



Comprehending The Affect Of Brain Waves On Mental Health

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Abstract

The electrical signals that our brain's neurones create are called brain waves. These signals exhibit frequency and amplitude fluctuations that correspond to various mental states and activities. Gaining an understanding of these patterns can help one understand how brain activity and mental health are related. Alpha (8–12 Hz) is related to relaxation, creativity, and calmness; beta (12–30 Hz) is associated with wakefulness, alertness, and problem-solving; and gamma (30–100 Hz) is involved in higher cognitive functions, consciousness, and perception. Delta (0.5–4 Hz) is associated with deep sleep and unconsciousness; theta (4–8 Hz) is linked to creativity, intuition, and deep meditation; and can also indicate stress or anxiety. Research has indicated that people suffering from depression frequently display elevated theta and delta waves and decreased alpha wave activity. Increased beta wave activity has been linked to anxiety, especially in specific brain areas. Additionally, especially in the frontal lobe, patients with ADHD may show increased theta wave activity and decreased beta wave activity. Studies indicate that gamma wave activity patterns may be aberrant in people with schizophrenia. However, relaxed-state theta and alpha waves are the most typical frequencies that an electroencephalogram (EEG) may pick up during meditation. Consequently, there is a tendency for the average levels of beta waves to decline. You can reach theta and alpha brain frequencies with the aid of meditation. The effects of meditation on the health of your brain can last a lifetime if you incorporate it into your daily routine.

Introduction

A german neurologist Hans Berger first discovered brain waves in 1920s with the first ever EEG (Electroencephalogram) machine (Tudor et al., 2005). Brain waves are electrical activity patterns that, in different combinations, represent mental health issues such as emotions, cognition, consciousness, and behavior (Roohi-Azizi et al., 2017). Numerous types of brain waves allow neurons to electrically communicate with one another. Different combinations of brain waves correspond to different types of mental activity; for example, slow brain waves are more pronounced during periods of exhaustion or sleep (Berry, 2011). It is stated that when a person's brainwaves are out of harmony, they can have issues with their emotional and neuro-physical health. Brain wave recordings can also be used to diagnose epilepsy, neurodegenerative diseases, and sleep disturbances (Golub and Reddy, 2022).

Voltage traces recorded by EEG electrodes are described as waves. They are defined in terms of three parameters: amplitude, frequency, and phase. Another important unit describing brainwaves in an EEG is brainwave spectral power expressed in Volts-squared per Hz (V²/Hz) (Aminoff, 2007). This unit derives from the spectral analysis of the electroencephalogram. Absolute brainwave power describes the power of certain frequency components present in the time period whereas relative brainwave power reflects the role of a specific frequency in the context of all frequencies, e.g., the percentage of the absolute power of a certain frequency in the whole power spectrum (Tan et al, 2024). Brain waves are the measurements of the electrical pulses in your brain. These pulses are measured in a unit of frequency called Hertz (Hz). There are five distinct levels of frequencies your brain may be pulsing at, and each frequency level represents what type of function your brain is performing (e.g., sleeping, focusing, recalling a memory, etc.)(Addante et al, 2021). Based on frequency brain waves can be divided into five categories:

1. Delta brain waves are the slowest brain waves (1-4 Hz). They are generated in deep meditation and dreamless sleep, coma and anaesthesia. Healing and regeneration occur when the brain is in this state (Frohlich et al., 2021).
2. Theta waves also occur in sleep and during relaxation (4-8 Hz). They are indicative of an inner focus, drowsiness, low-level alertness and dreams and vivid imagery occur in this state. In addition specific type of theta known as “frontal midline theta” is observed during mental calculation, working memory, error processing, and meditation (no thought condition)(Zhang and Jacobs, 2015).
3. Alpha waves occur during quiet, thoughtful times (8-13 Hz). Alpha waves indicate that the brain is in a resting state. It can be divided into three types. First, the posterior alpha rhythm—which is dependent on attention and alertness variables—is produced by the parietooccipital cortex. Second, mu rhythm, produced by central electrodes, is associated with movement and the somatosensory cortex. The third, tau rhythm originates from auditory cortex. Brain activity is inversely proportional to alpha wave (Dadashi et al., 2015).
4. Beta waves are the most common pattern in the normal waking state (13 Hz). They occur when one is alert and focused on problem solving. It is associated with cortical integrity, increased alertness and cognitive processes. It increases by stress, strong emotions and tension. Any cortical damage is associated with absence of beta waves (Kučikienė and Praninskienė, 2018).
5. Gamma brain waves are the fastest and are associated with higher levels of consciousness (30-40 Hz). The presence of gamma waves indicates that your concentration is at its highest. To put it another way, your brain is probably generating gamma waves while you're extremely focused and actively working to solve a problem. They facilitate your information processing. Studies indicate that individuals with cognitive impairments or learning disabilities might not generate as many gamma waves (Braboszcz et al., 2017).

Brain waves are relevant to mental health, as abnormalities in brain functioning can influence the development of certain conditions. For example, when certain areas of the brain are over-aroused, an individual may experience anxiety, nightmares or other sleep problems, impulsivity, and aggression (Pressman, 2007). Too little arousal in the brain, on the other hand, has been correlated with depression, chronic pain, and insomnia (Surova et al., 2021). If brain rhythms are unstable, an individual may experience obsessive compulsions, develop epilepsy, or have panic attacks (Kopańska et al., 2022).

Neuroscientists have recently discovered a link between an overabundance of gamma waves in the brain and schizophrenia. Gamma waves cause hyperactivity in areas of the brain, and when this hyperactivity is abnormally high, as it often is in those with schizophrenia, delusions and hallucinations can result. Poor sleep, which also results from an excess of hyperactive brain waves, has also been recently shown to be a contributing factor to symptoms of schizophrenia: Those who have trouble sleeping due to overabundant gamma waves in the brain may experience a “triggering” of schizophrenia symptoms (Woo et al., 2010).

Research on brain waves has also shown that certain individuals may be biologically more likely to experience depression. These individuals demonstrate an abundance of alpha wave activity in the left frontal areas of their brain (Ippolito et al., 2022). Another condition that is characterized by an excess of lower frequency brain waves is attention deficit hyperactivity. However, both of these conditions, along with others, have shown improvement when treated with neurofeedback therapy.

Neurofeedback is a therapeutic technique that is used to monitor and change brain wave patterns in an attempt to modify behaviors and improve mental health. In this type of therapy, individuals are taught to alter the flow of brain waves (Muñoz-Moldes and Cleeremans, 2020). A therapist uses EEG readings to determine the level of brain waves and assess the predominance of abnormal activity and then rewards the desired brain wave activity to encourage its production. In an individual who has depression, for example, the therapist will use sound and visual effects to reward beta waves in order to help relieve the symptoms of depression (Hima et al., 2020). Researchers show that meditation can induce relaxation-related brain waves, such as alpha and theta waves. In fact, studies reveal that meditation can help reduce stress, decrease depression, and improve sleep quality (Krishnakumar et al., 2015).

Meditation can induce relaxed brain waves

Meditation is the practice of slowing down and focusing your mind on the present moment. Meditation generally takes place in a seated position with the eyes closed. The practice can last for as little as 5 minutes or go on for hours. Regardless of the time frame, the purpose of the practice is to prevent the mind from wandering (Stapleton et al., 2020). What you focus on during your meditation practice can vary. Some of the most common things to focus on include your breathing cycle (in and out), a mantra (repeating a phrase in your head), the sensations in your body, the sounds you are hearing, and the visualization of a beautiful destination. Meditation can help you feel more relaxed, and this is reflected in your brain activity (Pathath, 2017). What happens in the brain when you meditate?

During meditation, the most common frequencies an electroencephalogram (EEG) will detect are relaxed-state theta and alpha waves (Braboszcz et al., 2017). And, as a result, the average levels of beta waves tend to decrease. In Dr. James Hardt’s book “The Art of Smart Thinking,” he explores the benefits of increasing theta and alpha wave production in the brain (Hardt, 2007). He argues that these two brain frequencies are the most important frequencies for enhancing creativity and problem-solving abilities. Meditation can act as a tool to help you access theta and alpha brain frequencies. Once meditation becomes a regular part of your daily routine, Hardt argues it can have lifelong benefits on your brain’s health.

After practicing meditation for a long enough periods, research suggests that alpha frequencies can become the brain’s dominant brain wave. A 2020 overview on the effects of various forms of meditation revealed that it took students 40 days of practicing a form of mindfulness called Yoga Nidra to make alpha waves their

dominant brain wave. Once alpha waves increased to dominant levels, the research revealed that participants of various forms of meditation and yoga practices experienced improved sleep quality, reduction in anxiety and depression, lower stress levels, enhanced learning and memory (De Anup et al., 2020).

Conclusion

Meditation affects brain wave production. What's so groundbreaking about these findings is that the effect meditation has on brain wave activity not only occurs during the meditation practice itself, but long after the meditation is complete. In other words, habitual meditation practice can change your brain wave activity for years to come. Research indicates that meditation tends to lead to an increase in the production of theta and alpha waves, which are the brain wave frequencies associated with enhanced learning abilities and overall mental well-being. The specific type of meditation or mindfulness practice does not appear to matter. What's most important for altering your brain waves is to make meditation a part of your daily routine.

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