



**International Journal of Biology, Pharmacy  
and Allied Sciences (IJBPAS)**

*'A Bridge Between Laboratory and Reader'*

[www.ijbpas.com](http://www.ijbpas.com)

---

---

**EVALUATION OF EFFECTS OF NEUROFEEDBACKINTERVENTION BASED ON  
QUANTITATIVE ELECTROENCEPHALOGRAPHY ON READING DISORDER  
SYMPTOMS IN CHILDREN AGE 7-12 YEARS OLD**

**ZAHRA JAHANGIRI<sup>1</sup>, HAMID YAGHOUBI<sup>2</sup>**

**1:** MA in Clinical Psychology, Department of Clinical Psychology, Faculty of Human Sciences,  
Shahed University of Tehran, Tehran, Iran.

**Associate professor, Department of Clinical Psychology, Faculty of Human Sciences,  
Shahed University of Tehran, Iran**

**\*Corresponding Author: E Mail: [jahangiri\\_65@yahoo.com](mailto:jahangiri_65@yahoo.com); Tel: +98 (21) 51210; Fax :+98  
(21) 51213564; Mob.: 0912 398 0488**

**ABSTRACT**

The aim of the present study is "Evaluation of effects of Neuro feedback intervention based on Quantitative Electroencephalography on Reading Disorder Symptoms in 7-12 children ".

Population include all children age 7-12 years old suffering from reading disorder and our sample includes 8 children with reading disorder problem which through an available sampling method (Patients of Neurofeedback therapy clinics) they were divided into experimental and control Group. Wechsler intelligence test results Showed that all participants, In terms of intelligence are within the normal range. Then Quantitative Electroencephalography was taken of all cases to determine the appropriate protocol for each person. Intervention protocol was adjusted according to symptoms decline for each participant. And the intervention was done in twenty sessions, one hour per session, for the members of this group. Before and after the intervention, "NAMA" test was taken to all participants. Before and after a period of one and half month, the test was taken in control group(With no intervention).

Results indicated that Neurofeedbackintervention is effective in reducing symptoms of Reading Disorder and it improves four skills, Reading words, word string, naming categories and non

---

words and Pseudo-words. The results also indicated that Neurofeedback intervention has no significant effect on improving skills such as phonetic skills, naming pictures and reading comprehension.

Neuro feedback intervention can be effective in improving some skills associated with reading disorder and has no significant effect in some other related skills.

**Keywords: Neurofeedback, reading disorder, Quantitative electroencephalography, reading skills.**

## INTRODUCTION

In many countries, more than half of exceptional students covered by special education [1] are suffering from learning disorder. Learning disorders in the DSM-V have been referred as neurodevelopmental disorders. Generally, Neurodevelopmental Disorders consists of a group of disorders that begin during growth. These disorders usually start in the early period of growth and often before children reach to school age and will be recognized with Developmental defects that cause problems in personal, social, academic, or occupational performance. The growth defects range from certain limitations in learning or controlling executive functions to fundamental problems in social skills or intelligence. Specific learning disability, as the name implies, it will be diagnosed once certain defects exist in a person capability to receive or process information correctly and efficiently.

Prevalence of specific learning disorder in the area of educational Reading, writing and

mathematics among children with different languages and cultures is 5 to 15 percent [2].

In Iran, Prevalence of reading disorder has been 25 percent in first grade male students and the lowest in the fifth grade girls (zero percent). Also the highest prevalence of reading disorder can be seen in the first grade of primary schools and in boys [3].

Reading Disorder is defined as: Condition that reading progress in terms of age, education, and Child's intelligence is lower than what is expected. This disorder is greatly impeding academic success or daily activities required reading [4]. Reading disorder characterized, Impairment of just reading words correctly, Speed of reading or fluency and reading comprehension disability [2]. Unlike language that grows spontaneously and develops during the growth, Reading is a skill that can be acquired at a later age by the effects of interventions. In this complex cognitive process, different skills are involved simultaneously, Such as Understanding the

distinction between letters and sounds, Communication between phonemes characters, Naming characters and their representations, Understanding the meaning of some written words in a sentence, Memory, Movement and the auditory and visual factors are parts of this Process. However, most researches attributed this disorder to Phonological awareness and knowledge and its relevant factors, but Valuable researches have been done about identification of the neurological and biological origin of this disorder and led to significant results [5].

Some researchers reported that PET photos of children and adults suffering from this disorder, during reading correct and incorrect words loudly (Words, non words), show that the left temporal cortex of the brain for these people are less active than people in control group. The researchers have found that the difference between brain processes of normal people and disordered people shows the defects in the left hemisphere of children and adults with reading disorder [6].

Another study was done by Rumsey and his colleagues in 1997; they used analysis of brain PET. In this study the brain function of normal and disordered participants were compared when they were reading (words and non words). The results showed that brain function of people suffer from this disorder

was decreased in the process of reading assignments, but this function was increased when normal people did those assignments. They concluded that an increase in brain function helps the accuracy and speed of reading in normal people, but the opposite happens in disordered people [7].

Research results on QEEG abnormality of individuals with reading disorder showed, these disorders were observed in 70% of individuals with reading disorder: 1) Dissonant connection between the combination of several areas: (P3, T3, T5, O1) More dissonant connections in areas P3, T3, T5, O1 of the left hemisphere compared to symmetrical areas of right hemisphere including P4, T4, T6, O2) Dissonant connections in the quarter-posterior left hemisphere (in the areas of T3, T5, P3, O1) compared to the same area in the right hemisphere. 4) Equal or more dissonant ratio (1 to 1.4) between the left and right hemisphere (in all areas). According to the results of this research, in 70% of cases, 1: At least 5 abnormalities that may include asymmetry, phase, and amplitude waves have been observed at the junction of the parietal-frontal lobes. 2: At least five abnormalities (which are related to the relative strength of the waves) can be observed in the P3. These findings reveal the importance of nervous

regulation of neurofeedback training for individuals with reading disorder [8].

Recently one of the reading disorder treatments has been proposed, EEG neurofeedback is based on Electroencephalogram. It looks like Neurofeedback intervention compared with conventional intervention reading disorder, is more effective. In a study by Thornton and Karmody (2005), Common types of intervention such as Orton-gillingham, Lindamood-Bell, Fast Forward treatments, were compared to QEEG activating disorder for reading and listening intervention and the results showed, intervention based on QEEG, has the greatest effect on those with a reading disorder. Results of this study show significant improvements in measures of verbal skills, attention and intelligence [9]. Some follow-up studies have shown that this method has sustainable impact on individuals that have been training [10].

although many studies report the effectiveness of neurofeedback intervention on reading disorder, some studies also showed no improvement in reading skills [11].

Broadly speaking limited research has been done about the effect of neurofeedback on reading disorder, most of the findings insist on the effectiveness of this type of intervention on reading disorder, but as we

mentioned above, due to the limited research resources in this area and some countercurrent results, further researches are needed to confirm the results. The hypothesis of this research is that, Neurofeedback treatment reduces symptoms in children age 7-12 with reading disorder.

## **METHODOLOGY**

Current study is Quasi-experimental study, therefore two groups of neuro feedback intervention group and the control group (without any intervention) was considered. The study sample consisted patients of 7-12 years old with reading disorder, who randomly within the timeframe of this study were referred to psychiatric clinics. Number of sample in this study was 4 people for each group. All subjects were referred and diagnosed by a psychiatrist or clinical psychologist. They used Wechsler test to recognize reading impaired individuals from suspected to mental retardation or borderline IQ individuals, and all participants had between 90 and 110 IQ. Subjects in the intervention group were treated with neurofeedback intervention for one and half months (20 sessions of therapy). During this period, subjects in the control group did not receive any systematic intervention. Then, for the treatment of subjects who were in neurofeedback group, Quantitative

Electroencephalography QEEG was taken to determine the treatment protocol of each person. In these protocols the goal is to reduce the symptoms of learning disabilities and reading disorder according to each person's symptoms. At the beginning of the research, Dyslexia Reading Test was conducted for both groups and also after a month and a half, The "B" form of the same test (Parallel form) was applied for them.

**Research Tools**

In this study the Wechsler intelligence tests and diagnostic tests of reading and dyslexia "NAMA" are used.

The Wechsler intelligence test (WISC-R): A scale to measure the intelligence of children. This test has twelve original subscales, each of them measure a special ability. After the raw scores for each subscale were calculated according to the manual test, regarding the

soft tables, we calculate the scaled score for each subscale. Total IQ score is obtained by the sum of high marks and converting it into a scaled score T. Scaled score can be compared to other peers by reference to the IQ table. Reliability of Wechsler intelligence test-retest is 0.9 and in academic operational forecasting is valid by coefficient of 0.5.

Reading and Dyslexia Test "NAMA": This test was published by koromiNouri&Moradi entitled "Reading and Dyslexia Test (NAMA)". The tests performed to diagnose dyslexia. "NAMA" consists of ten subtests [12]. In this study according to Woodcock,1987; stanovich,1994; Olson,1990; Baddeley et al, 1984, different subscales were used to measure the various skills of reading [13,14,15,16]. The description is given in **Figure A**:

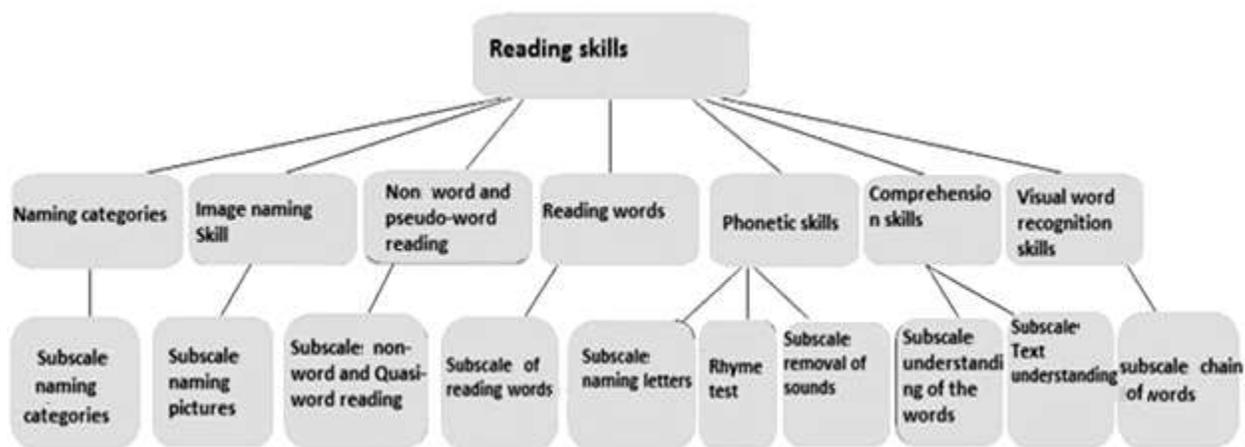


Figure A - Matching skills and NAMA test subscales

For scoring the test, by using manual test raw scores are calculated for each subscale. Then by referring to the booklet, Standardized scores of each raw score will be obtained. The obtained standardized scores such as Cognitive and IQ test include a mean of 100 and a standard deviation of 15. By comparing the scores with their peers we can understand child's reading situation. At the end, intervention protocols configured on each of the neurofeedback group of subjects were as follows:

Participant number one: Training in the area of Cz, Fz (5 sessions), beta training in the area of P3, C3 / C4 (15 sessions), to reduce severe symptoms of learning disabilities, reading disorder, aggression and anxiety.

Participant number two: training in the area of F3-FP1 (12-15 Hz and 12-14 Hz), training in the area of Fz, Pz (10-12 Hz and 20 28 Hz) during the first ten sessions and Training Oz, F3 / FP1 and P3 / T5 and Fz / Pz in the second ten sessions, to reduce the symptoms of learning, reading disorder, low self-esteem, improve visual memory and visual attention (Due to a malfunction of visual memory and visual acuity).

Participant number three: Training Cz (12-15 Hz) and reduction (1-8 and 17-30 Hz), Oz (8-11) / Fz (14-17 Hz) and C3 / C4 (12-15 Hz). To reduce the symptoms of decentralization,

low reading and writing skills, poor visual accuracy and low self-esteem.

Participant number four: Training Cz (12-15 Hz) / Fz and C3 / C4. To reduce the symptoms of learning disabilities, reading disorders and anxiety reduction.

## RESULTS

Due to the fact that number of participants in this study was four people per group and bearing in mind that this method of sampling was available, to analyze the statistical results, U - Mann - Whitney technique was used to compare groups and control Neurofeedback [17]. The result of the comparison between the two groups before and after intervention for each subscale is summarized In **Table 1**.

Test data from U - Mann – Whitney showed, for sub-scale reading words, the difference between pretest and posttest scores of the experimental group and the control group in the alpha 0.02 critical values were significant and neurofeedback intervention effectiveness was confirmed by increasing the reading words. Also, the difference between pre and post test scores of the experimental group and the control group for sub-scale of chains words is meaningful in critical values of alpha 0.01. So it can be said that neurofeedback intervention has statistically significant effect on visual word recognition skills. Also

Results for sub-scale of Nonword reading and sub-scale of psuedo-words reading and subscales of naming categories are significant in critical values of Alpha 0.04, and effectiveness of neurofeedback intervention on increasing reading words, psuedo-words and naming categories skills were confirmed. Furthermore, the results of the U - Mann-Whitney test was not significant for subscales of sound removal, naming letters and rhymes test so the effectiveness of neurofeedback intervention to increase phonetic skills, was

rejected. Also the results were not significant for subscale of pictures naming and the effectiveness of neurofeedback intervention to increase the skills of naming pictures was rejected. At the end the results showed, the U - Mann - Whitney test for sub-scale of understanding a text and understanding of the words, was not significant in critical values of 0.7 and 0.1alpha,so the effectiveness of the intervention on increasing reading comprehension skills were also rejected.

**Table 1: Comparison of pre- and post-intervention scores for each subscale**

Significance level	Z	Average rating	Overall Rating	Index Group	Name of subscales
0/02	-2/32	6/5	26	Test	reading words
		2/5	10	control	
0/01	-2/35	6/50	26	Test	words Chain
		2/50	10	control	
0/2	-1/17	5/40	22	Test	Rhyme Test
		3/50	14	control	
0/1	-1/44	5/75	23	Test	Removeing sounds
		3/25	13	control	
0/5	-0/58	5	20	Test	word sign test
		4	16	control	
0/1	-1/46	5/75	23	Test	Naming Pictures
		3/25	14	control	
0/7	-0/29	4/75	19	Test	Understanding the text
		4/25	17	control	
0/1	-1/59	5/88	23/50	Test	Understanding the words
		3/13	12/50	control	
0/04	-2/04	6/25	25	Test	reading non-words
		2/75	11	control	
0/04	-2/02	6/25	25	Test	sign category test
		2/75	11	control	

---

**DISCUSSION**

Available data indicate that 25% of children with impaired reading are suffering from ADHD simultaneously. On the other hand, it is estimated that 15 to 30 percent of children with ADHD have a learning disorder [4]. Because of the correlation between reading disorder and other disorders like attention deficit / hyperactivity disorder, finding a patient that only and only has reading disorder is difficult and almost impossible. For this reason, Due to simultaneous symptoms of attention deficit symptoms in these patients, the protocol to reduce the symptoms of inattention, for children with reading disorder is usually placed on the agenda. Furthermore, it should be emphasized, this disorder itself also causes other secondary symptoms such as anxiety and loss of confidence in the children, so the proposed intervention protocol is to reduce these symptoms too. It should also be mentioned that reading is a complex task. Different areas of the brain are active when it comes to the various assignments. Many of the findings show the major role that anterior labyrinth of temporal (Around the point T3) plays in reading fluency, and it mentioned some damage in this area of the brain in people who are suffering from reading disorder. Beta-2 activity (15 to 18 Hz) indicates that this

region is important in the process of reading. In simple learning tasks, Beta-2 is rarely active in this area. If the level of task difficulty increases levels of beta-2 activity in this area increases. If high levels of task difficulty increases very much, this area will no longer be active and Beta-2 activity stops. Through training this area of the brain to function normally, reading skills will be strengthened (it means that under normal conditions, be suppressed and in simple task of reading, be active and its activity increases by level of task difficulty). Higher wavelengths of beta (21-30 Hz) tend to be disrupted and cause the symptoms of anxiety, and must be suppressed [18]. According to this study, when in different assignments and when the difficulty level of them is different, we can say different frequencies and areas are working. Therefore to reform the pattern of EEG and improve all reading skills: it is needed to, first, several studies should be done on the correlation of the number and frequency of these skills in different areas of the brain and then to improve each of the skills, protocols should be implemented for authorities. Due to this fact, the results of this study would be justified. In this study, because of the focus of intervention on overall reading skills and reducing patients' symptoms were more prominent; In general,

the main hypothesis has been confirmed and neurofeedback intervention was effective to reduce the reading disorder symptoms. Whereas in other reading skills according to researches that include other areas of the brain, intervention effects was not significant and no improvement in other areas, including Phonetic skills, comprehension and naming pictures have been observed.

According to the study by Arns *et al.*, it seems like reading words skill is more associated with (C3, C4, FC3, FC4, T3, and T4) areas [19]. In this study, for three of the four subjects, at least 5-10 sessions have been worked on C3 / C4. Therefore according to correlation between these points in reading words we can say, the observed improvements in reading words is justifiable and it's in accordance with the results of the study by arns et al.

The purpose of **visual word recognition skills** is that the individual should detect words without any hesitation or further analysis when he/she observes them. According to the researches prepared in this area, this process is in connection with Headrest lobe areas, especially O1. Considering that the interventions which were carried out for patients participating in this study, the focus were set on this point and the tuning frequency associated with it, therefore

it is justifiable and expected that improving the ability is associated with this point.

- As mentioned earlier, **Phonetic skills**, is another skill that was examined in this study. Phonetic is a word recognition strategy in which the reader try to match the sounds with the letters or a combination of written letters [14]. Knowledge of the sound system is the prelude to learning sounds. To "decode" or establish a relationship between speech sounds and letters printed by the Child we should understand that speech can be divided into phonemic units; these units are shown in the form of printed words [20]. Accomplished researches show F7 activity in phonetic tasks [21]. The study by Cao et al using the pattern of brain activity showed that there is no difference in the activities of brain areas between the normal and reading disordered group during simple task of writing the words that have similar sounds. However, in hard assignments, less activity was seen in lateral frontal labyrinth, Spindle shaped labyrinth and middle labyrinth of temporal in the left hemisphere that is connected with phonetic & dictation skills. [22]. Also in the study by arns et al, the results showed, children with reading disorder demonstrated delays in subscales of naming letters and phonetic awareness . That seems to be associated with frontal-cerebellar phonetic system [19]. These

findings are in line with Eckart et al theory. According to this theory Frontal-cerebellar system plays an important role in people with reading disorder. Eckart believes that the E-frontal and cerebellar circuit are associated with fast and automatic labeling and phonetic processing. He proposed to study about the correlation between phonetic and spelling problems and EEG data [19]. According to the study above it seems that Alpha and Beta swinging in (T4, F4, C4) of the right hemisphere and T3, FC3 of left hemisphere are related to the phonetic skills. Due to the interventions focused on areas related to reading such as C3 / C4, p3, O1 of the left hemisphere for the patients, therefore, the effect of intervention on phonetic skills that was calculated by removal of sound sub-scale, rhyme and sign word sub-scales, and based on earlier researches of frontal-cerebellar system and fluctuations in the alpha and beta waves in (T4, F4, C4) of the right hemisphere was not significant.

**Naming pictures skills** are related to person's ability to visual distinction and visual memory. According to the study of Arns et al, It seems that the delta and theta same oscillations in the frontal / middle temporal lobe and same oscillating in alpha and beta wave in the FC4, C4, CP4, and T4 are involved in fast naming of letters [19].

But we need more research to see whether we can generalize the results to naming image skill or not. On the other hand, more examination on the results of the visual word recognition skills which were measured by chain of words sub-scale and the intervention effect was demonstrated on that, perhaps we can say this intervention had no specific effect on improving their visual memory.

**Comprehension skills:** by comprehension skills we mean the ability to receive the meaning from printed text; this is a main problem for lots of students with learning disorder. This ability won't develop by word recognition skills spontaneously [23]. It should be noted that comprehension is depended on reader's knowledge. Comprehension is depended on printed text descriptions as well as experience, language knowledge, and recognition of the compound structure of a sentence [24]. The studies illustrated that, 16- 18 Hz increase in T3 (left hemisphere temporal area), is effective to increase reading speed and comprehension [18]. The results of present study showed, neurofeedback intervention has no significant effect on reading comprehension skill and are not similar to the results of the study mentioned before. Since the reader's comprehension is depended to reader's knowledge, it's expected that to

improve reading comprehension in children suffering from reading disorder, modifying the abnormal pattern of EEG, and other strategies that help children to improve their knowledge level are effective. Therefore neurofeedback is an intervention that affects individuals' abnormality of EEG pattern not on the level of knowledge.

#### **Non word and pseudo-words reading skills:**

So far, a few studies were done about the relationship between reading pseudo-words and non words with different areas of the brain. The study by Georgiewaand et al have shown that, individuals with reading disorder while reading pseudo-word and non words, have less activity in the spindle shaped labyrinth [25]. In the present study, neurofeedback intervention resulted in significant effects on reading pseudo-words and non words, it seems that this activity like reading words activity is related to the main areas of readingsuch as (c3 / c4, p3 / o1 / oz). Since a few researches were done in this area, more information is needed about the different areas dependence to the different reading skills to explain results better.

**Naming categories skill:** This is directly linked to the ability to recall and memory of people. In arns et al study, significant differences were observed between normal people and patients with reading disorder in

scores obtained from memory and recalling test. These findings clearly show that, these individuals remember fewer words in memory test [19]. The study also shows that neurofeedback intervention had a significant effect on naming categories skill.

**Limitations and suggestions:** Considering that areas of reading and reading disorder is related to the culture, language and curriculum more than any other area, so one of the limitations was felt strongly in process of the study was limited tests of reading and dyslexia diagnosis, that these few number of tests were not scientifically valid and appropriate or were in a very limited age range. Regarding the framework of scientific research, it was better to use single protocol for all patients to study the effects of neurofeedback intervention on a particular disorder, but considering the ethical issues and the fact that all patients in the study were volunteers in neurofeedback therapy clinics, using a single protocol was nearly impossible and contrary to morality.

#### **REFERENCES**

[1] National Center for Learning Disabilities. Language characteristics and schooling in the united states: A changing picture, 1979-1989. U. S. A. Department of education, office of Educational research and improvement;

- 2002.
- [2] Diagnostic and Statistical Manual of Mental Disorder Fifth Edition (DSM-V), American Psychiatric Association;2013.
- [3] Leyla Sedaghati, Forough Roghaye,Shafiqe Bijan, Merasi Mohammad Reza, Prevalence of dyslexia in the normal school students 1st to 5th grade, Esfahan, *Audiology* 1389; Volume 19, Number 1, 8-1.
- [4] Kaplan, Harold; Sadvok, Benjamin (2007). *Summary of Psychiatry*, translated RezaiFarzin. (1388), Tehran, Arjomand publication.
- [5] Ahmadpanah Muhammad, PakadanayaPrakash. *Dyslexia: A review of recent research in the field study gifted children*. 1386, Year VII, No. 3, 337-352.
- [6] Brunswich , N , Mccrory , E , Price , C , j: Frith , U , ( 1999 ) , *Explicit and Implicit processing of words and pseudowords by adults developmental dyslexia: A search for wemicke'swortschatz?* *Brain* , 122 , 1901-17.
- [7] Rumsey, J.M and Donohue, B.C (1997). A magnetic resonance imaging study of planumtemporale asymmetry in men with developmental dyslexia. *Archives of Neurology* , 54, 1345-7.
- [8] Evans , James R ; Park , Nan-sook (1996). *Quantative EEG Abnormalities in a sample of Dyslexic Persons* .*journal of Snowling, M. J (2000). Dyslexia (2nd education )* . Blackwell publishers . Oxford. UK.
- [9] Thornton,E.kirtley; Cormody,Dennis P.(2005). *Electro Encephalogram Biofeedback for Reading disability and Traumatic brain injury*. *Child Andadolscenpsychiatric clinics of north America* 137-162.
- [10] Beccera,J; Fernandez, T; Harmony, T; Caballero M.I; Garcia F; Fernandez, A ; Santiago-Rodriguez, E ; Prado-alacala, R.A . (2006). *Followup study pf learning disabled children treated with neurofeedback or placebo*. *Clinical EEG and neuroscience*; jul ; 37,3; proguest health and medical compeletpg 198.
- [11] Marinus , H ; Breteler , M ; Arns ,

- Martijn ; Peters , Sylvia ; Giepman , Ine ; Verhoeven , Ludo (2010) . Improvements in spelling after QEEG – based Neurofeedback in Dyslexia : A randomized Controlled Treatment Study. *App 1 Psychophysiol Biofeedback* 35: 5-11.
- [12] NouriKarami, Reza Moradi, Alireza (1387), Reading and Dyslexia Test (NAMA), Publication of Jahad, teacher training unit, Tehran.
- [13] Wood, F.B (2000).SurprisesAhead: the new decade of Dyslexia , Neurogenetics and education. Keynote lecture 51st Annual conference international Dyslexia Association, Washington DC.Nov, 8-11.
- [14] Stanovich, K.(1993). The construct validity of discrepancy definitions of reading disabilities. In G.R.Lyon, D.Gray, J. Kavanagh, & N. Krasnegor (Eds.), *Better understanding learning disabilities* ( pp.273-307). Baltimore: Paul brookes.
- [15] Olson, R.K, Forsberg, H ,Wise, B and Rack , J (1994 ). Measurment of word recognition , orthographic and phonological skills in G. R Lyon( ed ), *forms of reference for the assessment of learning disabilities: new views on measurement issues*, Baltimore,MD: paul H ,brooks publishing co , 243-77.
- [16] Baddeley, A. D., Lewis, V. J., &Valler, G.(1984). Exploring the articulatory loop. *Quarterly Journal of Experimental Psychology*, 36,233-252.
- [17] Bhattacharya, Gori and Johnson, Richard (1379). *Concepts and statistical methods*.MA Translation Shahrashub and Mohsen.Michaeli, Tehran: Central University Press.
- [18] Walker, Jonathan E ; Norman , Charles A. (2006) .The Neurophysiology of Dyslexia : Aselective Review with Implications for neurofeedback remediation and results of Treatment in Twelve Consecutive Patients.*Journal of Neurotherapy*,Vol 10 (1).
- [19] Arns ,Martijn ; Peters , Sylvia ; Breteler , Rien ; Verhoeven , Ledo (2007) . Different Brain activation patterns in Dyslexic children : Evidence from EEG power and coherence patterns for the Double – Deficit Theory of Dyslexia . *Journal of Integrative Neurosciense* ,Vol .6 , no. 1, 175 -190.
- [20] Lerner, Janet (1997). *Theories of learning disabilities, Diagnosis of teaching strategies*, Translation of EsmatDanesh (1384).Tehran, and the capital of publishing

- Shahid Beheshti University.
- [21] Walker, Jonathan E ; Norman , Charles A. (2006) .The Neurophysiology of Dyslexia : Aselective Review with Implications for neurofeedback remediation and results of Treatment in Twelve Consecutive Patients.Journal of Neurotherapy,Vol 10 (1).
- [22] Cao Fan , BitanTali, Chou Tai-li,Burman Douglas D., Booth James R.,(2006), Deficient orthographic and phonological representations in children with dyslexia by brain activation patterns, J child psychol psychiatry,47 (10): 1041-1050.
- [23] Richek , M. ,Caldwell ,J., Jennings ,J.,& Lerner, J. (1996). Reading problems : Assessment and teaching strategies. Needham Heights, MA: Allyn & Bacon.
- [24] Lipson , M.,&Wixson , B.(1991). Assessment of instruction of reading disabilities: An interactive approach. New York: HarperCollins.
- [25] Georgiewa P, Rzanny R, Gaser C, Gerhard UJ, Vieweg U, et al. 2002. Phonological processingin dyslexic children: a study combining functional imaging and event related potentials.*Neurosci. Lett.* 318:5–8
- [26] BlachmanB. (1994).What have we learned from longitudinal studies of phonological processing and reading? Some unanswered questions: A response to Torgesen,Wagner,&Rashott. Journal of learning Disabilities, 27, 287-291.
- [27] Carmody, D. P., Radvansik, D.C., Wadhwani, S., Sabo, M. J., &Vergara, L. (2001) EEG biofeedback trainingand attention –deficit/ hyperactivity disorder in anelementary school setting. Journal of Neurotherapy, 4(3),5-27.
- [28] Harmony Thalia, Marosi Erzsebet, Becker Jacueline, Rodringuez Mario ,Reyes Alfonandez Thalia, SilvaJuan, Bernel Jorge,(1995), Longitudinal quantitative EEG study of children whit different performances on a reading-writing test , electro