

Brain Activation in Dyslexic Children

In word reading, information is processed on a letter level, in a semantic system and in an orthographic system. Written word to speech articulation may be processed by two routes: a direct and indirect method. The direct route can be described as a semantic one. In this system, a direct access to the semantic system is allowed. In the indirect route, features of the letters in a word activate the word's letter units in order to activate the word's entry to the orthographic lexicon. This procedure is succeeded by the word's entry to the orthographic lexicon. This route converts a letter string to a phoneme string through grapheme-phoneme conversion. This conversion serially assembles letters into phonology. Dyslexia can be caused by any dysfunction of any of the mentioned components of information processing. One of the most controversial issues on the pathomechanisms of developmental dyslexia is impairment in phonological language processing. Several evidences has supported this notion - studies showing anatomical malformations in language-associated brain regions (Galaburda et al., 1985; Dalby et al., 1998), neurobehavioural and neuropsychological studies showing increasing reading difficulties correlating with increasing task demands of phonological processing (Wimmer, 1993; Warnke, 1999) and functional brain imaging studies describing an abnormal brain activity in the left auditory cortex during reading tasks in dyslexic patients (Helenius et al., 1999; Temple et al., 2001). Developmental dyslexia can be caused by impairments in the phonological input system as well as the phonological output system. Phonological deficits may affect grapheme-phoneme processing, as well as other language related issues, such as phonological awareness, phonological short-term memory and verbal repetition. Several reports reveal that dyslexics display a good performance in purely visual discrimination tasks not involving object naming and letter strings naming. On the other hand, there has been contradictory evidence with regards to the ability of dyslexics in picture naming and confrontational naming. A recent study assessed picture retrieval time in dyslexic children by determining the time between the retina fovea landing on the picture by laser scanning ophthalmoscopy and the beginning of speech articulation. There was a vast range of overlap between dyslexics and non-language impaired children. The finding of normal picture naming, despite severely impaired reading ability in dyslexics may lead to the assumption that different pathways may be involved in processing letter-mediated information and picture naming. To further confirm this hypothesis, a recent study in Germany assessed the brain response patterns in dyslexic children and normal counterparts to see whether different neural patterns were used to process picture naming and word reading. Magnetoencephalography was used to investigate brain activation during word reading and picture naming tasks. Results show consecutive cortical activation spreading in various brain areas. Differences in both groups were seen only during the reading task: a delayed response in the temporal superior and angular gyri at 235-285 milliseconds and absence of neural cortical activation in the anterior temporal and inferior frontal areas at 430-530 milliseconds for dyslexics. Difficulties in phonological processing were reflected in the delay of activity and absence of late activity and language related brain regions. Since there were no significant group difference during picture naming, the researchers concluded that there were two different neural pathways governing both neurological functions: a phonological/orthographic system for word reading, which is evidently impaired in dyslexic children and a visual system for picture naming, which can be unaffected in dyslexics. Overall, support shows different pathways for processing letter-related and visual information. This understanding may be important for dyslexics in relation to coping with everyday life demands and relevant skills training.

About the Author

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