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Exploring Background Noise During Learning: A Neurofeedback Study

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ABSTRACT

Distinguishing effective background noise during learning is crucial for students. This study was conducted to determine the effective noise background during learning. Two healthy female subjects were recruited for this experiment. They were put in separate brainwave recording sessions for learning tasks without noise and with background noise. Their theta and alpha brainwave readings showed higher activity while learning with background noise. The finding indicated that both brainwaves represented insight and alertness were more dominant during active learning tasks than without noise. However, there was no statistically significant difference in both learning conditions for theta ($p = 0.09$) and alpha ($p = 0.07$) brainwaves. The higher activity level during the learning process with background noise could be interpreted as a sign of enhanced cognitive insight and alertness. Nonetheless, the magnitude of the difference observed did not reach a statistically significant level, thus necessitating further investigation and analysis.

Keywords: neurofeedback training, brainwaves, background noise, learning

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1 INTRODUCTION

Many generations have evolved and innovated from the basic framework of biofeedback to highly specific neurofeedback training (NFT), which is helpful for training and improving brainwave activity. Sattar and Valdiya (1999) stated that electroencephalogram (EEG) biofeedback focuses primarily on electrical activity in the brain and maps activity based on region. NFT typically receives audio or video neurofeedback and employs EEG to record electrical waves from brain activity (Marzbani et al., 2016).

NFT is a type of biofeedback in which individuals learn to regulate their brain activity deliberately and, therefore, gain control over processes that are typically not subject to conscious manipulation (Holtmann et al., 2014). Cognitive performance, symptoms, and behaviour are expected to improve due to altered brain activity. This is feasible through online feedback on changes captured by several technologies, most notably the NFT system of EEG (Weber et al., 2020). Table 1 explains the brainwave frequencies and characters that represent each wave.

Background noise, a ubiquitous environmental factor, has long been acknowledged for its potential influence on cognitive function and learning outcomes (Ke et al., 2021). Although silence has traditionally been viewed as the optimal environment for educational activities (Ollin, 2008), background noise has illuminated its impact on learning performance and brainwave activity (Söderlund et al., 2007). A thorough comprehension of the ramifications of background noise during the learning process can offer valuable insights into refining learning environments and enhancing cognitive processes to yield improved learning outcomes.

This study investigated the effects of background noise on brainwave activity and its potential implications for learning and memory retention. This study also provides valuable insights to improve the quality of educational services by proposing an effective and conducive background noise environment. It can enhance students' attention and focus during their learning process.

Table 1. Brainwave frequencies and characters.

Brainwave	Frequency	General characteristics
Delta	1-4	Sleep, obliviousness, deep unconsciousness
Theta	4-8	Imagination, insight, depth states, meditative state
Alpha	8-13	Alertness and peacefulness, readiness, deeply relaxed
Lower alpha	8-10	Recalling
Upper alpha	10-13	Optimal cognitive performance
Sensorimotor rhythm	13-15	Mental alertness, physical relaxation
Beta	15-20	Thinking, focusing, attention, alertness, excitement
High beta	20-32	Intensity, hyper-alertness, anxiety
Gamma	32-133	Learning, cognitive processing, problem-solving tasks