This user orientation & guide describes the principles and operation of the second of GRC’s cranial nerve stimulation systems to receive wide deployment and investigational use. After 26 months of research, 4 months ago, the pieces at last came together: We found and verified the mechanism-of-action that had been underlying our first device’s sporadic & unpredictable success. Armed with an accurate model, an entirely new and far more effective brain stimulation paradigm was developed, refined and incorporated into the “BrainPower” Cranial Nerve Stimulator (CNS) you now hold.

This device’s primary target is a group of “adrenergic” neurons clustered in a region of our brainstem known as the Locus Coeruleus (LC). These neurons produce and widely distribute most of the norepinephrine found in our brain.

The device’s secondary target is a group of “serotonergic” neurons clustered in another brainstem region known as the Raphe Nucleus (RN). These neurons produce and widely distribute most of our brain’s serotonin.

**Periodic use of this electrical nerve stimulator increases the activity of these brain regions, resulting in elevated baseline levels of norepinephrine and serotonin.**
The previous page’s diagram depicts the termination of the vagus and trigeminal nerves at the brainstem. Either of these ascending nerves could be exogenously stimulated to excite their targeted regions of the brainstem.

This stimulator’s widely used predecessor employed the traditional “CES” (Cranial Electrotherapy Stimulation) paradigm of attaching ear clips to the subject’s earlobes and passing a low, controlled current from lobe to lobe. Though all of the CES literature states that CES’s mechanism of action is unknown, when we saw the striking similarity between classic Vagus nerve stimulation and CES, we realized that CES is actually mistargeted (or weakly targeted) stimulation of the Vagus nerve. The diagram to the right shows the innervation of the human ear by the auricular branch of the Vagus nerve. The diagram is a bit unclear because what appear to be Vagus nerves terminating in the earlobe actually lie behind the earlobe on the surface of the neck. The earlobe itself has no Vagus nerve endings. However, when electrical current is passed between the subject’s earlobes on either side of their head, some of the current must, necessarily, cross through the immediate vicinity of the Vagus nerves shown in the diagram to provide comparatively weak and indirect stimulation of the Vagus nerve.

Once we understood what was actually going on, referring again to the diagram on the previous page, we chose to target the readily accessible Ophthalmic V\textsubscript{1} (forehead) branch of the Trigeminal cranial nerve shown green here...
Norepinephrine and Serotonin

The primary effect of periodic (and even occasional) use of this cranial nerve stimulation is an increase in basal cerebral norepinephrine levels. The secondary effect is to similarly increase basal cerebral serotonin levels. The locus coeruleus, and its electrical stimulation, have been extensively studied in rodents, primates and humans. Both in continuous and intermittent daily stimulation, norepinephrine levels are observed to begin rising immediately, with the similar rise in serotonin levels delayed by 14 days. Although new users of this technology may expect to observe effects of increased norepinephrine levels almost immediately, three to four weeks of daily stimulation should be allowed before expecting to observe effects of enhanced serotonin. Stimulation studies have shown that daily stimulation drives a gradual increase in levels of both neurotransmitters through the first 90 days, after which the system approaches equilibrium at these newly elevated levels.

As a hormone (rather than a neuromodulator) norepinephrine triggers our human stress response. When norepinephrine is released into our general circulation by our adrenal glands, it immediately activates the “sympathetic” (stress) side of our autonomic nervous system, placing us into “fight or flight” state. This well known hormonal property of norepinephrine causes confusion because its action in our brain as a neuromodulator is entirely different: Although cerebral norepinephrine has an overall excitatory effect upon the brain’s neurons, it is an “equal opportunity exciter.” It excites both the neurons whose specific role is excitatory (such as our glutamatergic neurons) as well as those whose specific function is inhibitory (such as our GABAergic neurons). So, in our brain (where the stimulation is happening) norepinephrine does not create stress, per se. What it does is induce a higher state of alertness, wakefulness, elevated motivation, mood and learning/ memory.

Counterintuitive though it is, classic depression is a downstream consequence of prolonged stress. Therefore, depression is often successfully treated by employing various stress-relieving strategies. A final piece of evidence for cerebral norepinephrine’s non-stress-inducing effect is that the most successful pharmaceutical anti-depressants are known as SNRI’s, an abbreviation for Serotonin Norepinephrine Reuptake Inhibitors. Reuptake inhibitors act by thwarting the neuron’s active recovery of recently released neurotransmitter molecules. In other words, SNRI’s are drugs to keep more serotonin and norepinephrine exposed in the extracellular synaptic cleft so that they can exert more effect. In short, cerebral norepinephrine does not increase or induce stress; stress is reduced.

30 to 60 minutes of stimulation per day is all you need... and probably less, later. A weight lifter builds muscle by demanding more strength from a muscle than is normally needed. The muscle adapts to this greater transient demand by growing to better meet the next challenge. But during all of the non-workout days in between, the weight lifter walks around sporting larger muscles... even though their larger size and capacity is not needed at the time. Many of our body’s systems rapidly respond to short term transient demands by making long term adaptive changes.

This is exactly what has been observed with acute (short duration) stimulation of the locus coeruleus. Just 30 to 60 minutes per day of “stimulated neural excitation” results in a long-lasting increase in locus coeruleus neural firing, which raises our brain’s non-stimulated norepinephrine levels for many weeks. Eventually, the effects can be expected to wear off, but probably not for a month or two once they have been established.
Why does “zapping” our forehead raise norepinephrine (and eventually, serotonin) levels?
Norepinephrine is known to increase our states of wakefulness, alertness, attention & motivation. It is also intimately connected to learning and the formation of lasting memories. Norepinephrine shows a diurnal cycle, ebbing at night while we sleep and rising to awaken us in the morning. We have all heard that if we wish to age slowly and remain young at heart we should learn a new language, expose ourselves to novel situations, meet and get to know new people, and perhaps travel. These place demands upon our brain which, as with demanding strength from a muscle, our brain responds to by increasing its alertness, storage of memories, motivation and drive. In short, internal cognitive events, such as struggling with a difficult problem, working to learn a new task or language, solving a puzzle, or even being surprised, triggers the release of norepinephrine.

And external events do too:
Our attention can be required to keep us and those we care about safe. Our senses allow us to detect and to avoid danger. But acting upon those sensations requires that we be awake and alert. When we are surprised or startled, we reflexively jump and norepinephrine floods our brain. It brings us to full readiness to meet whatever challenge the external world may be posing. To accomplish this, many of our body’s sensory nerves feed into the locus coeruleus, and their stimulation directly evokes norepinephrine to increase our wakefulness and alertness. While sitting still and reading we might doze off. But it is difficult to fall asleep while we’re dancing. If we dance all night, even though we may become physically exhausted, we’ll still be wide awake. Think about that. The sensory input from dancing, flooding into our brain, keeps our locus coeruleus humming along generating and emitting norepinephrine, which keeps us alert, awake, and on our feet.

This cranial nerve stimulator uses carefully designed electrical impulses to safely trigger the sensory nerves positioned beneath the skin of our forehead. Those “trigeminal” nerves connect directly to our locus coeruleus (LC), which gets the message that something big is going on. In response our locus coeruleus cranks out the norepinephrine to increase our alertness and our ability to handle whatever it is. After a few days of this stimulation, just as with muscles we use more often, our locus coeruleus’ continuous emission of norepinephrine increases – even when it is not being stimulated... and many people begin experiencing youth-related cognitive and health benefits.

Youth-related benefits?
Yes. Many aspects of youth appear to be connected to higher levels of norepinephrine. Our efficient and economical body employs a well known “use it or lose it” logic. Muscle consumes calories. So the size of muscles that are larger than needed is gradually reduced to economize on their calorie consumption. Similarly, our brain uses a disproportionate amount of energy for its mass... and the “lose it or use it” logic applies there too, even if it’s inconvenient for us. When we are young and the world is a place of thrilling discovery, novelty fills our days and norepinephrine is our constant companion. But as we pass through middle age, to varying degrees we are overtaken by a sense of “having seen it all before” and we are much less often surprised. How often have we heard the lament “nothing surprises me much anymore.”? Unfortunately, that’s all too often literally true. Novelty becomes the exception where it was once the rule, and unless one leads an extraordinary life, everyday there is less that is new to learn. Our brain adjusts to this reduced demand on its alertness, and on forming new memories, by gradually slowing down and economizing on its energy use. Reduced levels of norepinephrine lead the way.
The reason we can’t teach an old dog new tricks is because “old dogs” have not only lost the habit, but with low levels of norepinephrine, they have also lost the ability to learn anything new.

Why would someone desire higher norepinephrine levels?
Norepinephrine has a surprisingly wide range of little-known but well-researched and beneficial effects on human metabolism:

- Increases “short-term synaptic plasticity” – which is the neurological way of saying that it allows our brain to adapt, change, mend, learn & remember more easily and readily.
- Neuroprotective: Several degenerative brain disorders, including dementia, Alzheimer’s and Parkinson’s show acute loss of locus coeruleus function. This leads researchers to believe that norepinephrine may actively protect cerebral neurons from damage accumulation.
- Neurotrophic: Norepinephrine promotes neuronal survival. It promotes the initial growth and development of neurons in the central nervous system and peripheral nervous system and is capable of regrowing damaged neurons.
- Neural Antioxidant: Neurodegenerative diseases (e.g., Alzheimer's, Parkinson's and ALS) are characterized by the deposition of misfolded proteins caused by oxidative stress which is accompanied by a diminished level of norepinephrine in neuronal tissue. There is increasing evidence that norepinephrine may act as a scavenger of free radicals and experimental data supports its potent antioxidant property.
- Reduces gastric acid secretion: Age-related increase in stomach acid may be reversed.
- Decreases nocturnal urine output: Age-related nighttime bathroom trips may be eliminated.
- Powerfully anti-inflammatory: Broad spectrum reduction in arthritic pain and joint damage.
- May lower elevated blood pressure: Reverses stress-driven hypertension.
- May improve migraine: Increases cerebral blood-flow to lessen migraine frequency and severity.
- Exhibits clear antidepressant action: A non-pharmaceutical alternative without side effects.
- Enhances memory formation, wakefulness, attention & motivation. May be useful for ADHD.
- Reduces pain perception: Norepinephrine strongly mitigates chronic pain perception.
- Stimulates metabolism & reduces weight by driving the proton uncoupling protein (UCP).
- Elevates mood through concomitant release of dopamine from norepinephrine neurons.
- Enhances brain nutrition by improving blood-brain barrier permeability.
- May treat glaucoma by reducing intraocular pressure.

The discovery of the norepinephrine-raising effect of this form of cranial nerve stimulation allows us to reap many of the benefits enumerated above through a safe, effective, fast-acting, economical, non-pharmaceutical therapy that is largely without side effects. A little appears to go a long way, with the effects appearing to persist for a month or more. We believe this stimulation has the effect of naturally restoring a higher level of basal norepinephrine associated with a highly active energetic and engaged state of mind and brain.
**Why don’t we already (normally) have enough norepinephrine?**

It is easy to see how very different we each are externally. But our individual differences are every bit as significant internally. No two people have identical blood chemistry tests, blood pressure, pulse rate, fitness level, etc. Everyone’s cerebral norepinephrine level differs as well. We doubt it’s possible for this stimulation to increase everyone’s norepinephrine because we assume that some people may already, naturally, be operating at the high-end of the physiological activity range. But we know that there will be people whose level is normally low, and that norepinephrine levels tend to decline as we age. So while some younger people may have plenty, others, especially those who are well into maturity, may be better off with more.

**Can we run out of norepinephrine?**

No. Our wide array of cerebral neurotransmitters exists in delicate balance, and our brain has an extremely efficient capture and recycling system known as “reuptake.” Neurons which emit these molecules quickly recover them for immediate recycling and reuse because it’s much more energy efficient than building new neurotransmitters from scratch. And even the components of those molecules that may escape remain available for rebuilding new neurotransmitters. So it’s important to understand that a more active locus coeruleus (which is a natural characteristic of a healthy and engaged brain), simply means that norepinephrine is being emitted and recycled at a higher rate, and that at any given instant more of it is “extracellular” as it awaits reuptake and recycling.

**Are there any negative side effects of an increased norepinephrine level?**

Maybe, on expected sleep duration: We are all so different that the specific effects of this stimulation will likely vary from person to person. The most immediate effect of increased norepinephrine may be a significantly reduced need (and drive) for sleep. Highly anecdotal experience suggests that while total sleep duration may be reduced, the sleep depth may be significantly increased. This may result in the elimination of nocturnal sleep interruptions and waking with less “dream recall” than previously. In our preliminary experimentation, the use of this stimulation completely banished all fatigue (and hunger) from the day. Even though obtaining as many as six hours of sleep per night was challenging, it brightened mood and increased energy. When starting out with this therapy, try not to worry if you are not sleeping as much as you did before. This will change some aspects of your brain that you have become accustomed to. Rather than using your sleep duration, use fatigue (or total lack of all) as your guide. We believe that if your body and mind requires more rest, and you make it available, as much will be taken as needed.

Also remember that the increase in norepinephrine precedes an increase in serotonin by two weeks... and that serotonin is a proven sleep promoter. So even if your first few weeks with this are a bit rough and unnerving, by the time you get into week three, serotonin will have begun to join the party and may help to lengthen the duration of your sleep.

**What if you decide to stop?**

If all CNS stimulation is stopped, norepinephrine and serotonin will very gradually, over the course of at least a month, return to their original lower baseline levels. This therapy has good endurance, but ultimately a finite shelf life. The return to your baseline will be so gradual that any “going cold turkey” shock will be prevented. After a month or so, you will simply notice that you are back to the way you were before, for better or worse.
Interfacing electrical stimulation to our skin
The diagram of the skull and nerves shows the Trigeminal nerve’s Ophthalmic branch emerging from the interior of our skull through the upper edge of our eye sockets. It then proceeds up our forehead to innervate and provide all sensory feeling for our forehead and upper scalp. Thanks to its wide surface perfusion and large surface area, this nerve branch provides a very high bandwidth direct connection to our brainstem’s locus coeruleus and raphe nuclei to allow for their excitation. We are able to piggyback upon the popular TENS pain relief industry for access to an economical, mature and wide selection of self-adhesive, reusable, electrotherapy stimulation “electrodes.”

Please note that GRC’s CNS devices have been carefully designed and extensively tested for this application of cranial nerve stimulation. **UNDER NO CIRCUMSTANCES** should you ever use a traditional muscle stimulator or TENS-style pain/nerve blocking stimulator **ON YOUR HEAD**. Despite having compatible connectors, GRC’s devices are **NOT** functionally interchangeable with any other stimulation paradigm. Other stimulators produce far too much power for this application and their stimulation waveforms are “unbalanced” and incorrect for evoking the response we want. (If you are still unclear on this point, please refer to the “Darwin Awards – Chlorinating the Gene Pool” on the Internet.)

Over the course of four months we have tested many makes & models of reusable self-adhesive electrotherapy electrodes. We have tentatively settled upon our favorite four electrodes made by Axelgaard Manufacturing under the “ValuTrode” brand name:

<table>
<thead>
<tr>
<th>Model</th>
<th>Size</th>
<th>Price Each</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF3200</td>
<td>1.25” round</td>
<td>$0.69</td>
</tr>
<tr>
<td>VTX5000</td>
<td>2” round</td>
<td>$0.54</td>
</tr>
<tr>
<td>VTX5050</td>
<td>2”x2” square</td>
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</tr>
<tr>
<td>CF4065</td>
<td>1.5”x2.5” oval</td>
<td>$0.75</td>
</tr>
</tbody>
</table>

Amazon carries the Axelgaard brand, and these electrodes are widely distributed and available. The prices shown above (without shipping cost) are from State Surgical Supply of Arkansas, the lowest prices we have found. These per-electrode prices are for a “case” of 40 electrodes, sold in 10 individual packs of 4 electrodes each. As you can see, oddly, the largest electrodes (VTX 5000 & VTX 5050) are the least expensive, presumably due to their greater popularity and higher production volume. They are what we recommend. The larger electrodes cover more skin area and can therefore “recruit” a greater number of individual nerve fibers for a stronger stimulation effect. Axelgaard produces many lines of electrodes, some with “foam” backing at the same cost. Foam is used because it repels liquids that may be present (ice packs, etc.) in some therapies, but it tends to have less elastic “give” than cloth, so we prefer cloth.

The electrically conductive (hypoallergenic) adhesive technology is known as “hydrogel.” As its name suggests, it is a water-based sticky adhesive gel. You will find that new electrodes are initially **far too sticky** (annoyingly so). Then, with repeated reuse, over a span of several days, their adhesion moves through a convenient level of stickiness, to eventually (after about a week) begin
having trouble keeping their edges stuck down. A wide elastic headband which completely covers the electrodes can help to extend the useful life of these electrodes by helping to keep their edges in contact with your skin. (Headbands also offer the cosmetic benefit of covering the electrodes and helping to organize the wires to help their user appear somewhat less “weird.”)

Preparing your skin for best results
Removing forehead oil and dead skin will **significantly** improve your experience by reducing your skin’s resistance to the stimulation, and by minimizing the electrode’s accumulation of oil, which will shorten their life. We prefer to use the convenient alcohol-moistened and mildly abrasive “TENS Wipes” shown, which are also available from Amazon. But you may also use any gentler cleansing and mild exfoliating solution. Please appreciate that your skin beneath the electrodes **must** be free from all oil, makeup, and any other interference.

A pair of VTX5050 electrodes will cost $1.08 and should last about one week before their hydrogel dries out and/ or their adhesive gives up. Since this is not zero cost, cleaning your forehead to remove makeup, dirt, oil, etc. will significantly extend the electrode’s life, minimizing overall cost.

Placing the electrodes:

Exact electrode placement is non-critical since our foreheads are widely innervated with sensory nerves. You should feel free to experiment to accommodate any individual requirements. While the square 2” x 2” cloth-backed electrodes are our #1 choice (maximum coverage and minimum cost), people with lower hairlines may find that they lack the “headroom” to comfortably accommodate their 2” height. In this case, the oval 1.5” x 2.5” electrodes, while more expensive, may be used. They may be placed horizontally above each eyebrow, as shown above, to provide a wide area of above-brow forehead stimulation. The smallest 1.25” round electrodes can be used below the temples, over the “dip” slightly above the eye line if the forehead area is, for whatever reason, unavailable. If less stimulation is desired, the smaller 1.25” electrodes should provide that.
Care and Handling of Stimulation Electrodes

The back face of all Axelgaard stimulation electrode packaging (our preferred manufacturer) contains guidelines for the electrode’s care and handling. We won’t repeat that information here, so please take a moment to read through those instructions. Extending the electrode’s useful life by preventing their dry-out by storing them in carefully re-sealed bags will also improve their comfort.

Handling the electrodes
All of these electrodes have a somewhat fragile connection wire which terminates in a socket which mates with the stimulator’s lead wires. Having used these extensively, we can affirm that the wire begs to be used as a handle for lifting the overly sticky electrodes from their plastic retaining sheet... or from your head. But the wire is NOT, and was never meant to be, used for lifting the electrodes. If you do that, you will simply pull the wire out of and destroy the electrode. That said, we’ve been working with these electrodes for the past four months and have found it to be practically impossible NOT to at least involve the wire in the lifting process. So a workable compromise is to pinch the wire against the electrode and pull them upward together to lift the ultra-sticky electrode. Never pull on the wire alone, and always treat the wire as gently as possible.
Operating the “BrainPower” Cranial Nerve Stimulator

On/Off: The Control Knob is briefly depressed (clicked) to turn the stimulator on or off. When the stimulator is switching on or off – at the beginning or end of a session – a characteristic “trill” will sound to confirm the action. While the stimulator is running, the red LED light flashes in time with the stimulation pulses, 48 times per minute, which is once every 1.25 seconds.

Intensity: The Control Knob sets the stimulation intensity like a familiar volume control: Rotating the knob clockwise (CW) increases the stimulation strength and rotating it counterclockwise (CCW) decreases the intensity. The CNS stimulator provides 100 intensity levels to accommodate a wide range of user sensitivity, electrode size and position. To help the user sense the new intensity, a brief stimulation burst is emitted at the newly set intensity. Intensity only changes when the user adjusts it, and every session automatically begins at minimum intensity.

The Automatic Session Timer: CNS sessions automatically end after 60 minutes. During the final 15 seconds of a session, a brief “chirp” will sound once per second to let the user know the session end is approaching. If an entire 60 minutes is not available, the session can be ended early by briefly depressing (clicking) the Control Knob to switch the stimulator off.

Additional Features

If the Control Knob is pressed and held until a series of single chirps is heard, a session is restarted at the last intensity set by the user, rather than at zero intensity. This can be used to either extend an ongoing session or resume a recently ended session.

1. If the once per second end-of-session notification chirps are heard, and the user wishes to continue stimulating rather than allow the session to end, the Control Knob may be depressed and held (until the series of single chirps is heard) to reset the session timer to 60 minutes without resetting the stimulation intensity to zero.
2. If the session has ended by itself, or it has been ended early by its user, a new session can be “resumed” by restarting the stimulator by depressing and holding the Control Knob until the series of single chirps sounds. This special startup option overrides the automatic intensity reset allowing the new 60-minute session to pickup where the previous session ended, with the same intensity that the user was most recently using.

3. The comfortable stimulation intensity chosen by the user is not only determined by the user’s individual sensitivity, but also by the specific type, size and exact placement of the electrodes. Since these factors are impossible to exactly duplicate from session to session, we recommend only “resuming” a stimulation session when the electrodes have not been moved or removed after the previous session.

**Extending the Session Timer**

We believe that 30 minutes is the shortest useful stimulation duration, and that a 60-minute session probably returns the most benefit in the shortest time. But for those who have more time and wish to kickstart their brain’s norepinephrine production - especially during the first several days of their use of this technology - this stimulation can be productively used continuously for many hours to accumulate additional benefit.

Although the “long press” described above could be used every hour to reset the session timer for another 60 minutes, it might be more convenient to simply request an extremely long (12 hour) session that you can then terminate whenever you wish without needed to continually “re-up.”

To set the session timer to 12 hours: While the stimulator is running, press the Control Knob and simultaneously/quickly twist it clockwise (turning it up). You will be greeted by a unique “galloping chirp” sound to confirm the extended session mode. To prevent the stimulator from running forever, this sets the session to end after 12 hours, though we expect most people will end their sessions sooner.

**Experimenting “Offline”**

The stimulator does not know, or care, whether its lead wire is plugged in, or your forehead is connected to it. This allows you to freely experiment with the various features described above “offline.” You may turn it on and off, notice the flashing red LED light, turn the intensity up and down, hold the Control Knob down to reset the timer, and try depressing and quickly twisting the Control Knob clockwise to place the device into 12-hour long-session mode. When you are finished, turn the stimulator off to conserve its battery.
A Typical Stimulation Session, Step-By-Step

1. Decide which electrodes you wish to use. This will determine where they are placed, and what area of your forehead should be cleaned. The larger electrodes allow for the “recruitment” of a larger number of underlying nerve fibers for the generation of more comprehensive therapy. But preliminary testing showed that the smallest 1.25” round electrodes, placed outside and slightly above the eye line below the temples is also effective. So the largest 2”x2” are probably best, with the oval 1.5”x2.5” useful for those with lower hairlines, and the 1.25” round for a non-forehead alternative.

2. Use one of the TENS Wipes, or any cleanser of your choice, to remove any dirt, skin oil or makeup from the skin area where the electrodes will be placed.

3. Read the rear panel of the electrode package for any electrode-specific instructions from their manufacturer, then open an electrode packet and carefully (gingerly) peel the first electrode away from its plastic backing. You will find that they start out being incredibly (annoyingly) sticky. DO NOT PULL UP only by the connection wire or it will pull out of the electrode.

4. Place the first electrode in its location on your forehead. The emerging wire should always be oriented so that the wire can flow back along the side of your head to rest above your ear.

5. Gently remove and place the second electrode in its location on your head, across from the first one (see the diagrams on the earlier page). It is natural for us to want them to be symmetrical, though that’s mostly aesthetic since precisely identical placement is not required. You will probably find that the stimulation sensation differs from one side to the other, no matter what.

6. Plug the white stimulator/ electrode lead wire pins into the electrode sockets. (The electrode instructions instruct to attach the lead wires first, but that seems much less convenient.)

7. You may wish to run the lead wires down inside your shirt if you’re going to clip the stimulator to your belt or put it in a pocket. You may also use a Velcro armband if you choose to have the stimulator ride high on your bicep.

8. You may also wish to wear a not-too-tight elastic headband over the electrodes and perhaps tuck the wires up under the headband. This has the dual benefit of surprising you less if you walk past a mirror, but more usefully, of holding the edges of the electrodes against your skin after several days of re-use as their adhesion begins to weaken.

9. Plug the other end of the white lead wires into the silver connection jack on the top of the stimulator. You may rotate the right-angle plug in any direction for convenience.

10. Turn on the stimulator by briefly depressing and releasing the Control Knob. You should hear a “trill” indicating that the device is up and running. The red LED light should also be flashing once every 1.25 seconds. But you will feel nothing yet, because the stimulator always starts at level 0 (unless deliberately overridden by holding the Control Knob down for several seconds.)
11. Increase the stimulation to a working level by twisting the Control Knob clockwise in the traditional “volume up” direction. You will probably need to twist it many times before you begin feeling anything. When the level is not being adjusted, the stimulation is periodic and synchronized to the flashing light. But when its intensity is being adjusted, a stimulation burst is immediately generated after any change in the stimulation intensity so the user can see how it now feels. (Optimal stimulation intensity is discussed on the next page.)

12. Sit back, relax, work, meditate, chill out, or do whatever you wish while the stimulator is running. You will find that the feeling may be pleasant and that if your attention is distracted by something else, you’ll easily stop noticing that it’s ongoing.

13. Fifteen seconds before the end of the session (typically after 60 minutes), the stimulator will begin making a single chirp once per second to notify you that the session is coming to an end. If you do nothing, after 15 chirps you will hear the “trill” and the stimulator will shut off. If you wish to continue stimulating, press and hold the Control Knob until you hear a series of single chirps which will reset the session timer for another 60 minutes. If the session ends before you’re able to reach the Control Knob (it’s buried in a pocket under a coat or something) you can still resume the session at the same stimulation level by pressing and holding the Control Knob through the startup “trill” and until the series of single chirps.

14. Once you have finished, simply reverse the hookup process:

- Unplug the lead wires from the stimulator.
- Remove the headband.
- Disconnect the lead wires from the electrodes.
- Gently peel the first electrode from your skin and return it to its plastic backing carrier.
- Peel the second electrode from your skin and place it alongside the first electrode.
- Place that pair of electrodes into the heavy gauge ziplock bag provided to prevent dryout.

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Congratulations! You have just successfully used naturalistic bursts of pseudo-sensory stimulation, through the ophthalmic or zygomaticotemporal branch of your trigeminal cranial nerve, to directly stimulate the locus coeruleus region of your midbrain. (Something to tell the grandkids.)

When performed periodically (preferably daily, for as long as convenient), this stimulation should gradually increase the baseline tonic activity level of your brain’s locus coeruleus and, later, its raphe nucleus. This will, in turn, increase the baseline level of your brain’s neuromodulatory norepinephrine and later its serotonin, both which will continue to increase and finally level off after approximately 90 days to provide a gratifying array of long term health and cognitive benefits.
Stimulation Intensity

The theory of action underlying this brain stimulation system is that our brain’s locus coeruleus is responsible for inducing attention, alertness, focus, and memory (among other things). In other words, when something “important” happens, our brain is quickly brought to a heightened level of alertness and conditioned to remember and learn from whatever has happened. This can be either an internal event (an acute release of norepinephrine is what makes our pupils dilate when we see someone we find attractive – they have our attention) or external – when something in the outside environment may require our attention and management.

This stimulator is using a very small and safe amount of electrical current to deliberately trick the nerves of our forehead, which pass underneath the electrodes on their way to the locus coeruleus in our brainstem, into believing that our forehead’s sensory nerves are being acutely stimulated.

Nerve fibers are digital. They either fire or they don’t. There is no way to make them fire harder or “more” – they simply either fire or they don’t. But as you experiment with this stimulator you will clearly feel a stronger and more pronounced effect as you increase the stimulation intensity. So if nerves either fire or don’t, how can more stimulation feel stronger?

The answer is “augmented recruitment.” There may be other nerves located deeper in our scalp, or further away from the electrodes, or just less inclined to fire. A higher level of stimulation feels stronger to us not because the individual nerves are somehow firing harder, but because the stronger stimulation has recruited a greater number of nerves to fire with each burst of stimulation.

This electrophysiology suggests two general principles:

1. A higher level of stimulation will be more stimulating and more therapeutically effective by recruiting a greater number of nerve fibers.

2. But this will only be true up to a point. Once we have recruited all the nerve fibers we’re going to get, additional stimulation current provides no additional benefit.

At this early point in the development of this system we do not have any well developed sense for to what degree “more stimulation produces more downstream effect.” We do absolutely know that since this is “pseudo-sensory stimulation”, if you’re not feeling anything, you’re wasting your time. In other words, you need to feel your forehead being “buzzed.” It’s that buzzing that wakes up our locus coeruleus and it then, in turn, wakes up our brain.

But there is also no reason to overdo it. In time we may learn that “barely feeling something” is sufficient, but in our early testing we set the stimulation to a “definitely felt but completely comfortable” level.

So, until we learn more, the best advice is to set the level as high as is entirely comfortable, and feel free to adjust it up or down over time as the session progresses. ☺