

# WHITEPAPER



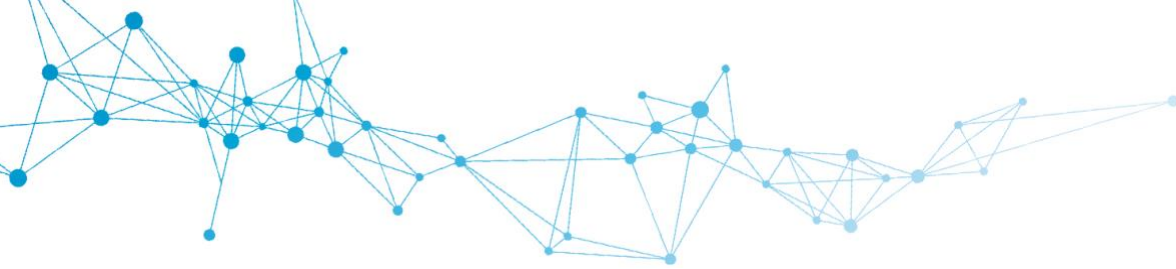
*October 2019*

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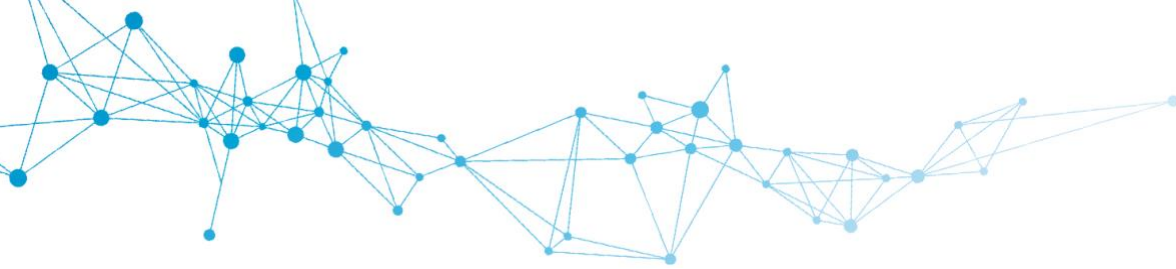
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## Foreword

The brain is the organ with which we detect pain, experience sleeplessness, irritability, and tiredness, but also sends us a desirable response on how to react to our sensor's perception. It is in the brain that clear thought appears; a feeling of relaxation and satisfaction emerges, and chemical renovation invigorates the body and prepares the mind for the day ahead. Today's statistics on mental and physical health are quite staggering.

August 2017, the American Psychological Association conducted the "Stress in America" [survey](#), which revealed that 74% of all the participants had experienced at least one symptom of stress in the past month. Their [study](#) had also concluded that most Americans would be happier, healthier, and feel much safer if they were to sleep an extra 60 to 90 minutes per night. [CDC](#) (Centers for Disease Control and Prevention) revealed that in 2016, chronic pain affected about 50 million adult Americans. The same year, about 20 million adult Americans experienced high-impact chronic pain - severe enough to interfere with life or work activities most days. So, what's the story behind?

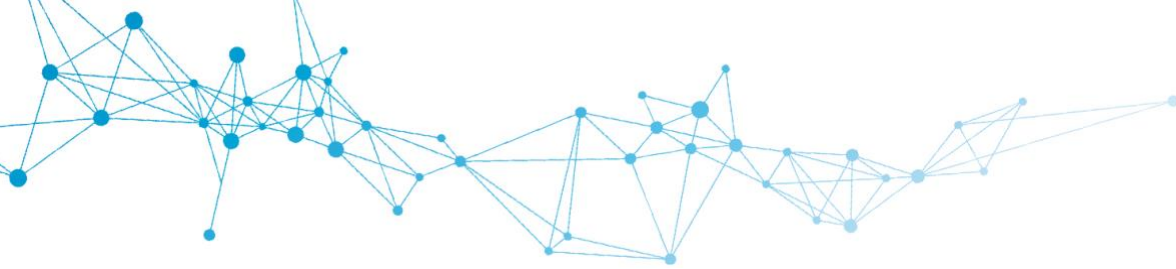
The communication between neurons in our brains determines our perception of reality, behavior, and management of emotions and thoughts. Brainwaves are the product of synchronized electrical pulses from masses of neurons communicating with each other at a specific frequency. They change according to our activity. According to Nikola Tesla, "Our entire biological system, the brain and the earth itself work on the same frequencies." The advancement of new technology has helped us get closer to speaking the brain's language. The cut edge technology, combined with the latest neuroscience discoveries, have helped us progress and reach our goal – set the seal on our little giant – NeoRhythm.

NeoRhythm was developed to tackle the 21st century's everyday problems and distractions occurring on both mental and physical levels, resulting in a decrease in life quality. NeoRhythm enables you to enjoy better living.

NeoRhythm is a unique wearable device that suggests the brain which frequencies to work at. To be effective, NeoRhythm uses electromagnetic pulses of medium intensity because of which it is called a Mi rTMS device (medium intensity repetitive transcranial magnetic stimulation). NeoRhythm's uniqueness lies in the multi-coil design because of which it can stimulate various parts of the brain simultaneously, resulting in you reaching a desired state of mind. NeoRhythm helps you de-stress; it enhances your mental capabilities, treats your sleeping disorders, enables you to meditate better, and successfully energizes and vitalizes your body.

It took us three years to develop and release the first of its kind wearable device that can stimulate different areas in the brain. That is so because of its unique structure. NeoRhythm consists of five strategically positioned inverted coils that combined stimulate a greater area to achieve the desired effect. Given the placement of the coils, we reach a 2-3cm stimulation depth, which can be hardly achieved by other available devices in the market. That kind of stimulation improves the brain's executive function and physiological processes. Before launching the product, we conducted two double-blind placebo-controlled studies that were published for their indisputable findings. Launching this consumer product, we would strive towards receiving and applying consumer feedback in making significant improvements.

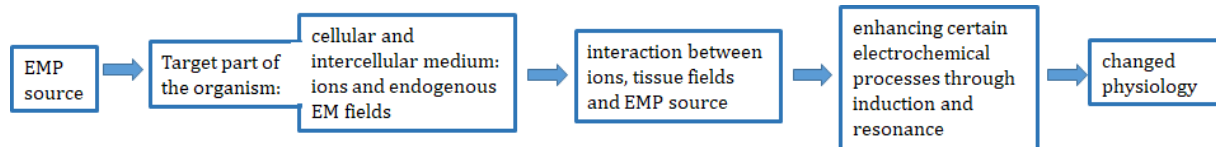
The objective of this whitepaper is to provide a general overview of NeoRhythm, including an in-depth description of the hardware, software, and all its seven different programs. All scientific proofs will be stated as well in order to achieve scientific validation.



## 1. NeoRhythm's fundamental underlying science

### 1.1 Basics

NeoRhythm is a wearable device that emits electromagnetic fields. To help you understand how this wearable functions, we present you a diagram that explains how electromagnetic pulses travel:

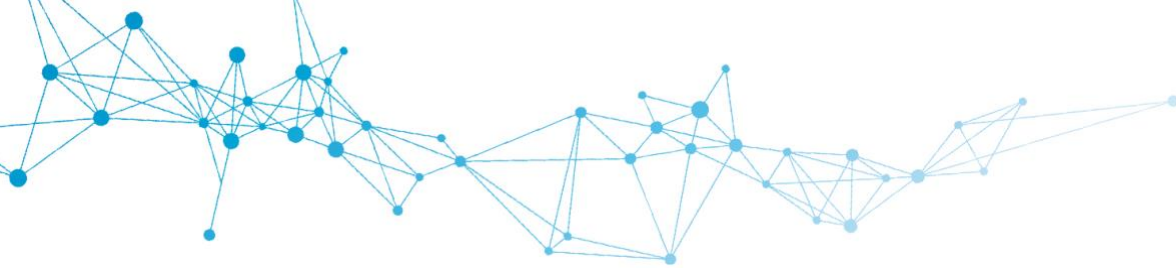


*Figure 1. General mechanism of EMF effects.*

In general, incident electromagnetic field (EMF) pulses enhance corresponding existing electrical oscillations (like brain waves). There are two common assumptions about what the therapeutic effect of EMF stimulation is. The first one states physiological disorders lead to the chaotic dynamics of biological elements (hormones, enzymes, mediators, cytokines, etc.) in the body and cause desynchronization of electrochemical and electromagnetic oscillations. The second assumption states that the ions and dipolar molecules create bonds between the biochemical and electrochemical levels. Since that relation is reciprocal, pathological biochemistry results in pathological electrochemical waves (frequencies).

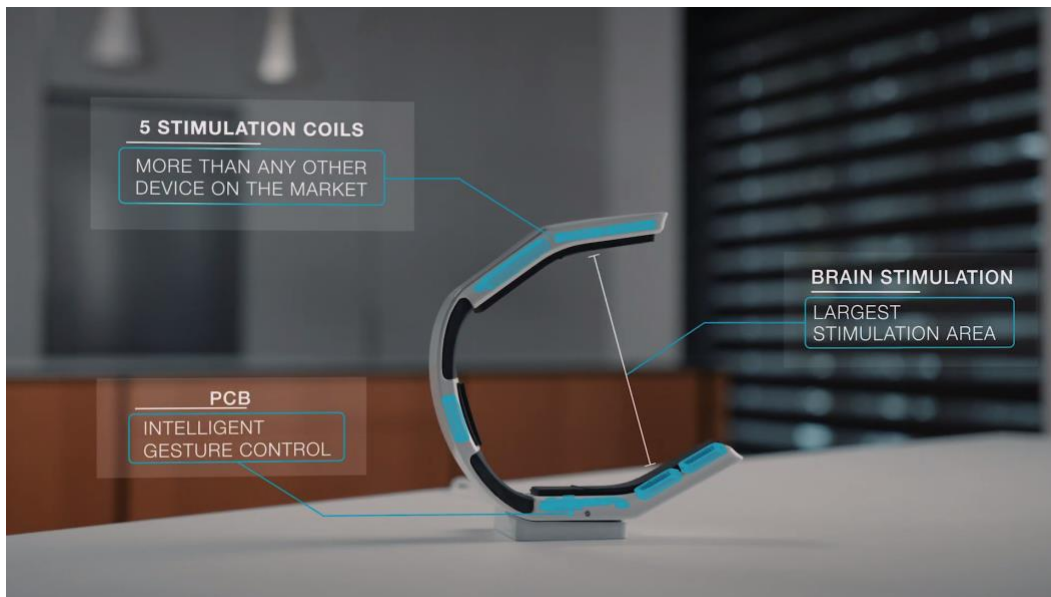
For example, people can feel exhausted and stay in bed, but can not fall asleep. That means that they have a very low intensity of alpha and delta waves in their EEG. Through EMF stimulation in a delta frequency range, we enhance this frequency band in the brain, making us fall asleep.

To conclude, by enhancing the right oscillations, we may induce a specific healthy physiological state.



## 1.2 Repetitive transcranial magnetic stimulation (rTMS)

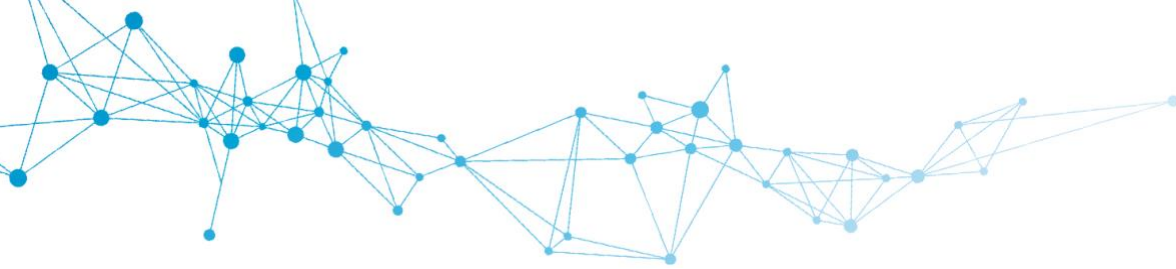
NeoRhythm is a wireless medium intensity rTMS wearable device consisting of five stimulation coils. It covers the largest stimulation area when compared to other known similar consumer products on the market.



*Figure 2. NeoRhythm – a wireless medium intensity multi-coil rTMS wearable device.*

Pulsed electromagnetic field (PEMF) therapy is a non-invasive, non-thermal treatment based on the emission of electromagnetic radiation to heal damaged tissues and bone, to relieve injury-related pain and enhance the overall wellness. You can apply PEMF therapy directly to the head, also known as repetitive transcranial magnetic stimulation (rTMS). rTMS is a non-invasive procedure that uses electromagnetic induction to stimulate specific areas of the brain by creating and changing the magnetic field.

Our brain has the exquisite ability to adjust its brainwaves to external frequencies. The phenomenon of such resonance is known as entrainment. The Merriam-Webster dictionary defines entrainment as drawing along with or after oneself. That is the reason why a slow song helps you relax, and a train ride makes you feel sleepy. Using brainwave entrainment techniques, NeoRhythm stimulates the adjacent brain regions and aligns them to specific frequencies. Therefore, by enhancing the right oscillations, we may induce a healthy physiological state.



Magnetic fields have various intensities, and according to Pawluk (2017), they can be classified into:

- extremely low: less than 50  $\mu\text{T}$  (0.5 gauss)
- low: 50  $\mu\text{T}$  – 1 mT (0.5 gauss – 10 gauss)
- **medium: 1 mT – 10 mT (10 gauss - 100 gauss)**
- high: 10 mT – 100 mT (100 – 1000 gauss)
- very high – greater than 100 mT (1000 gauss)

NeoRhythm uses Medium Intensity (MI) magnetic fields. Accordingly, it is also called an MI rTMS wearable device. More specifically, NeoRhythm uses intensities that range from .25 mT to 2.5 mT. This magnetic field (MF) intensity roughly corresponds to the incident magnetic field intensity on the brain level used in the Gao et al. 2014 research. In conclusion, NeoRhythm is non-invasive, successfully triggers entrainment, and is at the same time strong enough to be considered an MI rTMS device.

### 1.3 Brainwaves

NeoRhythm's programs stimulate different areas of the human brain as well as various life functions, especially those affecting behavior. Numerous activities commence taking place in the human brain, which functions as an electrochemical organ. Its electrical activity is transformed in the form of brainwaves produced when communicating neurons synchronize their electrical pulses. The type of brainwaves emitted differs depending on our current state of mind, hence their division into bandwidths (delta, theta, alpha, beta, gamma) with corresponding functionalities.

Brainwave speed is measured in Hertz (cycles per second), and they are divided into bands delineating slow, moderate, and fast waves. It is possible to describe different brainwaves' bandwidths in theory; however, in real life, brain activity is far more complex. When slower brainwaves are dominant, we can feel tired, slow, sluggish, or dreamy. Unlike them, higher frequencies are dominant when we feel wired or hyper-alert.

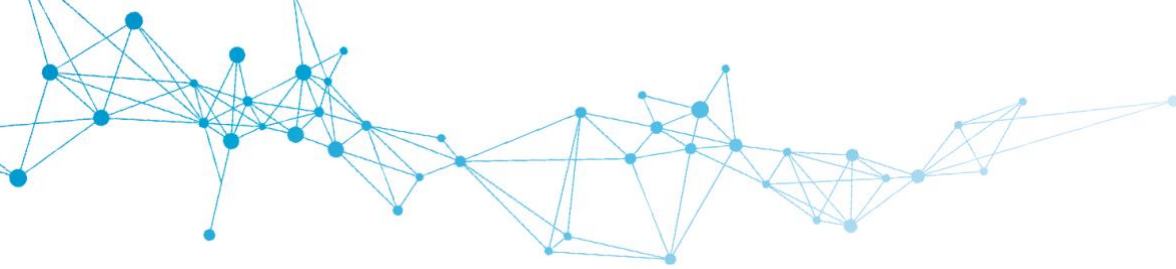
#### **Delta waves (up to 4 Hz)**

Delta brainwaves are slow brainwaves with high amplitude, amplitude being the maximum displacement measured from the wave's equilibrium position. Delta frequencies can be compared to a deep penetrating drumbeat. They are generated when getting into deep meditation and dreamless sleep. Delta waves suspend external awareness and are the source of empathy. Healing and regeneration are stimulated in this state, and that is why deep restorative sleep is so essential to the healing process. NeoRhythm uses delta frequencies in two programs: *Improve Sleep* and *Deep Relaxation*.

#### **Theta waves (4 to 8 Hz)**

Theta brainwaves occur most often in sleep but are also dominant in deep meditation. Theta is our gateway to learning and memory. In theta, our senses are withdrawn from the external world and focused on signals originating from within. Theta is present in the hypnagogic, hypnopompic state, in the REM phase of sleep, when we dream and when in deep meditation. NeoRhythm uses theta frequencies in three programs: *Improve Sleep*, *Meditation Theta*, and *Meditation Calming and Synchronization*.





### Alpha waves (8 to 14 Hz)

Alpha brainwaves are dominant during quietly flowing thoughts and in some meditative states. They help recognize the presence in real-time. It is the resting state of the brain. Alpha waves aid overall mental coordination, calmness, alertness, mind/body integration and learning. NeoRhythm uses alpha frequencies in four programs: *Pain Control*, *Meditation Theta*, *Meditation Calming and Synchronization*, and *Deep Relaxation*.

### Beta waves (from 14 Hz to 38)

Beta brainwaves dominate our normal waking state of consciousness when attention is directed towards cognitive tasks and the outside world. Beta brainwaves have a higher frequency and are emitted when we are alert, attentive or engaged in problem-solving. They also appear when making decisions, and during any other mental focused activities. NeoRhythm uses beta frequencies in the *Enhance Mental Capacity* program.

### Gamma waves (38 to 42 Hz)

Gamma brainwaves are the fastest of the brainwave frequencies and signify the highest state of focus possible. They have a low amplitude. Gamma waves pass information rapidly and quietly and are emitted when simultaneously processing data from different brain areas. NeoRhythm uses gamma frequencies in three programs: *Pain Control*, *Enhance Mental Capacity* and *Energy and Vitality*.

## 1.4 NeoRhythm – your guide on the self-improvement life journey

**Deal with problems. Find solutions. Enjoy better living.**

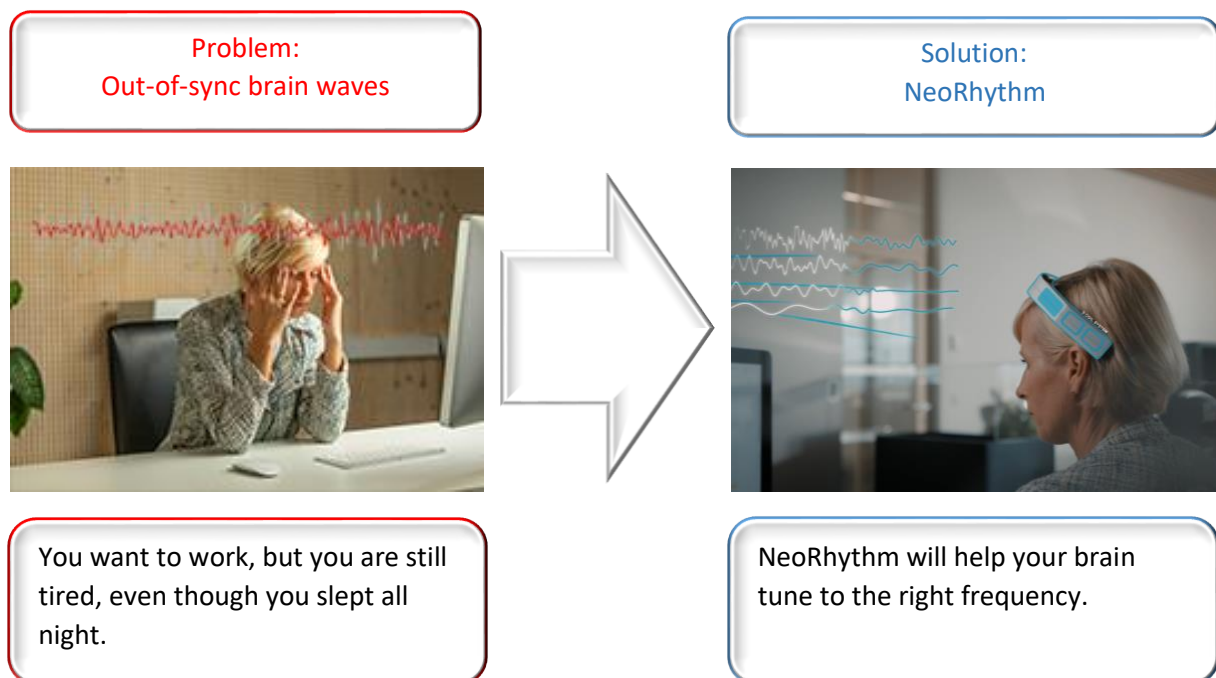
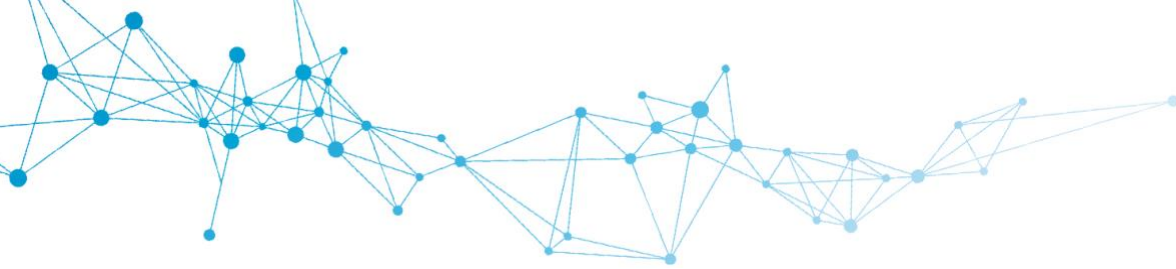


Figure 3. Starting with a problem ending up with a solution.



NeoRhythm is a complete and all-inclusive solution for every individual. It covers all the essential areas of human psychophysical activity. Our brainwave profile and our daily perception of the world are two inseparable phenomena. It is of great importance to acknowledge that when we refer to specific brain waves, we are implying that those particular brain waves are “dominant.” Throughout the day in your waking state, your EEG will display all types of brain waves at the same time. However, one particular brain wave will be dominant depending on the state of consciousness that you are in. When our brainwaves are out of balance, related problems in our emotional or neuro-physical health occur. Numerous studies have identified brainwave patterns associated with all sorts of emotional and neurological conditions.

By rule of thumb, any process that changes your perception changes your brainwaves. Let us consider relaxation as an example. There are many different non-invasive methods to achieve a relatively satisfying relaxed state. Some of them are based on psychological techniques, like Shultz’s autogenic training including progressive reduction of muscle tension; others include special practices, such as meditation, which trains your brainwaves into balance.

In modern times, however, one may need deep relaxation, when not being in a position to perform any stress-relieving exercise, while, for instance, driving a car. In such a situation, it would be utterly inadvisable to take medication for deep relaxation in the form of an anxiolytic pill. Pills may have long and undesired negative side effects like drowsiness and coordination impairment. In such cases, people must choose a completely different method for solving their problems. They should go for that one solution that would reinforce their multifunctionality without the odds of developing side effects. Brainwave entrainment is a recommended solution. It stimulates the brain to get in a specific state by using either a rhythmic sound, light, or an electromagnetic field. NeoRhythm uses the latter.

Different brainwaves correspond to different states of thought or experience. NeoRhythm’s task is to emit corresponding dominant and accompanying frequencies to which the brain synchronizes, to create a perfect mental environment for the desired state of mind.

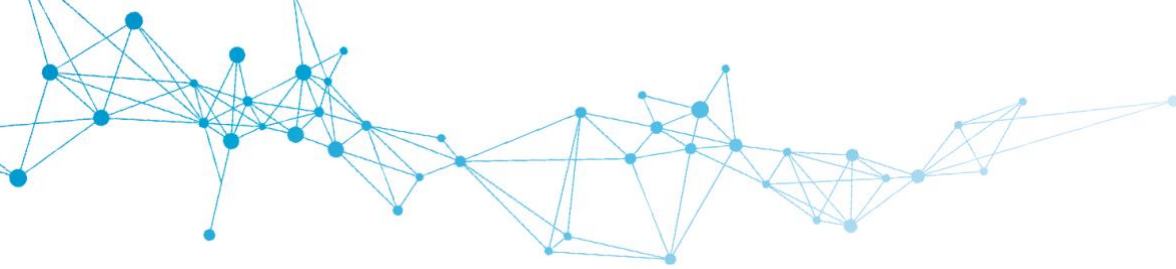
Each of the seven stimulation programs uses scientifically determined frequencies. That knowledge is based on the findings of dozens of scientific studies in the fields of pulsed electromagnetic therapy (PEMF) and transcranial magnetic stimulation (rTMS) across the world, including our own as well.

## **2. NeoRhythm’s Programs**

### **2.1 Improve Sleep**

Thomas Dekker once said that sleep is the golden chain that ties health and our bodies together. According to sleep deprivation [statistics](#), 40% of Americans get less than 7 hours of sleep per night. Deep rejuvenating sleep is crucial for your health. The only way for the brain to detoxify is through rest. Important hormones, namely the growth hormone, are produced during your sleep cycle. During sleep, different types of proteins are being synthesized — all crucial to your health. This synthesis improves your mental, emotional, and physical state and boosts your immune system. In addition to that, sleep deprivation will likely cause a rise in bodyweight since it significantly changes the hormones that regulate hunger and appetite.





Our normal waking state of consciousness, while we are alert, concentrated and focused, is governed by beta waves. Alpha state is the gateway to the subconscious, and it occurs during deep relaxation or light meditation. There are different stages of sleep. While we are sleeping, we enter our subconsciousness as well as our unconscious mind.

During this stage, it is the theta and delta waves that prevail. Once we go to bed, our bodies first calm down. The overall body muscle tone relaxes, and the brain wave activity begins to slow down when compared to its speed while awake. Theta brainwaves mostly occur in the light sleep and REM (Rapid Eye Movements) stage of sleep, associated with dreaming. Delta brainwaves are slow brainwaves produced in deep, dreamless sleep. They suspend external awareness. Healing and regeneration are stimulated in this state, which is why deep restorative sleep is essential for the healing process.

NeoRhythm's program *Improve Sleep* induces a predominance of theta brain waves accompanied by delta. Knowing that even subharmonics may have an essential influence on brainwaves, we use two frequencies during this program. The leading frequency (2.5 mT) comes from the low theta region (4 Hz) and should be in direct resonance with the targeted brainwave enhancement, and is supported by one of a lesser intensity (.25 mT) representing a subharmonic from the delta region (2.67 Hz). In a comprehensive study comprised of over 100 volunteers, [Pelka et al.](#) (2001) reported a considerable positive effect on sleep when using an overnight MF stimulation at 4 Hz with an extremely low and varying field intensity. [Jiang et al.](#) (2013) assessed the efficacy of rTMS in the treatment of patients with chronic primary insomnia. Their results showed that rTMS treatment significantly improves stage III sleep and REM sleep cycle when compared to the control groups' results. Furthermore, the rTMS treatment group had an advantage in the improving of the indices of HPA and HPT axes. The HPA (Hypothalamic–pituitary–adrenal) axis is responsible for modulating inflammatory responses that occur throughout the body. The HPT (hypothalamic-pituitary-thyroid) axis is responsible for the regulation of metabolism and responds to stress.

Staying awake or asleep is dependent on the various areas inside the brain. Several regions of the brainstem and hypothalamus cause wakefulness by sending arousal signals to the cortex. However, another area of the hypothalamus stops the arousal signals and causes the transition to sleep. We recommend wearing NeoRhythm at the occiput for 20 minutes before you lay down. It will slow down your brainwaves and help you unwind.

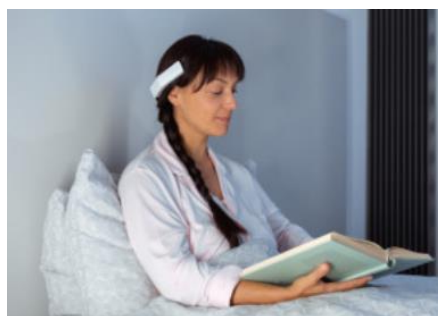
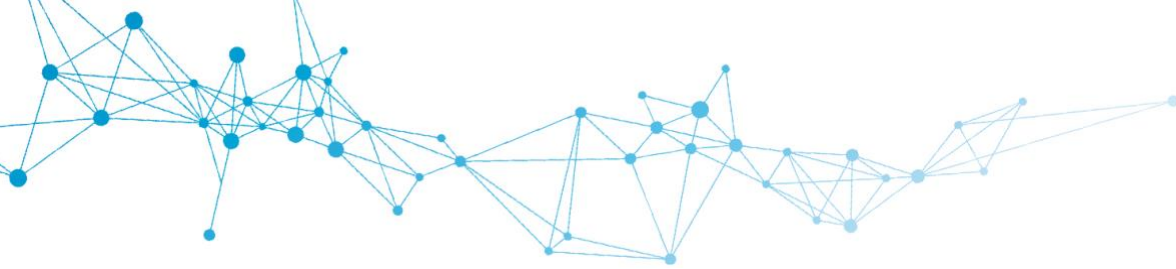


Figure 4. Position of NeoRhythm at the occiput during the 20 minutes long preparation for sleep.



After you lay down, select an 8 hours duration of the *Improve Sleep* program. During this stage, you can put NeoRhythm under your pillow or close to your head. You do not need to wear it, so it will not bother you while we sleep. Nevertheless, it will still assist you in staying asleep. NeoRhythm does not have to be connected to your phone while your chosen stimulation program is running. In addition to that, you do not need the app or your phone if you only want to use the same program you used last time. Just tap your NeoRhythm twice, and you will restart it. These features make NeoRhythm one of the most user-friendly devices on the market. Besides, you will get rid of all the unwanted frequencies emitted by your smartphone from your bedroom.



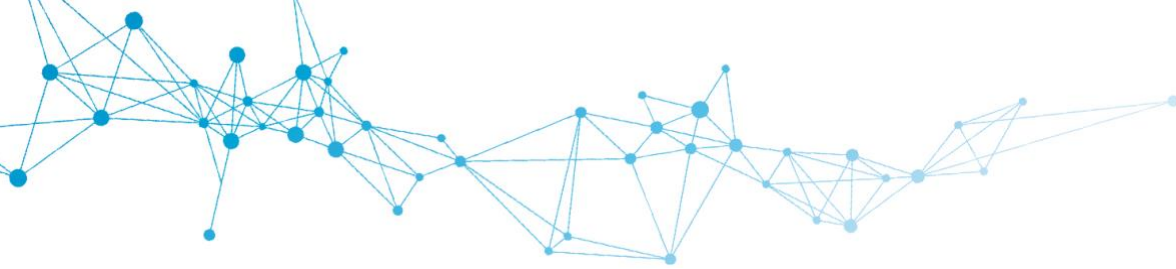
*Figure 5. Putting NeoRhythm under your pillow in an enclosed case, while you sleep.*

## **2.2 Pain Control**

Pain is an unpleasant sensation linked to tissue damage. People experience pain differently, which is why the description of pain and the way it feels differs. We feel pain when a signal about the occurred damage is sent through the nociceptors, special nerves that detect tissue damage, along the spinal cord to the brain. How an individual's brain interprets these signals and the efficiency of the communication channel between the nociceptors, and the brain dictates the way people feel pain. In layman's terms, pain comes to life in our brain. Consequently, we can conclude that we can prevent or decrease pain by suggesting the brain to react differently to it.

Pulsed electromagnetic field therapy uses healthy electromagnetic frequencies to enhance overall health and wellness. Every cell wall has a negative charge. To retain the healthy levels of that negative charge, cells must contain potassium and magnesium inside their walls, and ideally, keep calcium and sodium outside the cell. The vitamins, minerals, and hormones levels must be kept at an optimal level to preserve cell health. The blood pH is also essential. All these factors play a crucial role in maintaining cell health, given the electrical health of cells is key to all vital elements.

Pulsed electromagnetic field therapy significantly increases circulation and provides a wide variety of health benefits. Numerous studies have shown the positive effects of pulsed electromagnetic field therapy on pain reduction. For example, one of them, conducted by [Kortekaas et al.](#), showed that exposure to electromagnetic fields has analgetic and antinociceptive effects. The results confirmed that pain management might be achieved when exposed to pulsed electromagnetic fields. Pulsed electromagnetic field therapy is a safe and non-invasive way to reduce pain and inflammation. It can also be used to supplement and enhance currently existing healthcare possibilities.



NeoRhythm emits scientifically supported frequencies, which were shown effective for pain tolerance. It emits a 303.41 Hz (2 mT) frequency with an accompanying one of 12.64 Hz (.25 mT). We can place NeoRhythm either on a slightly lower position at the back of our head to cover parietal and temporal lobes or around the neck. One session lasts 40 minutes. We recommend using the *Pain Control* program twice a day.



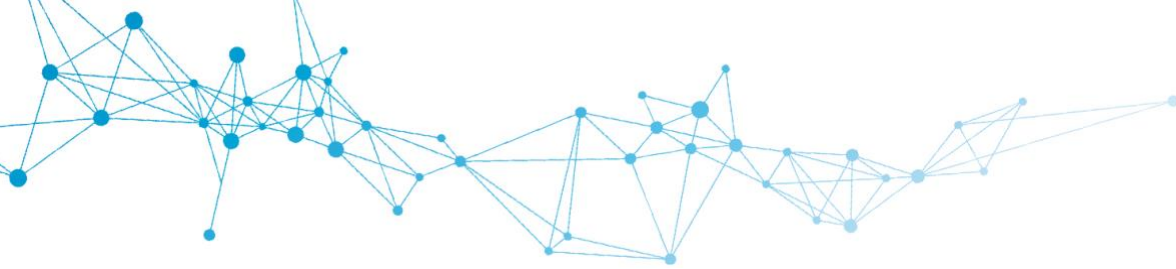
Figure 6. NeoRhythm's possible positions for the Pain Control program.

### 2.3 Enhance Mental Capacity

When you lack focus, we can become overwhelmed, too much to do and very little time to do it. When not well focused, all our efforts lead to failure, consequently increasing frustration and demotivation, leading to stress. Everyday stressful situations are ones when we need to do more in less time or deliver to the highest of standards. Tension also arises when we need to solve problems efficiently or make a crucial career or life decision. Striving to be efficient every single day can also lead to frustration. NeoRhythm can improve your attention by exposing you to pulsed electromagnetic fields using scientifically supported frequencies.

Our normal waking consciousness is dominated by the beta brainwaves - the alertness frequency band. The *Enhancing, Mental Capacity program*, induces a dominance of beta brain waves, or to be more precise, the scientifically supported 33.71 Hz frequency (2.5 mT) in combination with the 54 Hz frequency (.25 mT). When beta brainwaves are present, we can think clearly, and keep our focus. Beta can be very useful for people who have brain fog or are tired.

We conducted a double-blind, placebo-controlled scientific study using NeoRhythm's *Enhance Mental Capacity program*. For more details, please read chapter 5.2.1 [Scientific study of NeoRhythm for the "Enhance Mental Capacity" program](#). For additional information, we recommend you read our published scientific paper on [Enhancing Vigilance by Low Intensity Transcranial Pulsed Magnetic Stimulation Applying the Entrainment Model](#), available [here](#).



Lutz et al. (2004) conducted a study, consistent with the idea that attention and affective processes are flexible skills that can be trained. Their findings suggest that mental training may induce short-term and long-term neural changes. Results showed that electroencephalogram patterns of “meditators” differ from those of controls, in particular, over lateral frontoparietal electrodes. In addition, the ratio of gamma-band activity (25–42 Hz) to slow oscillatory activity (4–13 Hz) is initially higher in the resting baseline before meditation for the practitioners than the controls over medial frontoparietal electrodes.

Different regions spread across the cortex, are involved in many forms of cognitive control. Frontoparietal lobes play an essential role in our cognitive functioning, which is why we place NeoRhythm not on the top of our head but in a slightly lower position towards the forehead. One session lasts from 30 to 60 minutes. We recommend using the *Enhancing Mental Capacity* program up to three times a day. Make sure not to exaggerate since excessive high-frequency stimulation is not a very efficient way to stimulate the brain, because it uses a tremendous amount of energy.

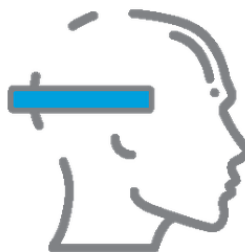
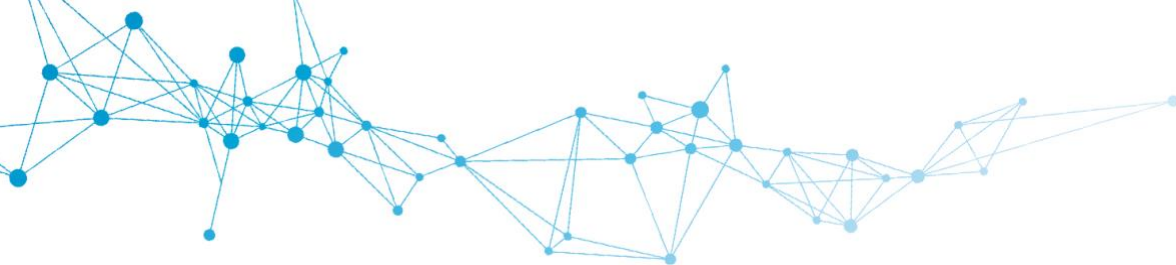


Figure 7. NeoRhythm’s positions for the *Enhance Mental Capacity* program.

## 2.4 Meditation

Meditation means reflecting on, studying, practicing, and shifting your focus within. Regular meditation practice will improve your life dramatically. It will bring you clarity in your thoughts and help you control those thoughts, behavior, and emotions. Surprisingly it can also lower high blood pressure. It was in 2008 that Dr. Randy Zusman, a doctor at the Massachusetts General Hospital, conducted a [study](#) measuring the effects of meditation on blood pressure control. 64% of all the participating patients who had spent three months meditating regularly had significant blood pressure drop resulting in a decrease in the number of medications consumed. It also helped them relax. People become calm and relaxed because of the formation of nitric oxide, which opens up your blood vessels and so reduces blood pressure.

NeoRhythm offers two programs to support meditation, the *Theta Meditation* and the *Meditation for Calming and Synchronization*. We wear NeoRhythm temporarily, placed above our ears, for as long as the optimal duration of the treatment.



*Figure 8. NeoRhythm's position for the Meditation programs.*

#### 2.4.1 Theta Meditation

Theta brainwaves mostly occur in sleep but are also dominant in deep meditation. Being able to enter the dreamlike theta state without falling asleep takes meditation practice. NeoRhythm can speed up the theta reaching process, making it easier to reach deep meditative state. Theta opens our minds to learning, memory, and intuition. During theta meditation, theta waves most probably originate from a relaxed attention that monitors our inner experiences. Alpha waves are characteristic of wakeful rest. Baijal and Srinivasan (2010) investigated the temporal dynamics of oscillatory changes during a concentrative form of meditation. EEG was recorded during meditation for meditators and relaxation for controls. Meditators exhibited increased theta coherence compared to controls. Pasquini et al. (2015) found correlations between the frequency of weekly meditation practice and the augmented theta band relative power induced during the meditative state of "mindfulness."

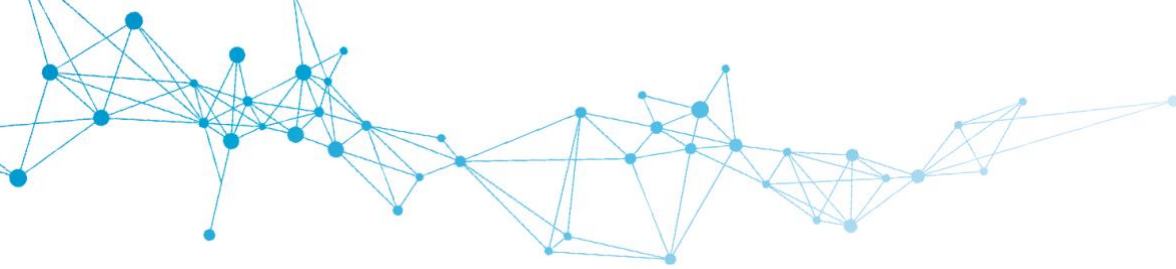
NeoRhythm emits the scientifically supported dominant 4 Hz frequency (2.5 mT) with its accompanying weaker (.5 mT) 10.67 Hz frequency. These frequencies naturally synchronize its brainwave frequencies with the rhythm of the theta frequency, figuratively opening the door into deep meditation. One session lasts from 30 to 60 minutes. You can also choose the "unlimited" option, that way the electromagnetic pulses will work for the duration of mediation.

#### 2.4.2 Meditation for calming and synchronization

Alpha brainwaves are dominant during moments of quiet thought. Alpha is 'the power of now,' being here, in the present. Alpha waves support mental coordination, calmness, alertness, mind and body integration, and learning. They control your mental processes and help you achieve optimal cognitive balance.

The regular production of alpha brainwaves ensures that your immune system stays in top shape. That is facilitated by their ability to keep the body relaxed and prevent stress buildup. Because of that, your body will not produce chemicals harmful to your immune system. By keeping anxiety and stress at bay, alpha brainwaves reduce the chances of having to deal with stress-induced or anxiety-related sickness.





Braboszcz et al. (2017) compared practitioners of three different meditation traditions (Vipassana, Himalayan Yoga, and Isha Shoonya) with a control group during a meditative and instructed mind-wandering block. They observed a higher 7–11 Hz alpha activity in the Vipassana group compared to all the other groups during both the meditation and the instructed mind wandering, and a lower 10–11 Hz activity in the Himalayan yoga group during meditation only. They showed that meditation practice is correlated to changes in the EEG gamma frequency range that are common to a variety of meditation practices.

NeoRhythm emits a scientifically supported dominant 9 Hz frequency (2.5 mT) with an accompanying weaker (.5 mT) 6 Hz frequency. They create strong entrainment to alpha frequencies. One session lasts from 30 to 60 minutes. You can also choose the “unlimited” option, that way the electromagnetic pulses will work for the duration of mediation.

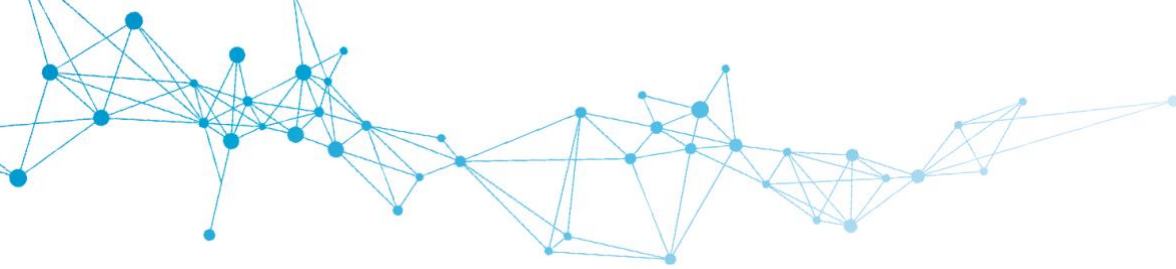
## 2.5 Deep Relaxation

Relaxing after a hard day is sometimes difficult, but it is also vital for your health. Daily accumulated stress wears you down mentally and emotionally, and saps the joy from life. Deep relaxation practice gives you mental clarity, focus and calm. At that stage, our five senses can finally get some rest and we focus within. When you are having trouble relaxing, NeoRhythm will soothe your mind and help you unwind.

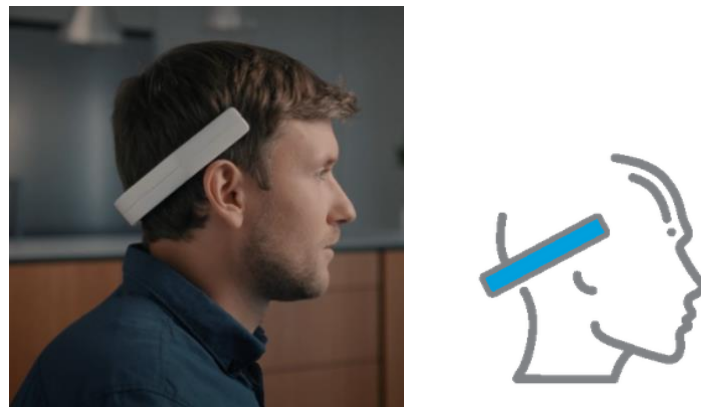
To evaluate the influence of extremely low frequency pulsed magnetic fields on the human brain, Gao et al. (2014) conducted magnetic stimulation experiments and analyzed the changes of spontaneous EEG activity. Compared to the sham exposure group, the EEG power of theta band (3.5-7.5 Hz) and lower-alpha band (7.5-10 Hz) from the stimulation group increased significantly after magnetic stimulation. Bell et al. (1994) studied frequency-specific responses in the human brain caused by electromagnetic fields. The effects of 1.5- and 10-Hz electromagnetic fields (EMFs), 0.2-0.4 gauss, on the intrinsic electrical activity of the human brain at those frequencies were studied. The study subjects exhibited altered brain electrical activity at the frequency of the EMF during the time of stimulation. Pawluk (2017) firmly supported this claim. When having anxiety, EEG research shows that lower frequencies, especially in the alpha range (9-13 Hz), are best.

We have also conducted a double-blind, placebo-controlled scientific study on the NeoRhythm’s *Deep Relaxation* program. For more detailed information, please visit our published paper [Influencing Relaxation by a Low-Intensity Transcranial Pulsed Magnetic Stimulation Applying the Entrainment Model](#) by Jerman et al. (2019) or read the short overview of the results in chapter 5.2.2 [Scientific study of the NeoRhythm for “Deep Relaxation” Program](#). The results demonstrated that magnetic field stimulation has an objective relaxing effect and does not cause drowsiness.





*The Deep Relaxation* program induces a predominance of alpha brain waves. It emits a 10.12 Hz (2.5 mT) frequency accompanied by a 3.375 Hz (.25 mT) frequency. Those frequencies calm you down and help you shake off stress, enabling you to achieve emotional, physical and mental well-being. We wear NeoRhythm at the occiput. One session lasts from 30 to 60 minutes. We recommend using the *Deep Relaxation* program once or twice a day, depending on your needs.



*Figure 9. NeoRhythm's position for the Deep Relaxation program.*

## **2.6 Energy and Vitality**

Do you have low energy? The human cell is like a battery. They are negatively charged on the inside while the outside environment is positively charged. That is the reason is why our cells maintain a voltage across their membrane. Diminished cellular voltage has a direct correlation to disease and sickness – just like a battery slowly dying. One of the effects of repetitive EMF stimulation on humans is the energizing effect. Cells can absorb energy from incidental electrical oscillations, which means that certain EMF stimulations of higher intensities can have energizing effects. NeoRhythm is one of the most reliable solutions to re-energizing cells with pulsed electromagnetic fields currently present on the market. NeoRhythm's *Energy and Vitality* program rejuvenates the body.

Rubik (2011) studied neurofeedback-enhanced gamma brainwaves from the prefrontal cortical region of meditators and non-meditators and associated subjective experiences. The results gathered from the meditators had shown that the 40-Hz rhythm, in some cases measured from the prefrontal cortical area, is intensified during meditation. The inner experience associated with increased clarified gamma amplitude from the prefrontal cortex evidently involves positive emotions of happiness and love, along with reduced stress. Meditators achieved greater increases in the gamma band from the prefrontal cortical region over controls during an initial neurofeedback session.

NeoRhythm's *Energy and Vitality* program uses a 40.5 Hz frequency (2.5 mT) accompanied by a 54 Hz frequency (.5 mT). We place NeoRhythm over the prefrontal cortical region. One session lasts 30 or 60 minutes. We recommend you using the Energy and Vitality program once or twice a day, depending on your needs.

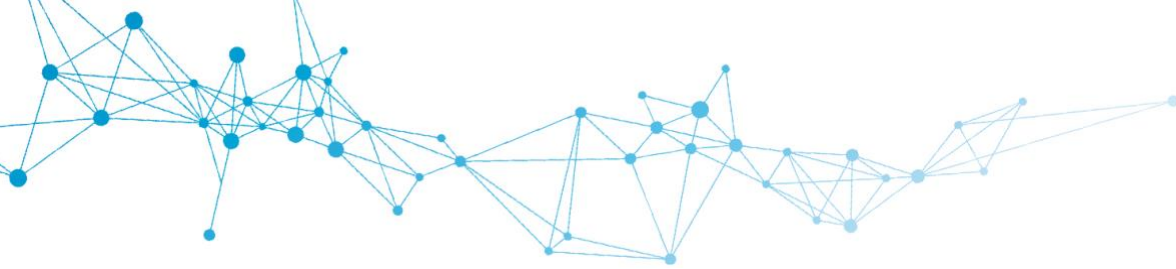


Figure 10. NeoRhythm's position for Energy and Vitality program.

### 3. Unique User Experience

NeoRhythm was created with the user in mind. Due to its compact and lightweight (only 105 grams) design, this sturdy device is perfect for travel.



It uses a **multi-coil design** to cover the largest area of the brain. This well thought out, and well-crafted device offers one of the most extensive and most precise stimulation areas on the market today. The strategic positioning of the five magnetic-field-generating inverted coils enables both separate and in-tune targeting of specific regions of the brain (prefrontal cortex, temporal lobes, cerebellum, parietal lobe, occipital lobe) or the spinal cord.



It is **smartphone free**: You do not need Bluetooth to run the selected program. NeoRhythm does not require the use of a smartphone during the treatment protocol. All you have to do is to choose a desirable program and tap NeoRhythm. Afterward, you do not need your smartphone until you want to change the program. There will be no risk of harmful frequencies building up in your room.

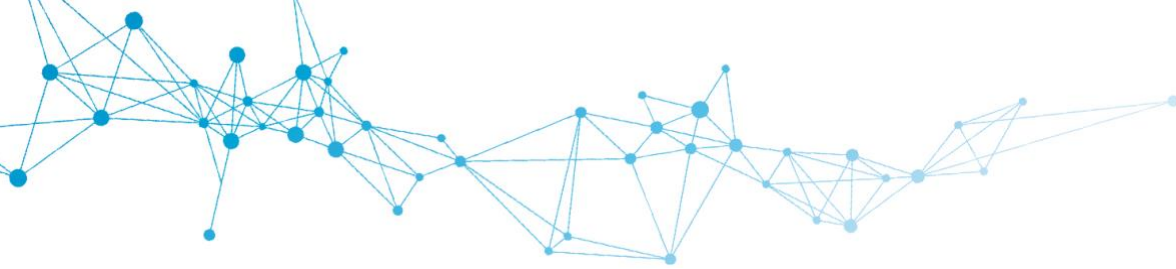


It is **gesture-controlled**: NeoRhythm offers a truly unique user experience because it has no pads, wires or any control buttons. There are no buttons that you could accidentally press. There are no wires that would tangle themselves into a knot when moving around your space. NeoRhythm's innovative solution is gesture-based interaction – tap the device to give instructions. Tap it once to select the last program mode used or tap twice to choose another program on your smartphone app.



NeoRhythm uses the **traffic light protocol** to let you know what is the device doing. You can turn the light off in the settings menu on the app in case it bothers you while you are using the device. Whether when you are sleeping, meditating, or attentively working on your new project. It is quite simple. Flashing green light means that stimulation is in progress. Blinking orange light indicates that the device is connected to your mobile device, whereas a blinking red light means that the battery is low. A steady, continuous orange light means NeoRhythm is being charged.

It is **non-invasive**: In addition to that, the electromagnetic pulses cannot be sensed. You cannot see, hear, feel, or taste the electromagnetic pulses. They affect you, but they do not bother you. NeoRhythm surpasses therapeutic drug treatments, often being accompanied by undesirable side effects.



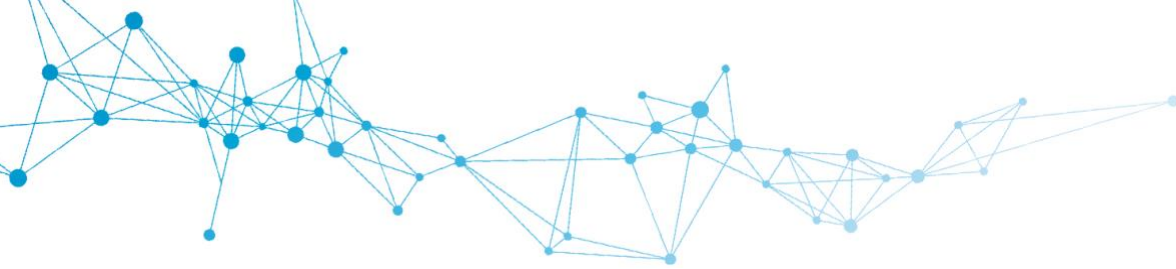
## 4. NeoRhythm Technical Overview

### 4.1 Hardware - NeoRhythm Headband

Operating system	Android 5.0 and above iOS 7 and above
Waveform	Trapezoidal
Frequency Range	3 – 303.41 Hz
Intensity Range	.25 mT - 2.5 mT
Number of Programs	7
Program Duration	20 min - 8 hours; either a continuous or a time-determined stimulation
Power	Internal rechargeable battery
Weight	105 g
Dimensions	6.3 in (160 mm) x 6.7 in (170 mm) x 1.1 in (28 mm)
Certificates	NeoRhythm is certified as a household device.  It follows CE directives: - Safety: EN 60335-1 - EMC standard: EN 60335-1 and EN 55014-1/2 - FCC standard: part 15 and part 18  Certified Tech by Arrow Electronics.



Figure 11. NeoRhythm's dimensions.



## 4.2 Software

NeoRhythm's application is an integral but still an independent component of the NeoRhythm Band. NeoRhythm connects to your smartphone via Bluetooth. When your smartphone is connected to the NeoRhythm headband, you choose the desired program and then tap NeoRhythm. Once that is done, you can put your smartphone away. You will use the app again only to change the program.

We care about your wellbeing; that is why we made the use of a smartphone minimal, consequently protecting you from the frequencies it emits that are harmful to your health. NeoRhythm does not require the use of your smartphone during the treatment protocol. No unwanted frequencies in the room to interfere with you.

In case you need help, we offer extensive support. You can reach out to us via our website link or NeoRhythm application.

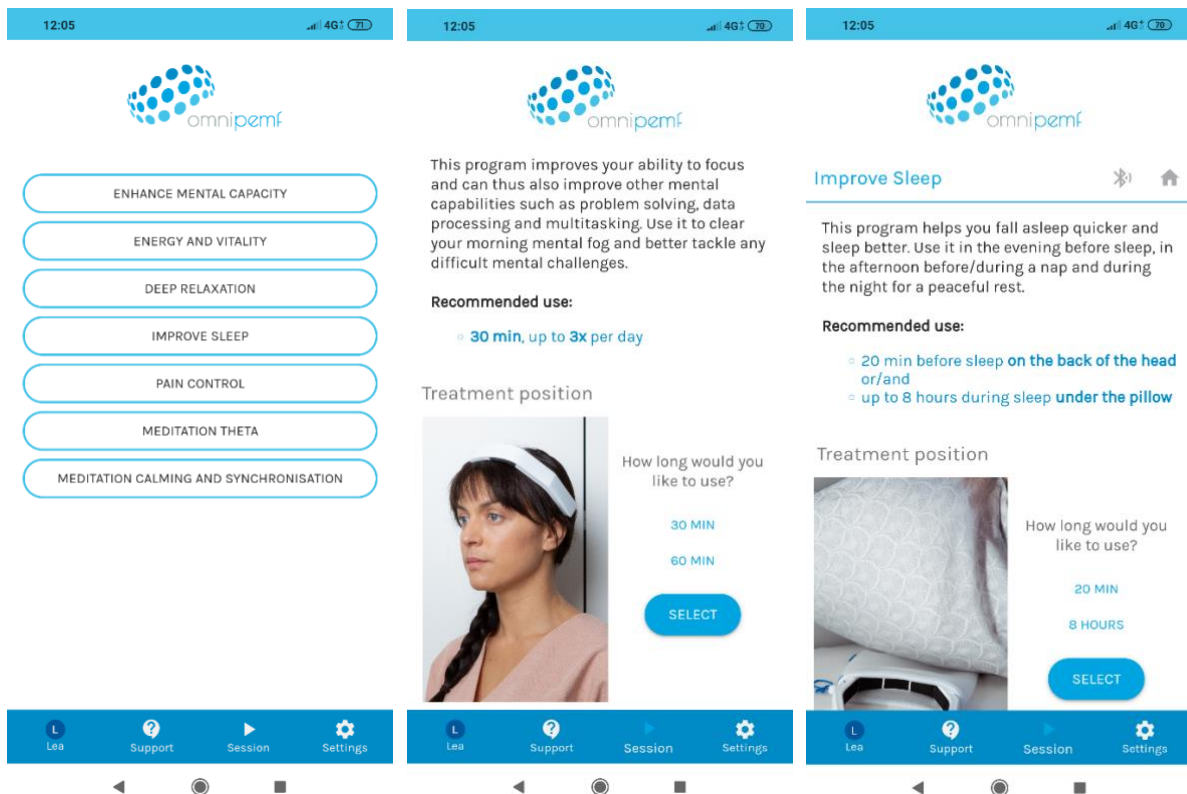
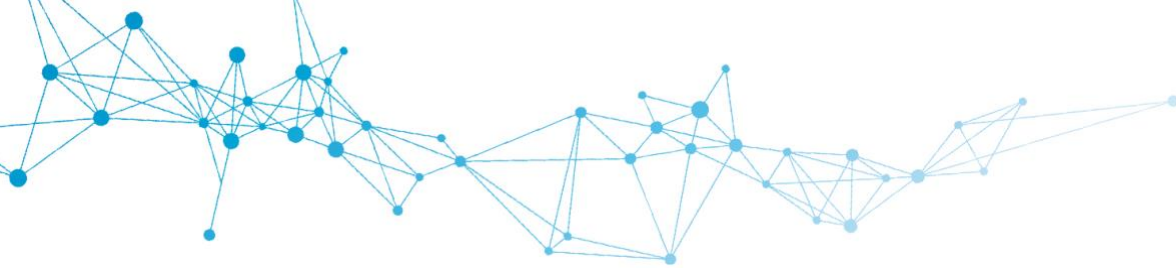


Figure 12. NeoRhythm Application.



## 5. NeoRhythm's Research & Development Process

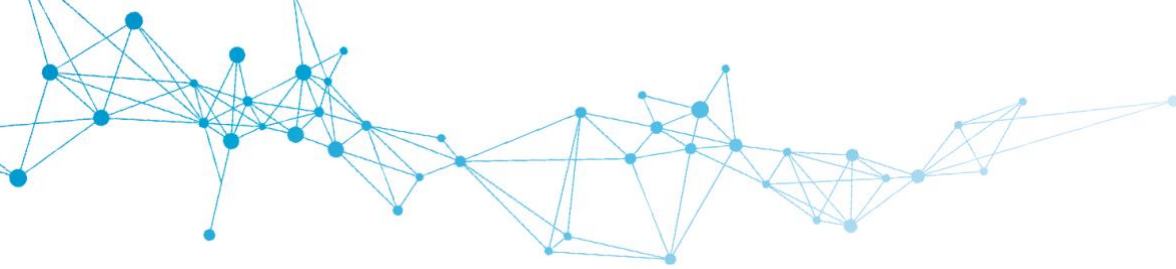
### 5.1 NeoRhythm R&D Overview

The initial idea was born in October 2016. The product design commenced in March 2017. After various attempts to efficiently combine functionality and design, we finalized the first prototype in May 2018. That was followed by intensive hardware and software testing. In May 2019, we tested two of our programs, the *Enhance Mental Capacity* and *Deep Relaxation* programs, by conducting two double-blind, placebo-controlled studies. The results were promising. During the period from July 2019 to September 2019, we received the CE and FCC certification. As we are starting sales, we intend to invite our future users to participate in a comprehensive study of the impact of all NeoRhythm's 7 programs on their psychophysical well-being. We will use an online questionnaire based on the VAS method to investigate before, during and after assessments of our users. Launching this consumer product, we would strive towards receiving and applying consumer feedback in making significant improvements and optimizing NeoRhythm.



*Figure 13. Development of the NeoRhythm device.*





## 5.2 NeoRhythm’s Validation Through Scientific study based on a clinical testing design

### 5.2.1 Scientific research of NeoRhythm’s “Enhance Mental Capacity” program

In May 2019 we tested NeoRhythm’s *Enhance Mental Capacity* program’s influence on volunteers’ cognitive processes (N=25). We measured how various electrophysiological parameters affect brain activity (EEG) when stimulated by our four standard frequency spectra (beta waves from 14 to 30 Hz, alpha waves from 8 to 14 Hz, theta waves from 4 to 8 Hz and delta waves from 0 to 4 Hz). The parameters monitored were skin conductance, heart rate, respiration rate, finger temperature, heart rate variability, and thorax expansion depth. The positive electrode for the EEG was placed on an F3 position according to the international 10/20 EEG system while the negative and ground electrodes were placed on the right and the left earlobe, respectively.

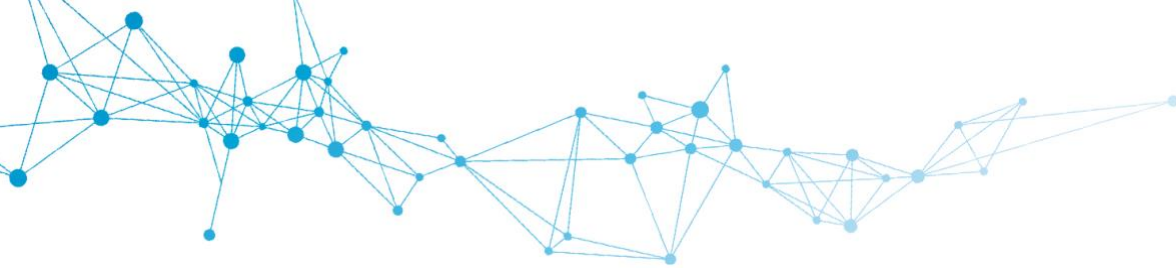
The scientific study based on a clinical trial design (double-blind, placebo-controlled) tested two different situations. In the first situation, from now on labeled as the experimental situation, NeoRhythm was turned on, while in the second situation, from now on labeled as the control situation, NeoRhythm was turned off. The primary stimulative frequency with a magnetic field intensity of 2.5 mT was 33.71 Hz. The supportive stimulation frequency with a magnetic field intensity of .25mT was 54 Hz. Influenced by the entrainment theory, the expected results of this study were a higher proportion of beta wave emission accompanied by a calming effect on the autonomous nervous system. The sleep state should not be induced because of supporting higher brain frequencies. During the 30 minutes of testing, volunteers did the Clock test of sustained attention. For the sake of analysis and interpretation of the results, the 30 minutes study session was split into three parts, each lasting 10 minutes. The first part of the testing refers to the first 10 minutes; the second part refers to the second 10 minutes, and the third part to the last 10 minutes.

For more details, please read the published paper “Enhancing Vigilance by Low Intensity Transcranial Pulsed Magnetic Stimulation Applying the Entrainment Model” [here](#).



*Figure 14. A volunteer with the NeoRhythm device placed in a specific position, and electrodes attached to her body for measurements of physiological parameters. During 30 minutes of analysis, volunteers were doing the Clock test to examine their sustained attention.*





After overviewing the results, we discovered that there were statistically significant differences between the experimental and control situations. The differences we noted were visible in the measurements of the following parameters: skin conductance, heart rate, finger temperature, alpha wave proportion, and thorax expansion depth. Lower skin conductance indicates greater relaxation of volunteers. It is interesting to compare the effects on skin conductance when using *Enhance Mental Capacity* and *Deep Relaxation* NeoRhythm programs. The lowest values this parameter has during the *Enhance Mental Capacity* program are still higher than the highest values it has during the *Deep Relaxation* program. In conclusion, there is a significant difference between these two pieces of research regarding relaxation.

Getting different values during the measurements was expected because the volunteers were performing a Clock test during the measurements for the *Enhance Mental Capacity* program meaning they were active. However, during the measurements for the “Deep Relaxation” program, the volunteers were least active since only sitting in a relaxed state. The participant's heart rate in the experimental situation was lower than the control's one during the third part of the measurements. Lower heart rate indicates greater calmness and relaxation and agrees with both the skin conductance and the thorax expansion difference. Thorax expansion differences demonstrated significant differences only in the first part of the measurements where the parameter values obtained during the control situation were higher than the ones during the experimental situation.

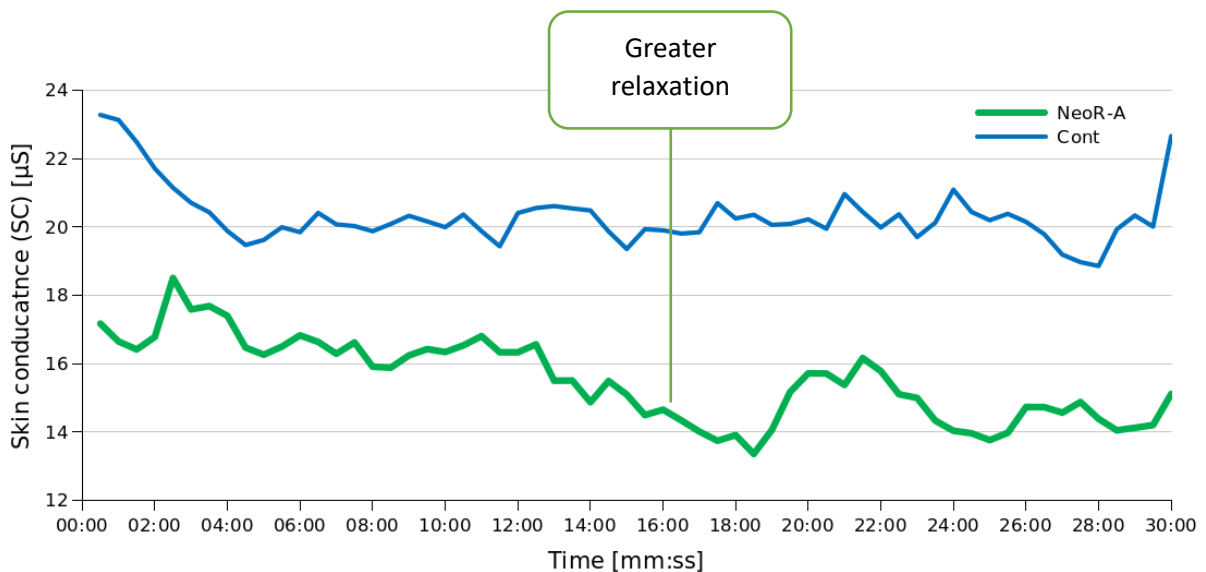


Figure 15. Skin conductance (SC) medians of the twenty-five volunteers obtained during the experimental (green) and control situation (blue).

Finger temperature was significantly higher for the experimental situation when compared to the control one. The higher peripheral temperature can indicate both higher overall activity of volunteers and a higher relaxation rate. Intense excitement triggers adrenaline rush when the skin becomes white (less peripheral blood, lower peripheral temperature).

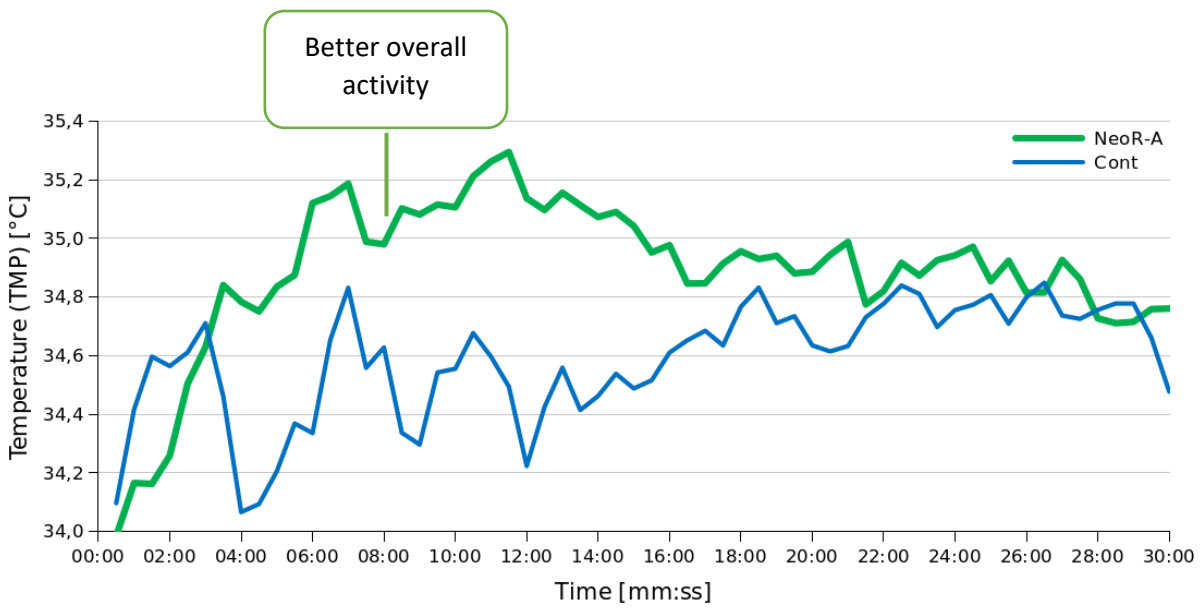
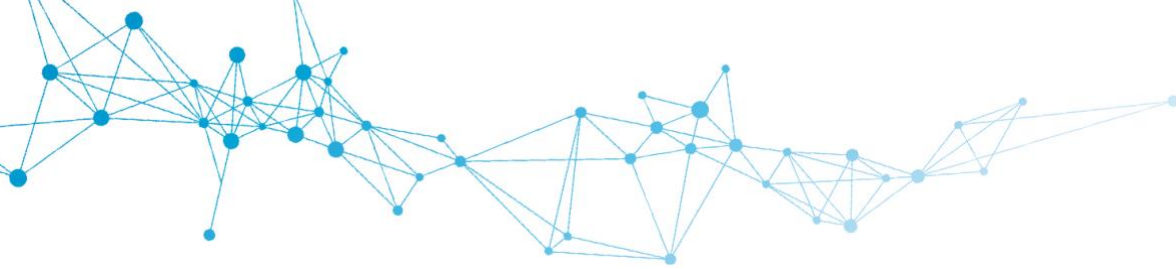


Figure 16. Finger temperature medians of the twenty-five volunteers obtained during the experimental (green) and control (blue) situation.

The proportion of alpha waves was statistically significantly higher only in the last part of the measurements when participants were in the experimental situation when compared to the control one (Figure 17). Higher alpha waves indicate slightly increased relaxation. Even if there is only a slight difference in the alpha waves between the two situations, there is a noticeable difference in the linear trends. It is slightly positive for the experimental situation and negative for the control situation. It can be concluded that people were more relaxed when placed in the experimental situation.

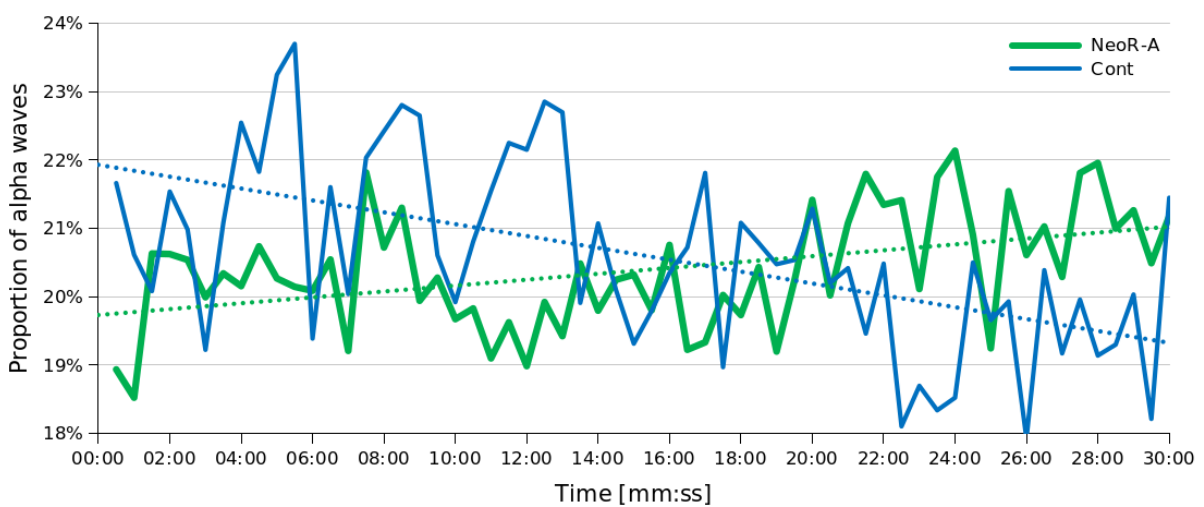
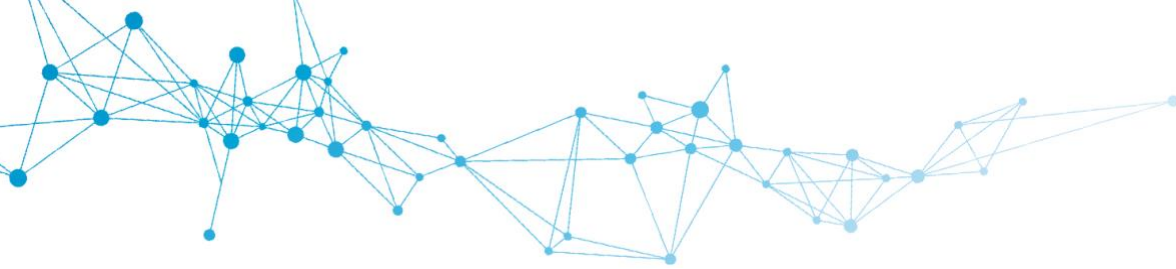


Figure 17. The proportion of alpha waves medians of the twenty-five volunteers for the experimental (green) and the control situation (blue).



Surprisingly, there were not many differences in the results concerning brain activity of participants in different situations. We assume that volunteers were already fully engaged in the Clock test and their brain activity reached the functional plateau. Trends in alpha waves showed a gradual relaxation in brain activity and a decreased tendency to sleep (less tiredness), which is suitable for the extended activity. However, a very slight trend in beta waves (experimental situation) goes in the direction of entrainment (increasing trend vs. the decreasing one in control).

The measurements of various physiological parameters revealed that the NeoRhythm device, in general, increased relaxation, and calmness (lower skin conductance, heart rate, thorax expansion difference, and a higher proportion of alpha waves). Higher peripheral temperature values obtained from the experimental situation indicated a higher overall activity of the volunteers but also a higher relaxation rate as well. The entrainment with beta waves was not observable, presumably because the Clock test situation already brought beta waves to their maximum, and there was no room left for higher intensities to appear due to the entrainment. However, increased calmness as shown in the alpha waves trend, speaks that the whole task was performed with less stress and with less nervous energy. It is common knowledge that being in a more relaxed state results in a better performance (decrease of the error rate as it was observed in the Clock test, Figure 18).

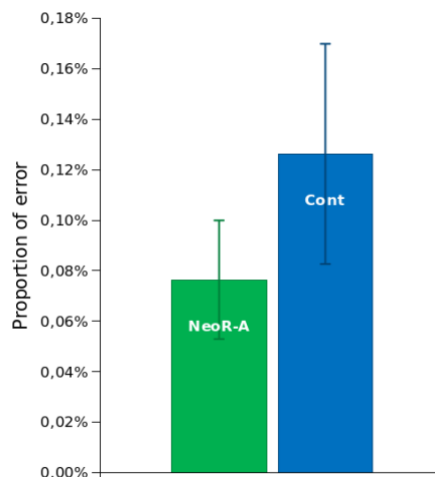
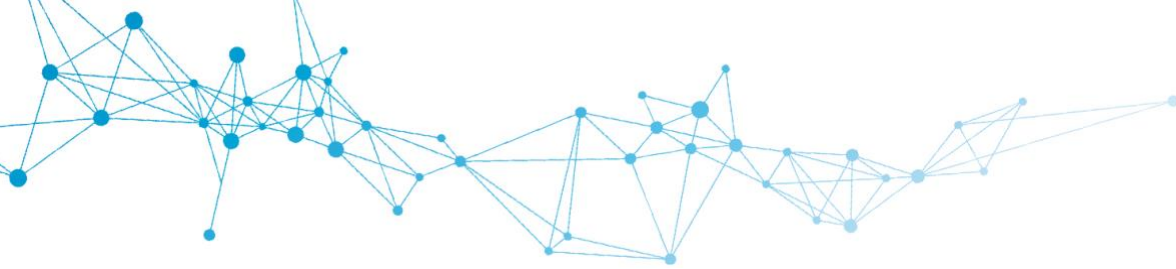


Figure 18. The proportion of error responses of total dot shifts  $\pm$  SE in the Clock test calculated from the averages of 25 volunteers obtained during the experimental (green) and the control situation (blue).

The tests demonstrated a trend of decreasing errors while using the NeoRhythm device. The unique stimulation frequencies provided by NeoRhythm helped volunteers stay more focused during the study, which resulted in their better performance in the problem solving task.

### 5.2.2 Scientific study of the NeoRhythm for “Deep Relaxation” Program

In May 2019, we tested NeoRhythm’s *Deep Relaxation* program’s influence on twenty-five volunteers. You can access the scientific paper *Influencing Relaxation by a Low-Intensity Transcranial Pulsed Magnetic Stimulation Applying the Entrainment Model* [here](#). In this post, we will present a shortened version of the results.



The scientific study based on a clinical trial design (double-blind, placebo-controlled) tested two different situations. In the first situation, from now on labeled as the experimental situation, NeoRhythm was turned on, while in the second situation, from now on labeled as the control situation, NeoRhythm was turned off. The primary stimulative frequency with a magnetic field intensity of 2.5 mT was 10.12 Hz. The supportive stimulation frequency with a magnetic field intensity of .25mT was 3.375 Hz.

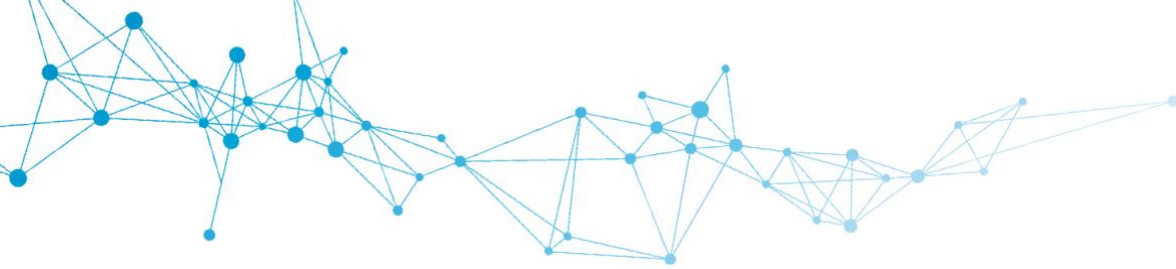
After having all the electrodes needed for the measurements of the physiological parameters attached, the research assistant started the measurements, which lasted for 30 minutes. For the sake of analysis and interpretation of the results, the 30 minutes study session was split into three parts, each lasting 10 minutes. The first part of the testing refers to the first 10 minutes; the second part refers to the second 10 minutes, and the third part to the last 10 minutes.

During this time, the volunteers were seated on a comfortable wooden chair and were instructed to sit calmly until the test assistant return. The measured parameters were the following : brain activity (EEG) in four standard frequency spectra (beta waves from 14 to 30 Hz, alpha waves from 8 to 14 Hz, theta waves from 4 to 8 Hz and delta waves from 0 to 4 Hz), skin conductance, heart rate, respiration rate, finger temperature, heart rate variability and thorax expansion depth. The positive electrode for the EEG was placed on an F3 position according to the international 10/20 EEG system, while the negative and ground electrodes were placed on the right and the left earlobe, respectively.

Influenced by the entrainment theory, the expected results of this study were a higher alpha wave proportion (relaxed state) and a positive parasympathetic tonic (calming) effect on the autonomous nervous system. Sleep state should not be induced because of the harmonious relationship between the main frequency and its supportive companion (3.375 Hz). It was expected that the latter would support the former in its effects.



*Figure 19. A volunteer with the NeoRhythm device placed in a specific position, and electrodes attached to her body for measurements of physiological parameters.*



The expectation that the autonomous nervous system will be stimulated in the parasympathetic direction was confirmed. The measurements of various physiological parameters revealed that the NeoRhythm device, in general, increased relaxation and calmness (lower skin conductance, heart rate, thorax expansion difference, and a higher proportion of alpha waves). The expected entrainment in alpha waves was confirmed in the second part of the stimulation (the second 10 minutes). The hypothesis that the passage to sleep will not be stimulated was also confirmed (higher beta waves).

Skin conductance was lower when participants were in the experimental situation, and continuously higher during all the 30 minutes of measurement when they were in the control environment. Lower skin conductance indicates greater relaxation.

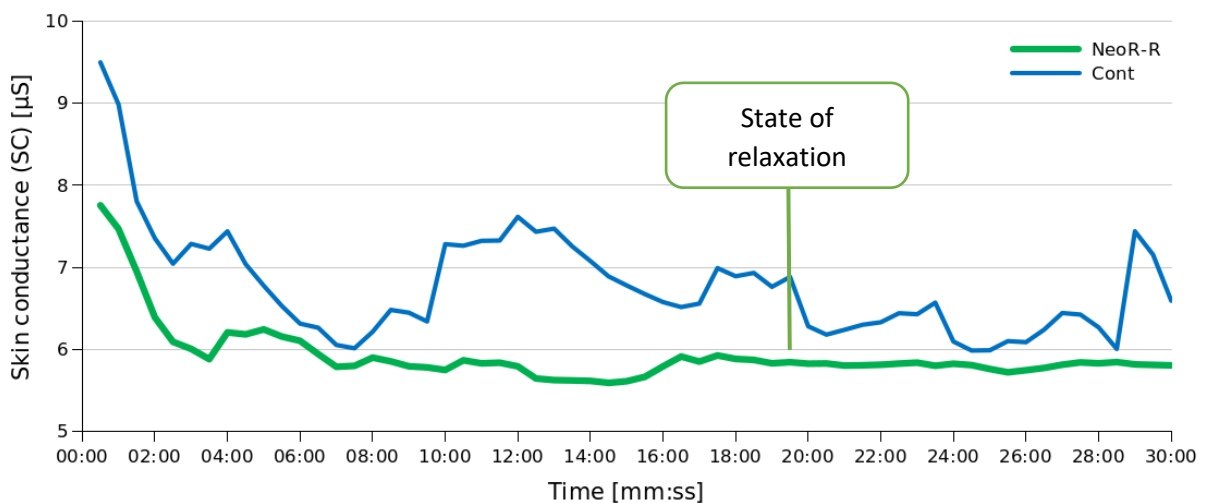


Figure 20. Skin conductance (SC) calculated with medians of the twenty-five volunteers obtained during the experimental situation (green) and the control situation (blue).

Heart rate values were lower for the experimental situation compared to the control during most of the measurements (Figure 21). The most significant difference between the control and experimental situation was visible at the beginning of the measurements, and gradually dwindled towards their end. Lower heart rate indicates calmness and relaxation, which is in accordance with both the skin conductance and the thorax expansion difference.

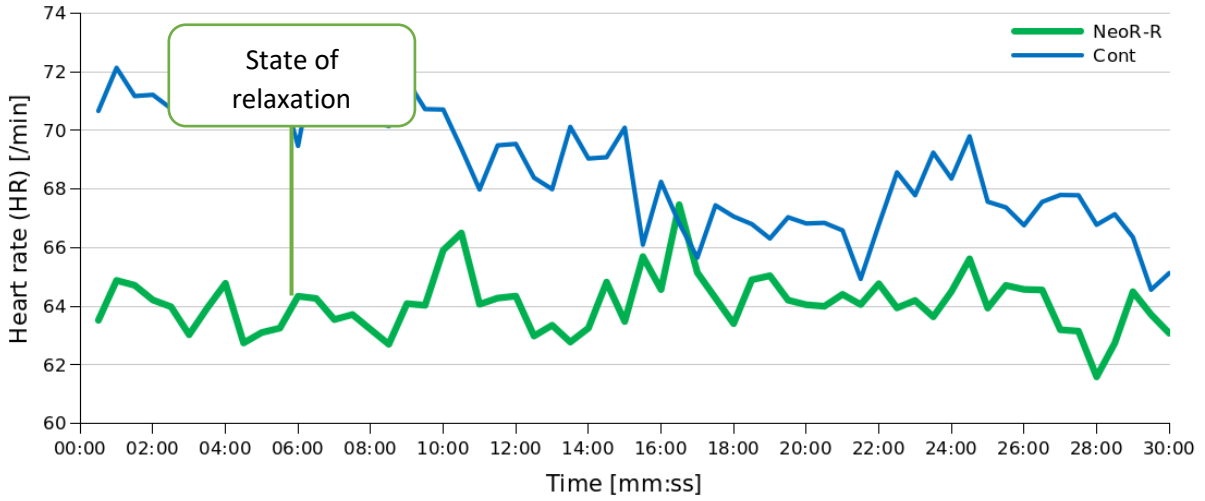
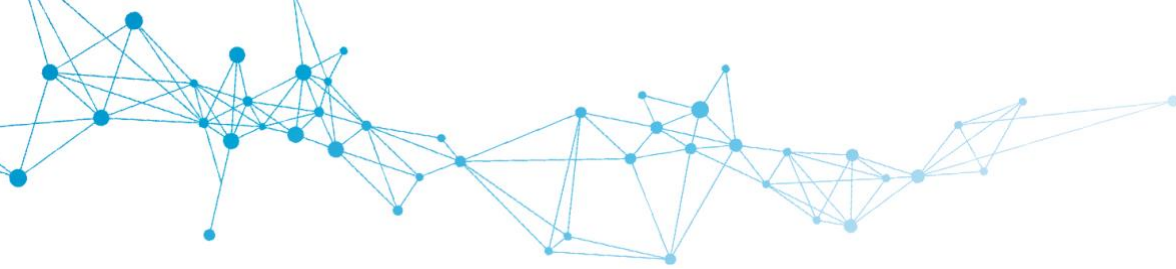


Figure 21. Heart rate calculated with medians of the twenty-five volunteers for the experimental situation (green) and the control situation (blue).

The proportion of alpha waves demonstrated statistically significant differences in the control situation only in the second part of the measurements (Figure 22) but showed the same basic trend in all three parts. The findings here differ from the skin conductance, thorax expansion difference and heart rate findings mentioned above because there the differences were more long-lived. Higher alpha waves obtained during the experimental situation indicate slightly increased relaxation.

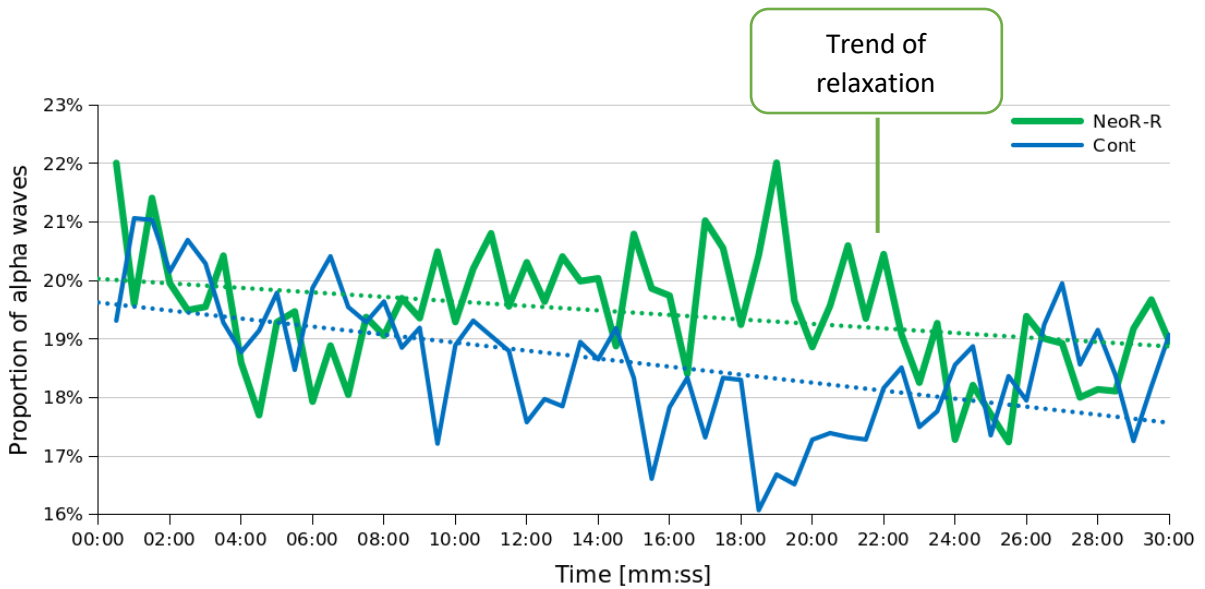
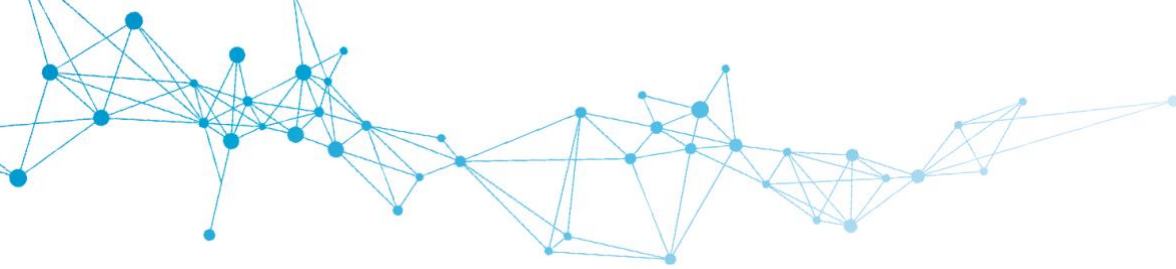


Figure 22: The proportion of alpha waves calculated with medians of the twenty-five volunteers obtained during the experimental (green) and the control situation (blue).





## 6. Conclusion

NeoRhythm is an advanced solution to modern day issues such as sleeplessness, lack of focus, tension, pain management and control, low energy and vitality, etc. It is the product of years of scientific research and technological breakthroughs achieved through the collaborative work of engineers and scientists.

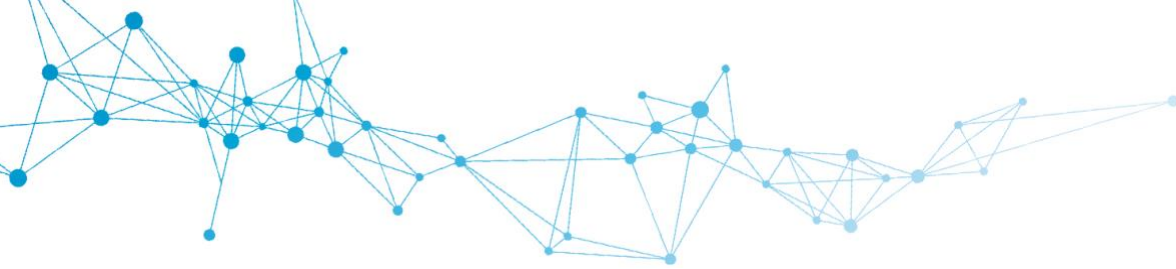
NeoRhythm is our little giant that can:

- Influence human's physiology in six areas:
  - o Mental capacity
  - o Sleep
  - o Relaxation and de-stressing
  - o Meditation
  - o Energy & Vitality
  - o Pain
- Gather user data to :
  - o optimize and increase the effectiveness of NeoRhythm device
  - o assist in the future development of the best possible user experience
- Be worn comfortably, regularly
- Be used remotely by a large number of people with personalized settings

Gathering our users' feedback on all 7 NeoRhythm's programs, we intend to collect substantial data, that will help us in the further development of NeoRhythm. We are interested in "the before" and "after" subjective experience of our users. We desire to contribute to their psychophysical well-being. We plan to use an online questionnaire based on the VAS method to investigate the long-term effects of NeoRhythm.

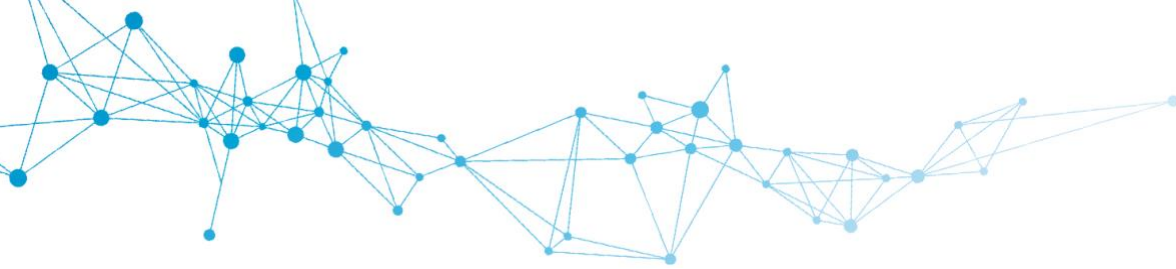
This is just the beginning. With the launch of NeoImpulse, NeoRhythm's successor, we plan to enter the medical field of human experience. We want to help medical professionals treat depression, anxiety, and migraines. 300 million people across the world suffer from depression. Almost 1 in 5 people are affected by an anxiety disorder in the USA. About 12% of people suffer from migraines. Therapists, physicians and other medical professionals across the world are doing an excellent job of treating these conditions. However, our goal is to help improve their treatments further by making them even more effective and more comfortable for patients.

We could say that with NeoRhythm, fiction became a reality. Innovative technology, combined with years of research, provides a solution available to the masses. Building upon our achievements, we are more dedicated than ever to pursue this mission further.



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