fields such as armed forces, emergency services and different sports. In a study [10], recreational golfers received either true Neurofeedback training in order to reduce frontal EEG high-alpha power or received no Neurofeedback training (control group), in between the pre-test and post-test sessions. The golfers were able to regulate their brain activity through Neurofeedback training. However, further research has to be carried out on refining the Neurofeedback Interventions to allow quick acquisition of expertise in a field.

## II. PROCEDURE

Neurofeedback is also known as electroencephalographic (EEG) biofeedback. Before providing the Neurofeedback Intervention, the training administrator has to be trained regarding the complete procedure. After this, the trained person can administer the training to the individuals. A subject is given the feedback by the trained person, to enhance certain brain wave frequencies and inhibit the other brain wave frequencies. Points are awarded for the correct series of brainwave activity achieved. In this way, a subject learns to self-regulate the brain waves in order to achieve the desired mental state.

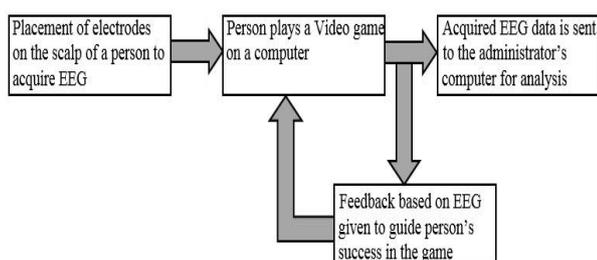


Fig. 1. Neurofeedback training process

Neurofeedback sessions can be conducted over a period of

time to obtain the desired results. In a typical session, electrodes are placed on the person's scalp according to the International 10-20 system of electrode placement. These electrodes measure the brain wave activity. The electrodes are placed in such a way, so as not to cause any discomfort to the individual. The data acquired by the electrodes goes to a computer, and the administrator gets the real time information of the individual's brain state. The individual is presented the audio or visual or combined audio-visual feedback in response to the brain waves pattern. In this way, the individual gets to understand the association between brain wave activity and the human performance.

The information about brain wave frequencies is generally provided to the individual in the form of a video game on a computer screen. As the individual tries to achieve a desired mental state, the game performance is affected accordingly. Neurofeedback training shows good results when the individual undergoes the training sessions for a long time regularly, for example, 6-7 months.

## III. CONCLUSION AND FUTURE DIRECTIONS

Neurofeedback Intervention is a way of making the individual aware of the brain waves patterns in relation to the human performance. As can be understood, Neurofeedback Intervention is a popular means to enhance cognitive performance like improving the attention, concentration, memory, physical balance, lowering the anxiety, stress, pressure in fields such as sports and arts. It also acts as a treatment for learning and developmental disorders, insomnia, stroke, head injuries, depression, headaches and migraine. It is a natural way of enhancing the brain abilities, without any need of pharmaceutical drugs, medications and surgeries. It is administered by a qualified person. The Neurofeedback training can be provided to children and adults. Different individuals have different psychological needs. Therefore, individualized training protocols should be administered to the participants. Depending upon the requirements, the number of sessions should be decided. However, Neurofeedback training sessions should be undergone for a long period of time to reap the best benefits. Future research should include quantitative and qualitative evaluation of a large number of individuals, to ascertain the effects of Neurofeedback training on the human performance. Various training protocols should be evaluated in large targeted populations. Neurofeedback Intervention should be examined in various fields, so as to assess its effectiveness under various conditions.

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