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Research paper

Quantitative Electroencephalogaphy (QEEG) and Neurofeedback Training (NFT) for Elderly with Mild Cognitive Impairment (MCI)

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Abstract

Neurofeedback training (NFT) has been widely used to alter the brain activity to enhance the brain function. This study aimed to apply neurofeedback to enhance the cognitive performance in elderly with Mild Cognitive Impairment (MCI) by focusing on alpha wave in the neurofeedback training as it is positively associated with cognitive decline in elderly. 10 subjects who passed the criteria were assigned to experimental and control group. With 15 sessions of alpha neurofeedback, increase in alpha absolute power was rewarded while simultaneous suppression of theta and beta2 were done in experimental group. Results showed that after completion of neurofeedback, all subjects in experimental group learn to increase their alpha absolute power while mixed result was recorded for suppression of theta and high beta either at individual, inter and intra group level. Cognitive results in individual level revealed that pattern of increase and decrease of score was regular in experimental group and at grouped level, significant increment observed in Digit Span and Symbol Search in experimental group only. These results suggest that MCI elderly could learn to increase specific components of EEG activity that such enhanced activity may facilitate in working memory and processing speed enhancement.

Keywords: *Cognitive enhancement; elderly; mild cognitive impairment; neurofeedback; QEEG*

1. Introduction

Cognitive performance of elderly will decline with age and this make them more susceptible to get age related cognitive impairment disease such as mild cognitive impairment and even worse it may lead to dementia [1,2]. With the yearly increasing number in AD cases worldwide, MCI has became a serious issue to be investigated further to find ways to at least slowing its progression to AD. Non-pharmacological rehabilitation technology such as neurofeedback training has caught researchers' attention to curb this problem. Neurofeedback training (NFT) is a self regulation technique that helps individual learns to control or change their brain activity [3] which has been proved to improve elderly cognitive performance [4,5,6].

A highlight on alpha and theta rhythms are given because individuals with greater cognitive impairment present a greater amount of theta activity than is normal in aging individuals [7,8] significant reduction alpha frequency is responsible for slowing down processing speed and memory in particular [9]. Alpha may be trained alone or it is combined with other rhythms such as theta and beta. In an exploratory study, peak alpha frequency (PAF) and alpha amplitude were inhibited and enhanced in two different arrangements in 35-38 sessions; (i) PAF inhibited, alpha amplitude rewarded (ii) PAF rewarded, alpha amplitude inhibited with one mock feedback control. In (i), it was shown that the elderly subjects had improvements in memory while in (ii) there was a general improvement in speed of processing and executive function [4]. Meanwhile another study of alpha training [10] depicted it was possible to increase alpha power even in short period in elderly despite of their aging condition. The study was carried out with 30 participants of elderly individuals (65-85 year-old) in which they were trained in 4 sessions (30 minutes per session) in a week to increase in upper-alpha (10–12 Hz) power while inhibiting theta (4–7 Hz). Significant increase in alpha power was seen in 8/10 and increase in alpha/theta ratio while there was a non-significant decrease in theta seen.

Theta protocol neurofeedback in literature often revolved around cognitive impairment problem which is the reason it is often done in elderly. Beccera et al. (2012) aimed to reduce the theta absolute power on individualized selected electrode and observed neurofeedback effectiveness in terms of changes in theta absolute power in EEG and improvement in WAIS –revised and NEUROPSI test [5]. The study disclosed the improvement in verbal comprehension index & verbal IQ of WAIS – revised and NEUROPSI test after 30 training sessions of neurofeedback in experimental group than in control group. Reduction in theta absolute power in the midline and left frontal leads could have induced the improvement in attention that was reflected in the total score of the NEUROPSI test. Despite of widely applied neurofeedback training in research setting, the training for elderly are less explored and it is even less for elderly with particular condition such as as mild cognitive impairment. Thus, in the present study, alpha training (training up alpha and training down theta & high beta) will be employed to see the effect of training in cognitive performance in elderly with mild cognitive impairment in terms of working memory, processing speed concurently with its EEG changes before and after the training.