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ADDRESSED AND ASSEMBLED PHONOLOGY OF BIDIRECTIONAL SOUND-TO –PRINT CONVERSIONS IN STUDENTS WITH DYSLEXIA AND A REFERENCE OF INVESTIGATION RESULTS TO CORRESPONDING FUNCTIONAL LOCALIZATION IN BRAIN CORTEX

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Abstract:
Thirty students with dyslexia and 30 age-matched normally developed controls participated in a study to compare group performance and to examine their ability to convert auditory and visual verbal stimuli in two-way directions. Three experiments and 13 tasks were administered to the students and 3 types of activities were explored. The first one was focused on the student's skills to match a heard word to a printed word, the second one was oriented to their skills to match a heard pseudo word to a printed pseudo word and the third one was an examination of their ability to readun familiar letter's strings. The elaborated results showed that there are statistically significant differences between the focus group and the controls regarding to the explored operations. In fact the examined dyslexic children cannotmake conversions of phonological input into orthographic representation properly. It refers as to meaningful stimuli (addressed phonology), as to pseudo words (assembled phonology) as well. They have also difficulties in print-to-sound conversions when they read pseudo words. A reference to other studies ,focused on brain cortex activation and reading shows that the deficient pseud word reading depends on the dysfunctions of left posterior superior temporal gyrus and when the reading difficulties refer to meaningful stimuli and whole-word phonological conversions (addressed mechanism), it is connected to deficient operations in left posterior middle temporal gyrus. The described difficulties and particularities of students with dyslexia, analysed and explained through the addressed and assembled mechanism deficits ,can be an important base for appropriate treatment approaches and a directional point to the arrangement of speech and language therapy and oriented to the etiology educational interventions.

Keywords: - *dyslexia, sound-to-print conversions, phonological representation, orthography, pseudo words, addressed mechanisms, assembled mechanism.*

INTRODUCTION:

Exploring learning disabilities is an educational issue having some significant psychological, social, and medical aspects. The ability to read is a crucial condition for personal development and when it is destroyed, to clarify the etiology is a necessary point of reference which the interventions, treatments and educational programmes have to be based on. There are criteria for identifying specific reading disabilities or dyslexia. There is neither visual impairment (B.A. Shaywitz, Fletcher & Shaywitz, 1995), nor motor and praxis deficits in the eye movement. The general development is not frustrated and the mental capacity of the individuals with dyslexia is intact Cases of specific reading disability are not a result of economic, social, cultural or language deficiency of the environment. To form skills to decode printed words is a typical difficulty for dyslexic pupils. Their phonemic awareness is underdeveloped too and they have also limited or low functioning immediate phonological memory (Blach man 2000), (Fletcher et al., 1994). The preschool age of these children shows good developmental indicators excepting some subtle predictors for expectable further learning difficulties. For example such a predictor is a delayed or imperfect ability to use rapid automatized naming. According to scientific researches the prevalence of dyslexia is ranged from 5% to 17 % of the school-age population (Lyon 1995).In fact the reliability of identification of dyslexia depends on the samples and the criteria through which the development of pupils is evaluated. There are specificities which have to be explored, clarified and explained in details regarding rates, tendencies and particularities of the development of every new generation of dyslexic children. An important question for researchers is to know what does frustrate the pupils with specific learning disabilities to achieve satisfactory written language acquisition, and the experts supporting them need a holistic picture revealing the mechanisms of information processing. Therefore a lot of scientific studies are provided in the area of knowing how does the brain work when the individuals read and what does happen when reading process is destroyed. Many investigative approaches like invasive technique (electro cortiacl stimulation mapping), non-invasive functional imaging technique, measure of cerebral blood flow and positron emission tomography are implemented to find more particularities and specificities in regards to neurophysiological and neuropsychological mechanisms of reading and its disorders. It is a directional point for the speech and language therapy and all the educational interventions. Medical diagnostics serving many subtle details about processing of spoken and written verbal information in the brain makes treatments for dyslexic pupils more effective and oriented to the explainable sequences of the established etiology.

1.0Neuroanatomy and neurophysiology of the reading process the initial input of reading process starts with visual perception of written or printed verbal stimuli. All the signals received by the retina (and especially by fovea central is) are directed to the primary visual cortex in the both of brain hemispheres. The optic nerves are transformed into optic tracts after their partially crossing in the optic chiasm and the information is served to the Brodmann's area 17in both of the hemispheres. There is a fissure called sulcus calacarinus which divides the area into two parts -the upper one cuneus and another one called gyrus lingual is. Both of them consist the primary visual cortex (Brodmann'sarea 17) in the occipital lobe where the visual information is delivered but needed some phases of additional specialized processing. Firstly such processing is made by the secondary association visual cortex including Brodmann's areas 21 and 22. Generally the temporal part of it defines what the observed objects are (regarding their forms, proportions and characteristics)and the parietal part of secondary visual cortex catches their spatial location. The secondary association areas have crucial role for the recognition of real or drawn objects and some neurons located there provide the identification of letters which is an inevitable premise for reading. The role of tertiary association areas is also very significant because of the assembling of already processed multisensory information which is the highest stage of its refining. For example the angular gyrus (Brodmann's area 39) located in lobulus parietal is inferior in left hemisphere is a pivot where all the operations (involving signs like letters, numbers, notes, symbols, etc.) are arranged and implemented .It is established that without participation of Broca's area (Brodmann's area 44 in left gyrus frontal is inferior) reading is impossible .The Broca's area is a secondary association region where a praxis function specialized to speech sound pronunciation is located. The articulation praxis is a programme which conducts and orchestrates all the collaborative movements of the tongue, the lips, the soft palate and the vocal cords as a potential ability to provide appropriate co-articulation and utterance. When a reader reads aloud, it is inevitable that he or she has to use this kind of praxis. Contemporary studies based on positron emission tomography have served a lot of evidences showing that even during the silent reading the neurons in the Broca's area a reactive. That means that the articulation praxis is an important part in the reading mechanisms. The Broca's area is connected to angualar gyrus directly without any functional mediators and the both of regions have a permanent informational exchange during the reading process. This is necessary because of the print-to-sound conversions which the reading is based on. The way of which the speech sounds are pronounced is a distinguish key for stable connections between the graphemes and the phonemes which they represent. The human ability to identify phonemes is located in the left temporal lobe in the area of Wernicke (Brodmann's area 22) which is a secondary association region adjacent to primary auditory cortex in gyrus temporalis inferior .It is a gnosis function which makes the phonemes distinctive and recognizable. This is another important pivot in the left hemisphere contributing to the formation of workable correspondence between phonemes and graphemes and mechanisms of their two-way representations in written language. There is a bundle of neurons (arcuate fasciculus) which bidirectionally connects the Broca's area and the area of Wernicke. It is also a part of the physiological mechanism of the reading process. Some cortex regions connected to semantic processing of information during the reading are located in frontal and parietal lobes. There are also motor conducting functions involved in the readings mechanisms. They control the eye movement by the participation of the external eye muscles. For example the frontal eye field (area 8) located in posterior part of the middle frontal gyrus has a crucial role for the reading skills. This field initiates and organizes voluntary scanning movements of the eye and it is independent of the visual stimuli but it is

connected to the visual area of occipital cortex by association fibres. The gaze praxis is also an important part of reading ability. It is a programme in the left premotor cortex setting the eye movement in a way allowing the text to be fixed and scanned properly by the gaze. Neuro physiological and neuro psychological reading mechanisms hardly could be depicted and explainable enough in a short review. Therefore aschematic outlining of the included levels in reading process can be used here. It is a simplified but enhancing the levels and functional specifications model. Mavlov (Mavlov, 1997) presents such a hierarchic model of the process of verbal communication. It includes two scales referring expressive and impressive functions. The expressive scale has psychological, language, praxis and neurological levels of successively and hierarchically up-down relaying information. The same information in the impressive scalepass successively down-up directed and relay through neurological, gnosis, language and psychological levels. Both of the scales have symmetric levels but the direction of the relaying information is opposite. Figure 1 presents a separated part of this model focused on the impressive functions only and regarding especially the reading process .Figure 1.Levels of reading process according to the Mavlov's hierarchic model of verbal communication .Finally the anatomic review of reading mechanisms could be resumed in a short simplified version which highlights the relations between some structures and functions in the brain cortex: They could be summarized and generalized in this way –the temporal lobe provides phonological awareness and decoding/ discrimination of speech sounds (phonemes); the frontal lobe is responsible for speech production, reading fluency, grammatical usage and comprehension; the angular gyrus and the supra margianal gyrus serve polymodal informational integration and processing, letters connections and they also link different parts of the brain together to execute the action of reading.

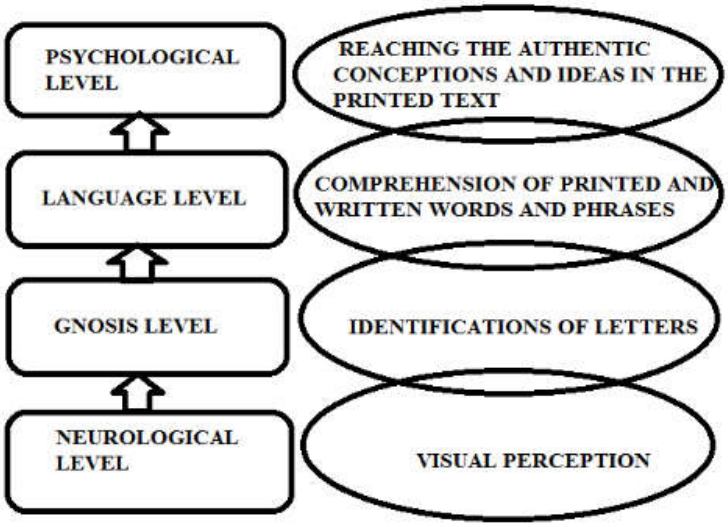

Figure 1. Levels of reading process according to the Mavlov's hierarchic model of verbal communication.

Finally the anatomic review of reading mechanisms could be resumed in a short simplified version which highlights the relations between some structures and functions in the brain cortex: They could be summarized and generalized in this way –the temporal lobe provides phonological awareness and decoding/ discrimination of speech sounds (phonemes); the frontal lobe is responsible for speech production, reading fluency, grammatical usage and comprehension; the angular gyrus and the supra marginal gyrus serve polymodal informational integration and processing, letters connections and they also link different parts of the brain together to execute the action of reading

2.0Rationale of the Study:

There are many sections and components included in the reading process. A crucial operation which is typical for the reading implementation is the conversion of the graphemes into phonemes. But the conversion of the letters into speech sounds does not mean that the verbal information is comprehended. On other hand different kinds of conversions are used during the reading process. Print-to-sound conversions of the words are not the same in every case and it depends on the semantic aspects and the comprehensibility of the text. The purpose of reading is to comprehend printed or written information but sometimes people have to read unusual names of persons or geographic objects or even rare unknown words. In fact they use different strategies for conversions of letters into speech sounds according to that whether the printed information is meaningful or not for them. (Panagiotis et al, 2002).There is a model explaining the process of reading which presents two independent mechanisms of reading (Coltheart et al 1993). The first one is called addressed or lexical mechanism which is a conversion of visual input to a whole-word phonological representation by means of the word meaning. The complexity of orthography does not make reading slower or too difficult for experienced readers. The addressed mechanism allows many words with complex orthography and rare print-to-sound correspondences to be read properly without any misunderstanding and difficulties. It refers to words having specific written lexical representation. This mechanism works processing meaningful verbal stimuli. It initially involves access to a lexical representation that subsequently mediates the retrieval

of the word's name (Coltheart et al 1993).This route of reading possesses entries to a hypothetical "semantic lexicon "and a hypothetical "visual lexicon". The effectiveness of the addressed mechanism depends on the frequency of the written and printed words usage. When they are well known for the readers and when they are often encountered in previous experience, the mechanism of their orthography recognition as whole-word representation (based on an access to "visual lexicon" and to the "semantic lexicon") is more effective and easily implemented. Another reading mechanism of print-to-sound conversions is actually sublexical and it is called assembled mechanism (Simos et al, 2000a). It provides phonological decoding –mapping of individual orthographic segments onto appropriate phonological representation. The assembled mechanism is needed to decode unfamiliar letter's strings. In fact the only way pseudo words (non words) to be read is the assembled mechanism of reading to be used. It makes the reading of meaningless and unfamiliar stimuli possible .The current study was focused namely on the addressed and the assembled phonology in regards to reading disabilities. What was a specific approach in the study was the exploration of two-way conversions referring to letters and sounds relations. The reading process is based on print-to-sound correspondence. It is a conversion of graphemic input onto phonological representation. The current study ranged bidirectional conversions and it is important to be known whether the differently directed conversions have the same effectiveness or not and how does it make any influence upon the ability of dyslexic children to read.

3.0Objectives of study:

Following were the objectives of the present study.

1. To explore addressed mechanism of the conversion of phonological input onto a graphemic representation in students with dyslexia and their no impair edage-mates

2. To explore assembled mechanism of the conversion of phonological input onto a graphemic representation in students with dyslexia and their no impaired age-mates

3. To explore print-to-sound correspondences in reading of unfamiliar letter's strings (pseudo words) by students with dyslexia and no impaired their age-mates

4.To compare the effectiveness of addressed and assembled mechanisms of conversion of auditory input into a visual representation

5. To compare the quality of assembled conversions based on sound-to-print correspondence and print-to-sound correspondence

6. To find potential significant differences between students with dyslexia and their no impaired age-matesin the area of the examined processes and operations

7.To make a reference to functional localizations in brain cortex,if some of the examined skills are underdeveloped and to juxtapose the results to findings of other studies In fact the conversion of phonological input onto an orthography representation is a typical operation for the process of writing. Such conversions were explored within the study by means of special task provoking sound-to-print correspondences without writing.

4.0Hypotheses of the Study:

Following were the hypotheses of the present study.

1.There are significant differences between dyslexic students and their no impaired same-age peers in regards to their ability to use the addressed mechanism of sound-to-print conversions

2. There are significant differences between dyslexic students and their no impaired same-age peers in regards to their ability to use the assembled mechanism of sound-to-print conversions.

3. There are significant differences between dyslexic students and their no impaired same-age peers in regards to their ability to read properly unfamiliar letter's strings (pseudo words).

5.0Variables of the Study

A) Independent variables Diagnosis

i.Dyslexia

ii.No impaired reading abilities

B) Secondary independent variables:Gender

i.Male

ii.Female

c) Dependent variables:

i.The ability to use the addressed mechanism of sound-to-print conversions.

ii.The ability to use the assembled mechanism of sound-to-print conversions.

iii.The ability to use the assembled mechanism of print-to-sound conversions.

8.0Population of the Study

Sixty pupils ,recruited from Bulgarian primary schools served as participants in the study. Half of them have been diagnosed with dyslexia by experts from Speech and language therapy center in Varna, Bulgaria. The rest of the participants had the role of control group as a base for juxtaposition and comparison of the results. All the children were third grade students studying in the year 2017 -2018 and having mean age from 8, 10 (years, months) to 9, 4. The gender proportion was 28 males, 32 females.

9. Method.
Three experiments were conducted during the study. The first one referred to the examination of the ability of students to use the addressed mechanism of sound-to-print conversions. The second one examined the ability of students to use assembled mechanism of sound-to-print conversions, and the third one was oriented to the ability of students to use the assembled mechanism of print-to-sound conversions.

Experiment 1
Stimuli Auditory and visual linguistic materials were implemented within the experiment 1. It includes 30 words used in 5 sessions. Procedure and Tasks the experimenter pronounced a word in every session. Every individually examined student had to point a word among 5 printed words and the pointed word had to be the same as the heard word initially pronounced by the experimenter. There had been intervals for4 seconds between the tasks. Every session included 1 heard and 5 printed words. One of the printed words was the same like the heard word. The rest of the printed words were polysyllable and had similarities with the initially auditory presented (pronounced by the experimenter) word. There were two types of similarities between the words. The first on was phonological similarity (for example two words differed having one different letter only) and the second similarity was semantic –some of the words were very close synonyms. All the 5 sessions of the experiment 1 were conducted to evaluate addressed sound-to-print conversions based on the meaning of the words, and every right answer was scored.

Experiment 2
Stimuli Auditory and visual materials were implemented within the experiment 1. It includes 30 unfamiliar letter's strings (pseudo words) used in 5 sessions .Procedure and tasks the experimenter pronounced a pseudo word in every session. Every individually examined student had to point a pseudo word among 5 printed pseudo words and the pointed pseudo word had to be the same as the heard pseudo word initially pronounced by the experimenter. There had been intervals for 4 seconds between the tasks. Every session included 1 heard and 5 printed pseudo words. One of the printed pseudo words was the same like the heard pseudo word. The rest of the printed pseudo words were polysyllable and had a phonological similarity with the initially auditory presented (pronounced by the experimenter) pseudoword .All the five sessions of the experiment 2were conducted to evaluate assembled sound-to-print conversions based on meaningless stimuli, and every right answer was scored.

Experiment 3
Stimuli A list of unfamiliar letter's strings (pseudo words, non-words) was used Procedure and tasks The examined students had to read aloud monosyllable and polysyllable pseudo words. The experiment 3 was conducted to evaluate assembled print-to-sound conversions and decoding of meaningless stimuli, and every correctly decoded and read aloud pseudo word was scored

10. Data Analysis
The researchers analyzed the collected data using some visualized details of descriptive statistics through histograms and box plots. The verification of the hypothesis was established by One-Way ANOVA.

11. Resultsand Discussion
The elaborated data revealed some differences between the groups and within the groups, and served evidences connected to the verification of the postulated hypotheses.

Hypothesis –1
There are significant differences between dyslexic students and their no impaired same-age peers in regards to their ability to use the addressed mechanism of sound-to-print conversions. Figure 2 shows a juxtaposition of the results of the students with dyslexia and their no impaired same-age peers in regards to their ability to use the addressed mechanism of sound-to-print conversions. Eighteen of the students in the control (no impaired students) group have the highest possible scores in the tasks to a match a heard word to the same printed word. All the rest of students in the same group are achieved the second possible highest result of 4 scores. In comparison the number of students with dyslexia who have achieved the maximum score is 6.There are two subsets only in the control group while the subses in the focus group of dyslexic pupils are 4 –the biggest one includes 8 males and 4 females having 3 scores (in contrast to 5 scores which is the highest possible).

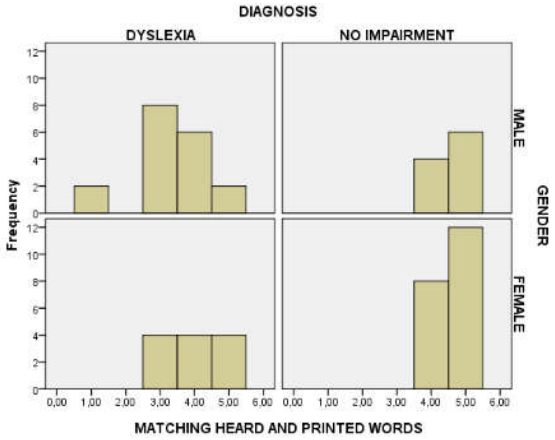

Figure 2.Juxtaposition of the results of the students with dyslexia and their no impaired same-age peers in regards to their ability to use the addressed mechanism of sound-to-print conversions

Table 1 presents descriptive statistics referring the addressed mechanism of sound-to-print conversion explored by tasks for matching heard words to printed words.The data shows that mean in controls is 4,6 compared to focus group having mean 3.6. Another distinctive difference is notable in the minimum scores which are 4 in controls and 1 in the target audience.

Table 1:Matching heard and printed words–descriptive statistics.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
DYSLEXIA	30	3,600	1,03724	,18937	3,2127	3,9873	1,00	5,00
NO IMPAIRMENT	30	4,600	,49827	,09097	4,4139	4,7861	4,00	5,00
Total	60	4,100	,95136	,12282	3,8542	4,3458	1,00	5,00

Figure 3 presents the proportions of right answers and a score comparison referring to focus group and controls.The lower perfonmance of dyslexic children is highlighted by box plot visualization.

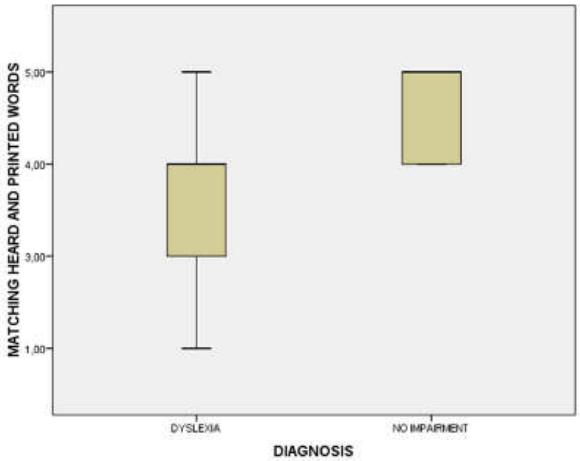

Figure 3. Matching heard and printed words.-differencesbetween dyslexic students and their normally developed age-mates in regards to their ability to use the addressed mechanism of sound-to-print conversions

Table 2presents that hypothesis 1 is not rejected (p-value < 0,01)and it is a verification of this hypothesis.

Table 2:Proofof statistically significant differencesbetween dyslexic students and their normally developed age-mates in regards to their ability to use the addressed mechanism of sound-to-print conversions by One-Way ANOVA

ANOVA

MATCHING HEARD AND PRINTED WORDS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15,000	1	15,000	22,656	,000
Within Groups	38,400	58	,662		
Total	53,400	59			

It shows that there are statistically significant differences between dyslexic students and their normally developed age-mates in regards to their ability to use the addressed mechanism of sound-to-print conversions.

Hypothesis –2

There are significant differences between dyslexic students and their no impaired same-age peers in regards to their ability to use the assembled mechanism of sound-to-print conversions

Figure 4shows a juxtaposition of the results of the students with dyslexia and their no impaired same-age peers in regards to their ability to use the assembled mechanism of sound-to-print conversions. The number of students having maximum scores in control group of normally developed pupils is 28 while the number of students having maximum scores in target audience is 14.There are two subsets only in thecontrol group as the second subgroupincludes 2 students only. The focus group is divided into 4 subsets two of them including cases with minimal and even no scores.

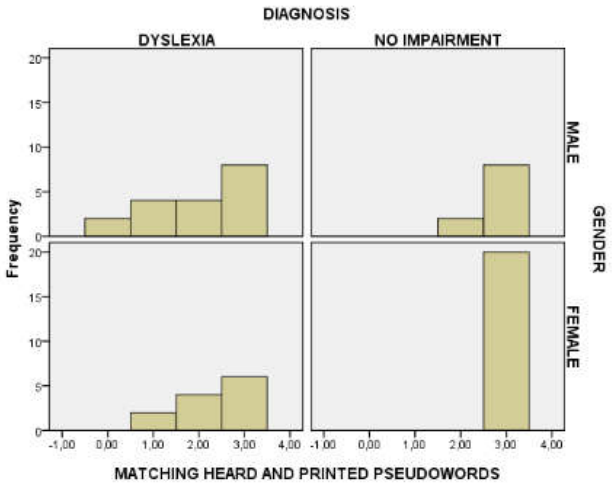

Figure 4.Juxtaposition of the results of the students with dyslexia and their no impaired same-age peers in regards to their ability to use the assembled mechanism of sound-to-print conversions.

Table 3presents descriptive statistics referring the assembled mechanism of sound-to-print conversion explored by tasks for matching heard pseudo words to printed pseudo words The data shows that mean in controls is 2,9333compared to focus group having mean 2,1333. Another distinctive difference is notable in the minimum scores which are 2 in controls and 0 in the target audience.

Table 3:Matching heard and printed pseudo words–descriptive statistics.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
DYSLEXIA	30	2,1333	,97320	,17768	1,7699	2,4967	,00	3,00
NO IMPAIRMENT	30	2,9333	,25371	,04632	2,8386	3,0281	2,00	3,00
Total	60	2,5333	,81233	,10487	2,3235	2,7432	,00	3,00

Figure 5 presents the proportions of right answers and a score comparison referring to focus group and controls. The lower performance of dyslexic children is highlighted by box plot visualization

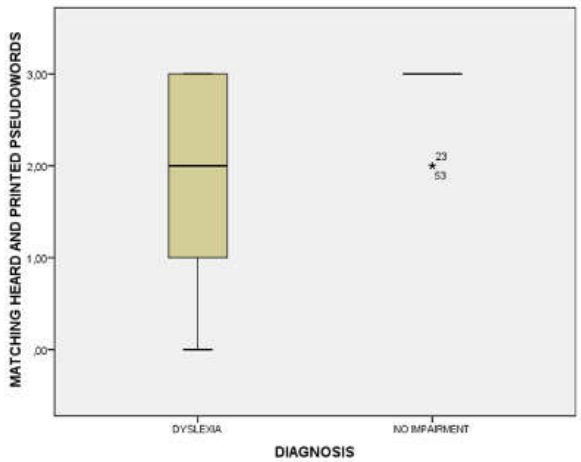

Figure 5.Matching heard and printed pseudowords -differences between dyslexic students and their normally developed age-mates in regards to their ability to use the assembled mechanism of sound-to-print conversions

Table 4presents that hypothesis 2is not rejected (p-value < 0,01)and it is a verification of this hypothesis.

Table 4:Proofof statistically significant differences between dyslexic students and their normally developed age-mates in regards to their ability to use the assembled mechanism of sound-to-print conversions by One-Way ANOVA

ANOVA

MATCHING HEARD AND PRINTED PSEUDOWORDS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9,600	1	9,600	18,982	,000
Within Groups	29,333	58	,506		
Total	38,933	59			

It shows that there are statistically significant differences between dyslexic students and their normally developed age-mates in regards to their ability to use the assembled mechanism of sound-to-print conversions.

Hypothesis –3

There are significant differences between dyslexic students and their no impaired same-age peers in regards to their ability to read properly unfamiliar letter's strings (pseudo
words).

Figure 6shows a juxtaposition of the results of the students with dyslexia and their no impaired same-age peers in regards to their ability to read pseudo words and to use the assembled mechanism of print-to-sound conversions. What is remarkable is the fact that all of students in the control group have maximum scores. The focus group is divided into 4 subsets. In fact within the all of the conducted experiments in the study the results of the target audience is always spread into 4 having different achievements subgroups

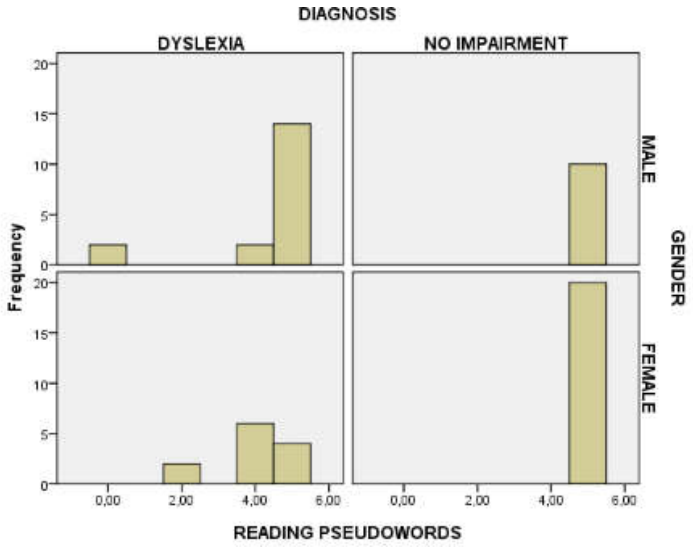

Figure 6.Juxtaposition of the results of the students with dyslexia and their no impaired same-age peers in regards to their ability to read pseudo words and to use the assembled mechanism of print-to-sound-conversions.

Table 5presents descriptive statistics referring the assembled mechanism of print-to-soundconversion explored by tasks for readingpseudowords.The data shows that mean in controls is 5 compared to focus group having mean 4,2. A very distinctive difference is notable in the minimum scores which are the same as the maximum scores in controls - 5 and 0 in the target audiencewhich is the lowest possible minimum.

Table 5:Readingpseudowords–descriptive statistics

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
DYSLEXIA	30	4,200	1,39951	,25551	3,6774	4,7226	,00	5,00
NO IMPAIRMENT	30	5,000	,00000	,00000	5,0000	5,0000	5,00	5,00
Total	60	4,600	1,06086	,13696	4,3260	4,8740	,00	5,00

Figure 7 presents the proportions of right answers and a score comparison referring to focus group and controls.The lower perfonmance of dyslexic children is highlighted by box plot visualization

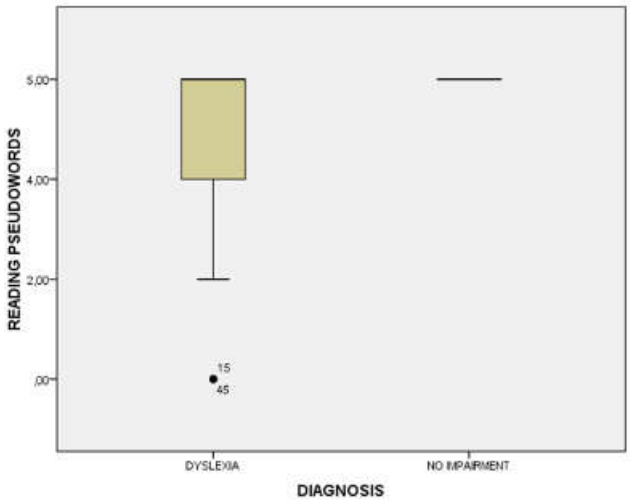

Figure 7.Reading peudowords -differences between dyslexic students and their normally developed age-mates in regards to their ability to read pseudowords and to use the assembled mechanism of print-to-sound conversions

Table 6presents that hypothesis 3is not rejected (p-value =0,003< 0,01)and it is a verification of hypothesis 3

Table 6:Proofof statistically significant differencesbetween dyslexic students and their normally developed age-mates in regards to their ability to read pseudowords and to use the assembled mechanism of print-to-soundconversions by One-Way ANOVA

ANOVA

READING PSEUDOWORDS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9,600	1	9,600	9,803	,003
Within Groups	56,800	58	,979		
Total	66,400	59			

It shows that there are statistically significant differences between dyslexic students and their normally developed age-mates in regards to their ability to read pseudowords and to use the assembled mechanism of print-to-soundconversions.The revealed and outlined deficits in processing of bidirectional phonological-graphemic conversions in students with dyslexia could be referred to many other scientific studies focused on functional localizations in brain cortex. Through many different techniques (likeinvasive technique (electrocortical stimulation mapping), noninvasive functional imagingtechnique, measure of cerebral blood flow and positron emission tomography)itis established that the ability to use addressed print-to-soundconversionsis located inthe brain cortex areas as it is shown in figure 8

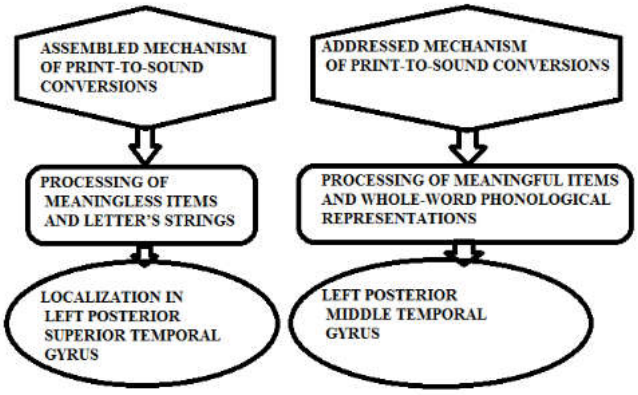

Figure 8.Assembled and addressed conversions and their functional references to localization of brain cortex activation.

More detailed explanation of these facts as a result of a study is presented by Panagiotis, Simos, Breier, Fletcher Foorman, Castillo and Papanicolaou: "Reading of meaningful items entailed a high degree of activation of the

left posterior middle temporal lobe (MTGp) and mesial temporal lobe areas, whereas reading the meaningless pseudo words was associated with much reduced activation of these two regions. Reading of all three types of print(meaningful words including exception words, pseudo homophones like burth, and pseudo words) resulted in activation of the posterior superior temporal gyrus (STGp) inferior parietal and basal temporal areas. These findings are consistent with the existence of two different brain mechanisms that support phonological processing in word reading: one mechanism that sub served assembled phonology and depends on the posterior part of superior temporal gyrus, and a second mechanism that is responsible for pronouncing words with rare print-to-sound correspondence sand does not necessarily involve this region but instead appears to depend on middle temporal gyrus." (Panagotis et al, 2002).Concerning that the current study was administered to participants whose primary spoken and written language is Bulgarian, we have to make some remarks about the addressed mechanism of reading. A short cross linguistic juxtaposition between Bulgarian and English could show that both of them are too distinguishable from each other .In this association what we are obliged to pay attention to is the phonology of so called exception words. They are a significant part of English orthography while there are no exception words in Bulgarian written language. A huge number of the phonemes in Bulgarian phonetic system (without a few of all 45) are represented by unchangeable monographs in the alphabet. On the other hand the order and the arrangement of graphemes in a written (printed) Bulgarian word follow the order and the arrangement of the phonemes which they represent in the same spoken word. It seems that this is a conversion typical for the assemble mechanism. But actually the addressed mechanism exists in print-to-sound conversions in Bulgarian readers and it is used in whole-word reading of meaningful items which is a functional specialization of the left posterior middle temporal gyrus.

12.Findings of the Study:

Following were the findings of the study:1.There is no dissociation of the deficits of print-to-sound and sound-to-print conversions -the deficits found within the present study and referred to these mechanisms are bidirectional.2.About the explored target audience some difficulties and statistically significant differences between the examined focus group and the examined control group are registered. They are connected to the ability of dyslexic students to use:•Addressed mechanism of conversion of phonological input onto a or the graphic representation•Assembled mechanism of conversion of phonological input onto a or the graphic representation•Assembled mechanism of decoding and conversion of visual input of unfamiliar letter's strings onto a phonological representation

13.Conclusion:

The enhanced dependence between the outlined in the current study underdeveloped abilities of dyslexic students, and the mentioned reciprocally corresponding with them regions of activation in brain cortex is a starting point for the approaches and the arrangement of different kind of interventions. A gradual physiological stimulation of low functioning brain mechanisms and the coordination between medical, neuropsychological, psychological, educational and speech therapy experts is the most effective way of treatment .The team work is a crucial condition for achieving good results in therapy approving the ability of dyslexic children to develop. Knowing dysfunctional mechanisms and processing deficits of the development of these children specialist scan optimize the quality of treatment and will conduct more effective interventions than making partial attempts from one kind of expertise only. The inclusion of many different experts in the team work means a highly effective range of information and deepness in the interpretations, and as a result of it additional expertises are available. Therefore applying neuropsychological approaches, and using data and analysis of many studies the experts can find a better way to optimize possibilities or even in the heaviest cases the severity of disability could be mitigated and reduced due to multi-professional interventions according to the specificities and the needs of the impaired individuals. In other word the collaborative efforts of educators, speech and language therapists, neuropsychologists and other experts oriented to brain capacity and destroyed functions will be effective enough based on well explained etiology and clear reveal of misconducted mechanisms.

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