Complete Guide To Brainwaves

Everything you need to know about brainwaves

omnipemf

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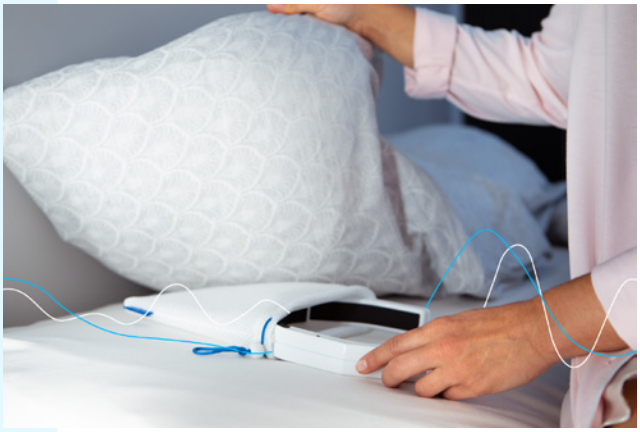
Complete Guide To Brainwaves

The brain is an electrochemical organ. Millions of electrical pulses pass between neurons when we work, exercise, relax or sleep. Electrical activity of the brain can be observed as brainwaves: the synchronized firings of populations of neurons. The speed of brainwaves is related to the level of activity. Below, we will briefly cover each of the five frequency bandwidths, starting with the slow delta waves.

Delta waves (0.5 – 4 Hz)

Delta are slow frequency waves that occur mainly when you sleep. Stimulating the brain to produce more delta waves aids in relaxation and prolongs the time of slow-wave sleep: the deep sleeping phase when your organism recharges its batteries. Sometimes, delta waves occur also during dreams or drug-induced dreamlike states, marking a condition when the brain stays active while being disconnected from sensory feelings from the environment.

- The only brainwaves slower than delta are Slow Oscillations (SO).
- Research has shown both types of slow waves play a vital role in memory processes: SO aid in engraving new experiences in long-term memory whereas delta waves help to de-clutter memory by forgetting the unnecessary information.
- Reduced delta power is associated with poor sleep quality.
- Delta frequency brain stimulation is used in the treatment of sleep difficulties.



Delta waves are used in our predefined program **Improve Sleep**. To take advantage of Delta in Custom programs, pick a **frequency between 1 Hz and 4 Hz**. These frequencies enhance deep sleep and relaxation. They can combat anxiety, panic, and other stressful emotional situations.

Theta waves (4 – 7 Hz)

Theta rhythm is the frequency of your brainwaves firing 4 to 7 times per second. It occurs when you relax, and is often associated with feeling calmness and with lower anxiety. Theta activity is enhanced when you try to memorize new things or retrieve information from your memory.

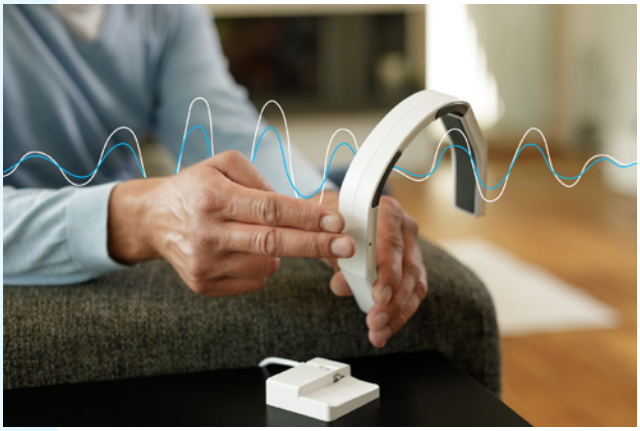
- Theta rhythm is also the landmark of the meditative state. Higher levels of theta mark the growing proficiency in meditation.
- Stimulating the brain to produce more theta waves improves memory processes.
- Theta waves may occur in some states of trance.
- Research with rats revealed that the brain uses theta waves to coordinate navigating through unknown terrain.

Theta waves are used in our predefined programs **Theta Meditation**, **Mindfulness Meditation**, and **Open-Heart Meditation**. To take advantage of Theta in Custom programs, pick a **frequency between 4 Hz and 7 Hz**. These frequencies boost the practice of meditation or introspection and may help you learn more efficiently by enhancing memory.

Alpha waves (7 – 13 Hz)

Alpha waves mainly occur when your mind is not focused on any specific task. They get stronger when you are day-dreaming and weaker when you try to focus. Those periods when your thoughts are wandering are vital for being creative, as they give your mind some space to explore memory and join pieces of information in a novel way.

- Alpha brainwaves increase when people are looking for creative solutions. Moreover, creative individuals' brains show more alpha activity.
- When your focus is drawn towards an external stimulus like sound or light, the levels of alpha waves drop down.
- Alpha waves also occur during meditation, especially in novice practitioners.
- Inducing alpha waves helps in relaxation.



Alpha waves are used in our predefined program **Quiet Mind Meditation**, **Meditation for Calming & Synchronisation** and **Deep Relaxation**. To take advantage of Alpha in Custom programs, pick a **frequency between 7 Hz and 13 Hz**. These frequencies help us with combatting stress, and they stimulate the regeneration of tissue.

Beta waves (13 – 30 Hz)

Beta waves occur mainly when you are concentrated and fully engaged in what you're doing. Their levels increase when you are alert and drop down when you're drowsy. Beta waves serve to control your attention, regulating what you think about.

- When you actively choose to do something, for example to read this text, beta activity increases.
- Beta rhythm acts like a brake on the contents of your thoughts, regulating which information stored in your working memory will influence your behavior.
- Beta waves are also linked with anxiety and stress, as your brain switches to higher activity whenever you're afraid, angry, or worried.

Beta waves are used in our predefined program **Enhance Mental Capacity**. To take advantage of Beta in Custom programs, pick a **frequency between 13 Hz and 30 Hz**. These frequencies enhance alertness and vigilance.

Gamma waves (30 – 100 Hz)

Gamma are the fastest brainwaves, oscillating with a frequency of 30 to 100 Hz. They occur when distant parts of the brain fire in a harmonious way, marking the simultaneous processing of complex information which happens when you are performing demanding mental tasks.

- When you have a moment of insight, coming up with an answer for an intellectual riddle or problem, a short flash of gamma appears in your brain.
- Meditation causes an increase in gamma. Among senior meditators gamma waves are present not only during contemplative practice but also when they are resting or doing everyday tasks.
- Levels of gamma brainwaves increase during lucid dreaming. Furthermore, lab experiments had shown that it's possible to induce lucid dreams by stimulating the brain to produce more gamma waves.

Gamma waves are used in our predefined programs **Focus Meditation**, **Lucid Dreaming** and **Pain Control**. To take advantage of Gamma in Custom programs, picks a **frequency between 30 Hz and 100 Hz**. These frequencies help us process demanding information.

Written by **Mateusz Konopacki**.

When your brain slows down: the science of delta waves

Every night when you take your well-deserved rest, your brain activity slows down. It becomes dominated by delta waves: slow synchronized firings of your neurons which happen up to 4 times per second.

Your brain produces the biggest amounts of delta waves during deep sleep. Also called slow-wave sleep, this is the time when your body recharges its batteries. It recovers after everything that you've put it through during the day, gets rid of toxins, and synthesizes new cells. The same goes for your mind: slow-wave sleep is essential for memory consolidation. Delta waves play an important role in that... although different from what you might have expected. But we'll cover that further down the road.

When the cruel scientists suppressed slow-wave sleep in a group of participants, they observed a range of negative effects. The treatment hampered the individuals' mental skills and impaired their glucose metabolism, increasing the risk of type 2 diabetes.

On the other hand, studies that enhanced SWS observed better learning and health. This could be done by stimulating the brain to produce delta waves. An increase in delta power has positive effects on sleep while decreasing it is associated with insomnia or poorer sleep quality.

Disconnected brain

Usually, delta waves happen when you are unconscious, but not always. In some extraordinary conditions, delta oscillations occur in conscious subjects. This was observed for instance in people under the influence of potent psychedelic substances like DMT. What is interesting, delta power was correlated not only with the reported intensity of the state and experienced visuals. It was also linked with higher entropy: a measure of brainwave complexity. Brain signal entropy is often used as a landmark of low high conscious states. It sounds spooky, but the rule is rather simple: the more conscious a state is, the more complex is the brain activity. For example, during sleep entropy and complexity are low, but when you are conscious they rise, and become even more complex in "higher states".

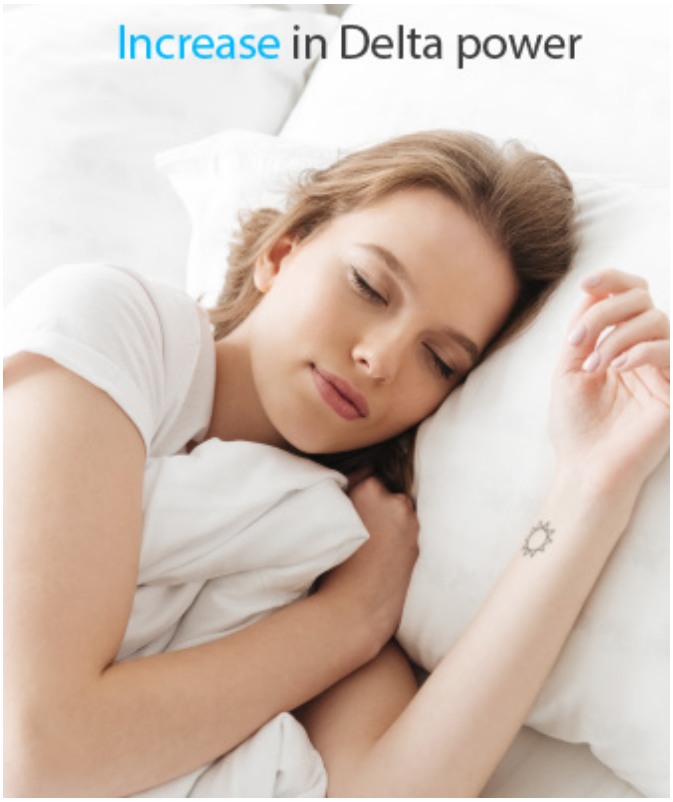
Observing delta oscillations in states that are highly conscious made scientists rethink their functions. Delta waves may sometimes be a sign of sensory disconnect rather than unconsciousness. It may be the case that both in dreams and in drug-induced dreamlike states delta oscillations may facilitate a condition when the brain is disconnected from the sensory input from the environment, yet its association cortex remains active.

Slowing down… even more

It was a well-known fact that slow-wave sleep is crucial for memory retention. Whatever useful new stuff you learn throughout the day, you need to sleep over it to make it stick (that's why pulling an all-nighter while cramming for an exam may not be your best choice). The same neurons which were active during the initial experience are reactivated during sleep to consolidate this memory trace in the brain.

Before we explore the relationship between brainwaves and the memory consolidation process, I need to clarify one common misunderstanding.
You might have been told many times that delta are the slowest frequency brainwaves.

Truth be told… they're not.
For a long time, delta waves were believed to be the slowest pattern of brainwave activity. This was due to the frequency filters used during EEG procedures: to avoid noise in the signal, a cut-off filter of 1 Hz was commonly used.



But there are brainwaves slower than 1 Hz, called slow oscillations. Apart from lower frequency, they are different from delta in their nature. Delta waves appear more locally, whereas slow oscillations globally sweep through the brain.
There is also a third type: sleep spindles. They are bursts of high-frequency activity which appear every few seconds during non-REM sleep (basically, when you're not dreaming). The coupling of slow oscillations with sleep spindles is essential to memory consolidation. For new information to be engraved in the memory network, slow oscillations have to be time-locked with sleep spindles.

Making rats forget

A group of researchers from San Francisco decided to explore the functions of delta waves and slow oscillations. They used a group of genetically modified rats. Thanks to the alterations, the scientists could tweak the animals' brainwaves by precisely stimulating neurons with light. This way, they could suppress either slow oscillations or delta waves.

Firstly the lab rats were trained in a new motor skill. Then when the animals were sleeping, the researchers messed with their brainwaves. When slow oscillations were suppressed, the next day rats' performance was poor, as the animals were unable to properly integrate the training. This was an expected result: as we mentioned, slow oscillations coupling with spindles are key to learning.

But then the research team disrupted delta waves. As a result, the rats' memories… improved. When delta activity was suppressed, reactivation of the task-related neural activity was stronger, and rats performed better when they woke up.

However strange it may sound, when it comes to memory, remembering is only one side of the coin. The other, equally important, is forgetting. It serves to unclutter the mind by eliminating unimportant information. By weakening the memory pathways which are unnecessary, the vital ones could get strengthened.

The researchers concluded that slow oscillations and delta waves serve two competing functions. Slow oscillations protect new memories, while delta waves erase them and promote forgetting. These findings offer great opportunities for the future: think about boosting memory or forgetting traumatic experiences.

The key to proper memory processes is the balance between slow oscillations and delta waves. It all makes sense when we look at brainwave patterns in common diseases. Delta waves are linked to dementia, and they proliferate in Alzheimer's disease, to the point when they permeate the brain activity also during wakefulness.

What happens if we induce delta?

A team of scientists from Germany thoroughly examined the effects of impulse magnetic field therapy for insomnia. Throughout four weeks participants received either magnetic stimulation in delta wave frequency or sham placebo treatment in the control group. Among those who received real treatment, the vast majority (70%) reported that their problems with sleep were reduced or disappeared completely.

The same delta frequency is used in Omnipemf's PEMF devices. No matter if you suffer from difficulties with sleeping or you just want to make the most of your bedtime, if you want to use Neorhythm to improve sleep just choose the predefined setting in the app.
A promising area of brainwave induction is tackling not only delta, but also slow oscillations. Several research experiments used less than 1 Hz frequency stimulation with either sound tones or weak electric currents. The treated participants not only slept better than the controls, but also their memories improved.

Written by **Mateusz Konopacki**.

From contemplation to memory: the power of Theta waves

Do you know what meditating, navigating a maze, and boosting memory have in common? Some kind of elite ninja training regimen? No. Well, maybe, but …

Do you know what meditating, navigating a maze, and boosting memory have in common?

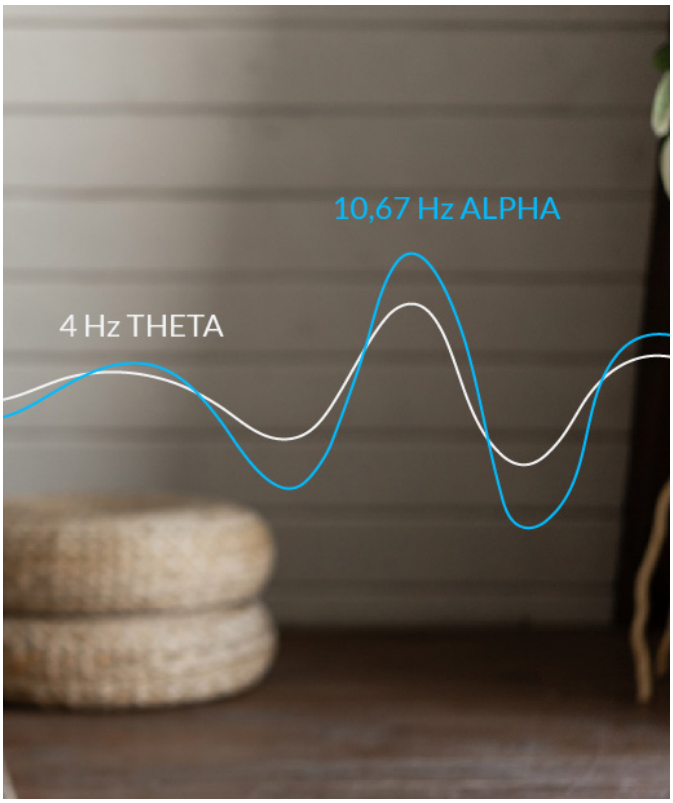
Some kind of elite ninja training regimen?

No. Well, maybe, but this post tackles neuroscience, not martial arts (sorry for that!) In your brain, there is a common milieu for being immersed in meditation, finding your way around an unknown environment, and learning new things: the theta waves.

Calm down and focus

Theta rhythm is the frequency of your brainwaves firing 4 to 7 times per second. Compared with other brainwaves, theta is a rather slow frequency. The only waves slower than theta are delta, which occur when you sleep. The speed of your brainwaves is to some degree related to the level of activity: not surprisingly, theta waves may often indicate deep relaxation.

Theta rhythm is also the landmark of the meditative state. Although sudden bursts of fast gamma brainwaves sometimes also occur among the masters who had spent many hours of their lives on meditation, there are two main kinds of waves associated with meditation: alpha and theta. When you begin your meditative practice, alpha waves are more pronounced, but the tendency changes towards theta as you progress in your practice. Higher levels of theta mark the growing proficiency in meditation. During practice, theta waves are generated by the frontal parts of the brain, associated with monitoring mental processes. Some researchers speculate that your frontal brain may be using this frequency to signal lower parts of the brain to induce physical relaxation. Indeed, theta waves are linked to lower anxiety and higher feelings of calmness and bliss.



Brains in the maze

Apart from the frontal cortex, there is another part of the brain which generates theta waves: the hippocampus, a highly important structure deep in your brain which governs a range of mental functions, among which are memory and spatial navigation.

A team of scientists from UC Berkeley used electrodes implanted in rats' brains to measure neural activity when the animals were navigating a maze. They observed that the brainwaves generated by the rat's hippocampus were changing in sync with the animal navigating the labyrinth. The researchers could even predict the rat's position in the maze, just by looking at the brainwaves.

Quite possibly, in rodents, the hippocampal theta waves serve to coordinate different areas of the brain during movement. When the animals are navigating through the maze in the laboratory or through real-life environments, their brains need to coordinate their spatial working memory with the neural areas which govern attention and planning. Putting it simply, the mental image of the space around needs to be accessible to the parts of the brain that plan and coordinate the animal's actions. Theta waves help in that communication between different

areas of the brain. Scientists studied theta oscillations extensively in rodents, but the question remained: is it similar in humans? There was a big problem: standard EEG recordings use a set of electrodes glued on the participant's scalp. Every larger movement disturbs the procedure causing noise artifacts in the signal, therefore people undergoing EEG are asked to sit still. You can imagine that makes it quite hard to study what their brains are doing when they move around…

An alternative is recording neural activity with an electrode placed directly in the brain. Sounds invasive? Yes, but there are some people who have undergone such operations for their own safety: the seizure patients. One of the cutting-edge methods of treating epilepsy involves devices implanted in the patients' brains that monitor the neural activity. Apart from increasing safety, this method also opens a range of possibilities for studying brainwaves.

A group of scientists took advantage of these wireless brain implants to observe what happens in human brains when individuals move. They found that theta waves increased when the patients were walking around, and navigating through unfamiliar terrain. This activity also tended to speed up when the participants were moving faster. What's interesting, one of the participants was blind from birth. His theta waves during movement were even more pronounced than in sighted patients.

Memory waves

Relaxing, meditation, and moving around – theta waves are vital for a range of useful tasks. But there is another area of theta activity that may interest you even more.

Who wouldn't want to remember things better?

EEG studies have shown that theta activity is enhanced when people are trying to remember things that they learn and when they are trying to retrieve information from their memory.

But is there a direct link between theta and memory?

Scientists are used to pose one basic question when they see two things that occur together: are they causally related, or is it just a coincidence? In other words, are theta waves actively involved in our memory processes? It may be the case that there is another unknown factor that triggers both remembering and theta oscillations.

In order to solve this mystery, researchers had to manipulate theta waves and see if it helps to remember. To this end, they used brainwave entrainment. It works by giving the brain rhythmic sensory inputs like sounds and lights which vibrate at the desired frequency. This guides the brainwaves towards this bandwidth.

A group of researchers from California used goggles and headphones emitting flickering lights and sounds to entrain theta brainwaves in a group of participants. In the first experiment, the subjects were asked to remember words and then subsequently had their memory tested. In between learning and test, they were exposed to either theta wave entrainments or white noise. In the second experiment, the researchers included another frequency of beta waves, to see if other bandwidths would work as well. Only those treated with theta entrainment had a significant advantage in remembering tasks.

How to introduce theta?

The research we discussed shows that we can boost memory by tapping into theta brainwaves. Enhancement of theta activity could be a successful treatment for patients with memory disorders.

Could it be helpful for you?

It seems so. There is a range of non-invasive techniques which enable you to take advantage of theta waves.

Of course, you may try navigating a maze while meditating and trying to remember a list of words at the same time. That might cause a spike in your theta waves, but there are easier techniques as well.

One of the methods is binaural beats, which involves listening to two rhythmic sounds of different frequencies presented to both ears respectively. Due to a perceptual phenomenon, the brain is stimulated with a frequency which is the difference between both tones: for instance, if one ear hears a frequency o 215 Hz and the other 235 Hz, the brain is stimulated with the frequency of 20 Hz.

In a study done in Thailand, researchers used binaural beats to entrain 6Hz theta frequency. The treatment helped the participants to relax and decreased their worrisome thoughts. What's important to note was that using this method, the most successful duration was 10 minutes. Longer times of exposure do not increase theta power and may cause fatigue.

The other study we mentioned before used sound and light theta entrainment to successfully boost memory. Wearing both goggles and headphones to see flickering lights and vibrating sounds could be a little bit inconvenient, but there is an easier method of entrainment that involves magnetic field stimulation. Devices such as Neorhythm use a set of electromagnetic coils to induce different kinds of brainwaves. If you want to increase theta, you can choose one of the predefined programs such as Theta Meditation, Mindfulness Meditation, and Open-Heart Meditation. You can also set a custom frequency between 4 and 7 Hz.

Written by **Mateusz Konopacki**.

Alpha waves: the frequency of introspection

Close your eyes.

Take a few deep breaths. Relax, sinking back in your chair.

OK, that's enough. When you were experiencing a brief moment of serenity, parts of your brain switched to alpha brainwaves: big populations of neurons firing together with a frequency of 7 to 13 times per second. Now, as you're actively focused on reading, alpha activity dropped down again.

The best way to find out about the role of different brainwaves is to give people tasks to do and observe what happens in their brains. Imagine sitting in a sterile lab with some weird hardware strapped to your head and solving tedious mind quizzes (yes, the standard cognitive tasks used by researchers are in fact really boring). Quite possibly, after some time your mind will start to wander off, drifting from one thought to another.

That's when alpha brainwaves kick in. When people are tested performing tasks while their neural activity is monitored, a clear tendency is visible: alpha waves get stronger when the individuals are daydreaming and weaker when they try to focus.

Alpha waves mainly occur when your mind is not focused on the task you're doing. All these moments throughout the day when you were supposed to be working but your mind keeps thinking about everything but what your boss pays you to think about – yep, that's alpha.

It's all in your mind

Apart from focus, there is one other dimension linked to alpha bandwidth activity: whether your attention is directed outwards or inwards. When you are daydreaming, your mind is withdrawn from the outside world and directed towards itself, as you experience thoughts and memories. This is a domain of alpha brainwaves. But when external stimuli such as light or sound draw your attention towards it, you become focused on the outside world and the alpha brainwaves cease.

That's why alpha waves occur also during meditation, which usually involves observing one's train of thoughts. Whether the meditator is keeping an attitude of a mindful observer and letting mental impressions float by or being completely immersed in daydreaming, alpha waves will spike.

Risk or benefit?

If alpha waves occur when you are not actively focused on the task, does it mean that they may hamper your performance?

For some classes of activities, the answer is yes. When the mind is wandering, you have less cognitive control over what you're doing. In many work environments which require vigilance and focus, this will mean lower accuracy and a bigger risk of failure. You better not increase your alpha waves if you're a flight controller.

However, if your line of work is a creative one, you may benefit a lot from alpha brainwaves.
Let's pause for a moment and define: what does it mean to be creative?

Dissecting creativity

There is a class of tasks that require connecting information in a logical way, solving mathematical equations, or just digging through books or the internet. But there is also another group of problems that require non-standard, extraordinary solutions: they force us to harness our creativity.

Both classes of problems demand different mind operations. For tackling non-creative tasks, you basically need three things: time, enough information, and a focused mind. But for creative ones, the focus is not enough. To find non-obvious connections between ideas, your brain needs to engage in some free exploration: to juxtapose different memories together, looking for patterns or inspirations. This is exactly what your brain does when your thoughts are wandering freely. It may also be the probable evolutionary reason for why your brain daydreams: it does it not to make your work time miserable, but on the contrary, to help you solve creative problems.

Wandering with purpose

It turns out that these periods when you lose focus, your thoughts wander and your brain generates more alpha waves may be necessary for being creative. Indeed, many researchers observed that alpha brainwaves increase when people are engaged in creative tasks, and that creative individuals' brains show more alpha activity.

But that didn't exactly mean that there was any direct link between alpha waves and creativity: after all, those two things occurring together could have been a coincidence. To really determine whether alpha waves have something to do with finding novel solutions, the scientists needed to see what happens if they manipulate the brainwaves.

Does tuning up to alpha bandwidth increase creativity?

It seems it does. A research team from North Carolina treated a group of participants with electric current (tACS) which stimulated their brains towards 10 Hz alpha bandwidth. After this treatment, the participants scored better on creativity tasks. Researchers then checked if using the same method, but with different frequency would yield similar results. It didn't: only the bandwidth of alpha waves produced an improvement.

What happens if you induce Alpha?

So far we know that an increase in alpha brainwaves marks the time then your brain wanders, which may be a good thing if you're working on a creative problem. What are the other benefits?

Just as the faster beta brainwaves are linked with high activity, the slower alpha bandwidth is associated with relaxation. It means that you can use alpha waves to calm down, which is especially useful at times of stress. In one experiment, a group of people suffering from anxiety disorder received neurofeedback training which increased their alpha and theta waves. After 15 sessions, their anxiety symptoms were reduced.

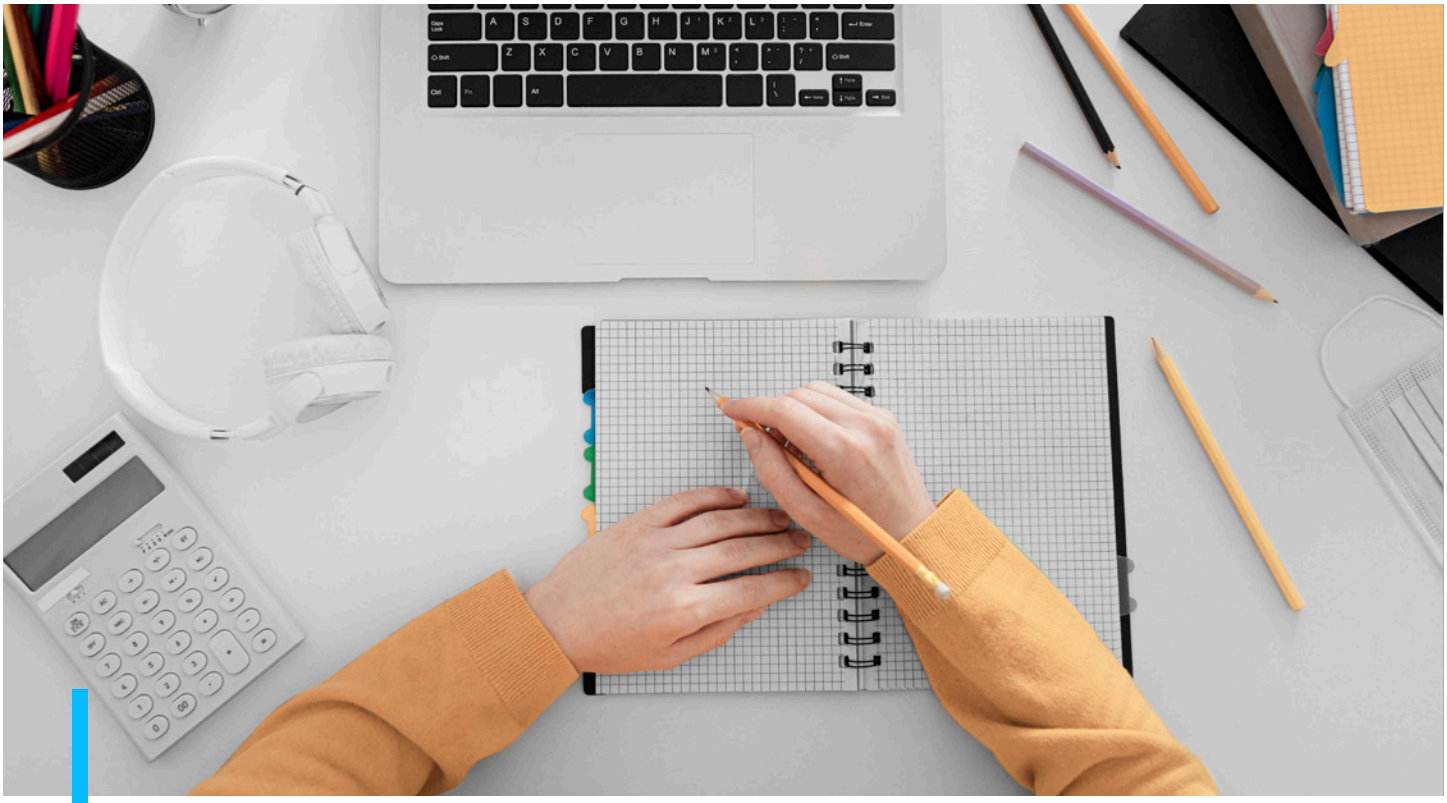
Increasing alpha waves may also increase memory retention. Studying typically involves bouts of intense focus when you chew through information, after which your brain needs to consolidate new data in long term memory. Alpha waves come in handy for these calmer moments of retaining novel memories.

Doing it yourself

How to use alpha for your benefit? One of the ways is to train your brain to generate more alpha waves. It could be done using neurofeedback. The idea is simple: an EEG device monitoring brainwaves is coupled with some sort of interface, which could even be an app on your phone screen. When you're trying to achieve target brainwaves, you get feedback about your neural activity from the setup, which gives you cues when you're doing it right or wrong.

You can also use non-invasive brain stimulation to drive your brain towards alpha frequency. If you're using Neorhythm, either use one of the predefined programs such as Quiet Mind Meditation, Meditation for Calming & Synchronisation or Deep Relaxation. To take advantage of alpha in custom programs, pick a frequency between 7 Hz and 13 Hz.

Written by **Mateusz Konopacki**.



Beta waves: the hallmark of alertness

A university lecturer making a passionate speech, a politician engaged in vibrant debate, or a talk show host: what all they have in common are the beta waves.

When someone is alert and fully concentrated, actively engaged in what they are doing, groups of neurons in their prefrontal cortex fire with a frequency of 13 to 30 times per second. Beta waves were considered the fastest cycles of synchronized brain activity before an even faster gamma frequency band was discovered.

Throughout the day when you're mentally attentive and not sleeping, your brain emits beta waves. Because they increase when people are alert and drop down when they're drowsy, beta waves are a sign of active brain activity. However, they are also linked with anxiety and stress – after all, your brain switches to higher activity whenever you're afraid, angry or worried.

Mental sketchpad

Working memory is a system in your brain that temporarily holds information, allowing you to use it without losing track of what you're doing. It comes in handy when you receive new data and need to connect it with other information already stored in your mind, or works like a notebook of consciousness, holding information in your mind while you make a decision. Think about solving a mathematical formula: you won't remember the numbers ten minutes later, but you need to store the numbers somewhere while looking for a solution.

Research shows that beta waves may be crucial for such mental operations. In one experiment, a group of animals were given a working memory task while the scientists recorded brain activity from their prefrontal cortex, which is the seat of working memory. The animals were presented with sets of objects, and they were trained to react when the subsequent sets matched. Imagine a sequence of A and B objects. Another set of AB would be a match, but not BA, AC, or CA.

When the animals were presented with sequences to find a matching pair, their beta waves went way up when the first object shown was not a match for the target sequence. Beta rhythms served to clear working memory, because the animal already knew that the whole sequence would not be a match.

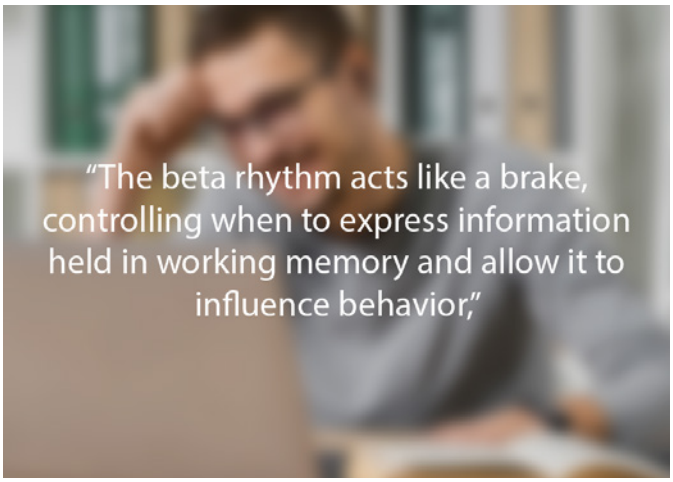
Choosing what to think about

Other studies have demonstrated that beta frequency may be used by the brain to switch between pieces of information stored in working memory.

A team of scientists from MIT asked a group of participants to perform a memory task while they monitored their brainwaves. The task involved holding a series of numbers in mind for a short period of time. The researchers observed that the participants' brains used beta waves to alternate between different chunks of data.

It seems that beta frequency acts as a gate which determines when information held in working memory is either read out, or cleared leaving space for you to think about something else.

As the author of the study Mikael Lundqvist has put it:



When you are holding a piece of information in working memory, it feels as if it is stable, as if it is there all the time. Scientists used to believe that this must be supported by steady neuronal firing, a constant activity which represents the thought. Research with beta waves shows that working memory may be supported by brief spikes of neural activity controlled by beta waves, rather than continuous firing. In other words, our memories are "blinking in and out of existence".

As you can see, beta waves regulate a lot of what happens in your mind, moment to moment. They also serve to control what you think about, being associated with the top-down control of attention.

What does it mean?

Your attention could be driven from two directions. If you hear a sudden noise in the corner of your room, your focus will be immediately drawn towards it. Scientists call it the bottom- up attention: the peripheral (bottom) endings of your senses drive your focus.

But when you actively choose to think about something, for example while reading this text, the top down attention kicks in. This is when beta waves come into play. They serve as a control mechanism over conscious thought. Out of all the pieces of information you hold in your working memory, which of them will be read out is determined by beta waves.

Increasing focus

If beta is so important for focused cognition, what would happen if you increase that bandwidth? As you might have expected, a higher amount of beta waves is correlated with better cognitive capacity. Several research studies have shown that tapping into beta can stimulate concentration or learning skills.

How to induce beta? There are a couple of ways.

One of them is to use “brain jogging”. It combines three elements: performing cognitive tasks, multitasking and physical activity. Several research studies found this mix to increase concentration skills, marked both by performance and an increase in beta bandwidth. There are several brain jogging programs available online, if you want to give it a try.

Other methods involve noninvasive stimulation of the brain to drive neural activity towards beta waves. If you use an Omnipemf device, you can either use a predefined program or choose a custom frequency. The program Enhance Mental Capacity uses beta waves to increase focus and productivity. When setting a custom frequency, choose one between 13 and 30 Hz.

You can also stimulate the braiwaves towards beta frequency using binaural beats. Similar to brain stimulation using alternating magnetic fields as in the NeoRhythm band, binaural beats use sounds to drive brainwaves towards the desired frequency.

In this method, two slightly different rhythmic sounds are presented to both ears respectively. The method is based on the phenomenon of the brain perceiving the difference between the two tones coming to each ear. For instance, one ear hears a frequency o 215 Hz and the other 235 Hz. In effect, the brain is stimulated with the frequency of 20 Hz.

Written by **Mateusz Konopacki**.

Brain frequencies: a guide to Gamma waves

Imagine a ripe fruit. You lift it, drag in the sweet smell. You bite in and let the sensations explode: the fresh taste, the cracking sound, the touch of juice dripping down your mouth.

In your brain, different elements of your memory network activate, combining the sensations of smell, taste, touch, and sound into one experience. When the parts of your brain fire synchronously, their synergy yielding your conscious experience of that moment, something special happens between your neurons: the gamma brainwaves.

Gamma are the fastest brainwaves, oscillating with a frequency of 30 to 100 Hz. They occur when distant parts of the brain fire in a harmonious way, marking the simultaneous processing of complex information which happens when you are performing demanding mental tasks.

When you have a moment of insight, coming up with an answer for an intellectual riddle or problem, a short flash of gamma appears in your brain.

Some scientists consider the neural synchrony observed in gamma brainwaves as the higher state of consciousness. Integrating distant parts of the brain may be the key process underlying conscious awareness.

Gamma band is also involved in concentration and managing attention, and it is believed to be highly important in learning and conscious perception.

Sharpening the mind

There is a group of people who have much stronger gamma brainwaves than ordinary people. In the brains of long-term meditators, gamma waves are not only stronger but also last for a longer time. When testing the brains of yogis, one study recorded gamma waves with an amplitude 25 times higher than among the control group of non-meditating people.

You may ask "What if those people who have higher gamma take up meditation in the first place?" Maybe contemplative practice is just easier for them. Maybe their brains have bigger capacities to concentrate, so they are more likely to withstand the strenuous training without getting discouraged?

We know that it's not the case. If groups of beginner and advanced meditators are compared, a clear difference in gamma wave levels can be observed. The practice of meditation causes an increase in the amount of gamma.

What is interesting, among senior meditators gamma waves are present not only during contemplative practice but also in "ordinary" situations, when they are resting or doing everyday tasks. This may reflect their higher awareness of thoughts and physical sensations

Given that meditation practice could be described as training in self-awareness and focus, the stronger gamma brainwaves in meditators support the theory linking gamma bandwidth with conscious perception and concentration.

Gamma waves may occur when meditators direct their attention to the subject of their practice, controlling the contents of their minds and bringing the attention back any time they notice mind-wandering episodes. Gamma may also refer to the metacognitive monitoring of all internal and external sensations: attentively observing thoughts and paying mindful attention to feelings from the body or to external sounds.

What happens if we entrain Gamma?

Is the practice of meditation required to reach gamma waves? Do you have to step onto an ascetic path of a monk to enjoy higher states of awareness?

Taking up meditation certainly comes with a range of benefits, so I highly recommend giving it a try. But when it comes to gamma frequency, there is also a shorter way: brainwave entrainment.

In a couple of research studies, scientists managed to induce gamma waves through external stimulation of the brain. For example, Jennifer Cahill used isochronic audio tones of 40 Hz frequency to drive her participants' brainwaves towards the same bandwidth. Simultaneously, she also monitored their brainwaves using EEG to make sure the induction was successful.

The principle of entrainment is simple: rhythmic stimulation of senses causes neurons to fire in the same rhythm. If you use a fast, consistent rhythm that mimics brainwave activity, the brain synchronizes its natural electrical cycles to the same rhythm.

What were the results of Cahill's experiment? The participants reported entering a calm and blissful state, a combination of being relaxed and concentrated. Their stream of thoughts slowed down, as they were consciously moving through different states of awareness, mentally focused and absorbed.

The changes occurred in their physical experience as well: some reported tingling or the feeling of increased energy. Interestingly, a number of participants lost the general awareness of their bodies, yet remained conscious of their body position.

Tuning into lucidity

In her study, Cahill noted an unexpected finding. Many participants reported their experiences to be dream-like. They felt as if they were somewhere between being asleep and yet aware at the same time. This intriguing observation stands in line with some previous research.

When monitoring the brainwaves of sleeping participants, a group of researchers from Germany noted an increase in gamma frequency brainwaves during lucid dreaming. Inspired by this finding, they decided to see whether it's possible to induce the state of lucid dreaming just by entraining gamma brainwaves.

They utilized a method called tACS, (transcranial alternating current stimulation) which involves a small pulsating electric current. Although the scientists used it to entrain the whole spectrum of brain frequencies in sleeping participants, only gamma waves resulted in lucid dreams.

The researchers' conclusion was that gamma oscillations increase self-reflective awareness. This is yet another proof of gamma waves serving as a milieu for higher states of consciousness.

Do it yourself

You can experiment with inducing gamma brainwaves yourself using Omnipemf's PEMF devices such as Neorthythm. There are two ways: you can either choose one of the pre-defined programs or design your own custom setting.

Gamma waves are used in the programs such as Focus meditation and Pain control. If you want to create your own program, pick a frequency between 30 and 100 Hz.

If you want to use gamma frequency to increase your awareness and obtain lucid dreams, Neorhythm has a special setting just for that goal.

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