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Neurofeedback Effectiveness on The Learning Skills of Elementary School Students

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ABSTRACT

The research was based on experimental method and pre-test and post-test with control group has been used. So, among female students with related parameters to participate in the research just 50 ones were choice. Three practice sessions per week for 20 were determined for each three groups. Both experimental and control groups participated in neurofeedback learning sessions (promoting the Alpha wave, Alpha-Theta protocol) in addition to school practices. However, experimental group received real feedbacks and also similar implementation process for simulated neurofeedback group, there is no relationship between these feedbacks and neuro-activities. Standard school rules used to estimate the students record. Additionally, their changes studied and compared in these two stages. Compared to other groups, increasing the mean of records in real neurofeedback group significantly presented as the result of analysis the unilateral covariance ($p<0.05$), also, however, mistakes decreased for each person in real neurofeedback group, there was no significant different between these changes in pre-test. Neurofeedback training is effective on performance improvement with capable of operant conditioning of brain waves. So, with regard to the results, suggests that neurofeedback training used to improve the school work of elementary students.

Keywords: Neurofeedback Effectiveness, Learning Skills, Elementary Students

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INTRODUCTION

Participants learn to influence the electrical activity of their brain by use of operant conditioning paradigm in neurofeedback. Clinical value of learned individual rules of the components of AC frequency as well as slow cortical potentials (SCPs) of electroencephalography (EEG) has been presented. For example, disorder of cortical simulation such as epilepsy in pathology (M. Sterman & Friar, 1972; M. Sterman, MacDonald, & Stone, 1974) and attention deficit hyperactivity disorder (ADHD) (Linden, Habib, & Radojevic, 1996; J. Lubar, Swartwood, Swartwood, & Timmermann, 1995; Rossiter & La Vaque, 1995; Shouse & Lubar, 1979). Influenced by neurofeedback intervention. Addition to many researches has been done for schizophrenia (Gruzelier, Hardman, Wild, & Zaman, 1999) some supplementary tools for therapy as clinical applications used to substance abuse treatment such as use of slow wave alpha-theta feedback training (Peniston & Kulkosky, 1989) as well as means of brain-computer communication in paralyzed patients measured by learned SCP control (Birbaumer et al., 1999). Normalization of the EEG frequency spectrum along with neurofeedback training (NFT) used for clinical improvement (M. Sterman & House, 1980). It must note that in cortical and thalamocortical networks (M. B. Sterman, 1996) neurofeedback training can lead to create the excitation level for a long time easily. This work developed in current study and focused on healthy people in order to show that the ability of these people are not only reason to control their EEG more but behavioral and electrocortical measures affected on these changes related to improved attentional processing, according to a series of NFT sessions (Egner & Gruzelier, 2001). Also, the benefits of music performance proceedings in conservatoire students considered dramatically (Gruzelier et al., 1999). Regulate mental activity arousal and therefore, cognitive processing influenced by the mechanism of neurofeedback perception as above study. But, development of training individuals to promote a specific frequency is not obvious and cognitive performance will impact by inhibit another particularly. The relation between theta activity (4-7 Hz), working memory (Kahana, Sekuler, Caplan, Kirschen, & Madsen, 1999; Wolfgang Klimesch, 1996, 1999), sensorimotor rhythm (SMR) activity (12-15Hz) and finally attention (Egner & Gruzelier, 2001; Rossiter & La Vaque, 1995) presented for cognitive performance. Comprehension, thinking and planning as well as ability to hold information in mind temporarily is done by working memory performance (A. Baddeley, 1992; A. D. Baddeley & Hitch, 1974). As previous study, cellular mechanism of memory influenced by the role of theta activity to facilitate long time augmentation (Pavlides, Greenstein, Grudman, & Winson, 1988) and the study of scalp indicated the relationship between recognition memory processes and theta activity (Burgess & Gruzelier, 1997).

Data used to determine the relation between theta and working memory indicated that theta activity increased significantly by words just recognized correctly later during encoding stage of a recognition task (W Klimesch, Doppelmayr, Schimke, & Ripper, 1997). Also, for correctly recognized words, the greater theta activity identified during later recognition stage. In this study, posterior association cortex used by working memory to save sensory information and to update the information by pre-frontal cortex (Gevins, Smith, McEvoy, & Yu, 1997; Goldman-Rakic, 1988; Wolfgang Klimesch, Schimke, & Schwaiger, 1994). During a working memory performance, these two regions connected each other by theta activity (Sarnthein, Petsche, Rappelsberger, Shaw, & Von Stein, 1998; von Stein, Rappelsberger, Sarnthein, & Petsche, 1999; Von Stein & Sarnthein, 2000). The relationship between theta and working memory significant presented by the idea in this research, hence there is a relationship between loading working memory and increasing theta power simultaneously. Among other items, the results indicated that encoding and retrieval of information in working memory influenced by theta (Wolfgang Klimesch, 1996, 1999). The operant training of SMR activity, more than past three decades studies, affected on the individual's ability to learn difficulties by attentional processing. J. F. Lubar and Shouse (1976) presented the relation between individuals scores improvement of continuous attention in NFT of the SMR significantly and ADHD and deficit disorder of attention. (J. O. Lubar & Lubar, 1984; Rossiter & La Vaque, 1995; Tansey, 1991; Tinius & Tinius, 2000). SMR activity development and in turn low commission errors and perceptual sensitivity improvement on the Test of variables of attention (TOVA) and also enhancement of attention-related P3b event related potential indicated that the impact of SMR training on healthy people examined in current study (Egner & Gruzelier, 2001). In this regard, healthy individuals are able to use SMR NFT to develop attentional processing. According to the literature of neurofeedback, there is a relationship between semantic processing and cortical activity in the range of 10-14 Hz (Haarmann & Cameron, 2005). For example, during the words practice in a semantic working memory performance, greater coherence in this frequency between anterior and posterior regions presented (Haarmann & Cameron, 2005). Training the increased activity required to keep and practice the working memory representation. It is still unclear that whether cognitive performance is influenced by SMR activity or not. According to some neurophysiological researches during inactive behavior of animal but focused and conscious, firing in ventrobasal thalamic nuclei constantly at the beginning of SMR increases by attenuation of somatosensory inputs (Howe & Sterman, 1972). In many current studies about human, further activity range (11-15 Hz) which placed into the sensory projection area of the cortex completed the motor performance if referred to stimuli visually (Mann, Sterman, & Kaiser, 1996). It must propose that interference between motor activity-which prevent the SMR activity- and the components of information processing include perceptual and integrative may be occurred (M. B. Sterman, 1996). So, reduction this interference can lead to information processing easily by learned voluntary control of SMR activity while the perceptual and memory performances remain ready simultaneously. In this study we want to assessment neurofeedback effectiveness on the learning skills the social aspects clients of elementary school students.

METHODOLOGY

Experimental method of research with pre-test and post-test was related to control group evaluated the impact of Neurofeedback training method on homework. Measurement process of dependent variable (tests) was independent of the researcher's involvement and done by researcher. Therefore, current method is type of Double-Blind. Participants were 45 healthy students between 6 to 10 years old selected as available method and located into groups randomly. They without any information about neurofeedback, shouldn't be participated in other exercises during research. The number of participants in each groups decreased because they left research process. To study their initial performance, pre-test consisting of 30 tests were taken from each groups (such as school official test). The components of individuals graphic electro-encephalomyocarditis documented in laboratory. After training ended, their records from 30 tests of pre-test examined to study their final performance and the graphic electro-encephalomyocarditis documented in laboratory. The number of 21 error questions of Beck Anxiety Inventory (BAI) used to examine the rate of their errors. According to all coordination with teachers, all participants in each groups required to practice for 3 sessions in a week for 20 sessions. These sessions were held for 3 groups equally. In neurofeedback sessions, participant should sit on a comfortable chair in a quiet room, both earlaps and regions T3 (left temporal) and region Pz (central parietal) prepared with white alcohol and nuprep gel by examiner and then reference electrode (yellow) and Grand electrode (black) linked respectively to left and right ear by TEN20. At first session and before neurofeedback started, alpha-theta bands determined for each person using baseline by ProComp 2 and bandwidth used for each characterized learned feedback. According to different researches, neurofeedback training divided into two protocols for each real neurofeedback. As researches referred to increase alpha power especially in left temporalis region, the alpha wave enhancement in region T3 showed during first 10 minutes of training (Gruzelier et al., 1999). In fact, active electrode linked to this region. In this study, there are two feedbacks (visual and audio) presented simultaneously. Visual feedback consists exercises and audio feedback referred to their sounds and ringtone (based on each individual success) in alpha wave control greater than threshold level. Alpha-theta protocol examined in region Pz during the next 20 minutes of training. This protocol aims to provide a deep conscious relaxation state. In this protocol, feedback showed as the sounds of ocean wave as well as river. The participant needed to close eyes and sat on chair within relax state perfectly but consciously and listened to the sounds. This protocol took at least 20 minutes. In next stage, some conditions such as preparing the skin and attaching the electrodes were done as previous. Both of these groups were differentiated just by feedback presentations. Actually, he/she was able to see the motion and sound of increased alpha protocol and also heard changes of river sound along with the sound of ocean waves and versus in alpha-theta protocol, but there was no relationship between these feedbacks and their EEG features. After information presented and the difference in the records of groups identified, one way to analyze the variance used in pretest stage and ANCOVA (Analysis Covariance) as well as to examine the effect of neurofeedback on record and level of the students' error. Bonferroni test used for Post Hoc test as well. SPSS applied for data analysis.

RESULTS

The results of descriptive information in associated with pre-test and post-test records for three groups is shown in Fig 1.

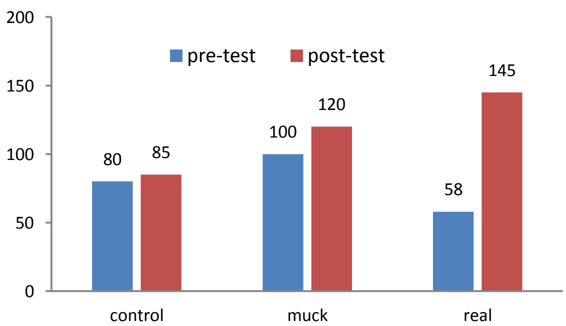

Fig1. Pre-test and post-test records for three groups

The effect of neurofeedback training on pre-test and post-test records for three groups examined by analysis covariance. In this analysis, school records in post-test and pre-test considered respectively as dependant variance and as covariance variables of neurofeedback training as independent variance. The impact of neurofeedback intervention on dependant variable examined if ensured about the essential conditions of this analysis, i.e, insignificant difference of records in pre-test of homogeneity of Gradients and variance groups. The results showed the effect of intervention factor and significant changes in the results of post-test with associated to pre-test records ($F=6.32$, $P<0.05$). Comparison of groups, two-by-two, using Bonferroni test is shown in Fig 2.

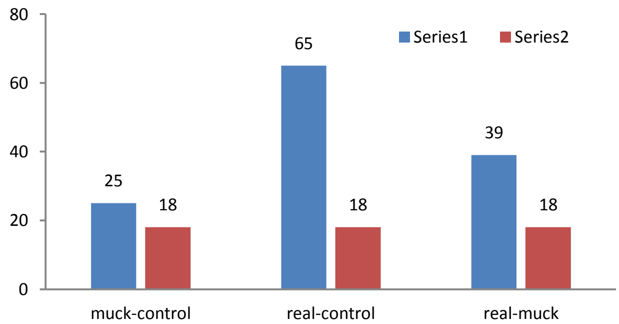

Fig2. Comparison of groups, using Bonferroni test

As seen, there is a significant difference between the mean of records in real and muck neurofeedback groups as well as control group in associated with post-test, but insignificant between the mean of control and muck neurofeedback groups. So, promotion of the mean of real neurofeedback record significantly compared with other groups and insignificant difference between both mock neurofeedback and control group resulted to improve the learning process by neurofeedback intervention. The neurofeedback influence performance improvement but not related to hypnosis and the placebo effects. The general results of effectiveness on all criteria are shown in Fig.3 to 5. Greater numbers refer to student weakness and its distances from zero refer to the student's distance from perfect state.

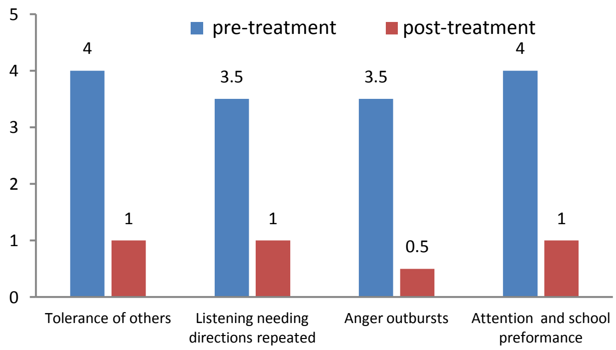

Fig3. The results of learning effects

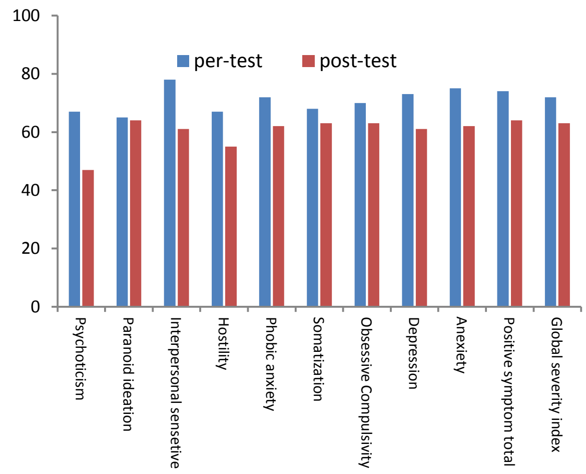

Fig 4. The results of social effects in class and home

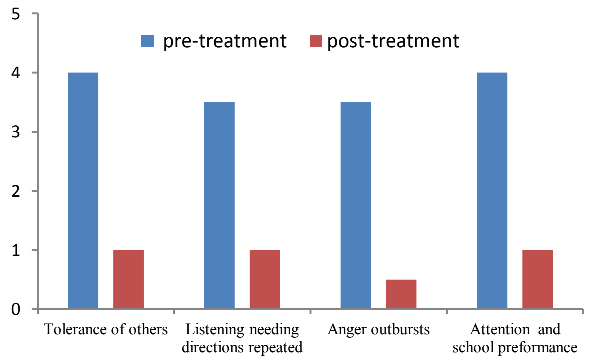

Fig 5. Personal results

DISCUSSION AND CONCLUSION

In recent decades, psychologists were able to examine different methods of leaning in mental conditions and improved it through various fields included music, cognitive learning tasks and even sports. Access to peak performance led to more practices and efforts by learners as well as teachers' competition. With these different efforts and competition, training and simple practices are not only enough for the students' promotion to peak performance, providing new conditions and positions are essential. Neurofeedback is one of more effective strategies to improve physical and mental disorders and to rise the peak performance from late seventies and overemphasized by sciences. Human is able to influence their body automatically. Both variable levels (real and mock neurofeedback training) presented in this research. Experimental intervention (independent variable) has been done using two protocols included the protocol to increase alpha in region T3 in first 10 minutes and immediately alpha-theta protocol in region Pz for 20 minutes (30 minutes training). Effectiveness of neurofeedback training as well as significant improvement of curriculum record in experimental groups compared with two other groups in post-test is shown by statistical results and findings. These results emphasized the related theoretical concepts and also all researches findings. Generally, neurofeedback can help to improve test performance for elementary individuals quickly. According to Hatfield perspective, Ross (2005) presented that skilled individuals performance derived from neuro resources led to change in motion-mental behaviors. Practices may lead to reduce the neuro activity in motion preparation stage as well as neuro organization (Ross, 2005). These changes cause to decrease motion-neuro noises and promote the neuroprocessing of motion behavior. These results in greater level of learning present the reduction of examination and therefore, communication of more refined cerebral cortex will explain. Perhaps, the ability of skilled individuals derived from long-term practices and experiences (Milton, 2007). So, it must note that the results of recent research is along with current information and studies which support some training and practices to utilize at least mental regions and more alpha power in left temporalis. This research is followed by Landerz. They examined the semi-skilled students' function through neurofeedback training (increased alpha) in left and right temporalis in their studies. Scientists supported neurofeedback training as a technique to increase semi-skilled test performance and proposed that individual performance can be improved by use of correct protocol in proper place. Versus, wrong choose can be led to negative outcomes and are inevitable on performance. Also, the neurofeedback effects (alpha-theta protocol) and biofeedback (heart rate) along with control group on arts performance. The results indicated that dance performance improved after training term for three groups (neurofeedback, biofeedback and control). But, it must note that the performance of neurofeedback and biofeedback improved significantly if the differences of dance performance divided into the number practice sessions. These subjects present the recent research. In this research, there is no improvement in two control groups with physical practices (without feedback). But, real group will be improved through use of the process of neurofeedback educational assistance except two other groups (control and mock). The results show the significant effects of neurofeedback training on reduction of the groups error level. While the mean of error level for real neurofeedback group in post-test numerically decreased in comparison to two other groups. These results are based on the variances of neurofeedback score in error level. There is significant background for the impact of neurofeedback training on controlling the error. Also, different researches, against the effect of neurofeedback training on reduction the signs of error, referred to some non-pure factors included motivation variables such as age and personal characteristics and individual attitudes to some variables of therapist and religious resorts and social and environmental conditions. According to the results of error test in recent research, there is an insignificant reduction in error level of real neurofeedback group compared to two other groups. However, the post-test stage in this study was along with the students' exams and the students tolerated many errors , it must note that insignificant reduction of error between real neurofeedback group and others is related to this stage maybe. But, real neurofeedback groups were satisfied for reduction their error states at the end of training term. Of course, it is clear that there is no possibility to accept or reject the impact of neurofeedback on curriculum error of elementary students. If Post Hoc test done and the results analyzed, the researcher was able to access better conclusion in associated with the effect of this method on individuals' error level.

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