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Mini-Review Article

Neuropsychological Analysis of Dyslexia

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Abstract

Scientific research attempts to shed light on the nature of the functional abnormality of the dyslexic student that leads to the intense difficulty in recognizing letters. The question of whether it is endogenous or environmental factors that cause the impairment has been resolved and the innate nature of dyslexia is now known. What scientists are trying to discover is how this functional damage manifests itself, and consequently, which functions are not carried out in the correct way, resulting in reading and writing disorders. Opinions on this topic are guided by the discipline to which the scientist who will research it belongs. The present study concerns the neuropsychological perspective of dyslexia.

Keywords: dyslexia; neuropsychology

Summary

Visual agnosia originates from lesions of the left occipital parietal cortex as well as from lesions of a special area (splenium) of the middle lobe. The result of visual agnosia is the appearance of grammatical dyslexia. In other words, it is an inability of the child to individually recognize the letters of the alphabet and associate their linguistic meanings [1]. For this type of dyslexia, the term "lexical blindness" was also used, which means that this patient can see the word but cannot understand it. Visual search and discrimination is disrupted by lesions of the right parietal, occipital, and frontal cortex[1]. Especially if the lateral fields of the frontal lobes malfunction, depth perception is significantly disturbed. However, the left hemisphere seems to be responsible for the perception of letters and words. The right hemisphere seems to be responsible for the perception of shapes and images. It has been established [2,3]that five- to six-year-old children, when preparing to read a text, activate mechanisms of the right hemisphere. As children grow older, they begin reading by activating left-hemisphere mechanisms, and then hemispheric cooperation is established. Lesions located in the left frontal cortex and left motor area [1] disrupt the perception of visual followers. Also, it was found [4]that people with brain damage in visual-motor reaction time tests show significantly lower performances compared to normal ones, especially if the brain damage concerns the motor fields on the opposite side from the hand. In fact, this hand had very low performance. It is a fact, however, that children who have slow visuomotor reactions in visual-motor time reaction tests also have brain dysfunctions in the motor and premotor fields [5,6]. If the left parietal cortex also participates in these dysfunctions, then this child will also have reading difficulties. Furthermore, we could say that chronic brain dysfunctions that are detected by visual-motor reaction tests and that the performances in them are low are also accompanied by difficulties in reading. There seems to be some responsibility of visuomotor neural communications in reading processes. If a child shows disturbances in auditory perception, there may be damage or dysfunction peripherally (auditory system, ear, labyrinth, cochlea, organ of Corti up to the medial geniculate body in the thalamus) or dysfunction central with central deafness and the damage or dysfunction is located in the left hemisphere in Wernicke's field or Heschl's gyrus. Also, if a child perceives pure tones or words, which means that Heschl's gyrus is functioning normally, but cannot distinguish words such as, for example, "good" and "bad" or "rose" and "pomegranate" etc. when he hears them, this indicates a lesion or

dysfunction in Wernicke's area. These neuropsychological differences were distinguished and described by Luria (1973) in a remarkable and valid way. He had also argued that local lesions of the secondary area of the left temporal cortex (Wernicke's field) in the child result in difficulty distinguishing speech sounds. This difficulty is the beginning of receptive aphasia. Damage to the cortex is the main etiological factor for sensory or receptive aphasia. Reading requires decoding mechanisms from the visual and auditory systems. Any form of receptive aphasia (meaning disorders in understanding words) results in reading disorders. Children with Wernicke's aphasia show the same difficulties in reading as they do in listening comprehension. Auditory memory is disrupted by lesions of the left temporal lobe [1]and by electrical stimuli - especially short-term linguistic memory - in the frontal-parietal-temporal fields of the left hemisphere [5]. Dysfunctions in the left hemisphere and temporal, parietal and occipital fields cause disturbances in auditory-linguistic comprehension [1]. In addition to tests of visual-motor reaction time and their importance in understanding reading mechanisms, there are also tests of auditory-motor reaction time. Typically, six (6) different sensorimotor combinations are used in these time reaction tests. These are the following:

1) Right ear right hand,

2) Right ear -> left hand,

3) Left ear -> right hand,

4) Left ear -> left hand,

5) Both ears right hand and,

6) Both ears Left hand.

Legs can also be used. In this test we ask the child to press a button or something else with his right or left hand after receiving a sound stimulus (tone) in his left or right ear. The average reaction time for adults in this test is 75ms, that is, the reaction time is shorter if compared to that of the visual-motor test, which is around 125ms. This is because auditory-cortical-motor connections are shorter than visual-motor connections. From the ear, the stimulus goes to the temporal cortices. Audio-motor communications are about half or less than visual-motor communications. These tests are valuable tools for the study of reading difficulties, and in the future, we believe, a lot of research will be done. However, their role in the diagnosis of brain function seems to be significant. This is shown by the fact that a left-hemisphere-dominant language-dominant person with normal hearing should have faster response times to combinations one (1) and five (5). But if this is not the case, then such a person would have to suffer from damage or dysfunction in the left hemisphere and thus cause reading difficulty. The role of tactile learning in reading appears to be quite important and primary [5]. Tactile-motor functions are measured with the hapticometer. Usually, a tactile or motor difficulty in one hand means damage or dysfunction in the opposite hemisphere from the hand and the tactile or motor fields. A difficulty, e.g. of the right hand is usually accompanied by reading disorders since both of these functions are controlled by special areas of the left parietal lobe. It is also worth noting the role of stereocognition mechanisms in reading functions. This has been found with therapeutic neuropsychological programs [7], which attempt to activate and improve disturbed functions by inducing specific neurotherapeutic stimuli. According to clinical neuropsychological studies (Gaddes, 1985), there is a relationship between reading difficulties and impairment in tactile recognition of the location of the fingers of both hands. However, the disturbance of the tactile perception of locating the stimulus concerns the fingers of the right hand. This is because reading and tactile finger recognition are performed by left parietal cortex mechanisms, so dysfunctions in these affect both skills. The degree of handgrip strength and reading functions appear to be related. This is because the thalamic communications involved in language functions, if they malfunction together with other brainstem structures, disrupt reading. Handgrip strength is controlled by brainstem structures and dysfunctions located in the brainstem reduce dynamic handgrip performance. It is also known [8] that electrostimulation of the left ventricle causes difficulties in object naming, numerical and linguistic recall. Future research will hopefully show more about the role of handgrip and its relationship to the brain mechanisms of reading. The child with expressive aphasia has difficulty reading. Usually, the child with developmental aphasia presents severe articulation problems and disturbances in their otic-motor organization [9]. It seems that for the language development of the child, while at the beginning of his life the receptive-perceptual language analysis plays an important role, after about the fifth year of his school life, i.e. around the age of eleven, the expressive-kinetic mechanisms of language are more prevalent in his linguistic behaviour. Bilateral brain lesions in the parietal cortex, and especially if they involve area thirty-nine (39), cause reading disorders. But apart from this, there is also a disturbance in the right or left orientation mechanisms. Thus, many times, children with reading difficulties also show problems of orientation to the right or left, up or down in their space. Hand preference, brain organization and their relation to dyslexia are important problems for Neuropsychology and Neurolinguistics [10]. Controversy exists between hand preference, brain organization, and their relationship to dyslexia. When left-handed, there is usually, but not always, difficulty reading. In left-handers, however, language dominance may be in the left hemisphere, or very rarely in the right, or both. Also, about what happens to left-handedness and about its relationship with many disorders such as e.g. dyslexia or with special abilities such as e.g. higher intelligence, much research remains to be done. Audiovisual sequencing ability and the relationship to reading has been studied by the Bakker group in Amsterdam. In a notable study [11], on children aged 6-8 he distinguished four (4) types of behavioral sequence: a) linguistic imitation (receptive or perceptual), b) non-linguistic imitation c) linguistic expression and, d) non-verbal expression. He examined temporal sequences in the four categories and three channels (visual-auditory-tactile). He found that the temporal sequence was related to age and that girls at ages 6 and 7 were superior to boys.Between ages 7 and 8, girls were equivalent in recall on sequence tests for all three sensory channels. From the 8th to the 11th year their tactile ability decreases and the emphasis is placed on audio-visual sequence abilities. Girls appeared superior in recalling temporal sequences for all sensory channels even after the age of 9 years. The boys' performances were without particular disparities and instabilities. The conclusion from this research is that the temporal perception of language material and linguistic coded material is carried out by the language hemisphere, i.e. the left. In a study [12], low performances in verbal-memory tests were found in both P- and L-dyslexic types. The

L-types also performed poorly in image rotation tests. This means that this guy has a visual-motor disorder in his reading difficulty. Parents of P- and L- dyslexic types had low performances in verbal-memory tests. They showed no disturbances in visual-spatial tests. In families with P-dyslexic types, a significant relationship between father and son was found for visuospatial functions. In families with L-dyslexic types, parent-child relationships for both parents and for both categories (verbal-memory and visual-spatial) were weaker.

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