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Evaluation of the Effectiveness of Working Memory Improvement Exercises on Increasing the Attention and School Performance in 9-12 Year Old Children with Attention Deficit

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Abstract

The Purpose of the present study is evaluation of the effectiveness of working memory improvement exercises on increasing the attention and school performance in 9-12 year old children with attention deficit. This is a quasi-experimental study which is of pretest-posttest type, with follow-up by a control group. The statistical population of this research includes the 9-12 year old students of Esfahan Province schools with 6 symptoms of attention deficit, who were chosen by multistage cluster sampling and were randomly assigned into two experimental and control groups. The testes of this research were second, third and fourth grade female students, from among whom 15 students were placed in the control group, and 15 students were placed in the experimental group. CSI4 questionnaire and CPT software and working memory software were utilized for data collection, and after a month the follow-up session was held. The collected data was then analyzed in descriptive and inferential levels by SPSS software, and repeated measures analysis of variance was also utilized. Findings of the present study have revealed that the working memory improvement exercises had an impact on decreasing the responding (P<0/05).

Keywords: Working Memory, Attention Deficit, School Performance.

Introduction

Paying attention to childhood problems is essential for ourselves as well as the society. If these problems are not treated, not only will the child suffer from them, but also they will eventually turn into adulthood mental disorders. From among the prevalent childhood problems is attention deficit-hyperactivity disorder. Children with psychological deficits may not be able to master such key tasks of different growth stages as self-esteem development,

peer relations, interpersonal conflict resolution, and acquisition of academic skills, etc. and these defects can themselves lead to failure and rejection feelings. Almost all mental health professionals in all behavior explanation models and theories are unanimous on a fact mentioned below. The first years of development are significant for future adjustment, and the existence of problems during these years provides the context for maladjustment in subsequent years. The Attention Deficit-Hyperactivity Disorder (ADHD) is a consistent pattern of inattentiveness and hyperactivity which is more frequent and severe than the characteristic of children with similar developmental level. Some of its symptoms must appear before the age of 7, though it is diagnosed in some children many years after appearance of the symptoms. For realization of ADHD criteria, the damage caused by inattentiveness and hyperactivity- impulsivity must be present in at least two areas, and interfere with proper functioning of the social, educational and out-of-school activities. This disorder must not occur in the process of pervasive developmental disorder, schizophrenia, or a psychotic disorder, and also no other mental disorder should better justify it. The prevalence of hyperactivity in children and adolescents is approximately 3 to 5 percent, and it has been the most prevalent disorder among children who were referred to psychiatric clinics. The attention deficit-hyperactivity disorder has a long history, and it was dealt with under different titles since the past. Given its high prevalence in comparison with other behavioral disorders of children, so many studies have been allocated to this problem. Since long ago, various treatment methods have been analyzed and used for improving the symptoms of this disorder, from among which drug treatments have been more common than other methods. On the other hand, transient effects of drugs, their side effects and lower ages limit for use of the drug have prompted the scientists to look for the effectiveness of other treatment methods including cognitive-behavior therapy. Accordingly, parent education, play therapy, diet, and recently the use of media have been proposed along with drug therapies in order to reduce the problems of this disorder, and various researches have followed each of these methods, each of which try to investigate and compare the effectiveness of one or a combination of these methods (Goldstein & Goldstein, 1998).

In proportion to various causes and reasons which explain the disorder, there are different methods of treatment, including: there is the evidence of working memory deficit in these children, which illustrates the necessity of use of cognitive and behavioral therapies. In a study titled "Computer Training of Working Memory in 7 to 12 Year old Children with Attention Deficit-Hyperactivity Disorder", the effect of this method of working memory training on improvement of impulsivity and attention deficit in these children was evaluated as efficient and effective. In another study titled “ADHD and working memory: the impact of central executive deficits and exceeding storage rehearsal capacity on observed inattentive behavior” it was shown that there is a relationship between working memory and attention and concentration problems in children suffering from ADHD. In a research on the “Impact of computer game and computer assisted type instruction on inattention and impulsivity of children suffering from attention deficit hyperactivity disorder” the scholars were able to illustrate the reduction of impulsivity in children suffering from attention deficit-hyperactivity disorder who were under computer assisted type instruction.

Further, in another study the scholars dealt with the effectiveness of cognitive-behavioral play therapy on reducing the symptoms of attention deficit-hyperactivity disorder in 9 to 11 year old students suffering from this disorder. Results of that study revealed that after the therapy the hyperactivity, inattentiveness and response error decreased and response time increased significantly. Along with paying to the problems of children suffering

from attention deficit-hyperactivity disorder, this study also dealt with the importance and necessity of using computer software as the media for increasing the attention (Kofler et.al., 2010).

Methodology

The present study is a quasi-experimental research which involves a pretest, posttest, and control group and follow-up. The statistical population of this study consists of all 9-12 year old students of Esfahan province schools in 2011-2012 academic year who had some attention deficit symptoms. The sampling method has been multistage cluster sampling method, so that from the 6 educational districts of Esfahan, 1 district was randomly chosen and then 1 school was randomly selected from among the schools of that district, and CSI-4 Test was performed on the second and third grade students of that school. From among the students who had at least six symptoms of attention deficit, 30 persons were selected, 15 persons of which were placed in the experimental group and 15 persons were put in the control group.

Research Tools

The CSI-4 Questionnaire was prepared. This questionnaire was then answered by teachers and parents. The first 9 questions of this questionnaire identify the children with attention deficit, and validity of the questionnaire for both forms of parents and teachers was respectively 90% and 93%.

Moreover, Continuous Performance Test (CPT) was performed by the computer in order to assess the response time and the error due to children's carelessness.

Research Procedures

After referring to the randomly selected school, 30 students whose attention deficit was diagnosed via CSI-4 questionnaire were identified and selected, and the sample was randomly divided into two 15 person groups (one experimental group and one control group). The independent variable (working memory training) was applied to the experimental group, in a way that each member was individually worked with at school. Each week, each member came to school for 30-45 minutes, and the tester practiced with her by the working memory software. In addition, Continuous Performance Test (CPT) was performed by the computer in order to evaluate the response time and the error due to children's carelessness. The researcher then set up the training sessions and at the end of each session provided the students with exercises related to that session which should had been done at home. In the next sessions a review of the contents and assignments of the previous sessions was performed and the assignments were evaluated. After holding the training sessions for the experimental and control groups, the posttest was executed. Trainings were held for one 30-45 minute session per week for each child, and after a month a follow-up session was held for both the experimental and control groups.

Research Findings

TheSPSS software was used for data analysis in this research. The statistical method used by the present study has been the descriptive statistics which includes: mean and standard deviation tables and the inferential statistics which includes: repeated measures analysis of variance.

Table 1:
Mean and Standard Deviation of Pretest and Posttest Scores and Follow-Up of Response Error Scores in Both Groups

GROUP	PRETEST			POSTTEST		FOLLOW-UP	
	Number	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Experimental	15	4.3	3.58	1.53	2.13	2	2.27
Control	15	2.53	1.5	2.47	1.85	2.2	1.42

As can be seen from Table 1, the response error scores of both experimental and control groups are given in the pretest, posttest and follow-up phases. The decrease in scores of the experimental group is visible.

Table 2:
Results of Shapiro-Wilk Test about the Assumption of Normal Distribution of Scores

Normal Distribution of Scores	Groups	Shapiro-Wilk		
		Statistics	Degree of Freedom	Significance
Response Error	**Experimental**	**0.774**	**15**	**0.002**
	Control	**0.847**	**15**	**0.016**

As can be seen from table 2, the null hypothesis of normality of distribution of scores is confirmed. It means that the assumption of normality of distribution of scores in the pretest of both experimental and control groups is confirmed. With respect to observance of this assumption and the assumption of homogeneity of variances, analysis of covariance was used to obtain analytical results. It must be noted that due to the random selection of the samples and their random assignment to experimental and control groups and the interval scale, the utilized tools and the fulfillment of other conditions (equality of variances and homogeneity of variance) justifies the problem of lack of confirmation of some components in the normality.

Table 3:
Results of Levine's Test for the Assumption of Equality of Variances of the Two Groups of Population

SCALE		F	THE FIRST DEGREE OF FREEDOM (NUMERATOR)	TWO DEGREES OF FREEDOM (DENOMINATOR)	SIGNIFICANCE(P)
Response Error	**Posttest**	**1.590**	**1**	**28**	**0.218**
	Follow-up	**3.897**	**1**	**28**	**0.054**

As can be seen from table 3, the null hypothesis of equality of scores variances of both groups in research variables in posttest and follow-up phases is not rejected. It means that

the assumption of equality of scores variances of both experimental and control groups in posttest and follow-up phases for research scales is confirmed.

Table 4:
Results of the Assumption of Homogeneity of Variance Test

Homogeneity of Variance	Value	DF Hypothesis	DF Error	F	SIGNIFICANCE(P)
Wilks' Lambda Test	0.052	10.000	7.000	12.703	0.948

Table 5:
Results of the Assumption of Homogeneity of Variance Test for each of the Posttest and Follow-Up Phases

SCALE		HOMOGENEITY OF VARIANCE				
		SUM SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	F	SIGNIFICANCE
Response Error	Posttest	0.120	1	0.120	0.109	0.746
	Follow-up	0.132	1	0.132	0.449	0.512

As can be seen from table 4, there is no different slope between the linear combination of pretest and linear combination of posttest for experimental and control groups. Table 5 is also investigates the homogeneity slope between the linear combination of pretest and posttest. It can be finally stated that multistage analysis of covariance or MANCOVA can be used for investigation of the experimental intervention effect.

Hypothesis 1: Exercises for improving the working memory reduces the response error of students of the experimental group in relation with the control group at posttest and follow-up phases.

Table 6:
Results of the Multivariate Analysis of Variance of the Effect of Group Membership on the Amount of Response Error Scores of Both Groups

VARIABLES		DEGREE OF FREEDOM	MEAN SQUARE	COEFFICIENT F	SIGNIFICANCE(P)	RATE OF EFFECT	STATISTICAL POWER
Pretest	Posttest	1	13.523	9.537	0.005*	0.293	0.841
	Follow-up	1	18.522	45.430	0.001**	0.664	1
Group Membership	Posttest	1	8.438	5.951	0.023*	0.206	0.647
	Follow-up	1	4.437	10.882	0.003**	0.321	0.885

*** (P < 0.05) - ** (P < 0.01)**

According to table 4-11, after removing the impact of independent variables on dependent variables, and considering the calculated coefficient F, it can be seen that there is a significant difference (P < 0.05) between the modified means of response error scores of

the participants according to group membership (experimental group and control group) in both posttest and follow-up phases. Accordingly, the hypothesis of the research is confirmed. Hence the working memory improvement exercises have an influence on reducing the response error of the students who participated in posttest and follow-up of the experimental groups. The rate of this influence has been 20.6 in posttest phase and 32.1 in follow-up phase.

Discussion

The working memory improvement exercises reducing the response errors of children in, Continuous Performance Test (CPT)

According to table 6, after removing the impact of independent variables on dependent variables, and considering the calculated coefficient F, it can be seen that there is a significant difference ($P < 0.05$) between the modified means of response error scores of the participants according to group membership (experimental group and control group) in both posttest and follow-up phases. Accordingly, the hypothesis of the research is confirmed. Hence the working memory improvement exercises have an influence on reducing the response error of the students who participated in posttest and follow-up of the experimental groups. The rate of this influence has been 20.6 in posttest phase and 32.1 in follow-up phase. Findings of the present research are consistent with findings of another research. Results of that research revealed that computer typing training had an impact on children's inattentiveness and it reduced their typing error . When the child gives an incorrect response to the computer game, he will be informed by a special alarm and he will lose some points. According to behaviorism theory, when, after an incorrect answer, there is no incentive, and the reinforcing stimuli (points) is eliminated, that behavior is weakened and there will be lower chance of its repetition. On the other hand, the behaviors which are incompatible with this behavior are strengthened and there will be greater chance of their occurrence. Consequently as time goes by, the appropriate behavior is increased and the incorrect responses are decreased so that the child can obtain better points and progress to the upper levels. Hence, by training the child via the working memory software, his accuracy in enhanced, and consequently in CPT software they could also achieve appropriate outcomes.

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