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Effect of Visual Tracking Intervention on Attention and Behavior of Attention Deficit Hyper Activity Children

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Abstract: Attention Deficit-Hyperactivity Disorder (ADHD) is one of the most common psychiatric disorders. In the United States the incidence of the disorder has been reported from 2-7% and Prevalence of the disorder among Iranian children have been reported between 3 and 6%. In a study on the function of the frontal lobe and its relationship with eye movements showed that children with attention deficit-hyperactivity disorder have special problems in inhibition and control eye movements. In this study eye tracking intervention is used for improvement of sustain attention of attention deficit hyper activity children. The 39 boys with ages between 6-10 years are randomly selected. After that they are matched in terms of intelligence with Wechsler test, they divided into experimental and control group. Both groups use of similar occupational therapy treatment but experimental group also use eye tracking exercises both group evaluated with Conner's rating scale (parent questionnaire), Continuous Performance Task (CPT-II) and Test of Visual- Motor Skills-Revised (TVMS-R) in pre and post-test. There was a significant difference in mean scores of cognitive problems (F = 9/22), coping behavior (F = 6.03) and hyperactivity (F = 9.77) between the two groups in the post-test ($p<0.05$) and in the continuous performance test scores, omission error (F = 17.89), commission errors (F = 19.45) and reaction time (F = 8.95) has been significant difference between control and experimental groups. In other words, educating pattern based on eye movement tracking improved continuous performance test and Conner's rating scale result significantly at post-test. Based on the results of this study, it seems that

intervention based on eye movement tracking lead to changes in levels of behavior. So, exercises that reinforce the eye movement pattern cause to improvement of cognitive function and behavioral aspect of this children.

INTRODUCTION

During recent year's attention deficit-hyperactivity disorder considered to be a disorder with particular symptoms such as general signs of hyperactivity, impulsivity and inattention. Attention deficit-hyperactivity pattern of inattention, hyperactivity and impulsive behavior is more and more common than is usually seen in children with similar growth level (Rief, 2008; Barkley, 1997). The disorder almost seen 4% in school-age children. This disorder causes damage in normal functions such as academic success, behavior at school, interaction with parents, siblings and peers (Barkley, 1997). Motor problems in children with attention deficit disorder-hyperactivity disorder due to cerebellar and frontostraital dysfunction has approved. As the motor system, oculomotor system of these children are also deficient in areas of the brain including the basal ganglia, thalamus, cerebellum, brainstem, reticular formation and upper calculus. Oculomotor system called as a mediator between the motor and cognitive function (Ceigh and Zee, 2006). The importance of this study is because the areas which are under the control of oculomotor movements are impaired in children with ADHD. Because of it children with this disorder are in troublein the saccadic movements and in the control of eye movements. The oculomotor disorders in children, leading to lower processing speed, less automatic skills and also more effort in doing the chores (Mahone, 2011). The aim of this study is whether the use of this type of intervention, leads to behavioral changes in children with attention deficit-hyperactivity?

MATERIALS AND METHODS

The 39 children 6-10 year-old boy, according to DSM-IV criteria for ADHD diagnosis were selected. The disorder diagnosis by a pediatrician and children with a history of other psychiatric disorders such as bipolar disorder, pervasive developmental disorders or mental retardation were excluded from this study. Children's IQ was assessed by the Wechsler intelligence scale. Children were assessed by the Wechsler intelligence test, then Conner's rating scale questionnaire was completed by parents and also children evaluated by the Continuous Performance Test (CPT-II) and also Test the Visual-Motor Skills (TVMS).

Wechsler intelligence test: Intelligence scale for children was revised in 1972. This scale measures the intelligence of children ages 6-16 years, 11 months and 30 days. This scale consists of 12 subtests. tests of verbal skills of children is include in public information, comprehension, calculation, analogies, vocabulary and numbers memory And practical scale tests of children is include in completing the photos, adjust images, cube design, assembly, encoding (the equivalent numeric codes in adults) and Mazz.

Continuous performance test: Continuous performance test drive the target randomly appear on the screen and the child must press certain keys as soon as the target stimulus appears. At the first examiner shows the response key and stimulator to child. Omission and commission error and reaction time is major variable of this test. This test also measures variable such as preservation, detectability and hit rate error. Persian version of this test has a reliability factor is the 53/0-93/0.

Revision of visual-motor skills test: Revision of visual-motor skills test were revised by Gardner and Morrison in the United States of America in 1995 that are no dependent on race, sex, culture and geographical location in this test and as a means of determining the impairment of eye-hand coordination, identification of children with disorders in visual-motor is used and also can document the progress of children, especially in fine motor skills, visual skills-motor in aged between 3-14 years old (Brown and Unsworth, 2009). The test made up from 23 Geometric design and each of these 23 projects are on a one page and asked the child to drawing and modeling of these designs. Psychometric evaluation of test done by Farahbod and Minaee. And test the consistency factor 99/0 and reliability of the test is 94/0 the validity of the total test is 99/0. The results of reliability and validity, reliability enough to use it in the context of the assessment of visual-motor skills of children of Tehran (Farahbod and Minaee, 2004).

Procedural: Boys with attention deficit hyperactivity diagnosis with psychiatric were referred to the researcher. Researchers explain the purpose and method of study to parents. They completed consent form, a demographic questionnaire and a Connors questionnaire the child examined with Wechsler intelligence test and visual motor skills test and then CPT-II was done. It should be noted that to avoid any bias during tests, Wechsler intelligence test assessment, continuous performance test and visual motor skills test was conducted by a Master of Psychology at the Institute of Cognitive Sciences. Then, the subject individually was treated in room in Roshd occupational therapy clinic. The room was quiet and have

a good ventilation conditions, temperature and atmosphere. Subjects for 5 weeks 2 sessions per week for 45 min used eye tracking intervention. Then for the second time, Connors parent questionnaire was completed by family as well as continuous performance test and test of visual-motor skills of were done again.

RESULTS

The 7/48 of the sample (n = 19) were in the control group and 3.51% (n = 20) were in the experimental group. The mean (SD) age in the control group 37/7 (and 01/1) and the experimental group 05/7 (and 82.0).

As shown in Table 1 is an average (and standard deviation) of attention deficit hyperactivity disorder in the experimental group pre-test score of 37.90 (or 5.72) and the control group is 36.42 (or 6.78) and also mean (SD) total score of attention deficit hyperactivity test in the test group 22.70 (or 6.46) and the control group is the 33.47 (10.76).

As seen in Table 2, the mean difference of all sub scales of continuous performance test in the experimental and control groups is evident in the post-test, so in the experiment group the mean average of detectability in post-test is more than pre-test. Also in the test group average omission error, commission errors, reaction time, flexibility and preservation in the post-test is less than the pre-test (Table 3).

Before using parametric tests MANCOVA to comply with its assumptions and Levene and boxes tests were used. Based on the box test to post-test (p = 0.66, F = 0.69, box = 4.68) which was not significant for any of the variables. Homogeneity of variance-covariance matrices are properly observed. According to Levene test also can be seen in Table 4 for post-test and non-significant for all variables, the condition of equality of variance between groups is respected. So do multivariate analysis of covariance is permitted results MANCOVA on attention deficit hyperactivity disorder component scores in both experimental and control groups at post-test shows significant levels of usability tests allows Mancova test for variables. Wilks Lambda indicates that there are significant differences at least one of the dependent variables in post-test ($p<0.01$-F = 5.82) also η^2 shows significant differences between the two groups and the amount of the difference in the post-test based on Wilks lambda test is 35%. It means that 35% of the variance of the difference between the two groups is due to the interaction of the dependent variables.

As the results in Table 5 shows the effect of the control of pre-test effect, between the experimental and control groups in terms of post-test mean scores related to cognitive problems (F = 9.22), coping behavior (F = 6.03) and hyperactivity (F = 9.77) between the experimental and control groups there is a significant difference ($p<0.05$). In other words eye movement's intervention skills caused to cognitive problems, coping behavior and hyperactivity in children with ADHD was significantly improved at post-test. Before using MANCOVA parametric tests to comply with its assumptions Levene and boxes test were used. Based on the box test in the post-test (P-29, F-1.15, box 30.58) was not significant for any of the variables homogeneity of variance matrix/covariance is properly observed According to Levene test to post-test and non-significancy for all variables, the condition of equality between group variance is observed. So do multivariate analysis of covariance is permitted the results of MANCOVA on the components of continuous performance test scores in both experimental and control groups at post-test showed that significant levels of all test, so, it allows the using of MANCOVA.

Table 1: The mean and standard deviation of attention deficit hyperactivity disorder components in pre-test and post-test parent Connors questionnaire

	Experiment groups		Control groups	
Characteristics	M	SD	M	SD
Cognitive problems				
Pre-test	16/00	1/75	15/05	1/81
Post-test	10/10	2/75	12/48	3/13
Coping behavior				
Pre-test	10/25	2/95	9/31	3/93
Post-test	5/70	2/08	9/79	6/71
Hyper activity				
Pre-test	11/65	3/92	12/05	5/01
Post-test	6/90	3/90	10/84	4/13
Overall				
Pre-test	37/90	5/72	36/42	6/78
Post-test	22/70	6/64	33/47	10/67

Table 2: The mean and standard deviation of the pre-test and post-test of continues performance test

	Experiment groups		Control groups	
Characteristics	M	SD	M	SD
Detectability				
Pre-test	0/14	0/26	0/22	0/26
Post-test	0/34	0/21	0/24	0/18
Omission error				
Pre-test	35/70	22/85	41/42	22/79
Post-test	14/45	11/06	35/00	23/03
Commission error				
Pre-test	28/60	8/59	25/85	5/33
Post-test	19/35	5/01	23/68	5/11
Reaction time				
Pre-test	600/99	193/43	600/98	224/28
Post-test	400/22	105/49	600/07	238/56
Variability				
Pre-test	40/39	24/32	25/11	23/56
Post-test	17/88	10/25	22/77	24/24
Preservation				
Pre-test	30/50	18/35	17/95	9/96
Post-test	11/56	8/62	15/95	9/32

Table 3: Mean and standard deviation of visual motor skills in pre-test and post-test

	Experiment group		Control group	
Skills	M	SD	M	SD
Pre-test	95/26	9/16	95/22	9/33
Post-test	114/9	10/25	97/11	9/67

Table 4: Results of Levine test for equality of variances of the two groups in the scores of attention deficit hyper activity in post-test

Characteristics	F-values	Significance level degree of freedom	The second	The first degree of freedom
Cognitive problem	0/002	0/97	37	1
Coping behavior	Mar-43	0/07	37	1
Hyper activity	0/087	0/77	37	1

Table 5: Summary results of analysis of covariance to the effect on eye movement's intervention to reduce symptom characteristic of ADHD boys

Characteristics	Source change	SS	df	F	p-values	η^2
Cognitive problem	Group	66/41	1	9/22**	0/01	0/21
Coping behavior	Group	130/64	1	6/03*	0/05	0/15
Hyper activity	Group	111/39	1	9/77**	0/01	0/22

***, **, *p<0/001, 0/01,0/05

Table 6: Summary results of covariance analysis on the effects of education on improving the visual patterns of continuous performance test components boys with ADHD

Characteristics	Source change	SS	df	MS	F-values	p-values	η^2
Detectability	Group	0/162	1	0/162	5/68*	0/05	0/15
Omission error	Group	1908/36	1	1908/36	17/89***	0/001	0/37
Commission error	Group	300/81	1	300/81	19/45***	0/001	0/39
Reaction time	Group	199638/66	1	199638/66	8/95**	0/01	0/22
Variability	Group	1047/58	1	1047/58	7/07*	0/05	0/19
Preservation	Group	324/32	1	324/32	6/33*	0/05	0/17

***, **, *p<0/001, 0/01,0/05

Table 7: Levene test for homogeneity of variance default results in the two groups on tests of visual motor skills at post-test

Characteristics	F	The first degree of freedom	The second degree of freedom	Significance level
Total score	2/35	1	37	0/13

Table 8: Summarizes the results of covariance analysis on the effects of education on improving the visual patterns of visual -motor skills test in boys with ADHD

Characteristics	Source	SS	df	MS	F	p-values	η^2
Total score	Group	1949/55	1	1949/55	40/52	0/001	0/53
	Error	17/31/92	36	48/11			

As the results in Table 6 shows that despite controlling the effect of pre-test , the experimental group and the control group in post-test, the average score detectability (F = 5.68), omission error (F = 17.89) and commission errors (F = 19.45), reaction time (F = 8.95), variability (F = 7.07) and preservation F = 6.33) control test, there are significant differences between the two groups ($p<0.05$). In other words, the training component of the visual patterns continuous performance test in ADHD significantly improved at post-test.

Based on Table7 in post-test and significance of visual motor skills for the total score, the homogeneity of variances is observed. So, MANCOVA is permitted.

As Table 8 shows there is a significant difference in the results between of the two groups ($p<0.001$). $\chi\eta = 0.53$ that shows the big effect size. In other words, teaching visual patterns improve visual motor skills had significantly been effective, in boys with ADHD.

DISCUSSION

Modifying first anti-saccadic movements in children with ADHD influence on their cognitive ability (Faraone *et al*., 2002) and reduce symptoms of hyperactivity and response inhibition in these children that this effect is similar to the effects of methylphenidate. According to Rambles studies, improvement and control of unwanted saccadic eye movement caused to decreasing the hyper activity and inhibition of response in this children and due to the fact that in this study the use of practices that lead to decreasing and inhibition of unwanted saccadic eye movement It seems that the hypothesis of visual tracking interventions on behavioral symptoms according to parents Conner questioners is confirmed. Driscoll study suggests that abnormalities in eye movements inhibition, leading to impulsivity and hyperactivity in children with hyperactivity-inattention disorder. Regarding to the relationship between the prefrontal cortex and the oculomotor system and also with reaction inhibition in this area. It seems that because use of oculomotor exercises involve similar brain regions may lead to reduce hyperactive behavior. The role of frontal cortex to synthesize and integrate the data for significant processes and behavior patterns have been proven. And given that children with attention deficit-hyperactivity dysfunction in the frontal regions such as the prefrontal cortex, especially, dorsolateral prefrontal cortex. And

since, the same neural circuits for controlling eye movements it seems that the use of visual tracking interventions could lead to the behavioral changes in children with ADHD.

Integration of visual and motor systems is the main factor in performance capabilities, such as drawing and writing-as basic skills education curriculum concepts for this reason behavioral researcher use Strategies to identify, eliminate or reduce problems in the field of visual-motor skills of children with specific learning disability.

Visual motor skills do the task of coordinating and accommodating visual processing skills, fine motor skills and hand -eye coordination. According to the Shymn and Russ (Myles, 2007). Visual information processing skills are divided into three groups:

- Visual spatial skills
- Visual spatial skills
- Visual-motor skills or visual-motor integration

Since, the development of these skills dependent to each other, therefore, the visual motor skills should also be considered and also the eye fixation which includes the ability to keep the eyeball, focus on form and ability in attention to detail plays an important role in the development and proper functioning in visual motor skills. When the object is to draw our attention, we reflect and we move uncontrollably and his eyes to the fascinating object. According to an object if it causes ejection eye movements, eventually leading to greater and greater response in the parietal cortex area of the brain. So, it seems that there is a close relationship between eye movements and attention (Munoz *et al*., 2006) at Princeton University Area.

CONCLUSION

Frontal cortex of the brain as visual field studies and found that stimulation of this area causes physiological and behavioral effects on attention. Other researchers have found similar results these results led us to the hypothesis thatt attention and eye movement works as coordinate. According to the results of this study, it seems using visual tracking interventions can be used as a complementary method. According to the theories of visual tracking and considerable evidence that provides complete visual-motor skills and visual tracking skills are reinforced at all levels is required to have behavioral functions.

The findings showed that using a rehabilitation program based on visual- motor trackingare a good way to improvement of visual patterns.

LIMITATIONS

Unavailability of qualified; Clients Lack of similar interventions and the irregular clients sometimes lead to an end to the intervention (pause a week).

SUGGESTION

Study in a larger population; Longer duration of treatment in the ADHD group; Studies reinforce the visual patterns in other psychiatric disorders in children such as autism, learning difficulties, etc. More specific visual tracking exercises.

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