

Chapter 94

Evaluation of Mathematical Cognitive Functions with the Use of EEG Brain Imaging

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ABSTRACT

During the last decades, the interest displayed in neurocognitive and brain science research is relatively high. In this chapter, the cognitive neuroscience field approach focuses in the aspect of the way that cognitive functions are produced by neural circuits in the brain. Within this frame, the effects of impairment to the brain and subsequent changes in the thought processes due to changes in neural circuitry resulting from the ensued damage are analyzed and evaluated. All cognitive functions result from the integration of many simple processing mechanisms, distributed throughout the brain. Brain cortex structures, linked with cognitive disorders, are located in several parts like the frontal, the parietal, the temporal, the occipital lobe and more are analyzed and specified. A critical topic of this chapter in the evaluation of brain operations is mapping regions that control cognitive and mathematical concepts functions. Dyscalculia, in this chapter, is described as a specific disorder of managing and conceiving mathematical concepts. Dyscalculia could be identified by difficulties in visual perception, in spatial number organization, in basic mathematical operations and in mathematical induction logic. Moreover, people who deal with dyscalculia present problems, in Euclidean and Non-Euclidean Geometry concepts perception, in Calculus aspects as well as in solving algorithmic problems where the design, the description and the application of algorithmic steps are required. In order to enhance cognitive brain functions perception, the use of EEG brain imaging is proposed measuring cerebral activity and event-related potentials. The procedure described in this chapter is about the comparison and contrasts EEG brain imaging patterns of healthy volunteers to EEG samples taken of adults considered being at risk of mathematics learning disabilities such as Dyscalculia and algorithmic thinking difficulties. EEG interpretation

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analysis is to follow where the deviation of a normal and an abnormal range of wave's frequency are defined. Several visualized EEG patterns in relevance with specific abnormalities are presented while several neurocognitive generated disorders could be identified with the use of EEG Brain-imaging technique. The electroencephalogram EEG brain imaging procedure, in order to evaluate problems associated with brain function, is to be further analyzed in this chapter as well. The EEG is the depiction of the electrical activity occurring at the surface of the brain. The recorded waveforms reflect the cortical electrical activity and they are generally classified according to their frequency (Delta, Theta, Beta, Alpha, Beta, and Gamma) amplitude, and shape. EEG Implementation with the use of 10/20 system of the standardized position of scalp electrodes placement for a classical EEG recording is described as well. The EEG implementation objective is to identify, classify and evaluate those frequencies and regions in the brain that best characterize brain activity associated with mathematical learning disabilities. Mapping the brain with non-invasive techniques based on trigger and sensing/evaluation experimental multimedia methods similar to those used in computer games and applications are expected to provide relevant results in order to enhance and confirm theoretical cognitive aspects. At that point, a cognitive and mathematical perception evaluation is to follow and specifically the assessment of the relation of difficulties in mathematics with particular parts of the human brain. EEG wave data visualization is contacted with the use of Acknowledge an interactive, intuitive program which provides data analysis instantly. At the end of this chapter EEG computational evaluation with the use of pattern recognition methods as well as the intuition of author's future work in relevance with the use of experimental multimedia technologies to enhance the dynamic recognition and evaluation of user cognitive responses during EEG implementation are noted.

INTRODUCTION

All thought several brain imaging techniques are used in order to evaluate several neurocognitive disorders like Alzheimer disease, bipolar disorder, epilepsy, ADHD and so one, the field concerning learning difficulties with the use of brain imaging techniques is yet to be explored. Especially while dyscalculia has been studied for many years within the frame of an educational field, cognitive neuroscience research on dyscalculia is a recent lighted research field. This paper presents a review of the use of EEG brain imaging for the recognition of mental tasks from on-line spontaneous EEG signals. Within this study the importance of the visualization and evaluation and of the neurological frame related to brain structure and function is presented as well as the use of EEG brain imaging technique in order to the neurological aspects of dyscalculia. In this process, experimental multimedia technologies may be employed in order to identify and compare imaging data. Dyscalculia is difficulty in learning or comprehending arithmetic, such as difficulty in understanding numbers, learning how to manipulate numbers, and learning facts in Mathematics and much more. It is considered to be a specific developmental disorder. With the use electroencephalogram, brain imaging technique abnormalities in the brain waves or electrical activity of the brain are evaluated. Findings of the EEG visualization method implementation and evaluation aim to confirm a potential compensatory mechanism of brain function related with dyscalculia and algorithmic thinking difficulties.

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