



Neurofeedback effectiveness on learning disorder with attention deficit/hyperactivity

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ABSTRACT

The goal of present study is neurofeedback effectiveness on learning disorder with lack of attention disorder/hyperactivity. This study was done at semi-experimental way without control group. Statistical society of study was including all 7 to 13 years old students of Sari city who had learning disorder with lack of attention disorder/hyperactivity that had gone to therapeutic and consultancy centers of this city. For selection of participants at this study, I went to Tuba consultancy center at Sari city which presents consultancy and neurofeedback services and study sample were including ten children who had learning disorder with lack of attention disorder/hyperactivity that were selected at access. At this study, children received 40 neurofeedback sessions three times at the week. Children were tested and evaluated with neurofeedback teachings. Data were analyzed with dependent T test. Results show that weren't effective on learning disorder of these groups of children ($P > 0/05$ t: 1/020) but it was effective on their ADHD (t: 4/490, $P < 0/05$). At general, but, neurofeedback isn't effective on learning disorder with lack of attention disorder/hyperactivity.

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1. Introduction

According to *Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition, †learning disorders will be diagnosed that advancement at standardized tests for reading, mathematics and writing expressions at considerable amount be lower than expected size according to age, intelligence or education level. The prevalence rate of this disorder according to rate of used finality and definitions are evaluated around 2 to 10 percent. Learning disorder is one of the most important children psychiatrically disorders. It is said that %50 of American students at U.S.A schools have at least one kind of disorder disabilities, but at general, it is evaluated they have learning disability domain from 1 to 10 (‡Kapalan and Sadok) around %30. From age range, students who have learning disabilities, it is increased from 6 to 11 years old gradually and most of them are at 10 to 15 years old age. These numbers will decrease considerably at 12 to 16 years old (§Lerner) the phrase of learning disorder points out to unit structure or disorder which is related to the defect at advancement related to the educational skills. This disorder has inhomogeneous entity that this inhomogeneity reflects at educational patterns, strengths and weaknesses of information processes and also at main categorical systems as educational disorders of specific domains such as mathematics or reading disorders (**Casey) he believes that these students have brain problems. ††Jones and Bender mention the main problems of these students at learning time related to lack of pay attention and reading comprehension defect. They believe also brain deficiencies these groups of students don't provide

permission of favorite learning activity this matter leads to their avoidance from learning environments. So, learning disabilities are divided to two main groups, first, evolutionary learning disabilities and second, educational learning disabilities. Also, educational learning disabilities are divided to three main groups, first, ††Dyscalculia, Dyslexia §§ and †††Dysgraphia. SHahani (2004) shows epidemiological studies at general populations and clinic samples that Attention deficit/††† hyperactivity disorder happens simultaneously with learning disorder. Various studies have insisted attention problems presence at huge amount at disable children. Carroll †††(2005) the most acceptable evaluation is %33, it means that at least %33 of disable students have attention problem at learning. Similar signs of attention deficit disorder and learning disorder are including attention problems and hyperactivity, defeat tolerance at least level, low self-esteem, having ethical problems, disorder at social skills, having educational problems and increase educational desert. Shaywitz §§§(1991) and others evaluated this rate %30 (Alizadeh, Bahmani and Mofidi 2008, Seedman, Valera and Markis 2005).

From other side, Alizadeh, Bahmani and Mofidi 2008 express that %10 to %25 of children who have attention deficit/hyperactivity; they have also at least had one of

specific learning disabilities problems. It should be mentioned that it doesn't seem attention deficit/hyperactivity be the reason of disability at learning, but it maybe disability at learning provides ground for attention deficit (Ahadi and Kakavand, 2009). So, common signs of LD and ADHD have been seen at two groups are including attention problems and hyperactivity, defeat tolerance at low level, low self-esteem, having ethical problems, disorder at

* * Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition

† Learning disorder

‡ Kapalan and Sadok

§ Lerner

** Casey

†† Jones and Bender

†† Dyscalculia

§§ Dyslexia

††† Dysgraphia

††† Attention deficit/ hyperactivity disorder

††† Carroll

§§§ Shaywitz

social skills, having educational problems and increase educational desert and very low job upgrading (Afstratopolo, 2012). New findings show that LD children, it is observed abnormal brain activity that it is more at alpha and theta domains. At the most ADHD children, we observe obviously brain electrical activity difference at comparison with children without these symptoms especially central and forehead theta activity which is related to lack of motivation and brain activity decrease (Lou, 2005). Brain waves are divided according to four groups according to frequency. They are including according to longest and fastest features delta (1 to 3 hertz), theta (4 to 7) , alpha (8 to 13) and beta (14 to 30). Delta waves will be seen person is at deep sleep state and theta will be seen. Alpha waves activity will reach usually to maximum that person is awake and some extant at relaxed state. Beta waves are along with cognitive concentration and process. When a normal person is faced with attention homework such as reading, arithmetic simple calculation implementation and listening to the story, usually it is seen changes at his electroencephalogram that frequency and size of beta waves will increase at frontal parts (especially right frontal). Contrary of this state, persons who have disorder, waves will move slowly with beta waves and without EEG, it means that every meaningful increase will have tendency at frontal part. Slow activity (beta waves) is feature of non-concentrated brain. (Lubar 2003****) at ADHD children, it's observed that increase and decrease of beta domain activity at the rest state and also at attention home works (****Wangler) ****Clarke et. al (2002) confess that at the children having learning disorder with more theta , lower alpha rate and rate of alpha/theta is more at comparison with ADHD children. Neurofeedback is safe and without pain method that with using of it, we can improve brain self- control and function at different ways. Its underline mechanism is including needed self-regulation boost for effective function (Steinberg and sigfrid, 2008). Neurofeedback is technique that persons teach by agent conditioning change themselves brain waves patterns (Masterpaskowa, 2003). Neurofeedback is agent conditioning approach that person can reform abnormal electrical activity and EEG. The goal of neurofeedback teaching is reform and its results cognitive and behavioral promotion at person. So, a neurofeedback suitable protocol can compensate shortage of alpha and beta ratio at part with highest ratio (Besira, 2006). Rabin (2000) for proof of effectiveness of this new therapy used it for 900 teenagers with ADHD disorders at New york Enricoformi school. He observed the effectiveness of neurofeedback on learning and depression of these students. After it, other schools of U.S.A used neurofeedback method (Demos 2005). GHolizadeh, Babapoor and Rostami (2010) have studied neurofeedback method teaching on 30 students that results after 20 teaching sessions show eye-catching improvement of students' visionary memory. Many studies have verified effectiveness of neurofeedback on different disorders such as schizophrenia, addiction learning disabilities and autism spectrum disorders, epilepsy, depression and ADHD and they had successful therapies and also widespread usage at teaching (Angela kiss 2007).

So, according to this matter, this question designed does LD and ADHD of brain waves problems at sick persons is effective on learning disorder with attention deficit/ hyperactivity and this neurofeedback is more effective on LD or ADHD?

Method:

At this plan, dependent variable, it means learning disorder with attention deficit/ hyperactivity before and after independent variable implementation. It means that neurofeedback teaching method by CAS and LDES tests measured and because it was

without lack of control, so research plan was plan type of pretest and past-test with one group that it is semi-experimental plan type. Society, sample, and sampling method: statistical society of this research was all children who had LD along with ADHD Tuba consultancy and therapy center of Sari city. From these children, 12 persons who had necessary conditions were selected at access. At semi-experimental researches, sample volume should be 15 persons but because of low number of samples, 12 persons were selected. These children in addition to learning disorder, simultaneously they should have problem of attention deficit/hyperactivity. Their age range was from 7 to 13 old years. At this study, we used two tests for measurement of learning disorder and ADHD.

1- ****LDES test: this test will use for diagnosis of learning disorder and it is including test of scale of ****listening, ****thinking, ****speaking, ****reading, ****writing, ****spelling, ****and mathematical calculations. Test has 88 questions that answered by child parents (or familiar person with child educational or homework position) at Likert scale. Scoring way is from 0 to 3 that 0, it is unsuitable for age from evolutionary aspect, 1 rarely, 2 sometimes and 3 always or most of time and then tester interprets it. Internal durability for this test is for every part %41 and test validity 0/60 to 0/70. (****McCarney, 2007).

2- ****CAS test: by this test, four scales of programming, attention, successive and simultaneous process is measured. This test has been designed for children of 5 to 17 old years. Four cognitive processes (programming, attention, successive and simultaneous process) is congruent with three structural units of three Luria protocol as following: 1- attention process with Luria first structural unit: brain stem, midbrain and the brain2-successive and simultaneous process with second structural unit Luria: head back , temporal and parietal 3- programming process with third unit of Luria: frontal lube . study results on 1600 children show that CAS scores has correlation with test scores of Woodcock- Johnson revised (WJ- R- III) that this correlation is from 0/35 to 0/64 and test durability is 0/80 to 0/90.

Implementation method: it was including neurofeedback teaching which was done three times at week and at general 40 sessions were done on subjects. Time period of every session was one hour. Comprehensive evaluation of process method was done at 5, 15 and 30 sessions and also psychiatrist evaluation was done at 10, 20 and 40 sessions. Before neurofeedback implementation, we took LDES test and also CAS test and after neurofeedback implementation, again also these tests were taken, so that we can access to the scores of pretest and past-test.

Results: for studying of this question that whether neurofeedback teaching is effective on learning disorder with lack of attention disorder/hyperactivity on children or not, students' scores compared at scales of pretest and past-test stages. Table 1 shows average and standard deviation of scores on learning disorder with lack of attention disorder/hyperactivity at stages of pretest and past-test at group. We observe according to Table 1 contents that whole average at pretest average is 143/66 and after past-test 133/08. According to averages difference, there isn't obvious difference at different features. But there was little difference at mathematics that we conclude that neurofeedback is more effective at spatial imagination. At table 2, we observe ADHD scores at pretest and past-test stages that at general, average of pretest is 73/33 and past-test 85/50. According to descriptive statistics at

**** Lubar
**** Wangler
**** Clarke

**** Learning Disability Evaluation scale
**** Listening
**** Thinking
**** Speaking
**** Reading
**** Writing
**** Spelling
**** Mathematical calculations
**** McCarney
**** cognitive assessment system

table 1 and 2, average of pretest attention deficit disorder at past-test stage is higher than its average at pretest stage. But about learning disorder, this matter hasn't happened; it means that at past-test stage, not only we don't observe average increase also it has decreased.

Table 1: learning disorder average and standard deviation

SD	M	SD	M	Ld
Past-test	Past-test	pretest	pretest	
3/50	11/41	2/23	11/58	listening
9/55	27/66	5/34	30/75	thinking
02/3	41/11	39/3	12/8	speaking
88/6	91/20	91/5	22/08	reading
41/4	18	5/05	20/33	writing
70/3	10/58	3/88	11/75	spelling
73/12	33/08	10/09	33	mathematics
25/34	133/08	19/23	146/33	Whole score

Table 2: attention deficit disorder average and standard deviation

SD	M	SD	M	ADHD
Past-test	Past-test	pretest	pretest	
13/35	90/33	13/35	79	programming
15/19	107/66	18/18	96/4	process
11/08	97/08	11/06	87	attention
8/62	93/08	10/38	88/83	Successive attention
14/96	85/50	16/72	73/33	Whole score

For studying difference between past-test and pretest scores and experimental usage effectiveness, we have calculated the difference between past-test and pretest scores and then we implemented dependent T test on amounts. The reason of dependent T test implementation on mentioned scores was because to determine experimental usage effectiveness at past-test and pretest scores. It means that experimental usage has created difference at past-test and pretest scores or not. Test results have been shown at table 3.

Table 3: dependent T test analysis for pretest and past-test of children who have learning disorder along with ADHD

P	df	T	Average standard deviation error	SD	M	
%002	9	-4/490	2/09	6/61	-9/40	pretest past-test ADHD
%32	11	1/02	10/35	35/88	10/58	pretest past-test LD
%22	9	1/318	16/15	51/09	21/30	pretest past-test LD and ADHD

According to table 3 because of computed T amount 4/490 at freedom degree 9 at pretest and past-test of ADHD scores this children group from T table 1/96 at meaningfulness level is bigger

than %05, so we conclude that difference between pretest and past-test is meaningful. According to scores of pretest and past-test of LD, computed T amount 1/02 at freedom degree 11 at T table 1/96 at meaningfulness level is smaller than %05, so we conclude that difference between pretest and past-test isn't meaningful. Also, we conclude that neurofeedback teaching wasn't effective on learning disorder of this students group. As you observe at table 3, at LD pretest and past-test along with ADHD, computed T amount 1/318 at freedom degree 9 at T table 1/96 at meaningfulness level is smaller than %05, so, there isn't meaningful difference between pretest and past-test scores of LD and ADHD.

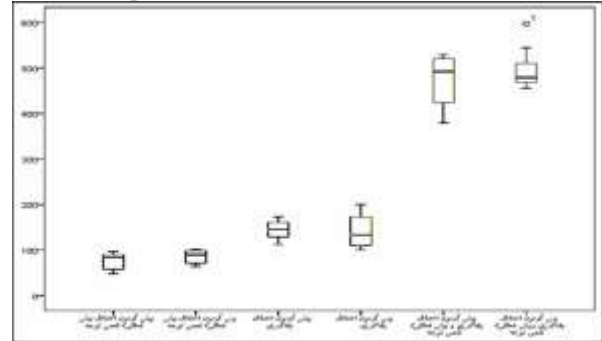


Diagram 1: Pretest and past-test scores of LD along with ADHD

Discussion and conclusion: The aim of present study is studying of neurofeedback effectiveness on learning disorder along with attention deficit. Gained results show that neurofeedback teaching will not improve learning disorder at this children group but it is effective on ADHD disorder. Present study is congruent with previous studies (Fax 2005, Joyce and Siver 2000 quoted by Demoo 2005, Fivesan 2011) and it points out that neurofeedback method as main feature of ADHD disorder therapy, it can decrease ADHD cognitive and behavioral symptoms during 13 weeks (40 sessions) of neurofeedback teaching that it was held around three time at week. At explanation of these findings, we can say that theta waves have relation with lack of concentration and attention, daydream and stress. Chabot (1999) says that neurofeedback with helping to waves regulation can improve ADHD symptoms. Luskio (2006) believes that at ADHD children, neurofeedback has capacity of these children brain waves normalization and it can improve children selective attention. Neurofeedback could improve children active selective attention but not passive attention that is related to work with computer. At explanation of this finding that neurofeedback hasn't effect on learning disorder with ADHD, theta band activity has been trespassed, it can be said that neurofeedback teaching has led to improve of theta waves activity but hasn't gained any success at alpha waves activity. So, according to this matter, theta band activity has been trespassed but alpha waves activity hasn't been increased. Gained documents of more than 300000 sessions show that neurofeedback is successful at %70 of items. According to specialists' opinions, even without experimental documents, again process that involves two important branches at conditioning psychology, agent learning and brain function neurology, it needs to be paid more by psychologists' society (Masterpaskowa, 2003). In addition to it, therapy with lower side effects is a case that always has been paid attention by therapists. At comparison with drug therapy, neurofeedback interference is learning without side effects and its non-invasive method that doesn't enter any input to brain. Also, at comparison with other therapies, gained positive results of this therapy will remain during time and there isn't any return to the past (Kuben 2007). For more permanent effect on learning disorder with ADHD, it needs to more permanent training sessions and durable exercises. Besira (2006) done study two years after neurofeedback training on children of 7 to 11 old year, he confessed that neurofeedback effects isn't temporary after it

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receiving but after longer time duration (after two years) it can improve symptoms. Even we can use this method on normal persons. As ^{††††††}Egner and Gruzelier (2001) found out that training of ^{*****}sensory motor rhythm (SMR) can improve perceptual sensitivity and decrease of reaction time and error. Increase of SMR amplitude, increase of sensory motor rhythm by neurofeedback will lead to improve perceptual sensitivity and decrease of reaction time error and incorrect declaration (^{§§§§§§}Vernon 2005). At present study, we should consider all limitations of social and human sciences but one of more eye-catching restriction was related to sample low number that generalization of these results are limited. One of another restriction was related to the lack of control group and placebo therapeutic group. This case is related to the first, sample restriction and second, ethical problems. So, we suggest that with ethical principles observance, another study with take ready of placebo group that provides better conclusion group especially if placebo groups are formed according to therapeutic groups. So, we suggest that continuous studies after neurofeedback receiving have been done so that we can study neurofeedback effect or lack of effect.

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^{††††††} Egner &Gruzelier
^{*****} Sensory motor rhythm (SMR)
^{§§§§§§} Vernon