

## BRAIN WAVES CREATE CONSCIOUSNESS

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### ABSTRACT

Consciousness has been a mystery from very early civilization. Every religion and many philosophers have tried to explain consciousness. After rapid development of science and technology, consciousness has been the subject of intense research in psychology, neuroscience and quantum mechanics. Neuroscience is the most promising field and has made significant progress in understanding the structure and function of brain. Human brain has 100 billion neurons and 300 trillion constantly changing connections. At the root of all our thoughts, emotions and behaviors is the communication between neurons within our brains. Brain waves are produced by synchronized electrical pulses from masses of neurons communicating with each other. Brain wave is repetitive or rhythmic neural activity in the brain. Brain waves are classified in five bands – delta, theta, alpha, beta, gamma – with different frequencies. Consciousness is a function of the frequencies in these bands.

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### INTRODUCTION

Questions about the nature and origin of consciousness have been asked as long as there have been humans from religious and philosophical aspects. Three recent dominant theories are cognitive theories, quantum theories and neural theories. But still lot of questions remain unanswered. In this article, I will explain more my previous theory (Das, 2017), of consciousness as function of brain waves and consciousness constant *Conscienc C* discussing the source and distribution of brain waves and consciousness.

#### Brain structure

Outer layer of the brain is grey matter and contains neurons and dendrites. The white matter below the grey matter contains axons of neurons. The brain has four lobes – frontal lobe, parietal lobe, occipital lobe, and temporal lobe (Frank, 2014) Each lobe has a twin on the other half or hemisphere of the brain. The occipital lobes at the back farthest from the eyes largely process vision. The temporal lobes at the bottom middle of the brain process hearing and some aspects of language,

especially in the left hemisphere, but are also where visual processing becomes object recognition. This is where our long term memories are stored. The parietal lobes at the top back help process our sense of space as well as Touch. The back portion of the parietal lobes are also linked with complex thought. The frontal lobes control important cognitive skills, such as emotional expression, problem solving, memory, language, judgement, and sexual behavior. It is in essence, the "control panel" of our personality and our ability to communicate. At the root of all our thoughts, emotions and behaviors is the communication between neurons within our brains. Brainwaves are produced by synchronized electrical pulses from masses of neurons communicating with each other. Brainwave is rhythmic or repetitive neural activity in the brain. Neural tissue can generate oscillatory activity in many ways, driven either by mechanisms within individual neurons or by interactions between neurons. The interaction between neurons can give rise to oscillations at a different frequency than the firing frequency of individual neurons. In general, oscillations can be characterized by their frequency, amplitude and phase. Along with 100 billion neurons and 300 trillion constantly changing connections, individual neurons use very precise rhythms and groups of neurons oscillate together in very specific frequencies. The relationship of neuronal networks and brain waves is critical to future understanding of the brain.

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Synchronized activity of large number of oscillating neurons communicating with each other gives rise to brain wave.

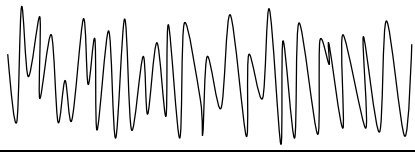

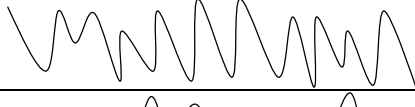


The major brain wave frequency ranges are –

**Delta waves (0.5 – 4 Hz):** They are generated in deepest meditation and dreamless sleep. Healing and regeneration are stimulated in this state. They have also been found to be involved in unconscious bodily functions such as regulating heart beat and digestion. Adequate production of delta waves helps us feel completely rejuvenated after we wake up from a good night's sleep. If there is abnormal delta activity, an individual may experience learning disabilities or have difficulties maintaining conscious awareness (such as in cases of brain injuries).

**Theta waves (4 – 8 Hz):** They occur most often in sleep but are also dominant in deep meditation. It acts as our gateway to learning and memory. In theta, our senses are withdrawn from the external world and focused on signals originating from within. Theta waves are connected to us experiencing and feeling deep and raw emotions. Theta has its benefits of helping improve our intuition, creativity, and makes us feel more natural. It is also involved in restorative sleep.

**Gamma waves (40 - 100 Hz):** They relate to simultaneous processing of information from different brain areas. These are involved in higher processing tasks as well as cognitive functioning. Gamma waves are important for learning, memory and information processing. Individuals who are mentally challenged and have learning disabilities tend to have lower gamma activity than average. 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. Thousands of neurons are exchanging information across many distant regions of cortex thus forming a synchronized assembly. But, how does the synchronization of vast number of neurons across the large area of cortex happen? This has not been understood yet. A mathematical tool called "Granger causality analysis" has been applied to explore this. British economist Clive Granger invented this method in 1969 to determine that two economic indicators are related in such a way that one might cause the other (Stanislas Dehaene, 2014). According to Granger analysis tool, signal X is said to cause signal Y if the past states of X predict the present state of signal Y better than the past states of signal Y alone does.

**Table 1. Brain rhythms**

Rhythm	Mental condition	Consciousness	Wave pattern
Gamma 40 – 100+ Hz information processing	Cognitive functioning, learning	Very high	
Beta 12 – 40 Hz	Attentive, problem solving, judgment, decision making	High	
Alpha 8 – 12 Hz	mental coordination, alertness, calmness	medium	
Theta 4 – 8 Hz	Deeply relaxed, semi- hypnotic state	low	
Delta 0.5 – 4 Hz	Dreamless sleep, meditation	very low	

**Alpha waves (8 – 12 Hz):** They are dominant during quietly flowing thoughts. They aid overall mental coordination, calmness, alertness, mind/body integration and learning. This frequency range bridges the gap between our conscious thinking and subconscious mind. Alpha is the frequency range between beta and theta. It helps us calm down when necessary and promotes feelings of deep relaxation. Beta waves (12 – 40 Hz): They dominate our normal waking state of consciousness when attention is directed towards cognitive tasks and the outside world. Beta is a 'fast' activity, present when we are alert, attentive, and engaged in problem solving, judgment, decision making and focused mental activity. They are involved in conscious thought, logical thinking, and tend to have a stimulating affect. Having the right amount of beta waves allows us to focus and complete school or work-based tasks easily. Having too much beta may lead to us experiencing excessive stress and/or anxiety. Most people exhibit fast brain waves throughout the day in order to complete conscious tasks such as: critical thinking, writing, reading, and socialization.

This method has now been applied to neuroscience. Normally there is bottom-up communication from sensory receptors to higher-order centers in the cortex. But also, there is a top-down component in which the higher-order centers send prediction signals about the reception. Hence, bottom-up and top-down communications are present throughout the cortex. Brain waves are measured by electroencephalography (EEG) by recording from electrodes placed on the scalp. Amplitudes of the brain waves measured by EEG are in the range of microvolts ( $\mu\text{V}$  or  $1/1,000,000$  of a volt). As seen in Table 1, frequency of the brain wave changes with the mental activity. Hence, mental activity is a function of brain wave frequency. When the brain wave frequency is high, brain is very active. When we are in the state of deep sleep or meditation, the brain activity is very low and brain wave frequency is 4 Hz and less. When we are in deeply relaxed, then the brain activity is low and the brain wave frequency is between 4 Hz to 8 Hz. When we are calm and alert, our brain activity is getting higher and the brain wave frequency is between 8 Hz and 12 Hz. When we are engaged in mental activities like problem solving,

decision making etc. our brain activity is high and brain wave frequency is between 12 Hz and 40 Hz. When we are engaged in extremely busy mental function, our brain activity is very high and the brain frequency is between 40 Hz and 100 Hz. Hence, it is obvious that brain activity is proportional to the brain wave frequency (BWF). Brain activity needs brain energy. Hence, brain energy is proportional to the brain wave frequency. Consciousness is related to brain activity, hence brain energy. Hence, consciousness is proportional to the brain wave frequency. If physical constant of consciousness is *Consciere C*, then consciousness is  $= C.f$ . between 8 Hz and 12 Hz. When we are engaged in mental activities like problem solving, decision making etc. our brain activity is high and brain wave frequency is between 12 Hz and 40 Hz. When we are engaged in extremely busy mental function, our brain activity is very high and the brain frequency is between 40 Hz and 100 Hz. Hence, it is obvious that brain activity is proportional to the brain wave frequency (BWF). Brain activity needs brain energy. So, brain energy is proportional to the brain wave frequency. Consciousness is related to brain activity, hence brain energy. Hence, consciousness is proportional to the brain wave frequency. If physical constant of consciousness is *Consciere C*, then consciousness is  $= C.f$ . A physical constant is a physical quantity that is universal in nature and has constant value in time. There are many physical constants in science. Some of the most recognizable ones are gravitational constant  $G$ , Planck's constant  $h$ , Boltzmann constant  $k_B$ , speed of light in vacuum  $c$ , etc. Gravity is a physical property of mass and gravitational constant  $G$  is a physical constant of the gravitational force  $F$  between two masses  $m_1$  and  $m_2$  at distance  $r$  is given by  $(Gm_1m_2)/r^2$ . Light consists of photons. Planck's constant  $h$  is a physical constant of the energy of photon. The energy of a photon at frequency  $f$  is given by  $E = hf$ . Boltzmann constant relates the kinetic energy of a gas particle  $E$  with the absolute temperature  $T$  given by  $E = k_B T$ . Similarly, consciousness is a function of brain wave. Consciousness energy  $E$  per brain wave frequency  $f$  for unit brain wave amplitude is given by  $E = Cf$ , where  $C$  is the consciousness constant *Consciere*.

Let us analyze brain waves of a person in problem solving state. In this case, the dominant waves will be in Beta range, but there will be additional waves in Gamma, Alpha and even Theta ranges. Let us call the brain wave frequencies in Beta range as  $f_{b1}, f_{b2}, f_{b3}, f_{b4}$  and  $f_{b5}$  and their amplitudes  $A_{b1}, A_{b2}, A_{b3}, A_{b4}$  and  $A_{b5}$ , in Gamma range  $f_{g1}, f_{g2}, f_{g3}$  and their amplitudes  $A_{g1}, A_{g2}$  and  $A_{g3}$ . Similarly, brain waves and brain wave frequency in Alpha range  $f_{a1}$  and its amplitude  $A_{a1}$ . Hence the total brain wave energy BWE would be

$$\begin{aligned} \text{BWE} &= C.A_{b1}^2.f_{b1} + C.A_{b2}^2.f_{b2} + C.A_{b3}^2.f_{b3} + C.A_{b4}^2.f_{b4} + C.A_{b5}^2.f_{b5} \\ &+ C.A_{g1}^2.f_{g1} + C.A_{g2}^2.f_{g2} + C.A_{g3}^2.f_{g3} + C.A_{a1}^2.f_{a1} \\ &= C(A_{b1}^2.f_{b1} + A_{b2}^2.f_{b2} + A_{b3}^2.f_{b3} + A_{b4}^2.f_{b4} + A_{b5}^2.f_{b5} \\ &+ A_{g1}^2.f_{g1} + A_{g2}^2.f_{g2} + A_{g3}^2.f_{g3} + \end{aligned}$$

$A_{a1}^2.f_{a1}$ ), since energy of a brain wave is proportional to the square of its amplitude.

Consciousness is created by brain wave energy. If there is no brain wave, hence no brain wave energy, there is no consciousness. Consciousness constant *Consciere C* is physical constant of brain wave, hence brain wave energy. Consciousness is a fundamental property of brain wave. As gravity is fundamental property of mass, photon energy is fundamental property of photon, similarly consciousness is fundamental property of brain wave energy, hence brain wave. If there is no brain wave, there is no consciousness. Now the question might be whether the consciousness constant *Consciere C* would apply to waves of same frequencies from other sources. The answer is no. As Planck's constant only applies to photon not to any other particle, Boltzmann constant only applies to only gas particle, similarly consciousness constant *Consciere C* only applies to brain wave. If we can measure the brain energy and can plot its wave in frequency domain, then we can find out the value of the consciousness constant *Consciere C*. The brain wave energy of brain waves is so weak that it is hardly measurable at all with current tools. As technology advances, it would be possible to measure such weak signal. Then the value of consciousness constant  $C$  in joules ( $X$ ) or in electron volt (eV) ( $Y$ ) can be determined as  $C = X$  joules or  $Y$  eV per Hz.  $1 \text{ joule} = 1 \text{ Kg m}^2 \text{ s}^{-2} = 6.24 \times 10^{18} \text{ eV}$

## Conclusion

Although many theories have been proposed to solve the mystery of consciousness, but there is no consensus to come to a definite conclusion to solve this mystery. The best and only way out of this dead-end is to accept that consciousness must be physical property of brain waves. The logic is:

- Science has proven that brain waves and brain energies exist.
- A person who is brain dead is not conscious, and brain waves and brain energies do not exist.
- Brain waves and brain energies exist only for living objects with brain.
- The nature and state of consciousness depends on the frequency of the brain waves.

Hence it can be concluded that consciousness is a fundamental property of brain waves.

## REFERENCE

- Das T, Consciousness as a function of brain waves and physical constant *Consciere*. NeuroQuantology, Sep 2017, Vol 15, Issue 3.  
Frank Amthor, Neuroscience, John Wiley & Sons, Inc., Hoboken, New Jersey, USA.  
Stanislas Dehaene, Consciousness and the brain. Penguin Books, New York, 2014.

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