World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
Available online at: http://www.wjpsonline.org/
Review Article

A Review on Brainwave Therapy

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Received: 14-09-2020 / Revised Accepted: 22-10-2020 / Published: 25-10-2020

ABSTRACT

Brain waves are the pattern of electrical activity occurring in the brain or the combination of electrical activity in the brain. It can be detected by EEG. In the brain the various states are directly connected to ever changing electrical, chemical and agricultural environment of the brain. The type of brain wave is defined by the frequency at which it is pulsing. The different brain waves produced by the brain are, Alpha brain waves (8-12Hz), Beta brain waves (12-38Hz), Gamma brain waves (40-100Hz), Lambda brain waves (100-200Hz), Delta brain waves (0.5-3Hz), Theta brain waves (3-8Hz) and Epsilon brain waves (<8Hz). Brain activity is generally characterized by a combination of brain waves. Depending on the activity of brain at a time, particular brain waves will dominate over the others. By using different methods it can induce or entrain desirable brain waves in the brain there by it is possible to treat many of the dysfunctioning of brain thorough drug free method.

Keywords: Brain waves, Alpha wave, Beta waves, Gamma waves

INTRODUCTION

Brain waves were discovered by German neurologist Hans Berger in the mid-1920s. Brain waves are the pattern of electrical activity occurring in the brain or the combination of electrical activity in the brain. It can be detected by EEG. In the brain the various states are directly connected to ever changing electrical, chemical and agricultural environment of the brain. The brain produces waves of currents that flow throughout its neural pathways. The type of brain wave is defined by the frequency at which it is pulsing. There are different brain waves produced by the brain and these are, Alpha brain waves (8-12Hz), Beta brain waves (12-38Hz), Gamma brain waves (40-100Hz), Lambda brain waves (100-200Hz), Delta brain waves (0.5-3Hz), Theta brain waves (3-8Hz) and Epsilon brain waves (<8Hz). Alpha brain waves are sign of relaxed activity in brain. Beta

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How to Cite this Article: Hima C.S., Asheeta A, Chithra C. Nair, Sandhya M. J. Nair, Fathima Beevi U. A Review on Brainwave Therapy. World J Pharm Sci 2020; 8(11): 59-66.

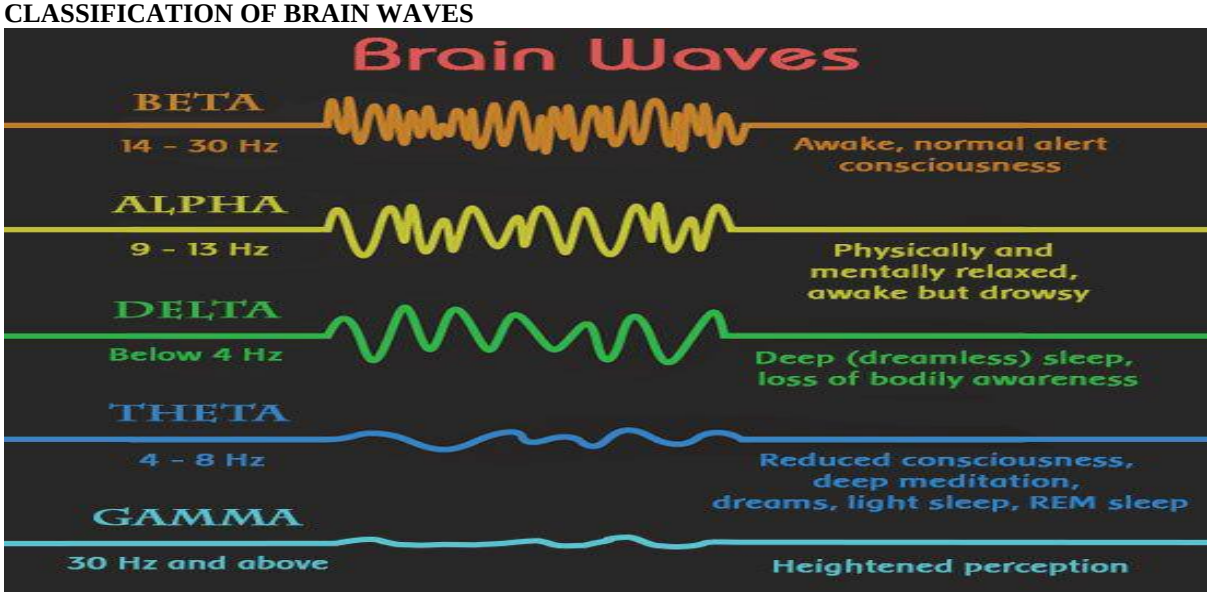
waves associated with normal wakening consciousness. Gamma is very weak in normal peoples. Theta is associated with learning and memory. Delta is absent in awake healthy adults and present in awake children.

The dominant brain wave that present at a particular time will decide the level of state of an individual. Brain wave technology helps to entrain brain with a particular wave that can bring a person powerfully to a desired conscious state, using this it can induce numerous mental and emotional states in an individual. They are crucial to all aspects of brain functioning: thoughts, emotions, and behaviors. The neuro-feedback mechanism influenced and altered through desirable brain activity can be increased in those who are experiencing symptoms of certain mental health conditions. The activity of brain is generally characterized by a combination of brain waves. Depending on what one is doing at the time, a particular brain wave will be dominant over the others. When one's brainwaves are not balanced properly, that individual may experience both emotional and neuro-physical health concerns. Many of the dysfunctioning of brain can be corrected by using different Brain Waves as drug free Method.[1]

HISTORY

Brain waves were discovered by German neurologist Hans Berger in the mid-1920s. Though Berger's path to this discovery began because he wanted to record what he thought was psychic energy in the brain, he eventually narrowed his focus and successfully made the first recording of electrical waves in the brain: an electroencephalogram, or EEG. Since his discovery, EEGs have been used to provide useful information about one's mental state and functioning, as they can lead to the diagnosis of epilepsy, sleep conditions, Alzheimer's, and other issues related to brain functioning.

CLASSIFICATION OF BRAIN WAVES



According to their frequency, brain waves are classified into five main categories:

Type	Frequency	Normally occur in
Delta	up to 4 Hz	Deep sleep, babies
Theta	4 Hz – 8 Hz	Young children, drowsiness, hypnosis
Alpha	8 Hz – 12 Hz	Relaxed, alert state of consciousness, eyes closed
Beta	12 Hz – 30Hz	Active, busy or anxious thinking
Gamma	30 Hz – 80Hz	Higher cognitive activity, motor functions

Delta brainwaves (0.5 Hz – 3 Hz): It produces deep dreamless sleep, healing and rejuvenation. Delta activity is characterized by frequencies under 3Hz and is absent in awake healthy adults, but is physiological and normal an awake children under the age of 13.

Theta brainwaves (4 Hz – 8 Hz): It produces stress relief, deep relaxation, meditation, light sleep & dreaming. These are the gateway to learning and memory.

Alpha brainwaves (8 Hz – 12 Hz): It will produce relaxed mental awareness, reflection, visualization & creativity. In order to have a creative inspiration, the brain needs to be able to generate a big burst of Alpha brain waves, mostly on the left side of the brain.

Beta brainwaves (13hz – 40hz): It will produce a heightened state of alertness and focused concentration. These are the waves associated with normal waking consciousness. It is useful for patients with ADD, depression or other emotional problems and can help with focused concentration, alertness and increasing IQ.

Gamma brainwaves (40hz or 100hz): It will produce bursts of insight and high-level information processing. These waves are usually very weak in normal people and are very strong in Tibetan monks while doing a Loving meditation.
Recently scientists are beginning to discover what monks have experienced for many years old. Rarely seen brainwave states associated with ecstatic states of consciousness. Lambda and Epsilon brainwave states.

Epsilon brainwaves (Less than < 0.5 Hz): The brainwaves below 0.5 Hz have been classified as a separate band called Epsilon. Wholeness and integration seem to be the main themes of these brainwaves.

Lambda brainwaves (100hz – 200hz): These are very high frequency brainwaves. These are associated with wholeness and integration. Also associated with mystical experiences and out of body experiences.[1]

FUNCTIONS OF DIFFERENT BRAINWAVES

The brain produces waves of currents that flow throughout its neural pathways. The type of brain wave is defined by the frequency at which it is pulsing. Entrainment can be utilized to synchronize the brain to specific frequencies. Brain wave entrainment and binaural beats occur naturally in our environment. Brains have a left and right hemisphere. The artists use right hemisphere more that is holistic and creative than accountants. At a time only one hemisphere is used. By merging both hemispheres and allowing them to work together it can increase mental fitness. A more integrated system creates better performance.

Functions of delta brain waves

Release of Anti-Aging hormones - One of the associated benefits of increasing your delta brainwaves is the release of anti-aging hormones. The delta brainwave pattern stimulates the release of melatonin and DHEA, 2 powerful anti-aging hormones. It also associated with decreased levels of cortisol - a hormone linked to stress that has been scientifically proven to speed up the aging process.

State of empathy - Delta brainwaves can provide the ability to read other people's emotions and determine their feelings at unconscious levels. Delta brainwaves cause a person to have a state of empathy, understanding and compassion for others.

Extreme bliss - Advanced meditation practices and yogic traditions have associated the delta brainwave frequency range with a feeling of all-encompassing bliss. There have been people that have testified to feeling the bliss associated with the delta brainwave while performing extremely deep meditation.

Advanced healing of body and mind - The delta brainwave rhythm is known to completely rejuvenate, replenish, and heal the entire body and brain. The delta brainwave revives the body after a hard day by regenerating necessary chemicals while a person is asleep. Due to the deepest levels of relaxation that the delta brainwave provides, the body and mind are easily able to restore themselves after minor stress, a rigorous workout, or after boosting the brain power.

Human Growth Hormone (H.G.H.) Release - The delta brainwave is associated with the stimulation of the pituitary gland, which in-turn is able to release human growth-hormone.

Connection with unconscious mind - Though the alpha and theta brainwaves are capable of bridging the gap between conscious thoughts and the subconscious mind. The subconscious mind, or brain's right-hemisphere, becomes activated when slower brainwaves like alpha, theta, and delta waves kick in.

Deepest possible level of mind / body relaxation: The delta brainwave is associated with extreme relaxation, yet completely unconscious mental processes.

Perfect intuition–Increase of theta brainwaves and delta brainwaves, the intuition will increase and the ability to recognize the feelings.

Connecting with the spiritual body*:* The slowest brainwave pattern delta connects the spirit and body to universal life energy. Becoming consciously aware of experiencing the delta brainwave frequencies has been associated with the deepest sense of spirituality, highest sense of internal awareness, and feeling directly connected to a Higher Power.

Paranormal Experiences- People are especially open to O.O.B.E.'s (Out Of Body Experiences), astral travel, connecting with spiritual beings (i.e. "spirit guides," "angels," etc.), E.S.P., and other phenomenon in the delta brainwave range.

Boosted immune system - Increasing delta brainwaves can lead to a boosted immune system due to the fact that delta brainwaves are associated with age reversal or slowing, the production of healthy hormones, and significantly decreased amounts of stress. Boosting immune system is due to the fact that delta brainwaves are associated with healing and rejuvenation of the body. The delta brainwave releases pleasant chemicals and neurotransmitters to help immune system at arguably its highest rate of performance.

Functions of theta waves

Sleep and Dreaming- Theta brain waves are slow and relaxing brainwaves that are usually present during sleep and dreaming. Located in the right hemisphere of the brain, they usually produced sleepy, emotional, relaxed or daydreaming. Artists are known to have frequent theta brain waves as well as any other highly creative individual.

Musicians, sculptors and artists - Since theta brain waves operate at a much slower rate, there are many benefits to our emotional state of mind. Musicians, sculptors and artists of many genres are able to experience more theta brain waves than other individuals. This is because they tap into theta brain waves as a way to become creative when there 'artistic juices' have run out.

Help for Business Professionals - Since theta brain waves are considered fast brain activity, they offer many benefits you can utilize in the workplace. Theta brain waves can help to solve problems with an extra amount of problem solving ability.

Functions of alpha brain waves

Deep Relaxation of Body and Mind –The stresses and worries drift away in the alpha brainwave state. Tension and nervousness disappear when brain's thought process is calmed down; your mind becomes clearer.

Higher Levels of Creativity – Alpha brainwave levels are found to be much higher in artists, musicians and creative thinkers. Creative thinkers also tend to be those who go on to become world famous entrepreneurs, as they are better equipped at solving life's problems and helping others

Improved Mood and Stability of Emotions – Having more alpha brainwaves usually indicates more positive, stable and balanced emotions. This can help to cope better with stress and keep calm in tough situations. Irritable, anxious and over sensitive people tend to spend most of their time in a beta state, and can usually greatly improve their minds by increasing their alpha brainwaves without resorting to taking drugs, excessive alcohol and other bad habits.

Performance and Getting In the "Zone" - The alpha brainwave state is associated with "peak performance". The players who get "in the zone" perform best.

"Super learning" and "Genius states" – Learning new skills, enhanced memory and genius-like abilities are found in those who spend their time mostly in an alpha brainwave state. This is because the tasks associated with the abilities require less overall effort to accomplish and the ability to retain large amounts of information is enhanced.

Enhanced Immune System – Long-term stress and tension have a negative impact on immune system. In an alpha brainwave state, the immune system is allowed to work at its best. The "feel good" effect of alpha brainwaves leads to the production of happy and well-functioning cells in your body.

Levels of "Serotonin" – It is released more during alpha brainwave states. Serotonin levels are associated with moods and low serotonin levels are linked to depression and other neurological disorders, such as anxiety and panic attacks.

Functions of beta brain waves

Ability to think quickly –If there is a high beta brainwave, it is able to think fast, generate new ideas quickly, and live in a high state of functioning.

Being more social – When a person talks, their beta brainwave range naturally increases. In most people, an increase in beta activity boosts conversational energy and ability to keep conversation going.

Feeling excited – The feeling of excitement is caused by an increase in the amount of beta brainwaves.

Goal oriented – When people are in the beta brainwave state, they naturally feel more goal-oriented due to the fact that they have more energy, are more social, and have high levels of focus that cause them to naturally be more goal-oriented. It could also be the fact that an increase in left-hemisphere brain functioning is associated with goals and goal setting.

Peak-performance – Beta brainwaves can certainly aid in performance ability.

Highest levels of focus –People with ADD and ADHD are commonly prescribed stimulants, which cause beta brainwave activity in their brains to

increase the level of focus. Hence, an increased ability to focus, get things done, and all the other things associated with beta waves.

More energy **–** Beta brainwaves could reduce tiredness. People low in beta brainwaves feel tired and report less overall energy throughout the day.

Positive thoughts- Positive thinking and an increase in beta waves makes perfect sense because the left hemisphere is associated with positive thoughts.

Write easily and quickly – Beta activity occurs in the left hemisphere that is highly activated while writing.

Increase in I.Q. – people higher in the beta brainwave range actually have higher I.Q.'s than the average population.

Functions of Gamma brain waves

The Brain's Optimal Frequency - Gamma brainwaves are considered the brain's optimal frequency of functioning. Gamma brainwaves are commonly associated with increased levels of compassion, feelings of happiness, and optimal brain functioning. Gamma brainwaves are associated with a conscious awareness of reality and increased mental abilities.

Gamma Present in Awake State and During Active REM- Gamma waves are continuously present during low voltage fast neocortical activity (LVFA), which occurs during the process of awakening and during active rapid eye movement (REM) sleep.

Gamma is the Harmonizing Frequency- The color, size, texture etc of an object are all perceived and processed by different parts of the brain, it is thought that Gamma allows for unification of all the different information. This brainwave activity is associated with states of self-awareness, higher levels of insight and information, psychic abilities and out of body experiences. This new region of brain activity and states of consciousness associated with it is called EPSILON.

APPLICATIONS OF DIFFERENT BRAINWAVES

Waves	Effects
The large slow waves of Theta and Delta waves	Learning Disabilities ADD/ADHD Problems with Impulses Daydreaming & Fantasizing Concentrating & Paying Attention Lack of Memory & Senility Chronic Fatigue & Fibromyalgia Traumatic Memories of Childhood Abuse Head Injuries Strokes Comas.
Correct Amounts of Theta & Alpha waves	Creativity, Visualization & Meditation Dream Like Images of "Twilight" States.
A Lack of Alpha & the Low Beta waves	Hyperactivity in ADHD Problems Relaxing Chronic Fatigue Syndrome Parkinson's Disease.
Too Much Alpha waves	Depression Sluggish Thoughts Slow Physical Movement Thyroid Symptoms & Problems.
Correct Amounts of Fast Wave Beta	Arousal & Alertness Ability to Concentrate Hyper Efficient Learning Good Memory Test Taking Skills Multi Tasking Ability High Performance.
Too Small Fast Beta Waves	Anxiety Tension & Stress Being & Bipolar Acting Out Sleep Disorders Alcoholism.

THERAPY INVOLVING BRAIN WAVES

Brain waves are patterns of electrical activity occurring in the brain. They are crucial to all aspects of brain functioning: thoughts, emotions, and behaviors. Because brain activity can be influenced and altered through neuro-feedback, desirable brain activity can be increased in those who are experiencing symptoms of certain mental health conditions.[2]

Brain activity is generally characterized by a combination of brain waves. Depending on what one is doing at the time, a particular brain wave will be dominant over the others. This balance is important: When one's brainwaves are not balanced properly, that individual may experience both emotional and neuro-physical health concerns.

Brain Waves and Sleep

The brain is very active during sleep, and each stage of sleep is characterized by the brain waves that accompany it.

- **Stage 1**: In this stage, alpha waves are replaced by theta waves as one transitions from relaxation to sleep. Sleep is light and easily disturbed.

- **Stage 2:** During this stage of sleep, brain waves become slower as alpha activity stops completely and theta waves predominate.
- **Stages 3 and 4**: These stages are very similar in that both are forms of deep sleep. Brain activity slows down as delta waves occur. These are the stages during which sleepwalking and nightmares occur.
- **Stage 5 (REM)**: During the rapid eye movement (REM) stage, the muscles become temporarily paralyzed, and the eyes move quickly. Dreaming also occurs during this stage. The pattern of brain waves is similar to that in stages 1 and 2.

Brain Waves and Mental Health

Brain waves are relevant to mental health, as abnormalities in brain functioning can influence the development of certain conditions. Example, when certain areas of the brain are over-aroused, an individual may experience anxiety, nightmares or other sleep problems, impulsivity, and aggression. If there is little production of brainwaves in the brain, on the other hand, depression, chronic pain, and insomnia will be produced. If brain rhythms are unstable, an individual may experience obsessive compulsions, develop epilepsy, or have panic attacks.

Neuroscientists found a link between an overabundance of gamma waves in the brain and schizophrenia. Gamma waves cause hyperactivity in areas of the brain, and when this hyperactivity is abnormally high, it will result schizophrenia, delusions and hallucinations can result. Poor sleep also results from an excess of hyperactive brain waves, shown to be a contributing factor to symptoms of schizophrenia.

Certain individuals may be biologically more likely to experience depression. These individuals demonstrate an abundance of alpha wave activity in the left frontal areas of their brain. Another condition that is characterized by an excess of lower frequency brain waves is attention deficit hyperactivity. Both of these conditions there is improvement when treated with neurofeedback therapy.[3]

Neurofeedback technique

Neurofeedback is a therapeutic technique that is used to monitor and change brain wave patterns in an attempt to modify behaviors and improve mental health. In this type of therapy, individuals are taught to alter the flow of brain waves. A therapist uses EEG readings to determine the level of brain waves and assess the predominance of abnormal activity and then rewards the desired brain wave activity to encourage its production. In an individual who has depression, for example, the therapist will use sound and visual effects to reward beta waves in order to help relieve the symptoms of depression.

Binaural wave technique

Binaural beats are created when two tones are detuned from each other by a small amount. For example, if a tone generator creating 100 hertz and another one putting out 102 hertz then it can hear the difference between the two tones, which is 2 hertz. Whenever this frequency matches a particular brainwave state, such as Delta, Theta, Alpha, Beta, or Gamma, it will entrain brain into the same brainwave state within a minute. Using EEG you can see the brain vibrating at the same rate as the Binaural Beat. Using headphones particular brainwave state is achieved and synchronization of left and right brain across the Corpus Callosum. It is an ideal state particularly for creativity or dealing with life.

Alzheimer's disease

Neurofeedback mechanism is used for Attention deficit hyperactivity disorder (ADD). The goal of this method is to train the brain to produce healthy brain waves in people with depression, there is significantly low amount of slow brain activity (theta waves) where there should be faster brain waves. Electrodes would be places on the scalp at specific points of interest on the outside of the scalp.

Once the electrodes are configured, the brain wave entrainment process would begin. The goal is to correct the brain wave rhythms so that they match that of a non-depressed individual. Typically an EEG taken to determine which areas of brain need to be untrained.[3]

Brain wave entrainment

This is the method of treating depression. Slower brain waves in depression than in individual without depression. Although neurofeedback direct at determining specific problems with brainwave, entrainment can be an effective supplemental treatment.

Entrainment involve using an audio, visual, or audio- visual stimulus to alter the brain waves throughout the brain. Neurofeedback is more specific, targeted and more natural than entrainment, but entrainment can be effective. The process typically involves an external stimulus such as to tones played in order to shift brain wave activity within a certain frequency range.

For example, a depressed person may have too much theta activity in the left hemisphere of their brain. This issue can be treated using

isochronictones (more effective than binaural beats and monaural beats) with mid-range beta frequencies.

Biofeedback music therapy

The power of music to heal has been recognized for centuries in various civilizations, and music therapy is known to improve psychological and physiological health of individual. Neurological basis of music therapy is a nascent field, with a great growth potential considering the advancements in development of instruments such as fMRI, used for evaluation of brain activity. About five factors contribute to the effect of music therapy: attention modulation, emotion, cognition, behavior and communication modulation. Biofeedback therapy in which patient learns to control his brain activity as a response to the realtime feedback. It shows positive results in treatments of anxiety, attention deficit disorder, epilepsy, autism and more. Feedback information is conveyed to a patient in a form of visual and auditory displays combined. A new approach that combines traditional music therapy and auditory biofeedback is Brain Music Treatment (BMT) developed in 1990s at the Moscow Medical Academy. Group of neurophysiologists, clinicians and mathematicians led by Dr.Ya I. Levin developed an algorithm for translating brain waves into music, which experimentally provided optimal therapeutic results. It shows positive initial results in patients with insomnia, where sleep patterns were improved by reducing anxiety. This method involves converting aspects of person's EEG activity into music files recorded on a CD, which patient then plays on a regular basis for the duration of a treatment over several months

ADHD:

Initially the children with ADHD were entrained to a mu-alpha rhythm (7 to 9 Hz) to decrease theta waves. After the initial mu-rhythm entrainment, they entrained SMR-betawaves for 22 minute sessions. The results as interpreted by TOVA demonstrated significant improvements in: inattentiveness, impulsivity, and variability. It shows behavioral improvements among the children. Using the right brainwave entrainment protocol may be a potential alternative for those with attentional deficits. [6]

***Altered states of consciousness*:** Photic stimulation at specific frequencies produced an altered state of consciousness. An extremely small study with just 4 individuals involved photic stimulation at 6 Hz, 10 Hz, and 18 Hz. It have altered their conscious awareness.

Anxiety: The treatment using 10 Hz stimulation (alpha waves) improved anxiety, but it wasn't statistically significant. A ramping format of alpha to theta to delta waves (over the course of 10 minutes) found a significant improvement in anxiety. In terms of long-term stress, there is evidence that alpha and beta stimulation improved measures of "competence" and "emotional exhaustion."

Behavior problems: It is found that brainwave entrainment was able to significantly improve behavior problems. One of these studies was conducted on children with ADHD and determined that they significantly improved not only in regards to attention deficits, but also in their behavior.

Biofeedback enhancement*:* The 15 minutes of stimulation with isochronic tones enhanced biofeedback protocols for bruxism (grinding of teeth). Brainwave entrainment is different from biofeedback in that it does not allow the person to consciously control their brainwave state.

Cognitive function*:* ADHD is improved by alpha and beta stimulation. Attention and learning ability has been suggested to improve as a result of beta stimulation protocols. Beta waves tend to be deficient among those who have learning disabilities and/or attention deficits.

Headaches: Brainwave entrainment providing therapeutic benefit for those suffering from general headaches or migraines and also the intervals between migraines appeared to be increased.

Potential Uses for Brainwave Entrainment

For individuals that lack certain brain waves to help them relax or focus, frequent usage of entrainment may provide a functional cure for their condition. For the majority of people, brainwave entrainment should be considered yet another tool that can be utilized to help manage and/or reduce symptoms of certain conditions.[5]

Chronic fatigue*:* Subjective improvements in energy level may be reported by those who increase stimulatory beta and gamma waves. Fast waves tend to be associated with higher levels of arousal. Low arousal is associated with chronic fatigue and may be exacerbated by slow brain waves (e.g. theta and delta).

Creativity*:* Peoples with excess beta waves may fail to relax enough to access certain (potential) creative properties associated with increased alpha waves.

Depression: The wrong entrainment protocol (e.g. slow wave stimulation) may actually increase certain measures of depression. Stimulation of delta and/or theta, will likely worsen the condition and

alpha is unlikely to have an effect. Beta stimulation may decrease scores of depression.

Hemispheric synchronization*:* There are numerous benefits of brain waves operating in "sync" as a result of entrainment. There may be an increased communication between the right and left hemisphere of the brain which could improve certain functions.

Insomnia*:* Perhaps one of the most promising uses of brainwave entrainment technology is for peoples with insomnia. The technology reduces the level of internal arousal and sleep. Specifically insomnia that is induced by excess stress (e.g. beta activity) would likely benefit from slower wave stimulation (e.g. alpha activity) to aid the brain in transitioning into sleep.

Learning: Performance improves with ADHD and cognitive function may be boosted so learning also improved. Those that are struggling to learn as a result of inattentiveness may benefit from stimulation with beta frequencies. Deficits in learning tend to be associated with abnormal or excess slow wave frequencies.[6]

CONCLUSION

Various states of consciousness are directly connected to ever-changing electrical, chemical and agricultural environment of the brain. Daily habits of behavior and thoughts can alter architecture of brain structure and connectivity, as well as, the neurochemical and electrical neural OSCI. The combination of electrical activity in the brain is called a "brain wave" and can be detected by EEG. Alpha brain waves are a sign of relaxed activity in brain and these are brainwaves of frequency between 8Hz-12Hz.

These are commonly produced in synchronized fashion connecting both hemispheres of brain and solely found in right hemispheres also. Theta waves have been identified as the gateway to learning and memory. Lambda waves have high frequency associated with wholeness and integration. Things like environmental stress, fear, anxiety, tension, over working tend to deplete the alpha activity in people. Brain wave technology is a technique to entrain brain with a particular wave can bring a person powerfully to a desired conscious state.

By using this it can induce numerous mental and emotional states in an individual. Brain Waves are important target for therapy as they have a key role in intelligence, learning process, therapeutics etc. Thus, anyone with impaired neurochemistry (such as elevated beta-endorphin) would receive the same benefit of normalized brain chemistry after the brain wave training.

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