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Technical paper

The Significance of Delta Wave Among Athletes

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Abstract

This article reports on the differences between the physiological response of the brain between athletes and non-athletes by using Quantitative Electroencephalography (QEEG). EEG waves were observed using qEEG and analysis were compared between the two groups. This research involved 41 undergraduates of Universiti Malaysia Sarawak (UNIMAS). The qEEG recordings were made during the Eyes opened, Eyes Closed, and Stroop task conditions to find out the dominant wave during each of the conditions in different region of the brain. The results revealed higher EEG Delta and Beta1 at frontal region (Fp1, Fp2), somatosensory, (C3, P4) and visual spatial area (P3, P4). Delta, Beta and Gamma wave were dominant while the participants were performing the Stroop Task. Coupling of delta and beta oscillations might be due to the athletes' anxiety during the Stroop task. In Eyes Closed state, delta and alpha wave were dominant at the fronto-parietal attention network area. This study contributes to the development of training protocol for neurofeedback training for athletes in preparation for training of peak performance in any sports activity. It is recommended that extensive analysis should be done on the interaction of delta-gamma oscillations in different parts of the brain to find out its implication on attention and emotion during the cognitive process.

***Keywords*:** *Athlete; Delta; EEG; qEEG; Sports.*

1. Introduction

Previous literature in sports explained the underlying neuro mechanism of motoric actions and decisions made in facing the challenges in different field of sports activities such as darts' throwing and pistol shooting. Such kinaesthetic moves required quick decisions because it is part of a dynamic strategy to face the continual mix of intricate challenges. Sometimes a slight movement of one arm require quick adjustments in other parts. In most of the sports, athlete's actions are part of a dynamic strategy to deal with an everchanging mix of intricate challenges [1]. For example, raising a gun resulted in a new calculation of movement for a precise shooting. Accumulation of evidence has shown that diet and lifestyle plays a vital role especially in delaying the onset and progression of the age-related health disorders and improve the cognitive function of an individual [2]. In most of the mental tasks, focus and concentration are required which were accompanied by spectrum of delta oscillations to inhibit the other processes which interfere with the resolution of the mental task.

In a study [3] on the neurobiological bases of attention there are separate neural systems that mediate different aspects of attention. Currently, two functionally distinct and potentially competing brain networks have been identified, which can be broadly distinguished by their contrasting roles in attention to the external world vs. the internally directed mentation involving long-term memory [4]. The dorsal attention system is supporting externally directed cognition [5] and the hippocampal-cortical memory system or the ventral system that linked to internally directed cognition often labeled as default network (ventral medial prefrontal cortex, the posterior inferior parietal lobule, the retrosplenial cortex, the posterior cingulate, and the lateral temporal lobe) [6]. The third system is the fronto-parietal control system, which includes many regions identified as supporting cognitive control and decision-making processes, including the lateral prefrontal cortex, the anterior cingulate cortex, and the inferior parietal lobule [7]. Attention has two complementary components: an intensive, selective component which applies to the initiation and execution of action, seems based primarily in dorsolateral frontal cortex, and an exclusionary one, is the equivalent of the inhibitory control of interference primarily based in ventral frontal cortex. Selective executive attention can be understood as a property of frontal networks in operation. In the perceptual and action cycle, executive attention would shift from one domain of action to another as different networks excite one another [8]. Another executive attention subfunction is the interference control primarily based in the orbitomedial prefrontal cortex. By suppressing distraction, executive attention is served. Several neuroimaging studies showed that any task requiring concentrated attention activates areas of the lateral and medial prefrontal cortex in addition to the posterior cortical areas of the perceptual specialization. It was proposed that delta increases during mental calculation, and this increase correspond to what they called "internal concentration"]. These authors later demonstrated that this delta activity is present in many other tasks that require internal concentration [7]. In previous study, it was evaluated the cross-frequency coupling between delta and beta oscillations; increases in the correlation between these two oscillations were present during anxiogenic situations in the orbitofrontal and anterior cingulate cortices [9].

Researchers from John Hopkins University, and John Krakauer of Columbia reviewed studies related to scanning of the brains of healthy and brain-damaged patients who have problems with their movement [10]. Their research revealed that that the brain continues updating the solution and calculation to adjust body movement. Athletes mind are sharp in finding better solution when