

Binaural beats: Brain wave induction and the use of binaural beats to induce brain wave patterns

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INTRODUCTION: The brain works with electrochemical shots, generating the brain waves that represent the activity of the cortex. The basic frequencies of brain functioning: gamma (30-70 Hz), beta (13-30 Hz), alpha (8-13 Hz), theta (4-8 Hz) and delta (1-4 Hz). With reference to the mental characteristics associated with each brain wave pattern, it is possible to improve the "quality" of these waves so that it is possible to condition cortical activity by inducing a specific wave pattern. One way to do this is through the binaural sounds that can be used to harmonize or synchronize both hemispheres of the brain in a single synergistic pattern of waves.

METHODOLOGY: Integrative review, made from the reading of articles found in the databases with the descriptors: binaural beats, cerebral wave, and brain synchronization.

The brain works with electrochemical shots, generating the brain waves that represent the activity of the cortex. The basic frequencies of brain functioning: gamma (30-70 Hz), beta (13-30 Hz), alpha (8-13 Hz), theta (4-8 Hz) and delta (1-4 Hz). Cortical activity is related to states of consciousness, the amplitude of these waves being directly proportional to the number of neurons in the cortex (1,2).

With reference to the mental characteristics associated to each brain wave pattern, it is possible, from the stimulations, to improve the "quality" of these waves so that it is possible to condition the cortical activity (2) by inducing a specific wave pattern, which can change states of consciousness depending on external factors, time of stimulation, culture, and individual expectations (3).

One way to do this is based on the scientific principle of Harmonization, also known as Brainwave Drag. This is activated by the use of binaural sounds that can be used to harmonize or synchronize both hemispheres of the brain in a single synergistic pattern of waves (3-6).

METHODOLOGY

It is an integrative review, made from the reading of articles, in Portuguese, Spanish and English, found in the databases with the descriptors: binaural beats, cerebral wave, and brain synchronization. For a better understanding of the technique the discussion was divided into: Brain Waves, Binaural Hearing, Binaural Wave Mechanism and Binaural Waves.

RESULTS AND DISCUSSION

From the analysis of the articles it is possible to define some important terms for the understanding of the binaural wave process and to understand the mechanism of operation of this tool.

Brainwaves

The brain works basically with chemical and electrical energy; By using electricity, the brain can be considered a low-frequency machine generated by the action of electrical phenomena. Each type of wave reflects a different psychological, neurological and physiological state. The type of neurotransmitter and hormones released into the bloodstream vary according to the type of frequency (7).

RESULTS AND DISCUSSION: Binaural pulses are apparent sounds whose perception arises in the brain independently of the physical stimulus. They are sounds with different frequencies that arrive separately and simultaneously through each ear, creating variations in the brain, since it receives a stimulus and the predominant frequency will be changed until the frequency of the stimulus. By choosing specific patterns of binaural rhythm one can modify experiences and feelings and reproduce the natural cycles of the brain. The technique can be applied to induce favorable mental states to extend treatments of various disorders that affect humans safely and non-invasively, and can be used to combat depression and anxiety.

CONCLUSION: This technique allows its use in learning and rehabilitation in people with cognitive impairment.

Key Words: *Binaural beats; Cerebral wave; Brain synchronization*

The brain waves represent the electrical activity produced by the neurons, being the result of the sum of excitatory post-synaptic potentials. Brain waves, like any wave, have frequency and amplitude. Thus, the frequency, measured in Hz, represents the neuronal firing activity; and the amplitude represents the intensity of the brainwave. For a high amplitude, a synchronized firing activity is required, and a larger number of neurons must be activated (8).

The basic frequencies of brain functioning are: Gamma, Beta, Alpha, Theta, Delta and Talfa waves.

Doubtful Delta waves (1 Hz-4 Hz) are found during deep sleep, corresponding to slower waves. The higher the percentage of delta waves in the brain, the deeper the sleep. In meditative states there are practically no delta waves, only in extremely experienced practitioners, mainly because it is extremely difficult to remain conscious while in delta (2,9).

Theta waves (4 Hz - 8 Hz) refer to a state of low consciousness and are associated with hypnotic states, emotions, during dreams and in REM sleep. Related to short-term memory, such waves are present when the individual is storing information. The memories of an individual are updated by theta waves, but are "stored" shortly by gamma waves. It is suggested that a normal adult can store about 7 information in short-term memory, because at each gamma cycle (40 Hz), approximately 7 Theta cycles (6 Hz) fit. Therefore, during this state the development of memory is increased and there is improvement of long-term memory (2,9,10).

Alpha waves (8 Hz-13 Hz) occur during mindfulness and meditation. During this state, cortical activity occurs in areas of the brain that are not focused on a sensory stimulus, ie if a visual stimulus is present, the regions related to the tactile and sound stimuli will suffer an increase in alpha activity. Another case of increasing the alpha level is while searching for information in the brain, such as when a person tries to memorize a list of words. The alpha state of consciousness is usually associated with imaginative processes, being relaxed, and creativity (2,10,11).

The Talfa waves are a new group of alpha waves. This state is associated with a healthy mind when induced by will. Some studies show that the activity of these waves can help with stress, anger and resentment from trauma in the past. Unintentional production of Talfa is found in people suffering from slow brain wave disorders such as attention deficit, premenstrual syndrome,

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seasonal affective disorder, fibromyalgia, depression, and chronic fatigue syndrome (2).

Beta waves (13 Hz-30 Hz) are quite present during waking state. Generally associated with emotions such as fear, anger, anxiety, alertness and concentration. They are present in large quantities when it is necessary to develop mathematical solutions to problems (2,9,11).

Gamma waves (30 Hz-70 Hz) are the ones with the highest frequency and are related to the processing of visual, tactile and auditory stimuli. It is related to the speed with which we can remember moments, usually visual memories. The higher the gamma frequency, the faster it is possible to remember something that has been forgotten and more information can be stored in short-term memory. They are associated with increased mental activity, may include flashes of brightness, moments of extreme concentration and intuition. Sensation of love and kindness, attained by practitioners of Buddhist meditation, is only a self-induction of high-amplitude gamma waves. This state attained by meditation is expressed as a state of deep love for all beings (2).

Binaural hearing

AT Binaural hearing means listening with both ears. This mechanism works in animals for the purpose of locating the sound source through a comparison of what is heard in each ear. The ears form independent receptor channels, without interference between them. Sounds are received independently by each ear and create different effects on different parts of the brain (8,12).

Mechanism of binaural waves

Physiologically, it is thought that the sensation of the binaural pulses originates in the superior olivary nucleus in the brainstem, are related to the capacity of the brain to follow the sounds of the movement and the detection of sounds in three dimensions. The frequencies imposed on the brain are perceived by the olive nucleus and its reception is made by the thalamus, which is the structure responsible for receiving and filtering external stimuli together with the reticular activating system. This rhythm is sent to the cortex which, in a few minutes, accompanies the imposed frequency (2,3,5,7,12,13).

Binaural beats

Binaural pulses are defined as apparent sounds, whose perception arises in the brain independently of the physical stimulus. They are sounds with different frequencies that arrive separately and simultaneously through each ear when using stereo headphones, which causes the brain to recalculate its frequency of operation, creating a new, called binaural beat (4,13). The brain by its asymmetric characteristic will subtract these two waves and capture only the difference between them (2,6,7,12-18).

For example: When you have sound waves of 340 Hz and a sound of 344 Hz, the difference between them is 4 Hz.

When the brain synchronizes the information between the two waves, it produces a Delta wave state that oscillates with that wave frequency. The pulses can create variations in the brain, since it receives a stimulus and the predominant frequency will be changed until the frequency of the stimulus, phenomenon known like frequency following response (FFR). FFR reflects activity in a population of brainstem neurons and is characterized by a waveform that follows the cycles of the auditory stimulus wave. (7,8,19).

By choosing specific patterns of binaural rhythm one can modify experiences and feelings and reproduce the natural cycles of the brain. Binaural sounds can be used to change the frequency of the predominant brain waves, inducing the generation of waves capable of producing relaxation, sleep, altered states of consciousness, lucid dreams, creativity, analgesia (1,4-7,20,21).

By subjecting the brain to certain waves, cognitive processes can be improved, it takes a while before the prevailing frequency (the frequency at which the brain is working) changes, generating the frequency of the stimulus (frequency of the binaural pulse) (8).

Da Silva and Becher concluded that the brain stimulation technique can be applied to induce mental states favorably to extend the treatments of several disorders that affect humans in a safe and non-invasive way, and can be used in combat depression and anxiety.

Experiments by Jirakittayakorn and Wongsawat showed that a group of individuals exposed to 6 HZ sounds for 10 minutes presented theta wave (4-8 Hz) cortical activity compared to the control group that did not receive the stimulus; Showing that there was an induction of a meditative state.

CONCLUSION

The data indicate that in different brain regions and with various types of stimulation, significant brain activity occurs in the specific frequency band. This fact allows the use of binaural waves for an application in the learning and also in the clinical rehabilitation in people with cognitive deficiency. Thus, binaural pulse is a feature that allows modifying the performance and the state of mind of an individual. By subjecting the brain to certain waves it is possible to promote cortical stimulation and synchronization of the hemisphere and thus improve cognitive processes.

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