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The Effect of Cognitive-Motor Exercises on Motor-Writing Skills in Dysgraphia Patients

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ABSTRACT

This study is a quasi- empirical research (pre-test, post-test and control group). The purpose of this study is to investigate the effect of cognitive-motor exercises on dysgraphia patients' motor-writing skills in Neyshabur. For this purpose 26 primary school students suffering from developmental writing skills were selected by sampling access method through cognitive interview based on DSM-IV, then they were divided into the test group (13 students) and control group (13 students) randomly. Both groups were investigated by Wechsler's test and Minnesota handwriting skill test. Then cognitive-motor exercises were given to the test group during 8 sessions in 90 minutes, and both groups were post-tested by above tests. The results showed the effect of cognitive- motor exercises on motor-writing skills in dysgraphia patients (P< 0/05).

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INTRODUCTION

From the mid-twentieth (1960s) the studies began about children whose behaviors were strange for many parents, teachers and assistants [1]. These children, in spite of having common intelligence are not able to continue their education without especial instructions, or some of them learn something very well one day and forget it all next day. Some of them proceed in some tasks from their mates but act like smaller children in another task. Many of these children face problems in an especial course; however some of them have problems in several courses. The problem of learning increases in them gradually [2]. One of the common issues in learning disorder is writing disorder (developmental). Writing disorder is defined as an educational learning disorder which is appeared in childhood. These children usually do reverse coding or write unreadably. Some researchers believe that unreadability in these children is because of inconsonance in them [3].

Revision of the present definitions about expression disorders leads to an inappropriate definition of this disorder due to the complicate and multi-dimensional nature of writing expression. This finding is based on this observation that there is no practical determined definition of writing language, which includes all components of writing language. The studies about writing language shows that most of the learning disorder patients have problems at least in one component of writing (like handwriting, spelling, grammar error, vocabulary sources or composition). At present, there is no definition and this component isn't defined objectively or practically [4].

The fourth edition of diagnostic and statistical manual of disorders of writing disorder includes the following cases:

A) Writing skills which is based on individual execution of the normalized tests are measured considering the calendaring age and intelligence, and the level of the person's education is less than the expected level. B) Disorder in the norm A intervenes significantly in school achievement and daily life activities which requires composition. C) In the condition of sensorial disorder, the present problems in writing skills are excessive, so they cannot be usually observed along with that disorder. Writing disorder is recognized when disorder intervenes significantly in school achievement or daily life activity. 3 to 10 percent of the children suffer from writing disorder in the school age. They show spelling errors immediately after going to the school [5].

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Many children in spite of knowing the correct form of the vocabularies are excused for weakness in spelling due to the bad hand writing. However, this fact originates from their writing requirements. Some strategies should be taken so that the students get access to a nice and readable handwriting [6] the tendency of writing has decreased gradually in dysgraphia students because of bad handwriting and they are not usually interested in writing and doing delicate tasks. Probably it is the cause of their weakness in writing-motor skills. In fact, taking pen or pencil in hands and writing itself is a motor skill, so the relationship between these two are very strong [7].

The best definition of handwriting includes "the ability of copying the letters and numbers in a determined time and form". The readability of handwriting is usually measured by its components, which include: writing the letters and words in the line, alignment, appropriate indenting, size and the slope.

Writing is a complicated cognitive- motor skill which depends on the maturity and unity in some cognitive-conceptual and motor skills and is created through education [8].

Kephart (1971) has arranged his theory in a way that leads into activities and performances for revising incompetence. He believes that children need many links among their cognitive-motor information. He says that many children don't complete this process effectively in the primary years of school. So, they cannot make communication with school programs [9]. The fans of cognitive-motor skills believe that motor learning is the origin of learning and higher mental processes are created after the appropriate development of cognitive- motor systems and connective links between cognitive and motor learnings [10]. Isomil and Grober's studies show that an arranged program of physical education has a useful effect on children's educational achievements [11]. However, one year later (1968) Roscoe and Brown investigated the correlation between cognitive-motor exercises and school achievement and concluded that there is no significant relationship between them. In a speculative study, the test group (including primary school students) spent half of their free time exercising gymnastics. 88/8 percent of these children passed their final exam successfully, while in the control group 60 percent of children passed this exam successfully [12].

Sterwang studied 174 children and concluded that there is a positive relationship between weakness in reading and weakness in motor abilities [13]. Shabani found that there is a significant statistical relationship between dynamic balance and intelligence quotient in fourth and fifth grade primary school students [14]. Besides, Mirzakhani, et al. research showed that instructing delicate motion of hand increases writing and drawing skills in slow learner students.

Crouch & Jakubecy in a study investigated the effect of the function of two techniques: writing activity and delicacy stimulation activity and concluded that applying the two skills improves the problems related to dysgraphia especially in the field of handwriting [17]. Considering the investigated studies in this area, this question arises: do cognitive-motor exercises affect motor- writing skills in dysgraphia patients?

Metodology:

This study is a quasi-experimental research (with pre-test, post-test design and control group), and it is performed to investigate the effect of cognitive-motor exercises on motor-writing skills in dysgraphia disordered students in Neyshabur learning disorder centers. For this purpose, from among dysgraphia disordered students in primary schools, 26 students were selected by sampling access method. These students were selected according to the cognitive interview and based on DSM-IV (which was executed by clinical psychologist) and they were divided into two groups randomly: the test group (13 students) and the control group (13 students). The samples should exclude other disorders, they had to benefit from common intelligence and they shouldn't suffer from visual, listening, psychological and emotional problems. So, Wechsler's IQ test was first individually performed on the members in each team, then the members filled writing skill paper. Then the test group received cognitive-motor exercises during eight sessions which lasted for1 and half hours for two months. The sessions were hold as following:

First session: executing pre-test and exercise for improving cognitive-motor skills.
Second session: the activities related to the big muscles and those related to delicate muscles,
Third session: an exercise for visual- motor conception attachment and that for listening-motor conception attachment.
Fourth session: reviewing the exercise on the three previous sessions.
Fifth session: an exercise for improving visual control including the exercise for improving visual concentration and visual pursue.
Sixth session: required exercises and instructions before writing.
Seventh session: exercise for improving recognizing the shapes including: recognizing the things and different images, sorting things and completing the images based on the pattern [10].
Eighth session: executing post-test and reviewing the previous exercises.

Research tools:

Diagnostic interview based on DSM-IV: in order to recognize the students' dysgraphia in this study, this method was used and was executed by clinical psychologist. Diagnostic interview is a semi-organized interview and based on the second edition of diagnostic and statistical manual disorders (DSM-IV). This interview includes two main parts: A) personal history and B) recognizing the mental condition. The first part of this interview includes personal characteristics, main compliant, present diseases, and previous diseases, medical, personal and family history. The second part includes investigating the appearance, conception, recognition, reflection, judgment and intuition. These interview concords with the interview pattern of comprehensive psychology [5].

This study also applied behavioral assessment. In the interview which included assessment behavioral norms and was based on behavioral analysis approach these factors were investigated: behavioral exaggeration, behavioral deficiencies, behavioral sets and provision factors, morbid behavior continuation and end. The purpose of behavioral assessment was behavioral analysis about the signs, their severity and frequency and adopting therapeutic programs.

Wechsler's intelligence scale for children is one of the commonest general intelligence tests for children aged 5 to 15, [17]. This test was normalized by Shahim in 1994. This test includes 5 verbal sub-tests (general information, comprehension test, calculations, similarities, and vocabulary sources), 5 practical sub-tests (completing the images, squares, adding the pieces, and coding) and two optional sub-tests (digital memory, and labyrinths). By executing this test a general intelligence scale, a verbal intelligence scale and a practical intelligence scale results. Children's Wechsler's revised measure usually benefits from high reliability. The mean of internal similarity reported by Wechsler in all 11 aging groups is equal to 0.96 percent for general IQ, 0.94 percent for verbal measurement and 0.90 percent for practical measurement. The reported internal similarity for special sub-tests has been more changeable. The least similarity coefficient in adding the pieces is equal to 0/70 and the highest coefficient in vocabulary resources is equal to 0/86. The coefficients of average reliability for verbal sub-tests are from 0/77 to 0/86, and it is a little less for practical sub-tests and it is from 0/77 to 0/84. Re-test reliability during one month was 0.95 for general measurement, 0.93 verbal measurements and 0.90 for practical measurement [18].

The test reliability is first assessed through comprehensive correlations with other ability tests, sports and educational achievements. The correlation of this test is calculated 0/78 by revision of the fourth test by Stanford- Bienne, it is 0/66 by intelligence group test, it is 0/71 by Peibadi school achievement test and 0/39 by class scores [17].

Minnesota handwriting skill test: includes some vocabularies in Persian which is dictated by the therapist and the child writes it. It includes 5 measures for calligraphy. Each measure is scored from 0 to 2. Then the sum of scores in 5 measures is changed into a total score and it is considered as a person's total score in handwriting skill [19]. The reliability coefficient of this test is calculated 0/86. In order to investigate the validity of this test, the internal similarity method and factor analysis were applied. To investigate the reliability of this test, Cronbach alpha test was applied, and the reliability coefficient was equal to 0/86.

Data analysis methods:

To describe data in this study, descriptive statistics scales (like mean, standard deviation, and histogram) are used and inferential statistic scales are applied for data analysis (co-variance analysis). The above analysis were performed by SPSS software (version 19).

Results:

Regarding table 1, comparing the scores' mean in participants' dysgraphia in the test and control group in pre-test stage shows that there is no significant statistical difference and the two groups are comparable. Based on the findings, the score means of the participants' dysgraphia in pre-test stage was 4/92 for the test group and it was 4/77 for the control group. The results of t test in independent groups showed that there is no significant difference in the pre-test scores of the test and control group ($t = 0/42$ and $P = 0/68$).

The first research hypothesis indicated that "cognitive- motor exercises affects dysgraphia patients motor-writing skills". In order to test this hypothesis, one-way co-variance analysis test was used.

The results of table 2 shows that the hypothesis of variance's homogeneity is confirmed in the test, so it seems that, co-variance analysis test is a useful and appropriate test for testing the hypotheses in this study.

The results of table 3 show that the slope homogeneity hypothesis is also correct, so co-variance analysis test was applied to test this hypothesis.

The results of table 4 shows that there is a significant difference between the remained scores mean in the test and control group dysgraphia in post-test stage ($P<0/001$). These findings show that regarding the control of intervening variances, instructing cognitive-motor skills in post-test stage could improve the motor writing skills in dysgraphia patients.

Table 1: The scores related to the mean and standard deviation of dysgraphia and IQ, separated by the test and control groups and gender.

Situation	group	gender	Scale	Dysgraphia	Verbal intelligence	Non-verbal intelligence	Total intelligence
	Test group	Male	Mean	5/25	89/63	100	94/75
			Standard deviation	0/71	9/84	6/16	7/09
		Female	Mean	4/4	92/2	93	93/2
			Standard deviation	0/55	7/26	9/3	7/50
		Total	Mean	4/92	90/62	97/31	94/15
			Standard deviation	0/76	8/7	7/97	6/81
pre-test	Control group	Male	Mean	4/63	93/5	102/5	97/5
			Standard deviation	0/74	5/4	5/55	5/98
		Female	Mean	5	82/6	89/4	85/8
			Standard deviation	1/58	11/52	8/88	3/27
	Total	Total	Mean	4/77	89/31	97/46	93
			Standard deviation	1/09	9/58	9/4	7/71
		Female	Mean	4/94	91/56	101/25	96/13
			Standard deviation	0/77	7/92	5/81	6/49
		Male	Mean	4/7	87/4	91/2	89/5
			Standard deviation	1/16	10/39	8/78	6/49
		Total	Mean	4/85	89/96	97/38	93/58
			Standard deviation	0/92	8/99	8/54	7/16
	Test group	Male	Mean	8/13	89/63	100	94/75
			Standard deviation	0/99	9/84	6/16	7/09
		Female	Mean	7/8	92/2	93	93/2
			Standard deviation	0/84	7/26	9/3	7/05
		Total	Mean	8	90/62	97/31	94/15
			Standard deviation	91	8/7	7/97	6/81
Post-test	Control group	Male	Mean	5/13	93/5	102/5	97/5
			Standard deviation	0/99	5/4	5/55	5/98
		Female	Mean	4/6	82/6	89/4	85/8
			Standard deviation	1/14	11/52	8/88	3/27
		Total	Mean	4/9	89/31	97/46	93
			Standard deviation	1/04	9/58	9/4	7/71
	Total	Male	Mean	6/6	91/56	101/25	96/13
			Standard deviation	1/8	7/92	5/81	6/49
		Female	Mean	6/2	87/4	91/2	89/5
			Standard deviation	1/9	10/93	8/78	6/49
		Total	Mean	6/5	89/96	97/38	93/58
			Standard deviation	1 /8	8/99	8/54	7/16

Table 2: The summary of Levin test results for investigating homogeneity in variances.

The test	F	Inter-group df	Internal fd	Significance level
Dysgraphia	0/337	1	24	0/567

Table 3: A summary of the results of the slopes homogeneity hypothesis in dysgraphia.

Statistical scales of the variances	Df	Mean squares	F	Significance level
Group* pre-test	1	0/463	0/74	0/4

Table 4: A summary of the results of co-variance analysis effect of group membership on dysgraphia on post-test stage.

Statistical scales of the variances	Df	Mean squares	F	Significance level
Pre-test	1	10/27	18/68	0/001
Group membership	1	56/92	103/5	0/001

The second hypothesis of the study indicated that "the effect of cognitive- motor exercises on motor-writing skills in dysgraphia patients are different regarding their age". In order to test this hypothesis, two-way variance analysis test was applied and its results are presented in table 5.

Table 5: A summary of the results of Levin test for testing variance's homogeneity hypothesis.

The test	F	Inter-group df	Internal fd	Significance level
Dysgraphia	1/97	5	20	0/13

Table 6: A summary of the results of two-way variance analysis test for dysgraphia questionnaire scores.

Statistical scales of variances	Df	Squares mean	F	Significance level	Ita-square
The main effect of group factor	1	50/07	52/25	0/001	0/72
Samples	2	0/48	0/5	0/61	0/05
The main effect of the sample's age Group* age	2	1/4	1/45	0/26	0/13

The results of table 5 and 6 shows that the hypothesis of variance homogeneity is correct, and the main effect of the test group and control group is significant (P = 0/001 and F= 52/25), the main effect of the participants' age was not significant (P= 0/6 and F= 0/5) and there was no significant relationship between the group factor and the participants' age (P= 0/26 and F= 1/45). These findings show that the second hypothesis of the study isn't accepted.

The third research hypothesis indicates that "the effect of cognitive-motor exercises on motor-writing skills in dysgraphia patients is different regarding their gender". For testing this hypothesis two-way variance analysis test was used which its results are reported in the following.

Table 7: A summary of the results of Levin test for testing variance's homogeneity hypothesis.

The test	F	Inter-group df	Internal fd	Significance level
Dysgraphia	0/356	3	22	0/785

Table 8: A summary of the results of two-way variance analysis between the samples.

Statistical scales of variances	Df	Squares mean	F	Significance level	Chi-Ita
The main effect of the tests group	1	59/138	59/82	0/001	0/73
The main effect of the genders	1	1/11	1/12	0/3	0/049
Group* gender	1	0/062	0/06	0/81	0/003

The results of table 7 and 8 show that the main effect of the test and control group is significant (P = 0/001 and F = 59/82). The main effect of the participants gender was not significant (P = 0/3 and F = 1/12), and there was no significant relationship between the group factor and the participants' gender (P= 0/81 and F = 0/06). These findings show that the third hypothesis of the study is rejected.

Conclusion:

Based on the findings in this study, this hypothesis which indicates that cognitive-motor exercises affect the motor-writing skills on dysgraphia disorder patients was confirmed. These results concords with the results of Isomil and Grober [20], Rahbanfard, Roscoe and Brown, Nomi kater & Tall mazor [21], Seif Naraghi and Naderi, Bruiniks & Bruiniks, Engelsman, *et al*. [3]. Nicolson &Fawcett [22] studies, but it is not concordant with the results of Shabani, *et al*. [14], which indicates that cognitive-motor exercises affects the motor-writing skills on dysgraphia disorder patients. In justifying this fact it can be stated that, according to Kephart's theory, cognitive-motor normal growth helps the child to learn a fixed and credible concept of the world he lives in. In Kephart's words, the child makes a fixed cognitive-motor world. This normal consecutive growing method assesses motor patterns and generalizations and compares children's motor growth who suffers from learning disorders and normal children. A normal child is able to imagine a stable cognitive-motor world in facing with their homework; however children with learning disorder problems face an unstable world. In many educational methods, it is supposed that these relationships have been existed before and it is required to plan some programs based on these imaginary qualifications and experiences.

Cognitive-motor theory advises that there is no hypothesis for many of such children, because they don't have the required experiences for internalization of a fixed and comprehensive plan of the world. These children are disabling in complete organization of their informative logistics systems in an extent to use their educational programs, so they face problems in organizing motor, conceptual and cognitive powers. Based on the theoretical

framework of this hypothesis it can be concluded that planning cognitive-motor exercises can be a step to better organization of informative logistics systems in dysgraphia children [1].

Besides, a group of disable children in learning (dysgraphia patients) have general problems in the skill of necessary consecutive motions for writing the letters and numbers. They also write slowly and they have problems in writing the letters' shape bi-coding, combination of different styles and letters and readability [23].

It can be concluded that the main part of children's failure in writing can be because of not learning the appropriate skills of motor-writing and cognitive-motor exercises can remove this deficiency to some extent. Because creating readable handwriting needs simultaneous process of motor-cognitive ranges, the motor aspects of handwriting become automatic gradually. It is such that the child can participate in higher levels of cognitive processes in relation with the text combination [24]. Cognitive-motor exercises in turn, are along with improving motor-writing skills and can be effective on dysgraphia patients' handwriting development.

The other finding of the study was in relation with the effect of cognitive-motor exercises on motor-writing skills in dysgraphia patients regarding their age. The results of two-way variance analysis show that this hypothesis is rejected. This finding concords with the results of Luzzatti, *et al*., Papagno and Girelli, [25,26], but it is not concordant with the results of Havvayie, *et al*., Krek & Chalfant [27,7]. Besides, these findings is concordant with the findings obtained from Feder & Majnamer findings [8]. They stated that handwriting skill usually grows in kindergarten and first grade of primary school (less than 6 years old). It is monotonous in the second grade of primary school (7-8 years old), Tseng and Chaw [28], and it becomes automatic in the third grade of primary school [8-9] years old. However, I this path 10 to 30 percent of children face problems. In justifying this finding it can be indicated that motor-writing skills include different models, and all of them grow in the age of 9 years old. Handwriting skills are shaped in the primary ages of school. Motor-writing skills are low in dysgraphia children and they are not eager to delicate motions and writing. Not using such motions leads to decrease in the skin's sensor's sensitivity and increases the power of cognitive- motion exercises gradually and increases the power of fingers' muscles, so justifies this finding [7].

One of the factors which justify the findings of this study is that up-to-date discussions of learning disorders are paid more attention and more precise tools are created for recognition and assessment. The families show more effort for removing these developmental deficiencies, which this structural differences in recognition and assessment, negate the differences in different aging groups [29].

The other result of the study was the effect of cognitive-motor exercises on motor-writing skills in dysgraphia patients regarding their gender. The results showed that there is no significant relationship between the participants' group factor and their genders. It shows that the effect of cognitive-motor exercises on motor-writing skills in dysgraphia patients is not different. This finding is concordant with the results of some researchers including Hamid, quoted by Kakavand and Daraie, [29], Hulstijn & Overvelde [30], Chang and Yu [31], but it is not concordant with the results of Shywitz & Shywitz, Liederman, *et al*., 2005. Meister, *et al*., Muir and Ruter, *et al*., [20]. In justifying these findings, the primary studies showed that the male students are more exposed to particular incompetency than female students. Even when the error level is minimized in these studies, this difference exists yet. The range of this difference is 2 to 8 times, this difference can be because of deficiency in measuring tools. Meister, *et al*., estimates learning disorder frequency 84/1, writing abnormalities 56/5 and hyperactivity attention deficiency disorder 339/1in male students. The fact is that there is more man with learning deficiency which may be in relationship with sexual chromosomes. For instance, Ruter, *et al*. found that reading problems in males are more than in females. So, gender can be one of the creating factors in particular learning disorder, but the studies show that this difference is not very significant [20].

However, many learning disorder traits are similar in males and females, some differences are found in them. For instance, the girls usually have more problems in cognitive, lingual and social areas, however the boys show more violence and loss of control.

Besides, Vogle [20] reported that girls show their educational disorders more in reading and mathematics area and boys visual-motor abilities, spelling and writing language. In the final step, the research findings can be justified like this: although in some studies the extent of dysgraphia prevalence and other disorders in two genders are reported different (4 boys and 1 girl), but one of the reasons of this difference is deficiency in measuring tool and tendency towards investigating learning disorders' sign in male gender, because in some new studies, the extent of disorder prevalence in two genders are reported the same [29]. This can justify the results in the present research.

On the other hands, nowadays the educational abilities in both groups are valued to the same extent and it can be stated that cognitive-motor exercises are effective in two genders to the same extent.

The limitations of this study include: the limitation of society to dysgraphia patients, not cooperation in answering the questions or incomplete answers, time-consuming nature of the study, created stops because of the students' absence in some educational sessions related to cognitive-motor skills and not paying attention to aiding instructions at home.

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