Chapter 2
Neurofeedback:
Retrain the Brain

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ABSTRACT

Neurofeedback (NF) is a type of brain wave training based on operant learning. NF has been employed in research and clinical settings for the investigation and treatment of a growing number of psychological illnesses. This technique involves detection of electroencephalographic (EEG) information from the surface of the scalp of a subject by separating its frequency decomposition into its component waveform (alpha, beta, theta, gamma, and delta) and making these components visible usually as polygraphic traces on a computer screen. Neurofeedback is being considered as a promising new method for restoring brain function in a large number of mental disorder cases. NF takes into account behavioral, cognitive, and subjective aspects as well as the brain activity of the concerned individual. About 25 years ago, NF was employed for clinical and research purposes in psychological illness. These psychological illnesses include attention deficit disorder, addiction to drug, depression, stress, and eating disorders.

INTRODUCTION

Neurofeedback (NBF) is a technique of self-regulation in which parameters of electroencephalography (EEG) recorded from subject's present cognitive status represents the subject's brain functioning and any pathological abnormality. NFB is a one of the special application of biofeedback (BFB) for visualizing and training the electrical activity of the human brain. Visualization of EEG helps the brain to learn to better self-regulate brain activity based on operant conditioning. It focuses on optimization of the brain functioning rather than suppressing symptoms which is done in case of medication and drugs (Prinsloo et al., 2017).

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In other words, NFB is a type of brain wave training, based on operant learning. In this training, our brain determines everything which we feel and do. NFB has been employed in research and clinical settings for the investigation and treatment of a growing number of psychological illnesses. This technique involves detection of EEG information from the surface of the scalp of a subject by employing frequency decomposition technique and separating brain waves into its component waveforms (alpha, beta, theta, gamma, and delta) and making these components visible usually as polygraphic traces on a computer screen. Neurofeedback is being considered as a promising new method for restoring brain function in mental disorders (Escolano, Aguilar, & Minguez, 2011). It takes into account the behavioral, cognitive, and subjective aspects as well as brain activity. For the past 25 years, NF has been employed for clinical and research purpose in psychological illness (Lubar, 1997). These psychological illnesses include attention deficit disorder, addiction to drug, depression, stress and eating disorders. But in recent years NFB studies are gaining much attention to determine human cognitive ability according to several published research studies (Pope & Palsson, 2001). In NFB training many researchers concluded that it revealed its therapeutic effects in the treatment of varieties of neurological and psychological disorders and improves certain cognitive aptitudes. Apart from this NFB training in healthy human users have been reported in many works (Vernon, 2005). NF training principles are based on brain activities, patterns of brain interest and positive or negative stimuli and the stimuli can be any visual or auditory modalities.

LITERATURE REVIEW

In their review article, Grefkes and Fink (2011) suggested that balance within the motor network may be critically disturbed after stroke when the lesion either directly affects any of the brain areas or damages related white matter. A growing body of evidence suggests that abnormal interactions among cortical region remote from the ischemic lesion might also contribute to the motor impairment after stroke. They suggested that pathological intra and inter hemisphere among key motor regions of the brain constitute an important pathophysiological aspect of motor impairment after subcortical stroke. They demonstrated therapeutic interventions such as repetitive transcranial magnetic stimulation, which aims to interfere with abnormal cortical activity that may correct pathological connectivity not only at the stimulation site but also distant brain regions (Grefkes & Fink, 2011).

In their paper, Escolano, Aguilar, and Minguez (2011) have revealed therapeutic effect of Neurofeedback to treat a variety of neurological and psychological disorders and have demonstrated its feasibility to improve certain aptitudes in healthy users. Their aim was to improve working memory performance in healthy users by the enhancement of upper alpha band. In their study EEG assessment in active and passive eyes open state were conducted pre and post neurofeedback training. It showed significance improvement in working memory of the healthy users (Escolano, Aguilar, & Minguez 2011).

In their study, Scharnowski and Weiskopt (2015) used alpha rhythm to conduct brain induced training. It proposed the use of Bluetooth low energy to connect the EEG signals to the smart phone. The result of their experiments indicated that the power of alpha waves demonstrated on the phone had a significant memory increase as a result of the memory of cognition brain training (Scharnowski & Weiskopt, 2015).

In Margaret E. Ayers's (2004) study on cerebral palsy and neurofeedback suggested sensorimotor inhibition can be obtained solely by inhibiting theta activity on the appropriated sensory motor areas utilizing bipolar hookup and analog or all digital real time feedback. Cerebral palsy is considered to be one of the most rewarding neurological challenges in neurofeedback (Ayers, 2004).