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Development of visual-motor perception in pupils with expressive writing disorder and pupils without expressive writing disorder: a comparative statistical analysis

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Abstract

Background: Learning disability is one of the most noticed subjects for behavioral specialists. Most of the learning difficulties are caused by senso-motor development and neurological organization. The main purpose of the present research is to examine the role of delayed perceptual-motor development and brain damage in origination of expressive writing disorder (EWD).

Methods: The studied sample is 89 pupils divided into two groups, one of which is pupils with expressive writing disorder (n=43) and the other is pupils without expressive writing disorder (n=46), consisted of second and third grade elementary school students. First of all, students with EWD are selected through dictation test and intelligence test, and then the two groups, students with and without EWD, would take the Bender Gestalt test. The average score of perceptual visual-motor development and brain damage of two groups is compared using T test for independent groups and χ^2 test.

Results: Results show that there is a significant difference in perceptual visual-motor development between students with EWD and students without EWD ($p<0.01$). Based on the results, perceptual-motor development of students with EWD is lower than students without EWD. There is no significant difference in brain damage between those with EWD and healthy people, ($p> 0.05$).

Conclusion: Based on our findings it could be concluded that those who are relatively more developed than their peers, in terms of visual-motor perception, are more successful in education, especially in expressive writing.

Keywords: perceptual disorders, writing, brain injuries, primary schools.

Introduction

Learning disability is one of the most noticed subjects for behavioral specialists. UNESCO estimates that about 10-15 % of children around the world are counted under the category of children with special needs, and about 8 % of them are those with learning disorder (1). National consultancy committee, in the case of disabled children, gives the following definition for learning disabilities:

Children with learning disability show their disability in one or more basic psychological processes related to understanding or using oral or written language. Representations of this disability may appear in the form of disorders in listening, thinking, speaking, reading, writing, spelling, or calculating. These disorders are found to be as consequences of circumstances such as perceptual flaw, brain lesion, minimal brain dysfunction, dyslexia, dysphasia, etc. Their disability in learning is not the one primarily related to vision, listening, motor deficiencies, mental retardation, affective distress and lack of environmental equipment (2).

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Considering the above definition, learning disabilities can be divided into three main categories: dyslexia, dyscalculia, dysgraphia (3). Students with specific learning disability, from this point of view, are reported to constitute 4 to 12 % of all students (4).

Some students have normal intelligence but are disabled in reading, writing, speaking, mathematical perception, etc. and come to a weak overall educational function. Children with learning disability are in middle to top level of intelligence, but face apparent problems in learning some skills. They also have some other abnormal signs including perceptual disorders in one or more sensual dimension, disability in unifying received sensual information, and disorder in sensual-motor coordination. Most of these sensual-motor and perceptual disorders are in direct relationship with learning difficulties (5). According to D.S.M III R, expressive writing disorder is a disorder in skill learning that is characterized by weak function in writing and composing (spelling) (6). The classification of psychological disorders DSM IV points to the overlap of this disorder with educational affairs that demand composing written texts (e.g. editing and rewriting sentences, and justified paragraphs) and also the significant lower position of writing skills than assessed intelligence and education which is expected from a certain age (APA, 1994).

One of the well-known theories in clarifying learning disabilities is visual-motor model by Getman (7). Getman makes emphasis on visual development in his model. He focuses on motor development and believes that it's the basis for perceptual and cognitive development. Actually, motor system has a mutual connection with learning. He imagines some levels for learning, which comprise motor and reflexive system. He believes that a learning program for children could be useful when it moves them to cognitive level after passing motor and perceptual levels successfully. If these programs do not look at those levels as their basis, they would not work and learning in cognitive level remains volatile (2).

Another theoretician in learning problems is Carl Delacato. He related most of the learning difficulties to inappropriate sensomotor development and neurological organization. Delacato theory is generally based on movement and sense. It means that children who do not correctly sense the world (not to see or hear appropriately), do not have enough efficiency in human properties like intelligence, speech, etc.; and this appropriate sensation is highly affected by performing moves such as crawling and creeping in the right time and correctly; and simultaneous and concordant development of these moves with the five senses results in appropriate and perfect development of brain. Therefore whenever stages of nervous development have not been passed correctly and there have not been coordination and cooperation between moves and senses the individual would face learning difficulties (8).

Clements discusses a characteristic which is most related to minor brain damage, one of which is special learning disabilities (reading and writing) (1). In Taylor's (9) view damage to motor cortex not only causes average deficiencies in motor control, but may lead to other complications like slow-wittedness and weak learning in children (10). Sherrington has renounced that motor system is the first nervous system that develops and prepares a basis for later perceptual development (11). Some specialists in learning disorders focus on perceptual development, delicate movements and visual-motor coordination and believe that writing is a composition of visual and motor skills in form of an integrated whole. In fact delay in concordant development of visual-motor aspects leads to writing disability (12). Many researchers have confirmed the important role of perceptual- motor skills in child development and announced that senso-motor skills make up the basis for mental development as are indicated in the literature briefly.

In this research, expressive writing disorder (Farsi dictation) has made the basis for

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work. EWD or writing disability is one of learning disabilities that students show apparent educational weakness in dictation. In this disorder students commit errors by misplacing letters, mistaking punctuations, reversing letters and works, and wrong spelling. Such students also commit grammatical errors in writing compositions.

Assessing and analyzing the mentioned theories and studies need time and full view. It is simplistic to accept that brain damage is the only cause of learning disorder. As in many cases a psychological phenomenon maybe affected by multiple factors. In other words, maybe interplay of various biological, psychological and socio-cultural factors play a role in formation of psychological phenomena. Another analysis is that maybe brain damage has a primary role in occurrence of learning disability and affects the function of cognitive acts, but other peripheral factors aggravate disorder and make more problems in function of psychological activities.

During last century human's knowledge have been increased about learning disabilities, but in clarifying causes of this disabilities theme remain great shortage of information, and research in this field is going on. The purpose of present paper is to study on these disorders with emphasis on role of senso-motor aspects and brain damage. Considering present theories and themes, we attempt to find answers to questions of "is there any relationship between delayed visual-motor development and EWD and is brain damage in students with EWD more than students without EWD"

Methods

Participants, Sample, and Sampling: The type of present research is causal-comparative. Population of research is a sample of male and female students in second and third grade elementary school in Karaj city.

This sample consisted of two groups: students with EWD and students without EWD. There were 43 children (26m, 17f) in first group with EWD and second group, without EWD, had 46 students (27m, 19f). Sampling was generally made in two stages. First of all, 4 elementary schools were chosen accidentally, then, by regular sampling, students were chosen accidentally form the list of classes (one out of every five student), so that totally 77 students in second and third grade were chosen from those four elementary schools.

In second stage, 43 students were selected who had normal intelligence (according to intelligence tests) and had 1.5 standard deviations lower than the mean. Considering the other selection criterion which was having at least 3 mistakes in dictation, they were selected as the sample and underwent visual-motor Bender-Gestalt development test. Another 46 students who had relatively letter dictation scores (considering class quizzes) were selected as normal students without dictation problems and also underwent Bender-Gestalt test. For choosing them we used all elementary schools in Karaj as sampling. Second and third grade teachers in every school were asked to introduce their students who have not dictation problems.

Instruments

a) *Visual-motor Gestalt test (13)*: The most important instrument used in this research is visual-motor Gestalt test. This test has been used for diagnosing brain damages, selecting children as they are ready to enter school, diagnosing reading and learning difficulties, assessing emotional problems, studying developmental disabilities, and also as a nonverbal intelligence test (14). Test reliability through test retest according to Koppitz (15) system is 0.53 to 0.90. Bender-Gestalt test has been applied for two purposes in this study: first, for investigating visual-motor perception development and then for diagnosing brain damage subjects.

The scores that subjects get in Bender-Gestalt test according to brain damage index is based on number of errors, i.e. if the student shows four or more than four determined errors of his/her old layout in

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Bender-Gestalt test, he/she is brain damaged and the score that subject gets in Bender-Gestalt visual-motor test on the basis of 30 criteria of Koppitz shows visual-motor perception development of subject.

b) *Raven test:* This test is applied in measuring individual's intelligence in three ability levels. Children's special form is used in present research that is applied for 5-10 years old children. This form can be applied either individually or collectively, but here it is applied individually to the subjects (16).

c) *Goodenough test:* Goodenough painting test as an intelligence test can be administered either individually or in a group and here it is administered individually. Goodenough (17) designed this test in 1926 and Heris (18) revised and completed the plan. This test is more valid and accurate in measuring intelligence in children aged 5-10. In present study it is used as on auxiliary and complementary instrument. Integration index of this test with Stanford-Binet test is reported 0.74 (18).

d) *Wechsler test (1991):* Wechsler intelligence test for children is made of two parts: verbal and applied. Each part consists of subtests measuring special abilities. Generally, Wechsler's revised children test is highly valid. The average of internal consistency of general intelligence for 11 age groups is reported 0.96 (19), verbal part 0.94 and practical part 0.90 conformity index has been reported to be at least 0.70 and at most 0.86. Validity indices for verbal subtests (0.77 to 0.86) were reported to be a bit more than those of practical subtests (20). Here it is used as an auxiliary and complementary instrument.

e) *Dictation test:* Dictation test is a researcher made test. In present study, dictation test has helped to separate weak students form average and excellent students. This result has gained through computing integration index between average of class scores, teachers' assumed score, and score of administered dictation test (synchronic validity).

Finally dictation test was administered to weak students introduced by teachers. The students, who their scores were 1.5 standard deviations below the average, were separated according to have 3 signs of dictation errors (considering class dictation scores and administered dictation test) and underwent the intelligence test.

Formation and administration of dictation test is as follows: first, a text for dictation test is extracted from Farsi text book of second and third grade elementary school, with help of experienced teachers. Numbers of words in texts for second and third grade were 136 and 126 respectively. In each test 4 or 5 words were put exactly like the words in text book, in order that weak students in dictation can be found more accurately. Using similar words in dictation testing was based on two basic hypotheses. First hypothesis was that, if the student has learned well about letters and spelling, he/she should be able to write words, which are similar to his/her text book and of same stems, correctly. Second hypothesis was that, one student may be weak in dictation, but he/she can write the correct spelling due to a big deal of practice, rehearsing, and continually seeing the words, then the test can not exactly indicate his/her weakness in dictation. After primary evaluation of scores (assessing level of difficulty, discrimination, scores distribution) the test was administered to 77 male and female students in second and third grade elementary school.

Statistical Analysis

First hypothesis: According to Bender-Gestalt test, visual-motor perception of students with EWD is lower than students without EWD. In order to test the hypothesis, resulted averages of the two groups (with and without disorder) in visual-motor perception development are compared and examined by use of Student's T test for independent groups.

Second hypothesis: Brain damage in students with EWD is more than students without EWD. In order to compare brain damage in the two groups, with EWD and

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Table 1. Resulted average and Standard Deviation (SD) for Dictation test.

Class Indices	N	Avg.	SD	Var.	Min. Score	Max. Score
2nd grade	35	123.85	11.02	121.59	94	136
3rd grade	42	116.66	7.94	63.15	91	126

Table 2. Statistical indices of Bender-Gestalt visual-motor development scores

Class Indices	N	Avg.	SD	Var.	Min. Score	Max. Score
With EWD	43	55.6	12.69	161.24	38	92
Without EWD	46	44.26	7.11	50.68	33	62

without EWD, Yates correction formula and χ^2 test (chi-square) were used.

In order to compare state of visual-motor development in students with and without EWD, average of raw scores (scores of Bender-Gestalt visual-motor development test) can't be used, because tested students have various ages. It is possible that two subjects in different ages get equal scores in Bender-Gestalt test while they are different in development. In other words maybe assessment of developmental sample for each of them by considering the norm of his age group indicates an acceptable and normal development or an abnormal and delayed one. Therefore, in order to have an accurate comparison of two group's development state, and take into consideration their peers, first, Bender-Gestalt scores should be converted to standard Z scores, then Z scores should be converted to balanced T scores, in order to delete negative signs and decimal figures and have a better understanding and interpretation of Z scores. A p-value of < 0.05 was considered statistically significant.

Average and standard deviation of visual-motor development for each group had calculated based on balanced T scores and results of statistical calculations are briefed in Table 2.

Results

In present study, diagnosis of EWD is determined by a score at least 1.5 standard deviation below the average score in dictation test. As indicated in Table 1, average dictate score of second grade students is 123.85 and its standard deviation is 11.02, and average dictate score of third grade students is 116.66 and its SD is 7.94. Hence based on Table 1, those with scores 1.5 SD below the average were separated and underwent other tests.

Based on Fig. 1, comparison of the two group's curves shows that:

- The two groups have different scores in one percentile point. Scores of disordered group in one percentile point is more than the healthy group in that point.
- Domain of the group with EWD in Bender-Gestalt test is more than healthy group (38-92).
- Minimum and maximum scores in the group with EWD are more than min and

Table 3. Distribution of brain damage in students with and without EWD.

EWD / Brain damage	With EWD	Without EWD	Total
With brain damage	4	0	4
Without brain damage	39	46	85
Total	43	46	89

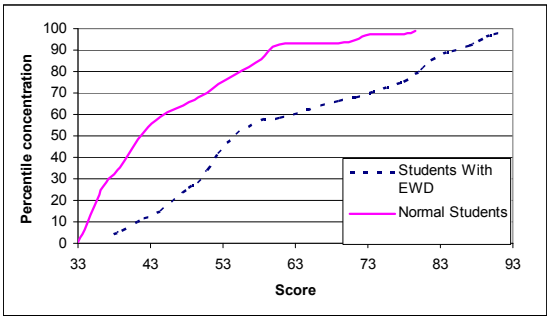

Fig. 1 Percentile concentration curve for healthy subjects and subject with EWD in Bender-Gestalt test.

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max scores in healthy group.

• Two groups seem different in development. Figure 1 shows the delayed visual-motor development of students with EWD compared with normal students. This can be understood by comparing percentages of two groups compared to the average (score 50 based on T scale):

▪ In healthy group about 78% scored below 50 and 22% scored above 50.

▪ In disordered group 48% scored below 50 and 62% scored above 50.

As the calculated T score (5.15) is bigger than T 1% (2.33) in single domain test, the null hypothesis is rejected and it is concluded, with 99% confidence, that there is a significant difference between the compared average so it can be concluded that visual-motor perception development of students with EWD is lower than students without EWD ($p<0.01$).

In order to assess whether the observed frequency distribution (brain damage) is formed by chance or not, a χ^2 text should be applied. Because the calculated χ^2 (2.25) is smaller than table χ^2 (3.84) in 5% level, the null hypothesis is not rejected and there isn't any significant difference between healthy students and those with EWD in terms of brain damage ($p>0.05$) (Table 3,4).

Discussion

The first research hypothesis, saying that "students with EWD have a more delayed visual-motor development than healthy students" was confirmed, and it was concluded with 99% confidence that there is a significant difference between compared averages.

The above conclusion indicates that there is a relationship between visual-motor perception and expressive writing ability. In other words, healthy children have higher visual-motor coordination, compared with children with EWD. This confirms that one of the effective factors in learning is quality of development in visual perception, motor activities (general and specific) and the coherence and coordination between them. It is to say that those who have passed a normal process in motor development levels and have combined these movements with their perception, in appropriate time and place, are more successful in understanding things. In fact, such individuals, by means of making secured connection between visual perception system and motor perception system and integrating these two, can rely on information received by each one in future and give meaning to them in formation. When the individual can trust perceptional or motor system, he/she can process the information with confidence and represent it as a motor action (like writing) when it is necessary. It is important to notice that writing dictation is rather an audio-motor activity than visual-motor one. Therefore, this question is raised that, what kind of relationship there can be between visual-motor development and expressive writing? It seems to be a sophisticated procedure, yet these two are suggested to have similar mechanisms. Actually, combination of perceptional data and motor information is important in adjusting and contrasting these two kinds of received information.

Generally any perceptual (visual or auditory) or motor activity has a complementary role in learning functionality. It is very important that the person can attend to two subjects simultaneously and make the required coordination and coherence. A child who can make appropriate connection between vision and movement, and has appropriate motor response to external stimuli when required, this ability can also probably be generalized to other skills such as making good connection between auditory stimuli and motor responses. Also in relation with the above mentioned problem of "how to connect two processes, visual-motor or auditory-motor", another important subject can be explained that is "stream of adjusting two phenomena-sound and vision-or how to fit hearings and seeing" not to imagine and learn one stimulus visually and auditory at the same time can play a role in learning it. This way the connection between seeing and hearing breaks

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and the child writes expressively what he hears. Therefore, there is an indirect relationship between dictation writing and visual-motor development.

Another important point involving researcher's mind is absence of relationship between dictation test scores and Bender-Gestalt test scores in children with EWD. A small group of subjects got acceptable scores in Bender-Gestalt test in spite of their disability in dictate writing. This indicates that some other factors are involved in creation and formation of the disorder. Hence, maybe one of the factors is type of encoding in individuals. That is, maybe the children who have got normal scores in Bender test but are extremely weak in dictation, are more of visual encoding type than auditory, and because it is easier to learn and recall words auditory, children are unable to recall images of words by hearing.

Many researches are carried out about the relationship between visual-motor development (perceptual-motor) and educational ability. The results show that children, who are motor-visually developed, are more successful in education (15, 21, 22).

Meanwhile, Malinger and Longley (23) carried out a research similar to the present study in 1988. They administered Bender-Gestalt test to 20 normal kids and 20 children with learning disabilities, which was administered and scored by Koppitz method. Results showed that number of errors in children with learning disability is significantly more than number of errors in normal kids. In present study, after analyzing collected data, it was found that the number of errors in drawings made by students with EWD (according to 30 criteria of Koppitz) is significantly more than normal students. Similar findings of different researches on this case indicate that there is a direct relationship between learning disability and visual-motor coordination.

The second hypothesis, saying that brain damage in students with EWD is more than healthy students, was rejected and the null hypothesis was confirmed. According to the conclusion above it is understood that there is no relationship between brain damage and disability in expressive writing. In other words, students with expressive writing disability have a healthy neural system and there is no lesion in their brain. This result is on the contrary with some theories and findings and so the research gets some ambiguities, because various theories introduce different causes for learning disorder. Some theoreticians have focused and emphasized on brain damage (24). Others notice the attention limitation, ways of information processing, motor development and so on. Therefore, on one hand the present result is an approval to theories opposing the brain damage view, but on the other hand puts an obvious paradox in research findings. Because some of the conducted researches are indicating neural signs in children with learning difficulties (Reference (25) leads to general acceptance of learning disabilities as a sort of minor brain damage). Hence, neural overhaul is yet a part of learning disability diagnosis stage. Hence it is difficult to make a distinct interpretation and conclusion of the present study, and the following should be taken into consideration:

Scholars hold various views about diagnostic ability of Bender-Gestalt test in brain damage. Some believe it an appropriate device for identification of minor brain damage. Others believe that Bender-Gestalt visual-motor test does not give detailed information on damages; it is limited to identifying major brain damage in right hemisphere and is unable to help diagnose minor brain damage and left hemisphere damages (26). Although Bender considers his test a suitable instrument for diagnosing neural disorders and brain damages and believes that visual-motor perception is an integral action of the individual's whole personality that is controlled by cerebral cortex, he suggests that it should be used with caution when it is taken as a device for diagnosis of brain damage. Things such as answering time, repeated erasing, and long hesitations should be taken into consideration as well

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as method of administration and marking, individual's background evaluation, and use of neural and other specialized tests (27).

The last point is that sometimes it is difficult to diagnose brain damage exactly as it is because both organic and functional disorders lead to mistakes in drawing test images (14).

Conclusion

The present research has tried to shed light on theories of causes of learning disabilities and purify previous research findings with emphasis on role of senso-motor aspects and brain damage in these disorders. Expressive writing disorder (EWD) has made the basis for work. Based on our findings it could be concluded that normal children have higher visual-motor coordination compared with children with EWD. It indicates that those who are relatively more developed than their peers, in terms of visual-motor perception, are more successful in education, especially in expressive writing. But there isn't any significant relationship between brain damage and EWD.

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