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The Complete Guide To Brainwave Entrainment

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Introduction

Brainwave entrainment (BWE) is one of the most powerful, mind-enhancing tools available today. Countless studies have verified its benefits – from cognitive performance to alleviating stress, to even countering physical pain.

As incredible as this technology is, the internet is filled with misinformation, aggressive marketing, and a host of other deceptions around BWE that could lead users down the wrong path. We created this comprehensive guide to clear the fog and give clear-cut advice to make the most out of this exciting tool.

If you want to see the following benefits in your life, then this guide is for you:

- Less stress
- Increased creativity
- Greater focus
- Removal of bad habits
- Deeper meditations
- Better mood
- Increased memory & mental performance

CHAPTER 1: BRAINWAVES

To understand how brainwave entrainment works, you first need to know the basics behind brain waves. In this section, you'll learn what brain waves are and how they're linked to various mental, emotional, and physical states. You'll also learn how neurotechnology allows you to modify brainwaves, giving you greater control over your mind.

WHAT ARE BRAINWAVES?

The brain is made up of approximately 100 billion neurons, and trillions of connections between them. There are more neural connections in a single cubic centimeter of brain tissue than there are stars in the Milky Way galaxy! This immense neural network is responsible for anything and everything related to your reality. From your sense perceptions to your thoughts, to all functions of your body – it's all driven by data flowing through your brain's neural web.

This data is passed from one neuron to the next through electricity (which can be clocked in at speeds upwards of 250 miles per hour – faster than a Formula One racing car)!

By placing electrodes on the scalp with a device called an electroencephalograph (EEG), scientists have discovered that electricity travels through the brain in rhythms. These electrical rhythms are called brainwaves.

WHAT TYPE OF BRAINWAVES ARE THERE?

Brainwaves are measured in Hertz (Hz), which are the frequency of electrical cycles per second. Brainwave frequencies can be grouped into categories. These categories are linked to various mental, emotional, and even physical states.

For example, slow brainwaves are associated with things like relaxation and sleep, while faster brainwaves are associated with things like alertness and heightened energy. By looking at one's brainwaves, you can understand the state of one's consciousness.

Down below, we give a description of each brainwave category, their frequency range, and the mental state associated with it.

Beta (30hz – 14hz) – Normal waking consciousness occurs in the beta range.

This category is associated with cognitive tasks such as problem-solving, decision making, verbal communication, and general mind wandering. Higher levels of beta brainwaves can be linked to stress, anxiety, and panic.

MU or SMR (The Sensory Motor Rhythm) (12Hz – 15Hz) – The Sensory Motor Rhythm (SMR) is associated with motor planning and execution (its range partly overlaps with other frequencies). It appears in spindles in recordings of EEG, and MEG (Magnetoencephalography) over the sensorimotor cortex. For most individuals, the frequency of the SMR is in the range of 12~15 Hz

Alpha (13hz – 7hz) – Awake, but deeply relaxed. Simply closing your eyes will produce alpha brainwaves. This category is associated with daydreaming, visualization, imagination, light meditation. Brainwave expert Anna Wise called the alpha range the bridge between beta and

theta. (More information can be found in Wise' book The High-Performance Mind)

Theta (7hz – 4hz) – Light sleep, dreaming, REM sleep, creativity, access to unconscious material, access to long-term memory, emotional healing, intuition, deep reverie, and spiritual wisdom. Hypnotists have found theta to be the range of hyper-suggestibility, where one can program or reprogram beliefs.

Delta (4hz – 0.2hz) – Deep, dreamless sleep. Intuition. Empathy. Brainwave expert Judith Pennington calls it the doorway to Universal Consciousness and “A radar that scans the environment and psychically picks up information and energy.” According to British physicist C. Maxwell Cade, “There have been reports that delta waves appear at the onset of paranormal phenomena.” (More information can be found in Cade's book The Awakened Mind)

Gamma (30–100 Hz) – Gamma rhythms are thought to represent binding of different populations of neurons together into a network to carry out a certain cognitive or motor function. According to a popular theory, gamma waves may be implicated in creating the unity of conscious perception. However, there is no agreement on the theory; as researcher C.H. Vanderwolf suggests: “Whether or not gamma wave activity is related to subjective awareness is a very difficult question which cannot be answered with certainty at the present time”.

HOW TO MODIFY BRAINWAVES TO CONTROL YOUR MIND?

The brain is a complex system, and every area of its network fires off various types of brainwaves at once. It is the combination of these brainwaves which can give a deeper insight into a person's state. For example, someone who has low levels of beta waves and elevated levels of alpha /delta tends to suffer from attention deficit disorder (ADD). Those that have elevated levels of beta waves and low levels of alpha waves tend to suffer from anxiety.

Brainwave entrainment is a powerful technology that allows us to have greater control over our brainwaves and in turn greater control over our mental states.

For example, ADD sufferers can use BWE technology to decrease theta brain waves, increase beta brain waves, resulting in a more focused mind. Those suffering from anxiety can turn down their beta brain wave production, which can result in feelings of relaxation and well-being.

Utilizing BWE technology gives you the closest thing to a dial control over your brain. Many long-term entrainment practitioners have said BWE allows them to enter any desired state at will – from deep tranquility to creative insight, and focused attention.

CHAPTER 2: WHAT IS BRAINWAVE ENTRAINMENT?

Think of a tuning fork. A tuning fork can be used to tune a guitar string to the right pitch. In the same way, brainwave entrainment uses specialized sound and light technology to tune your brainwaves to specific frequencies, and in turn, give you greater control over your mind. In this section, we dive into the science behind this principle.

WHAT IS ENTRAINMENT?

Entrainment is a physics principle in which one rhythmic system falls in synchrony with another rhythmic system. If you've ever found yourself moving your body to the beat of your favorite song, then you've experienced entrainment in its most basic form. Besides music, this principle can be found all around you, probably more than you realize. Here are a few examples:

- Fish in the ocean coming together to swim in synchrony
- Your circadian rhythm synchronizing to the rise and fall of the sun
- Women working closely at the workplace naturally matching their menstrual cycles
- Breathing patterns and heart rates of couples matching when sitting close together
- The human heart beating at the same beat of a pacemaker

One of the most famous observations of entrainment was made by Dutch Scientist Christiaan Huygens in 1665. He observed identical swinging movements of two pendulum clocks on his wall. Even when he brought one clock off sync, the two always found themselves back in step.

When he moved one clock to the other end of the room, the two fell out of sync. But when brought back together, the pendulums would again synchronize.

Why does entrainment occur? From a physics standpoint, less energy is required when one system falls in sync with a more powerful rhythmic system. Picture yourself swimming in a flowing river. How much more difficult is it to swim against the current versus swimming alongside it? It takes far less energy when you swing with the flow of the water.

From the stars in the sky to the fish in the ocean, endless systems fall under this same principle – including the human brain.

WHAT IS BRAINWAVE ENTRAINMENT (BWE)?

As we explained in the previous chapter, billions of neurons throughout your brain communicate with one another through electricity. These electrical pulses are rhythmic in nature. Just like any other rhythmic system, it can be subject to entrainment. source

Remember how we talked about pendulum clocks synchronizing when placed near each other? Your brainwaves behave in the same way when presented with certain rhythmic stimuli.

For example, if you stare at a strobe light flashing at a consistent and slow enough rate, your brainwaves will eventually begin to fall into that same rate.

This process is called brainwave entrainment (BWE), which occurs when the electric rhythms of your brain begin to synchronize with the same rhythms of an external source. This source could come in the form of pulsing light, sound, touch, or even electrical signals.

Here's why brainwave entrainment matters: By presenting ourselves with light or sound pulsating at specific frequencies, we can modify our brainwaves to the same rhythm and in effect, control our mental, emotional, and physical states at will.

What is EEG?

Electroencephalograms (EEG) signals are recordings of electrical activities along the scalp, which measure voltage fluctuations resulting from ionic current flows within the neurons of the brain. EEG signals have been widely used in brain-computer Interface, neural prostheses and in clinical areas for the treatment of mental disorders.

The dominant frequencies of the brain EEG signals are influenced by our daily activities. For example, if a brain is in excited and wake state, the EEG signal shows high-frequency activity without clear synchronization. In relaxed, wake state of the brain, the EEG shows clear

synchronization at a specific frequency, while this synchronization is thought to originate from an idling neural circuit oscillating at a characteristic frequency.

Brainwave entrainment (or brainwave synchronization) is a practice that aims to cause brainwave frequencies to synchronize with a periodic stimulus with a frequency corresponding to the intended brain-state. Auditory or visual stimulation is widely used for brainwave entrainment or neuro-modulation.

CHAPTER 3: THE HISTORY OF BRAINWAVE ENTRAINMENT

In this section, we'll take you on a journey recounting brainwave entrainment's rich history – from its earliest discoveries in ancient Greece over 2,000 years ago, to the discovery of brainwaves in the 1920s, to the explosion of consumer brainwave entrainment devices throughout the 1980s and beyond.

Around 200 AD, the famous Greek writer, mathematician, and astronomer Ptolemy noticed that when he spun a spoked wheel between him and the sun, the flashes of sunlight caused him to see unique patterns of color and light, and have feelings of euphoria.

In the 19th century, the famous psychologist Pierre Janet noticed that when his patients were presented with flickering lights, they had a significant reduction in hysteria, depression, and anxiety.

As technology advanced in the 20th century, neuroscientists began using tools such as the Electroencephalograph (EEG). In 1924 German physiologist and psychiatrist Hans Berger recorded the first human EEG, and by 1929 discovered the alpha brainwave (8 – 12 Hz).

In 1934 researchers Adrian & Mathews worked off of Berger's research and found that pulsating light (which would later be known as photic stimulation) could produce alpha brainwave activity.

During World War II, technician Sidney Schneider noticed operators who frequently stared at radar screens emitting rhythmic light flashes, entered altered states of consciousness. Schneider later developed one of the first sound and light machines called the Brainwaves Synchronizer.

In 1956, the famous neuroscientist W. Gray Walter published the results of studying thousands of test subjects using photic stimulation, showing their change in mental and emotional states. He also learned that photic stimulation not only altered brainwaves but that these changes were occurring in areas of the brain outside of vision. In Walter's words:

"The rhythmic series of flashes appear to be breaking down some of the physiologic barriers between different regions of the brain. This means the stimulus of flicker received by the visual projection area of the cortex was breaking bounds— its ripples were overflowing into other areas."

In the 1960's famous writer and Beat Generation figurehead, William S Burroughs and British artists put together a simple visual device called the Dream Machine, in which a pierced cylinder rotated around a light source to produce flickering effects. One of the first consumer-grade photic stimulation devices was born.

William Burrough's Dream Machine – source

In the 1960s, medical applications of brainwave entrainment started to be employed by physicians. The Anesthesiologist M.S. Sadove began using photic stimulation to reduce the amount of anesthesia required during surgery.

Business executive and radio producer Robert Monroe started experimenting with brainwave entrainment and have a series of powerful out of body experiences using it. In 1971 he published his cult classic "Journeys Out of the Body" sharing his experiences. He later created one of the first audio entrainment companies called Hemi Sync, alongside the Monroe Institute of Applied Sciences.

In 1973, biophysicist Dr. Gerald Oster published a famous article in Scientific American titled "Auditory Beats in the Brain", which found that when two pure tones of varying frequencies were combined, a third rhythmic beat was created which he called binaural or monaural beats. According to Oster, monaural beats occur when two tones are combined and sent through a loudspeaker, while binaural beats occur when stereo headphones are used to deliver each tone separately to each ear. Oster concluded that monaural beats were a more effective form of brainwave entrainment.

In 1981 Michael Hutchison published his cult classic Mega Brain, which helped popularize many brain enhancing tools such as brainwave entrainment to a mainstream audience.

Later that year, Arturo Manns published a breakthrough study showing the effectiveness of isochronic tones, which are pulsating sounds.

In 1984 medical researcher Dr. Gene W. Brockopp published a paper making several conclusions of audio and visual entrainment (AVE). Such conclusions were that hemispheric synchronization caused by AVE is related to increased intellectual functioning, practiced use of AVE overtime leads to a cumulative effect, and AVE may result in the recovery of early childhood experiences.

Throughout the eighties, advancements in microelectronics made it possible for engineers to bring audio and visual entrainment machines to the consumer market. Thousands of machines started to be used by laymen, outside the medical and research field.

Brainwave entrainment device ads from the 1990s

Throughout the nineties and 2000s, several research studies found brainwave entrainment to be effective in treating attention deficit disorder (ADD), improving memory, improving academic performance, inducing dissociation, alleviating short and long-term stress, improving mood, alleviating physical pain, and alleviating headaches.

With almost 100 years of research validating the effectiveness of brainwave entrainment, it's no wonder why it's used by thousands of people all over the world. What does the future entail in this exciting field? With the adoption of smartphones, virtual and augmented reality, and advancements in technology reducing the cost of EEG and other forms of biofeedback devices, the entrainment possibilities are endless.

CHAPTER 4: THE SCIENCE BEHIND BRAINWAVE ENTRAINMENT

Now that you know the basics behind brainwave entrainment, we dive even deeper into its science. You'll learn how BWE leads to the synchronization of both hemispheres of the brain, resulting in benefits such as creative insight, greater emotional stability, and enhanced mental performance.

As we mentioned earlier, brainwave entrainment occurs when the electrical rhythms of your brain synchronize to the same rhythms of an external source. This source typically comes in the form of pulsing light and/or sound. When you are presented with flashes of light, neurons in your eyes become excited and send electrical signals to the thalamus. The thalamus is an area of the brain that takes in sensory input from your environment and sends that data to different areas of the brain. The Complete Guide To Brainwave Entrainment

When electrical signals from your eyes hit the thalamus, it then sends the signal to your visual and cerebral cortex. As the visual cortex receives constant and repetitive signals from the pulsing light, its neural activity starts to synchronize to that same frequency.

Brainwave entrainment has begun. As BWE becomes stronger in the visual cortex, other areas of the brain follow suit and synchronize to the same source frequency.

In his book *Mega Brain*, Michael Hutchinson cites neurologist W. Gray Walter on this process:

“The great neuroscientist W. Gray Walter carried out a series of experiments in the late forties and fifties in which he used an electronic stroboscopic device in combination with EEG equipment to send rhythmic light flashes into the eyes of the subjects at frequencies ranging from ten to twenty-five flashes per second. He was startled to find that the flickering seemed to alter the brain-wave activity of the whole cortex instead of just the areas associated with vision. Wrote Walter, “The rhythmic series of flashes appear to be breaking down some of the physiologic barriers between different regions of the brain. This means the stimulus of flicker received by the visual projection area of the cortex was breaking bounds— its ripples were overflowing into other areas.”

BRAIN LATERALIZATION

The brain consists of two hemispheres, connected with a structure called the corpus callosum.

Most people have unbalanced brains, where one hemisphere shows greater activity than the other. This condition is called brain lateralization. source

Soviet neuropsychologist Alexander Romanovich Luria wrote in his book *The Working Brain*, that humans are approximately one-third left dominant, one-third right dominant, and the rest minor left dominant.

In his book *Thresholds of The Mind*, binaural beat expert Bill Harris writes about the problems associated with brain lateralization:

Because the brain filters and interprets reality in a split-brained way, we tend to see things as separate and opposed, rather than as connected and part of the oneness spoken of by the great spiritual teachers (and, in the last few decades, by quantum mechanical physicists). Thus, at a deep level, the dual structure of our brain, in conjunction with brain lateralization, predisposes us to see and experience ourselves as separate from, and often in opposition to, the rest of the world—instead of experiencing the elegant interconnectedness between us and everything else. Our childhood associations and programming build on this inborn tendency by training us to seek this and avoid that, to move toward pleasure and away from pain, to do good and not bad, and so on. The greater the lateralization in the brain, the greater the feelings of separation—and the greater the feelings of separation, the greater the fear, stress, anxiety, and isolation.

WHAT IS HEMISPHERIC SYNCHRONIZATION?

Hemispheric synchronization refers to a state when the brainwave pattern of the left and right brain hemispheres become similar.

The right hemisphere is associated more with emotions and creativity while the left is associated more with logic and speech. Despite popular misconception, most people have plenty of right-brain activity, and may even have a lack of activity in the left.

Someone with similar activity in both brain hemispheres is usually healthier, happier, more optimistic, more emotionally stable and less prone to mental disorders. Increased levels of synchronization are found naturally with experienced meditators and people who have found ways of becoming highly content with their lives. Since the discovery of hemispheric synchronization and its associated effects, it has become a highly sought-after effect, even prompting companies to market products based solely on this effect. However, you should keep in mind that while synchronization of the hemispheres and a well-balanced brainwave pattern are good, they should not be goals in themselves. Instead, synchronization should happen naturally as you pursue your goals with entrainment and self-improvement, because while synchronization is associated with health, it is not a miracle cure and nor is cerebral asymmetry the cause of every mental disorder (as many companies would have you believe). Additionally, the techniques used to fully restore a healthy brainwave pattern in cases of extreme cerebral asymmetry (such as in major depression) are often not as easy as using simple entrainment methods such as binaural beats.

Hemispheric synchronization has also been called hemispheric symmetry, coherence and cerebral synchronization.

WHAT PRODUCES HEMISPHERIC SYNCHRONIZATION?

Hemispheric Synchronization is a byproduct of nearly all types of brainwave entrainment.

In 1980, Tsuyoshi Inouye and associates at the Department of Neuropsychiatry at Osaka University Medical School in Japan found that photic stimulation in the alpha range produced hemispheric synchronization. Dr. Norman Shealy later confirmed the effect, finding that photic stimulation produced "cerebral synchronization" in more than 5,000 patients. In 1984, Dr. Brockopp analyzed audio-visual brain stimulation and in particular hemispheric synchronization during EEG monitoring. He said, "By inducing hemispheric coherence the machine can contribute to improved intellectual functioning of the brain."

There is similar evidence that CES (electrical stimulation), motion systems, acoustic field generators, and even floatation tanks can increase EEG symmetry.

Audio entrainment can take hemispheric coherence a step further by delivering different stimulation to each ear in certain sessions to correct common hemispheric asymmetries. For example, depressed individuals tend to have an overactive right (emotional) brain hemisphere, so the depression reduction session acts to decrease right brain activity while increasing left, the result is a more coherent, healthy and well-balanced brainwave pattern.

Further Reading

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- Pain Reduction and Relaxation with Brain Wave Synchronization (Photo-Stimulation), Dr. Norman Shealy, Dr. Richard Cox Inc. Study performed by the Forest Institute of Professional Psychology, Springfield, Missouri, 1990, 9pp.
- Review of Research on Multi-Modal Sensory Stimulation with Clinical Implications and Research Proposals, Dr. Gene W. Brockopp, unpublished, 1984:

CHAPTER 5: AUDIO ENTRAINMENT: BINAURAL BEATS, MONAURAL BEATS, ISOCHRONIC TONES

The deliberate use of sound to modify the mind has been long chronicled throughout history. Various indigenous cultures have used rhythmic patterns of clapping, chanting, and singing in ceremony to enter higher states of consciousness, attain wisdom, and heal the mind/body.

For thousands of years, instruments such as the aboriginal didgeridoo, Tibetan singing bowl, Native American flute, and the tribal drum have been revered as powerful tools of transformation.

In modern times, neuroscientists have found audio entrainment to bring about these same benefits. Binaural beats and isochronic tones have been shown to induce super learning, memory improvement, creativity enhancement, and even out of body experiences.

In this section, we outline what these forms of audio entrainment are, and how you can use them to see these very benefits.

BINAURAL BEATS

Discovered in 1839 by the German physicist Heinrich Wilhelm Dove, he found auditory beats form inside the brain when each ear is presented with its own tone of a slightly different pitch.

For example, when stereo headphones deliver binaural beats, the left ear would receive a pitch of 200 Hz, and the right ear 207 Hz, a beat 7 Hz would be created inside the brain ($207 \text{ Hz} - 200 \text{ Hz} = 7 \text{ Hz}$). This effect is generated within the olivary body of the brain, as it attempts to spatially locate the direction of the third tone. In 1973, Gerald Oster published a famous article in Scientific American titled "Auditory Beats In The Brain", which first brought this phenomenon to the public. He writes:

"A quite different phenomenon results when stereophonic earphones are used and the signals are applied separately to each ear. Under the right circumstances beats can be perceived, but they are of an entirely different character. They are called binaural beats. . . . Binaural beats require the combined action of both ears. They exist as a consequence of the interaction of perceptions within the brain."

There are many advantages and disadvantages to binaural beats. One of the major advantages is hemispheric synchronization. Since both hemispheres are required to create the beat within the brain, this method is an excellent way to create greater harmony between areas of the mind typically functioning independently.

Binaural beats are also known to have effective hypnotic and relaxing effects.

As far as the disadvantages, binaural beats don't create a strong entraining effect in the brain. This is contrary to much of the material you'll read online about this form of entrainment.

Binaural beats are one of the weakest forms of brainwave entrainment. Since the beat is created within the brain itself, its volume depth is barely audible – roughly 3 decibels. As is the case, this doesn't produce a strong neural effect.

In his paper "Entraining Tones and Binaural Beats", brainwave entrainment expert Dave Siever includes several studies which disprove the effectiveness of binaural beats to create brainwave entrainment. He writes:

"Binaural beats are not very noticeable because the modulation depth (the difference between loud and quiet) is 3 dB, a two-to-one ratio. (Isochronic tones and mono beats easily have 50 dB difference between loud and quiet, which is a 100,00-to-1 ratio). This means that binaural beats are unlikely to produce significant entrainment because they don't activate the thalamus"

Binaural beats can only be used for beat rates below 20 Hz, anything higher will not mix and produce the desired beat. For example, if 440 Hz is played in the left ear, and 470 Hz is played in the right ear, a beat will not form since the difference between the two is above 25 Hz.

Auditory beats will also not form in the brain when the two tones used have a pitch higher than 900 Hz. Binaural beats are best heard at lower pitches below 440 Hz.

One of the most common complaints with binaural beats is the requirement of stereo headphones.

MONAURAL BEATS

Monaural beats are the result of two tones combined before the sound reaches the ear, opposed to Binaural Beats where the tones are combined within the brain itself.

The advantage with monaural beats is they can be listened to without the use of stereo headphones. For those that would like to listen to audio entrainment track through speakers, this may be a strong option.

ISOCHRONIC TONES

Opposed to binaural and monaural beats, isochronic tones don't require two separate tones to form a beat.

Rather, it uses a single tone, which turns on and off at an evenly spaced pattern. For example, a 10hz isochronic tone would turn on and off 10 times per second.

Research has found that isochronic tones to be the most effective form of audio entrainment. According to brainwave entrainment expert David Silver, "They are an effective auditory entrainment method because they elicit a strong auditory evoked response via the thalamus and most people find them tolerable.

In 1981, Arturo Manns published a breakthrough study showing the effectiveness of isochronic tones. In his study, he used pulses of sound to successfully treat a form of chronic pain called Myofascial Pain Syndrome.

TYPES OF ISOCHRONIC TONES

There are several types of isochronic tones, based on the way the tone is turned on and off. Let's describe a few of these below:

- Square wave: Square wave isochronic tones involve instantaneous transitions between on and off. It is the harshest sounding isochronic tone, yet also the most powerful.

- Triangle wave: Triangle wave isochronic tones involve a continuous, linear ramp between on and off. It is much smoother sounding than the square wave, yet not as powerful.

- Sine wave: Sine wave isochronic tones involve a smooth transition between on and off. Sine waves are the smoothest sounding tone, and most often used for relaxation.

CHAPTER 6: VISUAL ENTRAINMENT: PHOTIC STIMULATION

Like sound, light has been used by various cultures throughout history to enter higher states of consciousness.

From civilization's earliest days, individuals such as medicine men, shaman, and priests learned to use the flickering of light coming from fire as ways to transcend reality and enhance their mental powers.

As we mentioned in the brainwave entrainment history chapter, around 200 A.D. Ptolemy found that when light passed the spokes of a spinning wheel, this caused feelings of euphoria, lightheadedness, and an assortment of shapes and colors in his field of vision.

Fast forward two thousand years. Today's mind explorers use visual entrainment devices with the same aim of enhancing their brain. Modern science has shown how effective flickering light can be on our mood, cognitive performance, and cognitive performance.

In this section, we take a deep dive into what this technology is, and how it can be safely utilized to entrain the mind.

WHAT IS VISUAL BRAINWAVE ENTRAINMENT?

Visual brainwave entrainment (also known as photic stimulation) is a method of using constant, repetitive light pulses to entrain the brain. These flashes of light can be delivered in several ways: television or computer screens, strobe lights, LED eye sets, and even virtual reality goggles.

Studies have shown visual entrainment more effective than audio entrainment. One of the reasons this is true is the brain's visual cortex being much larger than the auditory cortex. When the visual cortex becomes entrained, it can affect a greater portion of surrounding brain regions.

WHAT IS AUDIO-VISUAL BRAINWAVE ENTRAINMENT (AVE)?

Audio-visual brainwave entrainment (AVE) is the simultaneous use of rhythmic sound and light to entrain the brain. Devices that deliver this stimulation can be called sound and light machines, mind machines, and audio-visual stimulation (AVS) machines.

Although visual entrainment is more effective than audio entrainment, combining the two together can create even more powerful effects. Since both the auditory and visual cortex are stimulated simultaneously, greater portions of the brain are susceptible to entrainment.

This technology may sound cutting edge but combining both sound and light to alter the mind has been used for thousands of years.

In his book *Mega Brain*, Michael Hutchinson writes:

"...humans have always been intrigued by the possibilities for influencing mental functioning that emerge from combining rhythmic sound and rhythmic light stimulation. Ancient rituals for entering trance states often involved both rhythmic sounds in the form of drum beats, clapping, or chanting and flickering lights produced by candles, torches, bonfires, or long lines of human bodies passing before the fire and chopping the light into mesmerizing rhythmic flashes. From Greek plays to Western opera, our most popular entertainment forms have made use of combinations of lights and sounds. Some composers, such as the visionary Scriabin, actually created music intended to be experienced in combination with rhythmic light displays."

WHAT IS AUDIOSTROBE?

AudioStrobe is the standard way to communicate with light/sound devices. It is an inaudible signal (19200Hz) sent with the rest of the sound of your session. You will probably not be able to hear it, but any AudioStrobe-compatible light/sound devices you have will be able to interpret that signal and use it to drive the flashing of LEDs.

Because AudioStrobe uses sound to drive the LEDs, it can be used from any sound device, such as an iPod, CD player, or from the speaker/headphone port of your computer.

AudioStrobe is compatible with most of today's light/sound devices, including the Kasina, Procyon, MindSpa, Proteus, MindGear, Photosonix, Light/Sound Synergizer and others.

HOW TO SAFELY USE VISUAL BRAINWAVE ENTRAINMENT

Since visual brainwave entrainment can stimulate large areas of the brain, there are certain people who shouldn't use this technology:

- Those who have history of seizures, (especially epileptics)
- Those who experience headaches/migraines from bright lights
- Those who wear a pacemaker
- Pregnant women

If you are under the use of medication (especially psychotropic substances), consult your physician before utilizing photic stimulation. Those who are under the age of 18 should also consult with their physician.

According to the National Institute of Health, seizures from light stimuli is approximately 1 per 10,000, or 1 per 4,000 individuals age 5-24 years – roughly 0.3-3% of the population. Those who have a history of epilepsy have a 2-14% chance of having seizures due to photic stimulation.

On December 6, 1997, an episode of *Pokemon* was broadcast in Japan, which included footage of red-blue flashing lights. This resulted in 685 children being admitted to the hospital (only 24% of these children had a history of seizures).

When using photic stimulation device, it is necessary to keep your eyes closed. Your eye lead works as a filter to disperse the spotted light of LED light sources. In fact, most visual entrainment devices make it unsuitable to open your eyes.

With your eyes closed, a suitable amount of neural signal will be sent to the visual cortex for entrainment to occur.

THE IMPORTANCE OF DARKNESS TO OUR HEALTH

If you were ever asked what you need to survive, would you ever list dark as one of those things? The truth is most of us never would, but some of the latest scientific research has shown us that darkness is as essential to life as light when it comes to both physical and mental well-being. The problem for many of us currently however is that night has become day. Since time has become a limited resource, we tried to expand our daily activity for work, travel, shop, exercise and of course socialize during the night hours. And even when we do rest our weary

heads, it is often in a room filled with light-emitting electronic devices and in abodes that are constantly being flooded with light from street lights, city lights, and passing headlights. The night has literally become occupied by illumination and this is having a negative effect on many of us.

According to a new study published by The Royal Society about how light disrupts human circadian rhythm, there are some major negative repercussions to our health that have started to occur since the introduction of electric light to our homes. The report even went as far as to say that:

“SINCE THE INTRODUCTION OF ELECTRIC LIGHTING, THERE HAS BEEN INADEQUATE LIGHT DURING THE DAY INSIDE BUILDINGS FOR A ROBUST RESETTING OF THE HUMAN ENDOGENOUS CIRCADIAN RHYTHMICITY, AND TOO MUCH LIGHT AT NIGHT FOR A TRUE DARK TO BE DETECTED; THIS RESULTS IN CIRCADIAN DISRUPTION AND ALTERS SLEEP/WAKE CYCLE, CORE BODY TEMPERATURE, HORMONE REGULATION AND RELEASE, AND PATTERNS OF GENE EXPRESSION THROUGHOUT THE BODY.”

This “endogenous circadian rhythmicity,” which most of us know simply as “circadian rhythm,” is humanities natural body clock that regulates our body's sleep/wake cycles, our body temperature, our regular hunger cycles, and even our energy levels. Darkness is crucial for our circadian rhythm because when it is dark, our body increases the production of melatonin, and this hormone signals the body that it is time to sleep. The opposite occurs when the sun comes up, melatonin levels decrease, and this signals the body that it is time to wake up. However, artificial lighting and sleeping during the day due to an active night schedule has compromised this natural dark to light rhythm, and this has been further exasperated by living in homes that eschew natural light and darkness contrasts. It is theorized that this may lead to some potentially serious health issues, especially over time. These health risks include everything from facial wrinkles, decreased sex drive, obesity, and diabetes, to heart disease, fibromyalgia, stroke, Alzheimer’s disease, and even cancer.

CHAPTER 7: OTHER FORMS OF ENTRAINMENT

Sound and light are the most popular methods to entrain the mind, yet there are a few other options in our toolbox such as haptic or tactile stimulation over skin as a sensory input of brain. Also using vibrational energy from sources such as magnets and electricity for BWE has proven to help overcome addictions, depression, and even treat neurological disorders such as

Parkinson’s. In this section, we cover some of these alternative forms of brainwave entrainment.

TRANSCRANIAL MAGNETIC STIMULATION (TMS)

Transcranial Magnetic Stimulation (TMS) is a non-invasive brain stimulation technique using magnetic pulses to entrain the mind. It has been particularly successful in treating depression when patients have shown resistance to traditional forms of treatment.

TMS has also been effective in reducing anxiety, treating PTSD, treating OCD, treating substance abuse, and improving cognition. Of the methods listed on this page, TMS is the most practiced in medical fields.

During a TMS therapy session, large magnetic coils are placed against the patient’s scalp, typically near the forehead. This region of the brain helps regulate mood.

Once treatment begins, the polarity of the coils begins to rapidly change back and forth, delivering magnetic pulses to the desired neural region. The rhythms of these magnetic pulses help to entrain brainwaves to a target frequency.

Research and Further Reading:

- Rahnev, Dobromir. “Entrainment of neural activity using transcranial magnetic stimulation.” *Journal of Neuroscience* 33.28 (2013): 11325-11326.
- Thut, Gregor, et al. “Rhythmic TMS causes local entrainment of natural oscillatory signatures.” *Current biology* 21.14 (2011): 1176-1185.

- Thut, Gregor, and Carlo Miniussi. "New insights into rhythmic brain activity from TMS–EEG studies." *Trends in cognitive sciences* 13.4 (2009): 182-189.
- Malcolm, Matthew P., et al. "Repetitive transcranial magnetic stimulation interrupts phase synchronization during rhythmic motor entrainment." *Neuroscience letters* 435.3 (2008): 240-245.

TRANSCRANIAL ALTERNATING CURRENT STIMULATION (TACS)

Transcranial Alternating Current Stimulation (tACS) is a non-invasive brain stimulation technique using alternating electrical signals to entrain the mind. This technique has been found effective in improving learning, memory, focus, and mood.

tACS devices use 9-volt batteries, which are attached to two electrodes attached to desired areas of the scalp. These electrodes send sine waves of electric current 0.5-2 milliamps. tACS devices allow users to set the desired frequency these electric currents are sent, whether it's in the alpha, beta, or theta range.

Although sending waves of electricity to your brain may sound scary, this method is low in risk.

2 milliamps of current is the equivalent of 1/500th the power of a 100 watt light bulb. Research and Further Reading:

- Zaehle, Tino, Stefan Rach, and Christoph S. Herrmann. "Transcranial alternating current stimulation enhances individual alpha activity in human EEG." *PloS one* 5.11 (2010): e13766.
- Ali, Mohsin M., Kristin K. Sellers, and Flavio Fröhlich. "Transcranial alternating current stimulation modulates large-scale cortical network activity by network resonance". *Journal of Neuroscience* 33.27 (2013): 11262-11275.
- Fröhlich, Flavio, and David A. McCormick. "Endogenous electric fields may guide neocortical network activity."

Neuron 67.1 (2010): 129-143.

- Ozen, Simal, et al. "Transcranial electric stimulation entrains cortical neuronal populations in rats." *Journal of Neuroscience* 30.34 (2010): 11476-11485.

DEEP BRAIN STIMULATION (DBS)

Deep Brain Stimulation (DBS) is an invasive brain stimulation method, known to be successful in treating neurological diseases such as Parkinson's Disease (PD).

Parkinson's Disease is a degenerative disorder which affects the nerve cells in the brain's basal ganglia. The basal ganglia, which controls the body's movement, is located deep within the brain. As nerve cells in this region begin to die off, the person experiences symptoms such as tremors, slowness of movement, stiffness of muscles, loss of balance, and speech changes.

Deep Brain Stimulation is a method which helps to entrain the basal ganglia towards normal functioning. This method comprises two steps.

The first step involves the use of magnetic resonance imaging (MRI) to locate the exact target of the brain where the PD stems from. Once located, a device called a neurostimulator is surgically implanted at this target.

It then sends out electrical impulses, which entrains this region of the brain towards normal neural activity.

Almost immediately tremors begin to subside, and they experience greater control of their body's movement.

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control of their body's movement.

Research and Further Reading:

- Benabid, Alim Louis. "Deep brain stimulation for Parkinson's disease." *Current opinion in neurobiology* 13.6 (2003): 696-706.
- Limousin-Dowsey, P., et al. "Thalamic, subthalamic nucleus and internal pallidum stimulation in Parkinson's disease." *Journal of neurology* 246 (1999): 1142-1145.
- Benabid, Alim L., et al. "Long-term suppression of tremor by chronic stimulation of the ventral intermediate thalamic nucleus." *The Lancet* 337.8738 (1991): 403-406.
- Benabid, A. L., et al. "Long-term electrical inhibition of deep brain targets in movement disorders." *Movement Disorders* 13.S3 (1998): 119-125.

CHAPTER 8: WHAT IS BIOFEEDBACK / NEUROFEEDBACK?

Biofeedback is a training technique used to gain self-control over physiological processes such as stress levels, pain, concentration, and so on. Sensors are attached to the body (usually the fingers or head) to monitor various physiological signals such as skin conductance or EEG brainwaves. The user then uses these signals as feedback to obtain more control over his/her own body.

TYPES OF BIOFEEDBACK

Neurofeedback (NFB) - also called **neurotherapy**, is a type of biofeedback that uses real-time displays of brain activity—most commonly electroencephalography (EEG)—in an attempt to teach self-regulation of brain function. Typically, sensors are placed on the scalp to measure electrical activity, with measurements displayed using video displays or sound.

GSR / Skin Conductance - GSR stands for Galvanic Skin Response. This measures the skin conductance levels, which is an indirect measure of arousal, or stress levels. Low skin conductance levels usually mean you are more relaxed, while higher levels will indicate a stressed state of mind. This is a widely used biofeedback measure and is a very fast and accurate way to determine arousal levels.

BPM / Heart Rate - Heart rate can also be a measure of arousal. It can also be an indirect measure of breathing - faster rates indicate breathing in, lower rates indicate breathing out. But, in some cases this is not true, and in fact some forms of biofeedback use a chest strap to determine if breathing does match the heart rate.

HRV - HRV stands for Heart Rate Variability, which measures the variations in heart rate. The heart's rate should vary quite a bit in a healthy individual. Low levels of variability are an indication of problems.

CHAPTER 9: PUTTING BRAINWAVE ENTRAINMENT INTO ACTION

Now that you have a deep understanding behind brainwave entrainment, it's time to put your knowledge into action. In this section, the rubber hits the road as we provide a clear action plan for BWE success. You'll learn how to find high-quality entrainment systems, how to use them, and common mistakes to avoid.

HOW LONG DOES IT TAKE TO INDUCE ENTRAINMENT?

Although marketing in the entrainment industry claims you'll be able to enter deep states of meditation after pressing play, this is an exaggeration.

In reality, it typically takes 6 minutes to induce brainwave entrainment (if you are listening/watching to a high-quality entrainment session). This 6-minute marker is typical to induce alpha waves (12 Hz – 8 Hz). However, if you are looking to induce theta waves, it can take 15 minutes or longer for this to occur.

You should experience the benefits of the session for at least a few hours after it has ended. Therefore, it's important to choose your sessions wisely. Don't consume an energizing session before bedtime, or a relaxing session before an important work meeting.

HOW OFTEN SHOULD YOU CONSUME ENTRAINMENT SESSIONS?

To get in shape, you wouldn't expect to see results after the first workout. Moreover, you'd expect to get out of shape if you stop exercising altogether.

The mind works similarly. If your aim is to see long-term results like anxiety relief, or greater emotional regulation – don't expect to see these results after your first BWE session.

Like getting in shape, it takes consistent effort over a period to see the benefits. A few weeks of regular BWE practice is required for your brain to forge new neural connections. Be patient during this time and stick with it. Once these new neural highways are constructed, you can experience results much faster and deeper. Consistency is key. You'll see far greater results from 10-minute sessions 6 separate days of the week than a single 60-minute session once.

WHAT IS THE IDEAL ENVIRONMENT FOR A BWE SESSION?

It's important you create the right environment while experiencing a brainwave entrainment session. As we've stated, make sure your surroundings are quiet and distraction-free.

Sessions sometimes last awhile, so be sure you are sitting laying in a comfortable position. It's common to fall asleep during alpha/theta sessions if you are lying down, so be sure to sit up if you don't want to end up snoozing.

Lighting incense or diffusing essentials oils can also help enhance the experience.

CHAPTER 10: ADDITIONAL RESOURCES

Want to take your brainwave entrainment knowledge to the next level? We've got you covered. In this section, we'll equip you with all the best resources to learn more about this neuro-technology.

- • CraigT AVS – CraigT is one of the most knowledgeable individuals in this field.

His blog teaches the science of BWE and shares Craig's self-experimentation adventures with BWE.

- • Mind Place Community Forum – Another excellent forum on BWE (more focused on visual entrainment).
- • Mega Brain Power, Michael Hutchison – Published in 1994, Mega Brain Power became a cult classic which popularized brainwave enhancing technology to a consumer audience.
- • Mind Alive – Mind Alive is the entrainment company of Dave Siever, one of the pioneers in the field of brainwave entrainment research.
- • Mind Place – Mind Place was one of the first companies to offer light and sound machines to the public.
- • Hemi Sync – The very first commercially available audio entrainment programs made by the Monroe Institute. They also host entrainment driven retreats at their personal development center in Virginia.
- • Mind Enhancement Systems – The company belong to co-creator the AudioStrobe format and a store for AudioStrobe products.
- • Brain.fm – A great place for high-quality audio entrainment products.