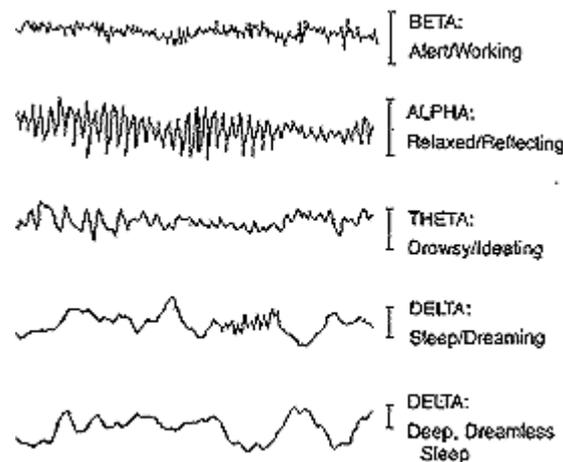


Brain Waves

Hans Berger (1873 – 1941) the German psychiatrist invented electroencephalography (EEG) for the recording of "brain waves" in 1924. He did this by measuring electrical activity in the brains of hospital patients with skull damage. He documented these alpha waves along with beta activity. He found that when alpha waves decrease and beta activity becomes dominant, we are fully awake. As he was the discoverer of the alpha brain wave rhythm it is known as "Berger's wave".



At the root of all our thoughts, emotions and behaviour is the communication between neurones within our brains. Brainwaves are produced by synchronised electrical pulses from masses of neurones communicating with each other.

Brainwaves are detected using sensors placed on the scalp. They are divided into bandwidths to describe their functions, but are best thought of as a continuous spectrum of consciousness; Delta being slow, loud and functional, to Gamma being fast, subtle and complex.

Brainwaves are a little like musical notes, the low frequency waves are like a deeply penetrating drum beat, while the higher frequency brainwaves are like a subtle high pitched flute.

Our brainwaves change according to what we're doing and feeling. When slower brainwaves are dominant we can feel tired, slow, sluggish, or dreamy. The higher frequencies are dominant when we feel wired, or hyper-alert.

The descriptions that follow are only broadly descriptions, in practice things are far more complex, and brainwaves have different effects when they occur in different locations in the brain. Brainwave speed is measured in Hertz (cycles per second) and they are divided into bands delineating slow, moderate, and fast waves.

Throughout the day in your waking state, an EEG will display all 5 types of brain waves at the same time. However, one particular brain wave will be dominant depending on the state of consciousness that you are in.

For example, if you are awake, but have really bad ADHD, you may have more slow wave (alpha and/or theta) activity than beta waves. During sleep there are generally combinations of the slower brain frequencies.

The frequencies given for the different brain waves vary slightly between different sources: -

- Delta - 0.2 – 3 Hz / 0.5 – 4 Hz
- Theta - 3 – 8 Hz / 4 – 8 Hz
- Alpha - 8 – 12 Hz / 8 – 13 Hz / 9 – 14 Hz
- Beta - 12 – 27 Hz / 12 - 38 Hz / 12 – 40 Hz / 15 – 40 Hz
- Gamma – 30 – 42 Hz / 38 – 90 Hz / 40 – 100 Hz

Brainwaves, Frequencies and Functions

Unconscious		Conscious		
Delta	Theta	Alpha	Beta	Gamma
0.5 – 4 Hz	4 – 8 Hz	8 – 13 Hz	13 – 30 Hz	30-42 Hz
Instinct	Emotion	Consciousness	Thought	Will
Survival Deep sleep Coma	Drives Feelings Trance Dreams	Awareness of the body Integration of feelings	Perception Concentration Mental activity	Extreme focus Energy Ecstasy

Delta Waves – From approximately 0.5 to 4 Hz

W. Grey Walter (1910-1977) was a world leader in EEG research. He discovered theta and delta brain waves and, with Shipton, developed the first EEG brain topography machine in 1951. EEG topography allowed for the mapping of electrical activity across the surface of the brain.

Delta brainwaves are the slowest but loudest brainwaves (low frequency and deeply penetrating, like a drum beat). They are generated in deepest meditation and in dreamless sleep. Healing and regeneration are stimulated in this state, and that is why deep restorative sleep is so essential to the healing process.

Delta waves are the predominant brain waves of babies. Analysis of the waking EEG of a new-born baby indicates that delta wave activity is predominant in that age, and still appears in a waking EEG of five-year-olds. Babies have been shown to spend a great deal of time in slow-wave sleep, and thus have more delta wave activity.

Slow-wave sleep (SWS), often referred to as deep sleep, consists of stage three non-rapid eye movement sleep. This period of sleep is called slow wave sleep because the EEG activity is synchronised, producing slow waves with a frequency of less than 1 Hz.

Delta wave activity during slow-wave sleep declines during adolescence, with a drop of around 25% reported between the ages of 11 and 14 years. Delta waves have been shown to decrease across the life span, with most of the decline seen in the mid-forties.

By the age of 75 delta brain waves may be entirely absent. Slow-wave sleep also declines in the elderly. However temporal delta brain wave activity is commonly seen in older adults and may be linked to strokes.

Theta Waves – Between 4 and 8 Hz

Theta brain waves are considered brain waves that oscillate between the frequencies of 4 Hz to 8 Hz (cycles per second). Theta brainwaves occur most often in sleep but are also dominant in the deep meditation. In theta, our senses are withdrawn from the external world and focused on signals originating from within. It is that twilight state which we normally only experience fleetingly as we wake or drift off to sleep.

In the theta brainwave state we are in a dream state, experiencing vivid imagery, intuition or information beyond our normal conscious awareness. The theta state is also linked to subconscious fears, deep seated worries and nightmares.

Theta waves indicate sleep, drowsiness, daydreaming, creative and imaginative thinking that is led by the subconscious mind (i.e. when ideas suddenly just come to you). Theta waves allow for easier communication between the conscious and subconscious minds. Theta waves have also been identified as helpful for learning, memory and the reduction of stress.

Theta waves have been linked to experiencing emotions, daydreaming, intuition, relaxation, the subconscious mind, and REM sleep (accompanied by bursts of gamma brain waves).

Children tend to have significantly more theta activity than adults. Theta is the main brainwave frequency range for children between 2 – 6 years old.

Theta waves can be found in different areas of the brain and may produce different effects. Individuals that go into deep meditative states may also experience an increase in theta brain waves. Healthy theta activity may enhance our ability to process emotions, be creative, and tap into our intuition.

There is some evidence that the theta range could help heal both the body and the mind from extreme stress and other ailments. Some researchers hypothesise that the theta brain rhythm can reset the brain's sodium / potassium ratio back to natural levels. The theory behind this is that if you are stuck in a state of high stress, these ratios become thrown out of homeostatic balance. Since the theta wave is capable of slowing down the body and the mind, it is thought to help with healing.

Since experiencing theta brain waves is linked to lower levels of arousal, it is hypothesised that theta wave dominance, particularly in the left hemisphere may contribute to feelings of depression in adults. Theta brain waves in certain regions of the brain are linked to learning disorders. The theta brain wave rhythm is often seen in children and individuals with ADHD.

Alpha Waves – Between 8 and 13 Hz

Alpha brain waves are brain wave activity with oscillations that range from 8 Hz to 13 Hz (cycles per second).

Alpha brain waves are dominant during quietly flowing thoughts, and in some meditative states. Alpha is ‘the power of now’, being here, in the present. Alpha is the resting state for the brain. Alpha waves aid overall mental co-ordination, calmness, mind/body integration and learning.

Alpha brain waves are increased by closing the eyes and relaxing, and can be reduced by opening one's eyes or by any concentrated effort. They are associated with a relaxed state of mind. When you get back from work, sit down and put on the TV your brainwaves will be in the alpha range. This is the typical relaxation range for anyone over the age of about 13.

The alpha wave is typically produced by the right hemisphere of the brain, but often is synchronised across both right and left hemispheres on an EEG. Alpha waves are generated mostly from the occipital lobe of the brain during drowsiness and sleep.

Individuals who relax with closed-eyes tend to exhibit more alpha wave activity. In fact, the alpha range typically becomes dominant when a person closes their eyes and focuses on relaxing. When you open your eyes, alpha wave activity becomes reduced.

Many researchers believe that alpha activity is linked to drowsiness, relaxation, and boosted mood. It bridges the gap between our waking state and our sleeping state.

Types of Alpha Brain Waves

The alpha brain wave range contains a few different types of specific alpha waves. All types of alpha waves play an important role in our sleep-wake cycle.

Occipital Lobe Alpha Brain Waves: This is the most widely researched type of alpha activity. Scientists have found that alpha activity increases significantly during states of relaxation and while our eyes are closed during periods of rest. In this state we are not asleep, but our brain is relaxed and thoughts are slowed.

REM Sleep Alpha Brain Waves: During rapid-eye movement sleep, there is an appearance of alpha waves. This activity tends to be produced by the frontal-central region of the brain. Researchers currently aren't sure of the purpose of alpha production during REM sleep, but some researchers hypothesise that they indicate slightly increased arousal.

Slow-Wave Alpha Brain Waves: The other type of alpha waves observed are found during slow brain wave sleep. This is sometimes referred to as the alpha-delta state. This activity can be observed across the anterior-posterior region of the brain. Some researchers believe that this may indicate a slightly wakeful period during deep sleep.

Alpha Brain Waves: What Do They Do?

Balanced Mood: Individuals who are depressed as a result of being “highly stressed” feel an antidepressant effect when their alpha activity increases. Alpha activity in the right hemisphere of the brain has been shown to boost mood. Some people also experience a more “balanced” mood when their alpha waves increased.

Calmness: Most people associate the alpha range with feelings of calmness. People that are stressed have a diminished ability to produce these waves. When we are at our calmest with our eyes closed and are relaxing, this is when alpha is the dominant brain wave state.

Creativity: It has been hypothesised that alpha activity is linked to increased creativity. Since it is produced predominantly by the right hemisphere of the brain, it is thought that it may enhance artistic ability as well as creative problem solving skills. Sometimes when we relax, we experience “aha” moments.

Daydreaming: If you close your eyes or daydream a lot, this may increase your alpha waves. Alpha waves are more common in younger children that tend to daydream a lot and have difficulties focusing.

Decreased Focus: During the alpha brain wave state, many individuals have poor focus and concentration. It has been shown that the greater the amount of alpha activity, the more likely someone is to make a mistake.

Studies have shown that when someone makes a mistake, their alpha activity increases by an average of 25%. When alpha decreases, attention and focus increase. Therefore, alpha is not ideal for critical thinking and/or detail-oriented, technical work.

Flow State of Mind: It has been thought that the 10 Hz alpha wave is linked to a “flow” state of consciousness. A state of flow is characterised by being calm and focused at the same time. In other words, the saying “mind like water” holds true. It is able to go with the flow without getting overly aroused or being sleepy. The alpha state is considered a happy medium between the fast paced beta waves and the drowsy theta waves.

Immune System: Some researchers have hypothesised that our immune system benefits from increased alpha waves. This in part has to do with the fact that relaxation can help our bodies recover from the effect of stress.

Peak Performance: It is hypothesised that a synchronised 10 Hz rhythm across both brain hemispheres may play a role in helping people achieve a relaxed state of peak performance. There have been studies conducted involving basketball players and golfers. When they missed a shot (basketball) and/or hit a bad shot (golf), they experienced spikes of beta activity. When they sank a free throw or hit a good shot, they maintained alpha activity.

Positive Thinking: This isn't the high-energy, excitement-type, positive thinking of the beta range. However, when people experience an increase in alpha waves it is

linked to having a more optimistic outlook on life. People tend to be calm and think fairly positive with dominant alpha. Think of this as the opposite of rapid-negative stressful or angry thoughts.

Problem Solving: For thinking outside the box the alpha range may help. Sometimes it helps to simply slow the mind down and then the solution appears easily and naturally in the alpha state.

Relaxation: Anytime you feel deeply relaxed, you are experiencing alpha brain waves. If you like to lie out in the sun while lying with your eyes closed, this also provides an alpha boost.

Visualisation: If you like to close your eyes and visualise, this is the brain wave that you will experience. Anytime you close your eyes, are relaxed, and visualising internally (e.g. mind's eye), you will learn what the alpha range feels like.

Biofeedback: This is a technique that involves helping people to naturally train their brains to produce certain brain waves. The idea behind it is that you receive “feedback” when your brain increases activity of a certain wave. The goal is to eventually learn how to consciously produce this type of brain wave activity without feedback after multiple training sessions.

Stress Relief: Research has shown that individuals that are stressed tend to produce an overabundance of beta waves. Most of these individuals may experience what is called “alpha blocking”. This means that their alpha activity is so low, that it doesn't allow the individual to lower their level of arousal. In order to decrease stress, it has been found that biofeedback training can help people to increase their alpha waves.

Alcohol and Drug Abuse: can significantly reduce alpha frequency and amplitude. Thus decreasing the benefits to be had from this particular range. In part this may be why individuals that abuse drugs and alcohol have a difficult time relaxing once the “high” wears off.

Alpha and beta wave activity is decreased in marijuana users, in the first month after they stop smoking. Chronic marijuana users experience sleep disturbances and sometimes vivid dreaming when they stop using.

Beta Waves – Between 13 and 38 Hz

Beta brainwaves dominate our normal waking state of consciousness when attention is directed towards cognitive tasks and the outside world. Beta is a ‘fast’ activity, present when we are alert, attentive, engaged in problem solving, judgement, decision making, and engaged in focused mental activity.

Beta brainwaves are further divided into three bands –

Low Beta (13-15Hz) – focussed thinking, or musing.

Mid Beta (15-22Hz) – states of high engagement.

High Beta (22-38Hz) – highly complex thought, integrating new experiences, high anxiety, or excitement.

Continual high frequency processing is not a very efficient way to run the brain, as it takes a tremendous amount of energy. Beta waves are characteristic of an engaged mind, which is alert and well focused. These are the dominant waves most of us will experience during the day.

They are produced when our attention is directed to the outside world. They are also used in complex problem solving, having conversations, any form of active exercise (using motor skills) and in learning new information and skills. Brain waves towards the upper end of the Beta range can indicate stressed or anxious thoughts.

Gamma Waves – Between 38 and 90 Hz

Gamma brainwaves are the fastest brain waves and relate to simultaneous processing of information from different brain areas. The mind has to be quiet to access gamma brainwave frequencies. Gamma was traditionally dismissed as 'spare brain noise' until researchers discovered it was highly active when in states of universal love, altruism, and the 'higher virtues'.

Gamma rhythms modulate perception and consciousness, they disappear when people are under anaesthesia. Gamma rhythms are above the frequency of neuronal firing, so how they are generated remains a mystery. The presence of Gamma relates to expanded consciousness and spiritual emergence.

Gamma waves are found when carrying out very complex motor processes. When people describe themselves as being 'in the zone', highly alert and focused, these are Gamma wave traits. They can also be associated with very anxious or panic attack type behaviour. Gamma waves are important in harmonising and bringing together thoughts being processed in different parts of the brain. They are also produced during hypnotic states.

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