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Original research

The effectiveness of neurofeedback on reducing attention and concentration problems in the visual field of children with attention deficit/hyperactivity disorder

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Abstract

Introduction: Attention-deficit/hyperactivity disorder is a part of neurodevelopmental disorders characterized by disruptive levels of inattention, disorganization, or hyperactivity-impulsivity. The aim of the present study was to identify the effects of neurofeedback on reducing attention and concentration problems in the visual field of children with ADHD.

Research method: The method of the present research was quasi-experimental with a pre-test-post-test design with a control group and was placed in the category of applied research. The statistical population included children 6-11 years old with ADHD and visual problems who referred to the Elixir Psychotherapy Center in the 2nd district of Tehran in 2015. The sample size of this research was 30 people, after the clinical psychologist's diagnosis, the people were tested with accuracy and concentration test (IVA) and were selected non-randomly (purposefully) and randomly replaced in 2 groups of 15 people, control and experimental. Subjects received neurofeedback for 30 sessions of 50 minutes, 3 times a week. The research hypotheses were tested using descriptive statistics methods (mean indices and standard deviation) and for data analysis using inferential statistics methods (univariate and multivariate covariance analysis) SPSS 21 software program has been used.

Findings: The results, considering the subscales related to the visual field, the two experimental and control groups had significant differences in the subscales of stability, care and concentration.

Conclusion: The results of the analysis of covariance showed that the research hypothesis based on the effectiveness of neurofeedback on reducing attention and concentration problems in the visual field of children with ADHD was investigated, and the results showed that this therapeutic intervention was effective in the subscales of stability, care and concentration. Is.

Keywords: hyperactivity, technology, neurofeedback, visual attention and focus

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Introduction:

There are a set of diseases known as neurodevelopmental disorders that start during the growth period and are usually manifested early in development and often before the child enters elementary school with developmental defects. Attention-deficit/hyperactivity disorder is a part of neurodevelopmental disorders characterized by disruptive levels of inattention, disorganization, or hyperactivity-impulsivity. This disorder can continue until a person's adulthood, in such a way that it leads to social, academic and occupational performance disorders in the future (1). Attention deficit/hyperactivity disorder is among behavioral disorders. This disorder describes children who always show signs of inattention and hyperactivity-impulsivity disproportionate to their age, which causes disruption of major life activities. This disorder is completely different from one child to another only in the light of specific patterns of behavior and it can be said that ADHD is a general term that is used to describe different patterns of behavior that are slightly different from one another (2). According to the results of research announced by the Diagnostic and Statistical Manual of Mental Disorders DSM-5, the main feature of attention deficit/hyperactivity disorder (ADHD) is a persistent pattern of inattention or hyperactivity-impulsivity that disrupts performance or growth. Behavioral inattention in ADHD is not caused by a lack of understanding or stubbornness, and is manifested in the form of distraction from the task, lack of perseverance, difficulty staying focused, and irregularity, and is not caused by stubbornness or lack of understanding or stubbornness. The prevalence of ADHD in most cultures is approximately 5% of the basis of concentration disorder is the imbalance in the activity of brain catecholamines (chemical mediators of brain cells) in the cerebral cortex. The noradrenergic system of the brain is responsible for many behaviors including our attention, alertness and executive function (1).

Imbalance between the norepinephrine and dopamine system in the prefrontal cortex of the brain is responsible for brain dysfunction (3). Attention and concentration problems are caused by the reduction of the overall size of the brain and the delay in posterior and anterior reaching. Different treatments are used to treat attention and concentration disorders, including drug therapy (methylphenidate (Ritalin), tricyclic antidepressants or bupropion, atomoxetine, clonidine), psychotherapy and technological treatments, including the use of neurofeedback (4). Rajabi (5) conducted a research with neurofeedback in modifying the amplitude of brain waves and continuous visual motor performance with symptoms of attention deficit disorder with hyperactivity, entitled "Effectiveness". The results showed a significant improvement in all aspects of the continuous performance test (correct answers, omission error and presentation error) and theta brain wave range, sensorimotor rhythm and beta in the neurofeedback group. The results of this research indicated the effectiveness of neurofeedback as a therapeutic method in correcting brain waves and treating attention problems in female students with attention deficit hyperactivity disorder compared to the control group. Also, Kurtz et al. (6) in a study entitled "Material Neurofeedback Supplement for Attention Deficit/Hyperactivity Disorder: Meta-analysis of Clinical and Neuropsychological Results from Randomized Controlled Trials" on 520 participants with ADHD, including 13 trials using the PubMed method. ERIC and CINAHAL random effects

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model was used. Studies with Cochrane's risk of bias tool were reviewed, showing that controlled studies with possibly blinded results have now succeeded in supporting neurofeedback as an effective treatment for ADHD. Future efforts should focus on implementing a standardized neurofeedback protocol, ensuring learning, and optimizing relevant clinical transfer (6).

So far, many methods have been used to check brain function, but these methods require high costs and sometimes have dangerous side effects such as injecting radioactive materials and exposure to a strong magnetic field. In this treatment, patients learn how to strengthen their brain's metabolic changes to lead to a reduction or limitation in drug consumption (7). In neurofeedback, there are no input signals and only output signals, which are done at the level of unconscious neuronal activity. Neurofeedback is a learning process Neurofeedback is a safe and painless method that works directly on the brain, during which sensors are attached to the patient's head (8). As a result, the activity of brain waves, which are unconscious processes outside of the person's will, are Thus, the goal of neurofeedback is to focus on increasing brain activity by creating positive feedback, in such a way that the person consciously corrects his patterns or brain waves considered for the person and the therapist (9). The main problem of the current research is how to reduce attention and concentration problems in the visual field of children with ADHD, without resorting to other treatment methods such as drug treatment, considering the problems that exist in the field of medicine (such as lack of acceptance of the drug by some clients, instability of the effect of the drug, incompatibility or unresponsiveness of the physiological structure of some people to the drug), on the other hand, the attractiveness of the treatment method, the lack of resistance of the person in doing the homework.

Research method:

The research method was a quasi-experimental type with a pre-test-post-test design with a control group, and this research is placed in the category of applied research. Didari referred to the Elixir Psychotherapy Service Center in the 2nd district of Tehran in 2015.The method of obtaining the sample size based on the research method in psychology and educational sciences by Dr. Delaware was 30 people for experimental research, which people were selected non-randomly (targeted) and randomly divided into 2 groups of 15 people, control and alternative experiment. Research tools:

IVA test (auditory and visual assessment, ADHD measurement, accuracy and concentration): IVA is a 13-minute audio-visual continuous test that evaluates two main factors: reaction control including: (caution, stability, persistence) and attention including: (care, concentration, speed). Diagnostic and Statistical Manual of DSM-IV Mental Disorders has been compiled and deals with the diagnosis and separation of ADHD types including attention deficit type, hyperactive (impulsive) type, mixed type and unknown type (NOS). In addition, this test is used to examine problems of other disorders such as self-control problems related to head injury, sleep disorders, depression, and anxiety, learning disorders, dementia and other medical problems. In addition, this test is used to examine problems of other disorders such as self-control problems related to head injury, sleep disorders, depression, and anxiety, learning disorders, dementia and

other medical problems. This test is applicable for people 6 years old and above and adults. The duration of this test (including the training section) is about 20 minutes. The task of the test consists of answering or not answering (response inhibition) to 500 test stimuli. Each stimulus is presented for only one and a half seconds. Therefore, the test requires attention. This test measures four main categories: 1- Attention 2- Response control 3- Quality 4- Validity In general, this test measures 50 features in two dimensions of vision and hearing and determines the brain of a person in processing how does visual and auditory information and motor response work. This test consists of five general scales and twenty two subscales. Its five groups are as follows: 1- response control, 2- attention, 3- documents or features, 4- indicators or diseases. The results of studies show that the IVA+PLUS test has sufficient sensitivity (92%) and correct predictive power. (89%) for the correct diagnosis of ADHD in children. The validity of the test in the open test method shows that 22 IVA scales have a direct and positive relationship with each other (46-88%). In general, the findings show that this test has good and high reliability and validity in examining attention and accuracy and diagnosing ADHD (10).

In the current research, descriptive statistics methods, including mean and standard deviation indices, were tested for data analysis, and inferential statistics methods, including univariate and multivariate covariance analysis, were tested. The necessary statistical processing on the grades was done using the SPSS 21 software program.

Findings

The descriptive characteristics of the research variables are given in Table 1.

Table (1) Table of descriptive indices of research variables in visual evaluation in two control and experimental groups

variable group		Number	pre-test		post test	
			Average	standard deviation	Average	standard deviation
Precaution	control	15	101/80	8/33	101/80	8/33
	Test	15	90/00	23/08	103/80	19/84
	Total	30	95/90	18/07	102/8	14/98
Stability	control	15	97/33	9/74	97/33	9/74
	Test	15	90/13	25/71	104/87	14/43
	Total	30	93/73	19/45	101/10	12/69
Endurance	control	15	98/60	9/36	98/60	9/36
	Test	15	91/13	17/13	99/93	16/81
	Total	30	94/87	14/08	99/27	13/38
taking care	control	15	81/73	21/44	81/73	21/44
	Test	15	82/60	23/00	106/60	11/91
	Total	30	82/17	21/85	94/17	21/22

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Focus	control	15	96/67	10/64	96/67	10/64
	Test	15	95/07	18/80	106/93	9/99
	Total	30	95/87	15/03	101/80	11/41
Speed	control	15	84/4	12/87	84/47	12/87
	Test	15	84/67	16/11	98/13	17/55
	Total	30	84/57	14/33	91/30	16/64
sensory	control	15	87/27	10/57	87/27	10/57
	Test	15	88/93	19/00	95/87	15/85
	Total	30	88/10	15/13	91/57	13/94
attention scale	control	15	81.40	9/90	81/40	9/90
	Test	15	78.40	14/85	98/33	15/35
	Total	30	79.90	12/34	89/87	15/34
Response control scale	control	15	47/90	41/17	47/90	17/41
	Test	15	79.73	26/44	102/20	16/97
	Total	30	85.10	22/66	96/33	17/92

Table 1 shows that there is not much difference between the average scores of the pre-test in the research variables in the control and experimental groups. But there is a difference between the average scores of the post-test in the two experimental and control groups. Now, the significance of this difference will be investigated.

Research hypothesis: Neurofeedback has an effect on reducing attention and concentration problems in the visual field of children with ADHD. To test the desired hypothesis, according to the number of variables related to the visual field, as well as examining the pre-test and posttest in two control and experimental groups. Multivariate analysis of covariance test was used.

Table 2. Descriptive statistics related to the post-test scores of the research variables, separately from the control and experimental groups

Statistical index Variable		Number	Average	Standard Deviation
Precaution	control	15	101.80	8.33
	Test	15	103.80	19.84
Stability	control	15	97.33	9.74
	Test	15	104.87	14.43
Endurance	control	15	98.60	9.36
	Test	15	99.93	16.81
taking care	control	15	81.73	21.44
	Test	15	106.60	11.91
Focus	control	15	96.67	10.64
	Test	15	106.93	9.99

Speed	control	15	84.47	12.87
	Test	15	98.13	17.55
sensory	control	15	87.27	10.57
	Test	15	95.87	15.85

Table 2 shows the descriptive indices of the research variables in the post-test, by group. Now, the significance of this difference will be investigated. In order to answer this hypothesis, it can be said that because the purpose of comparing the average scores of several groups of dependent variables in two groups, therefore, it is necessary to use the multivariate analysis of covariance (MANCOVA) test, which before performing this test, their default is based on the equality of the matrices. We check the variance-covariance of the two groups using Box's test.

Table 3. The results of the intergroup effects test in two groups in terms of research variables

Indicator dependent variable	SS	Df	MS	F	Sig	PES (eta squared)	Statistical power
precaution	618.487	1	618.487	6.384	0.02	0.233	0.674
Stability	975.866	1	975.866	11.916	0.002	0.362	0.908
Endurance	316.179	1	316.179	2.79	0.11	0.117	0.357
taking care	2730.379	1	2730.379	26.283	0.0001	0.556	0.998
Focus	556.505	1	556.505	13.334	0.001	0.388	0.936
Speed	777.802	1	777.802	6.121	0.022	0.226	0.655
sensory	256.977	1	256.977	3.69	0.068	0.149	0.45

The analysis of each dependent variable alone, using Benferroni's measured alpha (0.007), which is obtained by dividing alpha (0.05) by the number of dependent variables (7 variables), showed that the two control groups and Testing in stability variables, Care and concentration are significantly different from each other.Because the significance level obtained is less than the criterion value of 0.007. Also, the average comparison between the scores of the research variables in the two groups shows that the experimental group has higher scores in the stability, care and concentration subscales compared to the control group.

Discussion and conclusion:

The aim of the present study was to identify the effects of neurofeedback on reducing attention and concentration problems in the visual field of children with ADHD. The results, considering the subscales related to the visual field, the two experimental and control groups had significant differences in the subscales of stability, care and concentration. In explaining the obtained results, it can be said that the neurofeedback training process is based on the principle of active

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conditioning, which is based on the two concepts of reinforcement and reinforcement. In the neurofeedback process, operant conditioning is when the patient receives a reward for finding the right mental state. In this way, when the power of a certain rhythm of the patient's brain signal reaches the threshold level, in return, he receives audio or visual feedback that is usually similar to a game. Therefore, the person tries to adjust his mental state in such a way that he receives the desired stimulus (visual or auditory feedback) and this increases the desired behavior (putting the person in the desired mental state) and increases the probability of the occurrence of that particular rhythm. Another explanation is the effect of neurofeedback therapy on reducing ADHD symptoms and its effect on brain waves through games or movies. Since theta waves are related to distraction, inattention, daydreaming and anxiety, neurofeedback can improve ADHD symptoms by helping to regulate these waves. In this regard, Loskio et al. (12) also believe that in ADHD children, neurofeedback has the capacity to normalize the brain waves of these children and can improve children's selective attention (12).

The mode of playing a movie or directing a computer game is done without the use of hands and only with the person's brain waves. In this way, by seeing the progress or stopping of the game and receiving rewards or losing points or the changes that occur in the sound or playing the movie, the person finds out the favorable or unfavorable conditions of his brainwaves and tries to guide the game. Or the movie, control the state of its brain wave production (for example, if the person is supposed to reduce his alpha wave, the game will proceed if the alpha wave is less than a specified limit.) During training, brain activity is controlled by the conscious and unconscious management of attention. Conscious learning occurs when a person learns how the attentional feedback signal relates to his state of mind. Most of the learning happens at the unconscious level, where the brain gradually becomes able to directly and automatically control the feedback signal. New skills acquired consciously and unconsciously are internalized during training and automatically transferred to the daily activities of a person. It's just like learning to drive. Just as driving becomes a series of automatic actions after complete learning and is never forgotten, the skills learned during neurofeedback training will be permanent. Therefore, neurofeedback helps the brain to learn how to regulate itself and correct its functional deficiencies. Therefore, there is no manipulation or intervention of foreign substance that has side effects or creates dependence. In addition to what was said, Narimani, Rajabi and Delawar (13) mention that neurofeedback offers a mechanism to people to balance their cortical profile by reducing slow wave activity and increasing fast wave activity.T herefore, it is expected that by compensating the EEG abnormality, the person will show more attention and concentration and have a higher level of arousal, and as a result, he can improve his performance (13). They state that the importance of reducing or increasing the range of theta (4-8) Hz, delta (1-4) Hz brain waves in high mental performance should be mentioned. . It is accompanied by reaction, impotence of calculation, poor judgment, lack of impulse control and reduced attention and arousal in people, so it is expected. By suppressing or reducing the theta wave amplitude in the central region of the skull (CZ), Roud witnessed a change in behavior, especially an increase in arousal and attention in people. Therefore, it can be concluded that neurofeedback training can help people with hyperactivity

disorder in regulating their brain waves and thus, improve their attention problems. In explaining the results, it should be said that the human brain is capable of self-healing, that is, it has the ability to learn or re-learn self-regulation mechanisms of brain waves, which are essential for the normal functioning of the brain (14). Therefore, neurofeedback training is actually strengthening the underlying mechanisms of self-regulation for effective functioning. By giving feedback to the brain about what the person has done in the last few seconds and what the brain's natural bioelectrical rhythms were in, this training system encourages the brain to correct, adjust and maintain proper activity. As a result, the brain is asked to manipulate different brain waves by producing more of some waves and less production of other waves (15). The underlying mechanism of this change can perhaps be explained based on the operant conditioning theory, so that if the stimulus change (brain wave amplitude) is accompanied by a desired outcome (movement of video images or sound production) based on a predetermined agreement, it will be strengthened. It will lead to learning, and this learning will be more effective when using simpler stimuli (such as neurofeedback training) that lead to receiving reinforcement.

Ethical Considerations: After the necessary approvals and obtaining permission from the university, in order to complete the questionnaires, the goals and working methods were explained to all the people participating in the study, and their consent was obtained and they were assured that the results of the research will be available to them if they wish. They will be placed. The people were assured that they can decide to withdraw from the research at any stage of the research and this will not have negative consequences for them.

Limitations of the research: This research, like other researches, had limitations, and one of these limitations was the mental and emotional state of the participants when answering the questions, which may affect the accuracy and accuracy of their answers, and this limitation was uncontrollable. .

Conflict of interest: The authors hereby declare that this work is the result of an independent research and does not have any conflict of interest with other organizations and individuals.

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