Comparing the effectiveness of central nervous system reorganization method (Domain-Delacato) and neurofeedback on improving reading skills of dyslexic children.

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ARTICLE INFORMATION	ABSTRACT
	Background and purpose: Dyslexic children have a combination of problems related to learning the connection between sounds and understanding the abstract symbols of letters; Therefore, they have difficulty recognizing letters, dividing words into letter sounds, combining expressions into words, spelling, and writing. Therefore, the present study was conducted to compare the effectiveness of the central nervous system reorganization method (Domain-Delacato) and neurofeedback in improving the reading skills of dyslexic children. **Methods**: The current research was a semi-experimental study with a pre-test and post-test design with a control group. The statistical population of the present study consisted of all students aged 10 to 13 with reading disorders who were referred to educational and clinical centers in Qochan city in the academic year of 2018-2019. The research sample included 45 subjects who were selected by the available sampling method and were randomly placed in three experimental groups 1 (15 people), experimental 2 (15 people), and control (15 people). The reading and dyslexia test of Karmi Nouri and Moradi (2008) was used to collect data. For the statistical analysis of the data, the analysis of covariance was used with the help of SPSS software. **Results**: The results indicate that the method of reorganizing the central nervous system (Domain-Delacato) and neurofeedback, compared to the control group, improved the scores of reading skills and reading components of words, word chain, rhyme test, naming pictures, understanding text, understanding words, deleting Sounds, pseudowords, and nonwords, letter signs and categorized signs (P<0.05). The neurofeedback group has been more effective in increasing reading skills and components of word reading, word chain, rhyme test, naming pictures, understanding words, pseudowords and nonwords, and category signs than the central nervous system reorganization method (Domain-Delacato). Also, there is no statistically significant difference between the effectiveness of the central nervous system reorganization method (Domain-Delacato) compared to neurofeedback in increasing the scores of text understanding, removing sounds, and letter signs (P>0.05). **Conclusion**: The research results and the examination of the hypotheses showed that the method of reorganizing the central nervous system (Domain-Delacato) and neurofeedback is effective in improving the reading skills of dyslexic children.

Introduction

Learning disorder is one of the most common childhood disorders and the most common learning disorder is reading disorder (Sadock, Sadock, & Ruiz, 2015). Dyslexia is a type of disorder in confusing words that are similar to each other, reading words upside down, guessing words according to the beginning and end letters, having many problems in spelling words, having difficulty in distinguishing parts from the whole, and having unwillingness and aversion to learning to read (Tulin, 2019). About 4 to 8 percent of school-age children in the United States have dyslexia, which includes a variety of reading, spelling, and comprehension deficits. Also, dyslexia is seen in approximately 75% of children and adolescents with specific learning disorders along with reading deficits (Sadock, Sadock, & Ruiz, 2015). Rao, Raj, Ramanathan, et al. (2017) reported the prevalence of dyslexia disorder as 13.67%.

Dyslexic children have a combination of problems related to learning the connection between sounds and understanding the abstract symbols of letters; Therefore, they have difficulty in recognizing letters, dividing words into letter sounds, combining phonemes into words, spelling, and writing. They appear to have difficulty in all levels of information processing and various academic domains (Smith-spark, Henry, Messer, Edvardstoittr, & Zeicik, 2019). Dyslexic students struggle with phonological strategies (especially when words are presented aurally) and vocabulary recognition (Schneider, Goodters, Hussey, Hickey, & Wacher, 2019). The most common problem of dyslexic children is problems in identifying, manipulating, encoding, and decoding words. Performance in these tasks is considered one of the most critical and realistic predictors of reading ability (Meiran, Dreisbach, & Von Bastian, 2019).

According to the theory of reorganization of the nervous system, Duman and Delacato believe that the development of the nervous system has an order and predictable pattern. In humans, the development of this system is complete until the age of eight, and stopping its growth causes disturbances in every subsequent stage. In the theory of the nervous system, the neural development of each person is a repetition of a kind of growth and transformation (phylogeny), and everyone goes through the same and similar stages. Delacato believes that special skills such as walking, speaking, and reading are related to the complete development of the nervous system. In this regard, he considers many learning problems to be the result of disorders of this system caused by genetic factors, pregnancy infection, and environmental deprivation. In his opinion, learning disorders will be reduced if activities are provided that develop each level and stage of the nervous system. In this view, readiness to read is related to the nervous system, and 0.70 children whose nervous system is insufficient are caused by environmental deprivation. His treatment method is reorganizing the central nerves, relying on movement therapy programs, neuromuscular retraining such as rolling over, crawling in different ways, crawling on all fours, and walking, trying to mobilize movement patterns from the lower parts of the brain. (Delacato, 1998). Another new way to treat this disorder is neurofeedback. A recently used method to improve EEG abnormalities is EEG biofeedback or "neurofeedback". Neurofeedback is one of the neuropsychological educational and therapeutic methods so that in the process of operant conditioning, a person can learn to change the electrical activity of his brain. (Zoffel, Haster and Herman, 2011). Neurofeedback is a training program in which people reinforce their subjects (often 2,000 times or more during a 40-minute session). This is a relatively pure learning model in which there is no punishment, negative reinforcement, or emotional content and no need to talk. Neurofeedback provides the individual with a mechanism to normalize their cortical profile by decreasing slow wave activity and increasing fast wave activity; Therefore, it is expected that by compensating for the abnormality of the electroencephalogram, the person will show more attention and focus and enjoy a higher level of arousal (Rajabi, 2014). Considering the contradictions and

inconsistencies of some studies, as well as by examining the problems of these children and studying the research done on dyslexic children, it seems that these children need more investigations in reducing the symptoms, and also the studies showed that by enriching the growth environment and creating manipulation in the environment can return these children to the normal process of their lives. Therefore, according to the results of previous studies, the existing challenges, and the lack of study in this field, the present study was conducted to compare the effectiveness of reorganizing the central nervous system (Domain-Delacato) and neurofeedback on improving the reading skills of dyslexic children.

Method

The present study was quasi-experimental with a pre-test and post-test design with a control group. The statistical population of the present study consisted of all students aged 10 to 13 with reading disorders who were referred to educational and clinical centers in Qochan city in the academic year of 2018-2019. A total of 45 people with reading disorders were selected by available sampling method; and were randomly divided into three groups of 15 people. Criteria for entering the research: 1) having a reading disorder; 2) age range 10-13 years; 3) having natural intelligence; 4) not having accompanying problems such as hyperactivity; 5) not having specific mental and physical problems; 6) having consent to participate in the research.

Tools

1. Reading and Dyslexia Test: This test was standardized by Karmi Nouri and Moradi (2004) for male and female students in the first to fifth grades of monolingual (Persian) and bilingual (Tabrizi and Sanandji) primary schools and includes ten sub-tests. Word reading test: this test includes three lists of 40 words and three levels of words (such as lead, fox) with Cronbach's alpha 0.98, words such as a table, and bus with Cronbach's alpha 0.99 and words such as (water, hail) with alpha Cronbach's were 0.91 in this research; Reading test of meaningless words: In this test, the subject reads 40 words. Cronbach's

alpha was 0.85 in this research. Word comprehension test: This test consists of 30 multiple-choice questions where the student chooses one of the four options as the correct answer (for example, price means? A: price, B: loan, C: loan, D: interest); Word chain test: the subject separated a text that consisted of 109 words without spaces (such as America cow). Cronbach's alpha in this research is 165. Obtained; Text comprehension test: This test includes two subtests (common text for second and third grades and two specific texts for each grade). The number of words in the texts is 320 and 340 words, and eight questions with four options are considered for each text (text question example: Where did the dragonfly live?); Rhymes test: This test consists of 20 rhyming words that the subject finds the rhyming word of the target word; Picture naming test: This test includes two versions of A. Web. Each version has 20 shapes, and the student remembers the look and name of each shape (eg, a picture of a dog and a hat); Vowel elimination test: this test contains 30 words; The subject says each word after removing the desired sound; Letter sign test: This subtest consists of three letters (M, A, N). The subject remembers the number of words that begin with this letter (for example, with the letter M, pencil, man, banana); Word sign test: This subtest contains six words (boy's name, girl's name, fruit name, kitchen utensils, body parts, and colors), and the subject remembers the number of words related to each category. This test is performed individually, and according to the cut-off point of this test (157), students whose score is 157 or less 157 (114 errors or more) in this test. Bode is diagnosed as a dyslexic student. In Hosseini et al.'s research (2015), the overall Cronbach's alpha for high-frequency vocabulary tests was 0.97, with medium frequency 0.98, with low frequency 0.98, word chain 0.95, rhyme 0.89, naming pictures 67. 0, naming two pictures 0.68, understanding text 0.48, understanding words 0.71, eliminating sounds 0.95, reading non-words 0.95, and pseudo-words 0.97 were obtained. Also, the factor analysis results in Hosseini et al.'s research (2015) showed that this test consists of

two main factors. The first factor includes high and medium-frequency vocabulary tests, understanding words, removing sounds, reading non-words and pseudo-words, and The second factor includes tests of word chain, rhyme, naming pictures, naming pictures 2, and understanding text and signs.

2. Delacato intervention method: The Delacato treatment guide was used in this study. The whole treatment, including four stages and 86 treatment sessions, was carried out daily and individually at certain hours.

The first stage includes:

One-sided crawling for 5 minutes about 80 times, 2- sleeping on the stomach, 3- listening exercise for 8 minutes, 4- vision exercise for 8 minutes, a total of 21 minutes every day in the first stage for three weeks

The second stage includes:

Walking on all fours with an intersection pattern 30 minutes, 2- Speech listening training 4 minutes, 3- Reading listening training 15 minutes, 4- Vision training 4 minutes, a total of 53 minutes, daily training for three weeks.

The third stage includes:

Walking with an intersection pattern 20 minutes 2- Hearing training 8 minutes 3- Visual training 8 minutes 4- General body coordination 30 minutes 5- Right and left orientation 10 minutes, a total of 76 minutes a day for six weeks.

The fourth stage includes:

Lateral dominance activities, 2- writing for 20 minutes, 3- jumping for 10 minutes, 4- foot dominance for 15 minutes, 5- ear dominance for 10 minutes, 6- blinking for 4 minutes, 7- walking for 4 minutes, 8- aiming for 4 Minutes, 9- Looking through the hole for 4 minutes, a total of 60-90 minutes a day for 8-10 weeks.

3. Intervention method of neurofeedback treatment: First, a history was taken from the clients and done for the initial diagnosis and evaluation of these children. We put the child on a comfortable chair for the performance and asked him to be completely calm. Neurofeedback has sensors called electrodes on the patient's scalp and two other electrodes that were placed on the client's ears. Then a Base Line of the brain

hemispheres by neurofeedback in the front and back, right and left hemispheres, which includes the F4 area; FZ; F3; CZ; PZ, was performed, and evaluation was done in CZ area in 5 modes: eyes open, eyes closed, reading, listening, and drawing. The filters were set manually, the beta band was 15-22 and the SMR band was 12-15 Hz, and the threshold was set automatically so that the person could go up with his ability and get points. Flexicomp Infinitie neurofeedback model has 110 megabytes and 200 grams of weight, its size is 130mmx 95mmx 37mm, and the sampling frequency is 2048 samples per second. It has external sensors and automatic grading, and it has memory card-compatible sensors that can be connected to the computer through an optical fiber. It can install softwares like Bio graphinfinitie with developer tools, independence check, EEG, and data recording capabilities. Therefore, this device with suitable quality is used for research works .

Results

The mean and standard deviation of the age of the participants in the Duman-Delacato group was 12.78 (3.54), the neurofeedback group was 12.48 (3.13), and the participants in the control group were 12.38 (3.24). As you can see in the descriptive index table, the pre-test reading skill scores and their components in the three groups are similar. It can also be seen that the average reading skill scores and their components in the two test groups increased in the post-test compared to the pre-test, and the average reading skill scores and its components in the control group did not differ significantly in the pre-test and post-test. Table 2 shows the results of covariance analysis to investigate the effect of group membership on reading skills scores.

The results showed that there is a significant difference between the average scores of reading skills according to group membership (experimental groups and control group) in the post-test phase (F = 60.447 (2.44) and P < 0.01); Therefore, there is a difference between the effectiveness of central nervous system reorganization method (Domain-Delacato) and

neurofeedback on improving the reading skills of dyslexic children.

The results showed that in the post-test stage, the method of reorganizing the central nervous system (Domain-Delacato) and neurofeedback increased reading skills compared to the control group (P<0.05). Also, there is a statistically significant difference between the effectiveness of the central nerve reorganization method (Domain-Delacato) compared to neurofeedback in increasing reading skills (P<0.05). The neurofeedback group has been more effective in increasing reading skills than the central nervous system reorganization method (Domain-Delacato). Also, the significance levels of all tests indicate that there is a significant difference between the subjects of the experimental group and the control group, at least in terms of one of the dependent variables (10 components of reading skills) (P<0.01). As a result, between the average scores of reading words, word chain, rhyme test, naming pictures, understanding text, understanding words, removing sounds, pseudo-words and non-words, letter signs and category signs of the participants according to group membership (experimental and control groups) in the stage After the test, there is a significant difference (P<0.01). According to the results in the post-test stage, reorganizing the central nervous system (Domain-Delacato) and neurofeedback increased the scores of reading words, word chain, rhyme test, naming pictures, understanding text, understanding words, removing sounds, pseudo-words, non-words, letter signs, and categorized signs compared to the control group. (P<0.05). Also, there is a statistically significant difference between the effectiveness of the central nervous system reorganization method (Domain-Delacato) compared to neurofeedback in increasing the scores of reading words, word chain, rhyme test, naming pictures, understanding words, pseudo-words and non-words and category signs (P<0.05). The neurofeedback group has been more effective in increasing the scores of reading words, word chains, rhyme test, naming pictures,

understanding words, pseudo-words and non-words, and category signs than the central nervous system reorganization method (Domain-Delacato). Also, there is no statistically significant difference between the effectiveness of the reorganization method of the central nerves (Domain-Delacato) compared to neurofeedback in increasing the scores of text understanding, removing sounds, and letter signs (P>0.05).

Conclusion

This study aimed to compare the effectiveness of the central nervous system reorganization method (Domain-Delacato) and neurofeedback in improving the reading skills of dyslexic children. The results showed that between the average scores of reading skills and the components of reading words, word chain, rhyme test, naming pictures, understanding text, understanding words, removing sounds, pseudo-words and non-words, letter signs, and category signs. According to group membership (experimental groups and group control), there is a significant difference in the post-test stage; In explaining the obtained results, it can be suggested that the changes in the behavior level are a reflection of the changes in the brain level. As a therapeutic method, Neurofidic has focused its work on brain waves, and the changes in the behavior level can be considered as the result of changes in brain waves. However, this only sometimes happens; that is, we sometimes see behavioral changes without changes in the measured brain waves. In explaining this issue, it can be said that trying to change brain waves through methods such as neurofeedback leads to changes in the brain level. Any kind of change in the brain's electrical activity that follows treatment causes a reorganization of the entire bioelectrical system, which in turn creates a pervasive, natural, and reflexive normalization response in the brain that leads to recovery. Therefore, the relationship between the change of brain waves and behavioral changes is not linear and two-way, where one change leads to an apparent change in the other. It is visible and measurable for us.

In the present study, a large part of the solution to reading disorders can result from compensation

for environmental deprivation. It is in this part that the effectiveness of Delacato's treatment method, which includes reorganizing the central nerves, is revealed. This method relies on movement therapy and neuro-muscular retraining programs such as rolling, crawling in different ways, moving on all fours with an intersection pattern, walking with an intersection pattern, hearing training, vision training, and orientation tries to acquire movement patterns. It has not been used in the past from the lower parts of the brain (Delacato, 1966; 1963); In other words, in Delacato's view, readiness to read and write is related to a complete nervous system, and 70% of children whose nervous system is not sufficient to face speech and writing problems. The important assumption of this theory is that movement can be used to improve and develop cognitive and perceptual skills and treat children with learning disorders (Hiness, 2001). Therefore, according to the results obtained from this research, by performing Delacato's sensory-motor movements, the brain is used again from a motor and sensory point of view, and learning disorders become less prominent. In other words, although we cannot revive dead brain cells, we can activate many inactive living cells (Delacato, 1992).

It is recommended to use the random sampling method with a larger sample size and students with different intelligence distributions to increase its external validity and generalizability.

Conflict of Interest

The authors of this article have no conflict of interest in conducting and writing it.

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