



# Effectiveness of a Visual Attention Training Program on the Reduction of ADHD Symptoms in Preschool Children at Risk for ADHD in Isfahan: A Pilot Study

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## Abstract

**Background:** Attention deficit hyperactivity disorder (ADHD) symptoms are difficult to treat. As ADHD is naturally a disorder of attention and related executive functions, attention training (ATT) has been considered as a treatment for the disorder. Although there are few studies investigating the utility of ATT in the ADHD population, published studies provide support for ATT in reducing the symptoms of ADHD.

**Objectives:** The aim of the current study was to examine the effects of training attention on ADHD symptoms in a group of preschool-aged children at risk for ADHD disorder.

**Methods:** In this study, a group of 5-year-old children ( $n = 30$ ) with ADHD symptoms were assigned randomly to either a training-group who participated in 11 sessions of visual attention training based on Pay Attention Program or a non-trained control group. Both versions of Child symptom inventory-4 (CSI-4) were employed to assess ADHD symptoms based on parent and teacher's rating. Also the accuracy and the continuous performance of children were examined with Toulouse-Pierron test. The Assessment was performed in three phases: (1) before, (2) after, and (3) one month after the termination of training.

**Results:** Results of the multivariate analysis of the covariance demonstrate that there was a significant difference ( $P < 0.05$ ) in the decline of attention deficit symptoms between two groups based on teacher's rating at post-test. In addition, there was a significant decrease ( $P < 0.05$ ) on the scores of omission error of Toulouse-Pierron test at post-test and follow up for the training group. There was no significant reduction in hyperactivity symptoms in two groups.

**Conclusions:** It seems that the performance of children's attention with ADHD improves by visual attention training.

**Keywords:** Attention Deficit Hyperactivity Disorder (ADHD), Attention Training, Pay Attention Program, Preschool Children

## 1. Background

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neuropsychiatric disorders in childhood which has three main characteristics of inattention, hyperactivity, and impulsivity (1). ADHD affects individuals across the life span with a typically early onset in the development process, usually within the first 5 years of life. Nevertheless, the peak of referring to specialists is by six or seven years old, when inordinate, poorly organized, and poorly regulated activities of a child interfere with the educational activities (2). The etiology of ADHD is still unknown, but there are evidences of structural and functional abnormalities in the brain of the individuals with ADHD (3) and a cortical maturation delay in terms of reaching the peak cortical thickness (4). Two large meta-

analyses of observational studies which compare cognitive functions in patients with ADHD with healthy participants, founded Spatial working memory, impulse inhibition, and vigilance to be the most impaired functions (5, 6). According to another study (1998), the deficits of ADHD may be characterized as inefficiencies in underlying attention networks that sub serve EF and may be amenable by training (7).

The importance of effective interventions for ADHD in early childhood is not only to reduce impairment during the preschool period itself, but also to be as strategies that may alter the longer term trajectory of the disorder. Although there are accumulating research highlighting the benefits of stimulant medication for ADHD (8), still 20 to 30% of individuals with ADHD show no posi-

tive response to stimulant medication (9, 10). In addition, due to the resistance against medicating young children, developing effective non pharmacological treatments for preschoolers can be an important health policy objective (11). Whereas ADHD is naturally a disorder of attention, attention training (ATT) has been investigated as a feasible non-pharmacological alternative to treatment with stimulant medication. According to studies which investigate the efficiency of ATT as a treatment for ADHD (11-14), ATT may be a promising approach for a non-pharmacological treatment of ADHD.

## 2. Objectives

Although the potential benefits of early intervention on young children who exhibit ADAD symptoms are known (15), there are few intervention studies in this field. In the Iranian population, to our knowledge, there is only one study investigating the effectiveness of working memory training on ADHD symptoms (16). The aim of this study is to investigate the effectiveness of the visual part of PayAttention! Program for preschool children exhibiting ADHD symptoms at risk for later diagnosis of ADHD.

## 3. Materials and Methods

### 3.1. Study Design

The present study applied a quasi-experimental design via pre-test and post-test in two groups.

### 3.2. Study Sample

The sample consisted of 30 children attending their last year of pre-school who exhibited ADHD symptoms without diagnosis, because the complete assessment and diagnosis of ADHD before six is not suggested. Participants were selected from preschool centers in Isfahan using convenience sampling. All the children recruited in this study had normal IQ and received no medication through the study. Children who were involved in any other psychological or medical intervention were excluded from the study. The study complies with current ethical considerations. Informed consent was obtained from all subjects before the study.

### 3.3. Study Measures

To collect the required data, the present study employed the following instruments:

#### 3.3.1. Child Symptom Inventory-4 (CSI-4)

This tool is a behavior rating scale for screening emotional and behavioral disorders in children between 5 and 12 years old based on DSM-IV-TR. The parent checklist consists of 112 items including 41 items which are related to destructive behavior and attention deficiency (group A, B, and C). We only used the group (A) items that were related to ADHD. Each item is scored on a 4-point Likert scale from never to often. Teacher checklist consists of 79 items, 35 of which are related to destructive behavior and attention deficit disorders. We only used 18 items in group (A) that were related to ADHD. The retest reliability of the parent and teacher checklists of the CSI-4 in Iranian population is reported to be 0.90 and 0.96, respectively (17).

#### 3.3.2. Toulouse-Pieron Scale

Toulouse-Pieron Scale is one of the tests for continuous performance. This tool helps in the investigation of three sectors related to attention: indices of Correct Response, No Response, and Wrong Response in executing the test and the Time taken to complete the test. Each page has lines consisting of forms all over the page and target forms are distributed in the whole page. The person should find and cross out the targets during a specified time. Reliability coefficient (test-retest) in Iran is obtained 0.94, 0.96, and 0.91 in different studies (18). The run time for each stage is 3 minutes and the first step is to practice. Then, three test steps are taken and their mean score is the index of the subject's performance.

#### 3.4. Pay Attention Program

This is a pediatric attention training program that is modeled by Jennifer Thomson and Kimberly Kerns (1994) after the Attention Process Training (APT) program developed by Sohlberg and Mateer (1989). The Pay Attention program has therapeutic activities on attention for children and students with traumatic brain injury, ADD, ADHD, and brain tumors. This program is designed for children (ages 4 to 10) with attention processing problems. Visual and auditory activities are designed to systematically increase the child's ability to sustain, select, divide, and alternate attention using a variety of hierarchical tasks designed for this age range and cognitive levels (11). In the present study, we only used the visual tasks of the program.

#### 3.5. Method of Conducting the Study

The children with ADHD symptoms were randomly assigned to two conditions as follows: 15 boys (mean age = 68.84 m, SD=3.31) were included in the experimental group and 15 boys (mean age = 68.76 m, SD = 3.40) in the control

group. After conducting the pre - tests, pay attention program was offered by a clinical psychologist to the experimental group within 11 individual sessions of 30 to 45 minutes weekly. The content of each session is summarized in [Table 1](#).

**Table 1.** Pay Attention Program Activities (Visual Part)

Session	Type of Activity
1,2	Exercise based on sustained visual attention training (sorting cards)
3,4	Exercise based on sustained visual attention training (home stimuli without distraction)
5,6	Exercise based on sustained visual attention training (identifying targets through cards)
7,8	Exercise based on selective visual attention training ( home stimuli with distraction)
9	Exercise based on alternative visual attention training ( sorting cards based on variable targets)
10	Exercise based on alternative visual attention training (searching based on variable targets )
11	Exercise based on divided visual attention training (sorting cards based on simultaneous multiple targets)

In this period, the control group only took the regular school activities; one week and one month after the end of the training, post- test and follow-up assessments were done.

### 3.6. Statistical analysis

Statistical analysis was done using SPSS software for windows (version19). To evaluate the data normality, the Shapiro-Wilk test was applied. Furthermore, to investigate the equality of variance between groups, Leven test was employed. Multivariate analysis of covariance (MANCOVA) was conducted to determine statistically significant differences between the group membership variable on post-test and follow-up scores of dependent variables controlling for the pre-test scores. The P value was considered less than 0.05.

## 4. Results

There were 27 (90%) subjects who completed the entire study. One boy from the experimental group dropped out after 3 weeks as he was reluctant about the activities. Two other boys from the control group dropped out because their parents did not give back the questionnaire.

[Table 2](#) indicates means and standard deviations of the participant's scores in attention training group and control group on dependent variables. The result of Shapiro-Wilk test indicated that the distribution of scores was normal. The result of Leven's test of variance homogeneity

was not significant, which suggests that error variance was equal in two groups.

[Table 3](#) reveals the results of MANCOVA among the two groups. There was a significant difference between the groups in the symptom reduction (Wilks = 0.418, F 19, 8 (= 3.312, P < 0.05).

Also, the result of multivariate analysis of covariance is presented in [Table 4](#).

As indicated in [Table 4](#), there is a significant difference between two groups on the scores of attention deficit symptoms based on teacher's assessment at post - test. (F (1, 13) = 5.148, P < 0.05). The Eta Square indicates that 34% of the effect is due to the group membership. In addition, results show that the group membership has a significant effect on the scores of omission error at post-test (F (1, 13) = 13.64, P < 0.05) and follow-up (F (1, 13) = 1.01, P < 0.05). The Eta square indicates that at post-test, 54% and at follow up 69% of the variance between the groups can be explained by the group membership.

## 5. Discussion

The effectiveness of attention training for preschoolers has been investigated in several studies.

One pilot study was conducted on 5-year-old children with ADHD symptoms which found that an intervention on attentive control and working memory modifies their executive functions and alleviate the presence of ADHD symptoms (19). These results were considerably replicated by another pilot study conducted with first-graders with symptoms of ADHD (19). Another study investigating the effects of two different trainings, one specific for working memory and the other one for inhibition, revealed that working memory training can have significant effects for preschool children and is more effective than inhibition training (20).

One investigation about the efficacy of executive attention network after training in preschool children demonstrated that trained children activate the executive attention network faster and more efficiently than untrained children and the effect was still observed for the next two months without further training (21).

Finally, the efficacy of an intervention program on EFs with ADHD children aged between 4 and 5 years was investigated in which Children and their parents took part in separate group sessions where they played games designed to enhance inhibitory control, working memory, attention, visuo-spatial abilities, planning, and motor skills. The results revealed a significant decrease on the severity of ADHD symptoms from the pre to the post test based on the parents' and teachers' ratings (22).

**Table 2.** Mean and Standard Deviation Scores of Two Groups on Dependent Variables

Variable	Experiment						Control					
	Pre-test		Post-test		Follow up		Pre-test		Post-test		Follow up	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Attention deficit (P)	09.33	2.23	08.66	1.8	8.33	1.11	11.77	2.9	10.88	1.96	10.55	2.35
Attention deficit (T)	11.33	3.31	11.33	2.64	9.77	2.68	11.22	1.64	10.66	1.22	10.33	1
Hyper/impulse (P)	09.22	3.59	08.55	2.74	9.33	3	09.88	1.76	10.55	2.06	10.77	2.98
Hyper/impulse (T)	11.88	4.53	10.55	4.09	9.55	3.77	10.88	2.57	11.22	2.53	11.11	2.57
Omission error	07.35	2.94	08.69	3.47	8.02	3.20	08.45	3.38	10.92	4.36	09.68	4.52
Commission error	03.65	1.46	00.66	2.66	2.355	2.58	04.74	1.89	03.58	1.43	04.16	1.78

**Table 3.** MANCOVA Results for Comparing the Performance of Two Groups on Dependent Variables

Test	Value	Hypothesis df	Error df	F	SSig
Pillai's trace	0.582	8	19	3.312	0.015
Wilk's Lambda	0.418	8	19	3.312	0.015
Hotelling's Trace	1.395	8	19	3.312	0.015
Roy's largest rate	1.395	8	19	3.312	0.015

**Table 4.** The Results of the Effect Test Among the Participants of the Two Groups on Dependent Variables

Variables	SS	df	MS	F	sig	Eta Square
AD (Post-P)	0009.57	1	0009.57	01.57	0.25	0.16
HD (Post-P)	0005.281	1	0005.281	02.902	0.078	0.225
AD (Post-T)	0005.454	1	0005.454	05.148	0.016 <sup>a</sup>	0.340
HD (Post-T)	0005.05	1	0005.05	03.332	0.056	0.25
AD (Follow-P)	0005.73	1	0005.73	00.064	0.938	0.006
HD (Follow- P)	0001.243	1	0001.243	00.799	0.468	0.074
AD (Follow- T)	0000.606	1	0000.606	00.263	0.772	0.026
HD (Follow- T)	0007.698	1	0007.698	01.476	0.252	0.129
Omission (post)	8728.765	1	8728.765	13.642	0.001 <sup>a</sup>	0.543
Commission (post)	0131.667	1	0131.667	01.015	0.378	0.081
Omission (Follow)	8779.123	1	8779.123	26.039	0.001 <sup>a</sup>	0.694
Commission (Follow)	0214.621	1	0214.621	02.699	0.088	0.481

<sup>a</sup>P < 0.05

In sum, studies of attention training in ADHD not only reveal improvements in EF but also provide some evidence supporting the generalization effects such as the improvement of untrained measures of attention and academic efficiency, as well as the reduction of ADHD symptoms in teacher and parent ratings and restlessness and head movements (21).

In this study, we administrated the visual tasks of the Pay Attention program with a group of preschoolers.

As revealed by the analyses, training had significant

effects on the performance of the experiment group on Toulouse - Pieron test. The percentage of errors data clearly shows that children in the experiment group become more proficient performing the task in post - test and this effect remains until one month of follow up. Our results also reveal that after 11 sessions of intervention, attention deficit symptoms significantly decrease based on a behavioral rating scale by teachers in the post-test assessment. The findings of the current study are in accordance with previous researches (11, 13, 21, 22) . The effects, how-

ever, were less evident for the ADHD symptoms based on parents' rating. To explain why there are differences between parent and teacher's assessment of the ADHD symptoms and the scores of Toulouse-Pieron test, the following reasons can be suggested. First of all, it should be noticed that in comparison to an Attention test, behavioral check lists are less proficient in evaluating the differences. Furthermore, the attitudes of the raters can influence their rating. Secondly, we only used the visual part of the Pay Attention! Program and Toulouse-Pieron test is a visual attention test. Hence it is not surprising that the training program improved performance on the test. On the other hand, considering descriptive data reveals that after intervention, there are differences between two groups based on parent and teacher's assessment but these differences are not significant. It may be due to the limited time of training, because improving the attention in children with ADHD symptoms needs further intervention. Severity of the symptoms can be another explanation. Our sample exhibited ADHD symptoms but did not receive the diagnosis of ADHD disorder.

The present study had some limitations. We used only the visual part of the Pay Attention! Program because it was the only part which was applicable for children without any translation to Persian language. Small sample size, limited time of training, and the lack of the Persian version of valid tools for comprehensive assessment of attention like Attention network test were other limitations of this study.

### 5.1. Conclusion

This study was an attempt to investigate the efficacy of a visual attention training program on the ADHD symptoms of preschool children at risk for later ADHD diagnosis. Although, there are some studies supporting the beneficial effects of attention training for children with ADHD and the results of our study were consistent with previous studies (11, 13, 21, 22), the empirical evidence in this field is still insufficient. The lack of blinding and incomplete outcome data may result in an increased risk of systemic errors (bias) and small sample sizes may increase the risk of imprecision. Even considering these limitations, it does appear that attention can be trained and since devoting great attention to early cognitive interventions for children diagnosed with ADHD or exhibiting ADHD symptoms is of great importance, it is necessary to validate and extend existing knowledge on the effects of attention training for patients with ADHD.

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### Footnotes

**Authors' Contribution:** Sanaz Joekar and Shole Amiri conceived and designed the study. Sanaz Joekar and Solmaz Joekar collected the data. Sanaz Joekar and Solmaz Joekar performed interpretation and analysis of data. Sanaz Joekar and Asma Aghebati drafted the manuscript. Asma Aghebati, Solmaz Joekar, and Behrooz Birashk revised it critically for important intellectual content. Sanaz Joekar performed the statistical analysis. Shole Amiri performed administrative, technical, and material support and study supervision. All authors read and approved the final manuscript

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