

Stress, the Brain and Audio-Visual Entrainment

- by Dave Siever, CET., 2010. Mind Alive Inc.

Introduction

The brain is very susceptible to stress, and in our modern world, it is being hammered like never before. The ability for the brain to survive this onslaught of over-stimulation and stress depends on several factors including genetics, mom's stress and nutrition during pregnancy, childhood traumas, brain-injuries from falling, unresolved issues, current nutrition, worries, and busy-ness of one's current life. Deficiencies in key nutrients such as vitamin D, iodine, omega 3s, magnesium, zinc and selenium are sometimes all that is needed to throw the brain into disarray, so that just staying half-functional occupies much of a person's time and emotional reserves. In order to deal with all these stresses, many of us tend to gravitate towards unhealthy and destructive practices such as drugs and alcohol. But Audio-Visual Entrainment (AVE) offers a new safe, inexpensive and non-pharmaceutical approach to handling all these stresses in our lives so that we can be more healthy and productive.

Driven to Burnout

Many people fall into stress and the eventual burnout because of childhood baggage. There may have been times when they felt like they were never good enough for their parents or teachers. Sometimes, they may have felt like they were a second rate person. Many of my clients with adult burn-out often felt like they weren't acknowledged for their efforts and achievements as children, so they push and push and push and push themselves trying to be successful. They want the big house, fancy new car, the cottage or time-share so that the wounded 8-year old within them can say, "I did it," in response to their childhood fears. As adults, they might become wealthy, but this is fear-based performance robs them of key neurotransmitters (NT) such as serotonin and dopamine. They soon become "holics" to replenish them. They are caught between a rock and a hard place - for the gain in alpha-dog status (nice house, car, cottage, top-dog of the office) is rewarded with serotonin, dopamine and testosterone while climbing the social-economic ladder. But, the combined business stresses and loss of vital relationships with family and friends drains these healthy neuromodulators away. However, those who pursue wealth from a stance of enjoying money for fulfillment of life, typically know where to draw the line between family, recreation and work. Their alpha-dog status comes from liking themselves and being respected and appreciated by their friends and family. Human beings are such social animals (that's how we developed language) that social prowess trumps material possessions – always!

Modern-Day Craziiness

Nowadays, people's lives get so intense and crazy, that day-to-day living wears them down. I've seen it happen to young couples where both partners are busy developing a career and children enrolled in hockey, ballet, soccer, Scouts and Girl Guides, plus all of the school stuff. It's no wonder these young families get caught-up in this conundrum, complain that they don't get 30 minutes a week just to be with each other! They also have a very small buffer to deal with the unexpected. So, with their brain like a tightly wound spring, they have a tendency to speed while driving, get all wound up whenever they see road construction, get grumpy towards slow check-out clerks at grocery stores and, like the "-holic" types become intolerant of their spouses, children and most anyone as their brain tries to cling to some sense of sanity. As their neurotransmitters get thrown off balance, all kinds of things begin to "tick them off," which increases their stress even more. It's ironic, that between the mortgage, job, bills, desires and children, It's ironic that, although we have the freedom to follow our hearts and marry the spouse of our dreams, our drive for "success" (mortgage, job, bills, children, etc.) tends to detract from our happiness, often us to turn on one another and then drag collective selves through hell together. It's no wonder that there are so many divorces these days. It's not that there is anything wrong with our mate, it's that in our stressed-out state, we cannot relax enough to appreciate the tender, loving, nurturing moments our spouse has to offer.

The following lists some of the things stressed people get even more stressed over. Ask yourself, “What stresses me even more - as a result of already being stressed?”

Table 1. Some things that stress us out even more, when we are living on the edge.

Tailgaters	Booming stereos	Conservatives
Slow drivers	Being criticized	Liberals
Road delays	Overly moral people	Rich people
Delayed airline flights	Immoral people	Poor people
Gas prices	Beautiful people	Computers
Whiny kids	Ugly people	Bills
Polluters	Spiders/wasps	Line-ups
Dumb people	Smokers	Exams
Smart people	Non-smokers	Etc., etc., etc.

The Chemicals of Performance and Stress

The stress response involves three main neurotransmitters: serotonin, norepinephrine (NE) and dopamine. Serotonin is made in the brain stem and it mainly comes from tryptophan in meat. Serotonin is distributed to neurons throughout the brain. It is high during rest, feeding and being in the company of friends and also increases when using alcohol and many recreational drugs. Salespeople with high-sales performance also have high levels of serotonin. College students with the most friends have serotonin levels 20 to 40% above the norm. Females have 20 to 30% more serotonin than men which contributes to their increased sociability and gentler approaches when dealing with children and resolving conflicts.

People, who are low in serotonin don’t sleep well, are guarded and get upset over most everything. Stress, anxiety and anger are all manifestations of the *flight-or-fight* response. With a real threat to one’s safety, social threat (attack to the ego), annoyances and hassles to one’s lifestyle or any imagined threat of any of these, the brain’s serotonin rapidly falls (as quickly as one second), and the brain’s adrenalin, norepinephrine increases dramatically. This restricts blood flow to the hands and feet to prevent bleeding, increases the burning of glucose, and sharpens the senses. There is also a drop in blood flow within the brain’s frontal lobes, thus immediately impairing attention and reasoning (two traits of ADHD). This results in increased aggression, impulsiveness and lack of reasoning, and is the major cause of stress, family violence, road-rage, insomnia, heart attacks and so on.

When a person is in a stressed state for an extended period of time, his/her ability to enjoy life comes to a halt and dopamine levels vanish. Dopamine acts on the *nucleus accumbens* within the forebrain, a primary reward and pleasure center that is primarily sensitive to dopamine, serotonin and endorphins. Stimulant drugs such as amphetamines and cocaine produce a sense of pleasure by changing the concentration of dopamine in the accumbens, but so does socializing, having fun and excitement! People under long-term stress can’t recover from stress well by socializing because their increased aggressiveness, tiredness, negativity, and the shutting down of social-related neurons in the brain and temporal lobes, which impair their ability to socialize. So instead, most begin to develop addictive behaviours such as craving carbs, shopping, sexual encounters, gambling, porn and sometimes religion as these all boost dopamine and serotonin. Notice that these activities are primarily unhealthy.

Whether a person comes from the desperate urge to be the alpha-dog or from having a hectic lifestyle, his/her continued stress over an extended period of time hammers the brain. And depending on the severity of the stress, adrenal robustness and emotional support, the person eventually exhausts his/her supply of norepinephrine. Now, with the loss of serotonin, dopamine and NE, the outward aggression begins to wane and turns inward, and the person starts to fall into depression. Then the person engages heavily into the “-holic” activities, which causes further guilt and self-criticism. This transition can be seen on an electroencephalograph (EEG), where the “happy” side (Figure 1) is more engaged than the unhappy “fear” signature (circled in Figure 2). With a negative persona

and depression, the happy left side is shut down and the fear side on the right is in control. Unfortunately, once one has slid into this mind-state, it's nearly impossible to get out of it merely by thinking positive thoughts, because this mind-state maintains the negative thoughts, which keep the downward spiral going.

Figure 1. Happy person - left frontal lobe engaged.

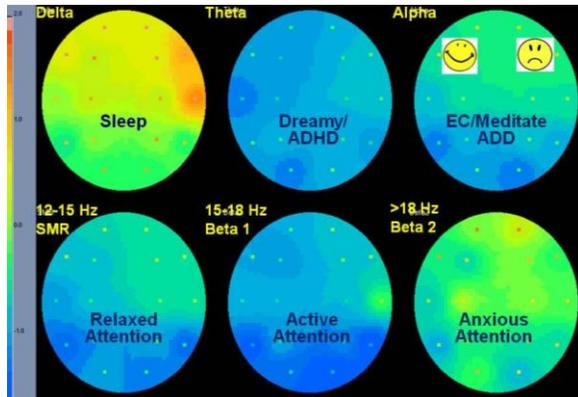
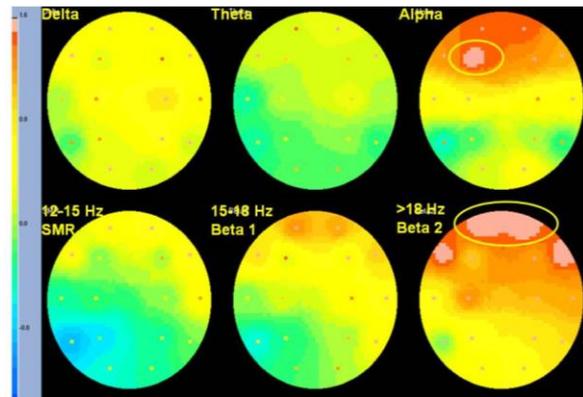


Figure 2. Depressed person - left frontal lobe shut off.



Neurotechnology

Neurotechnology is any technical intervention (including nutrition) that can be used to nudge the brain, brain waves and brain chemistry to help it get back into efficient, healthy functioning. We can control many aspects of our life if we take a great deal of time for self-discovery, nutritional education and maintaining a healthy, balanced lifestyle. However, so many of us are already neurologically exhausted before we become aware of the ramifications. Neurotechnology serves as a way of combating stress and depression, and is often an extremely effective way to recover and restore us back to healthy well-being.

The Wonders of Audio-Visual Entrainment

Auditory-visual entrainment (AVE) is the effect that flickering lights and pulsing tones have on the brain. All of our senses (except smell) access the brain via a section of neurons deep within the brain, known as the thalamus (sensory gatekeeper to the brain). The thalamus is highly innervated with the cortex and generates the brain's main rhythm - the alpha rhythm - in conjunction with the neurons of the cortex. Therefore, sensory stimulation can easily influence neuronal activity. AVE not only enhances brain waves, but increases the cerebral blood flow lost from stress and anxiety. AVE also restabilizes neurotransmitters, calms down anxiety-generating mental chatter and alters states of awareness and consciousness, thus allow the mind and body to recover and restabilize.

History

Reports of "flicker stimulation" go as far back as Ptolemy, but the first clinical report of flicker stimulation appear in the early 1900s when Pierre Janet, a French psychologist, observed that by having his patients gaze into the flickering light produced from a spinning, spoked wheel in front of a kerosene lantern, there was a reduction in their depression and anxiety. With the development of the EEG by Hans Berger in 1928, Adrian and Matthews published their results in 1934 showing that the alpha rhythm could be "driven" above and below its natural frequency of 10 Hz with photic stimulation. This discovery prompted several studies throughout the 40s and 50s on the "flicker following response," as it was then called. In 1956, W. Gray Walter published the first results on thousands of test subjects comparing flicker stimulation on the subjective (sensory and emotional) feelings it produced. Finally, in the late 1950s, as a result of Kroger's observations that the flashing blip on radar screens often put US military radar operators into trance, Kroger teamed up with Sidney Schneider of the Schneider Instrument Company and produced the world's first electronic clinical photic stimulator - the "Brainwave Synchronizer." It had powerful hypnotic qualities and soon studies on hypnotic induction were published. In 1984,

Dave Siever, of Mind Alive Inc., developed the Digital Audio-Visual Integration Device (DAVID), used to help Performing Arts students manage stage-fright. In 1988, Dave began extensively studying AVE and has since completed several studies on its clinical effects and has published the results in psychology journals and textbooks.

Effects of Audio-Visual Entrainment

AVE achieves its effects through several mechanisms simultaneously. These include:

1) altered EEG activity	4) improved neurotransmitter production
2) dissociation/hypnotic induction	5) increased cerebral blood flow and metabolism
3) limbic stabilization	

1) Altered EEG Activity. The direct transmission of energy from AVE only goes so far as to excite retinal cells in the eyes and pressure sensitive cilia within the cochlea of the ears. The nerve pathways from the eyes and ears carry the elicited electrical potentials through the geniculate and into the thalamus. From there, the entrained electrical activity within the thalamus is “amplified” and distributed throughout other limbic areas and the cerebral cortex via the *cortical-thalamic loop* (the same process that makes alpha waves). As the AVE frequency changes, so does the frequency in the brain – it’s that easy! This is how the dashed lines on the highway, sunlight shining through the trees while we’re driving or staring into a fire can pull us into a trance. Figure 3 shows the visual pathways for visual entrainment. Figure 4 shows the effect of square wave visual entrainment (VE) at 2, 4, 8, 12 and 20 Hz.

Figure 3. Visual pathways

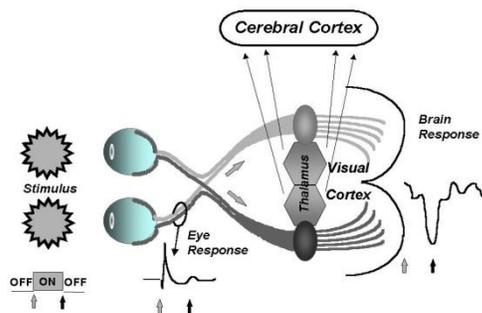
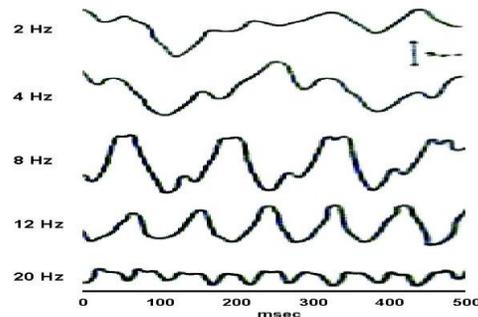


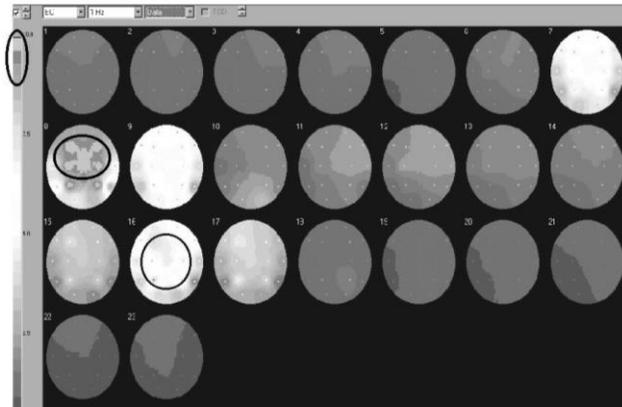
Figure 4. Visual entrainment effect on brain waves



The effects of AVE on brainwaves are primarily found throughout the main regions of the brain (pre-frontal, frontal, over the sensory-motor strip, and in parietal regions). It is within the pre-frontal and frontal areas where attention, executive function and reasoning reside. The input of the senses and the activation of movement reside in the sensory-motor strip. The integration of various senses needed to understand our environment, for social interaction such as the interpretation of facial expression, body language and verbal expression, plus awareness of one’s own body are primarily mediated in the somato-sensory region of the parietal lobes.

This is why AVE lends itself well in the treatment of such a wide variety of disorders including PTSD, panic, anxiety, depression, cognitive-decline and attentional issues. AVE can increase brain wave amplitudes immensely. For instance, a 1999 study by Frederick showed that eyes-closed visual entrainment (VE) at 18.5 Hz will increase EEG brain wave activity by 49% at the vertex (top of the head), which was the only site examined in this study. Auditory entrainment (AE) increased brain wave activity by 21%. Sine-wave stimulation produces a pure brain wave response, which is why it should be used for all meditative and hypnotic inductions. Other waveforms elicit harmonics within the brain such as this combination sine-square stimulus, shown in Figure 5, where a second harmonic shows up in the EEG. Square waves at meditation (alpha) frequencies can even sometimes produce anxiety and panic attacks, so by selecting the appropriate waveform, AVE can be used for meditation or stimulation, even when using the same frequency.

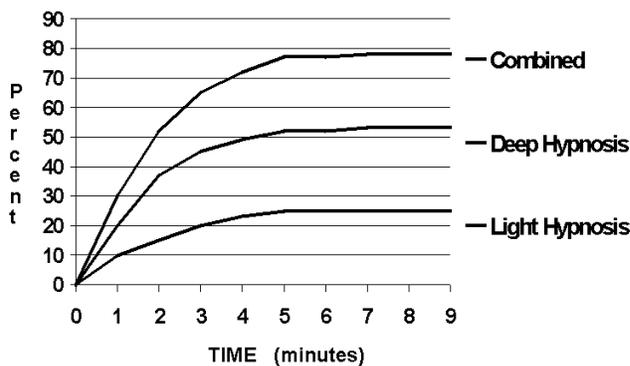
Figure 5. Brain map in 1Hz bins during 8 Hz AVE (“SKIL” analysis - eyes closed)



At frequencies above 10 Hz, AVE has the ability to inhibit excessive and problematic brain wave activity at the half frequency of stimulation. This is a very important aspect of AVE because some brain disorders such as ADD, ADHD, OCD, cognitive decline in seniors and depression all involve high-magnitude, slow brain waves, which AVE can reduce. When treating depression for instance (as shown in Figure 2), by stimulating with 20 Hz on the right side, we can reduce the “bad” left-brain alpha, thus revitalizing the happy side. By stimulating with 10 Hz alpha on the left side, we can boost the right-brain alpha and thus settle down the fear and negativity. The abnormal frontal (racy-head) beta will also automatically settle down as the brain changes its way of thinking to a more positive disposition. By using a quantitative EEG, we have shown that in the course of a few weeks, we can change the brain in Figure 2 to the brain shown in Figure 1.

2) Dissociation/Hypnotic Induction. Dissociation is a great way to combat stress. That’s why people meditate, go on pleasant hikes, watch hockey games, go to night clubs and pubs - to COMPLETELY forget about life for a while - and reset the brain from stress. We get involved in the present moment and let go of thoughts relating to our daily hassles and hectic schedules - paying bills, worries, work, threats or anxieties and the resulting unhealthy mental “chatter.” Dissociation involves a disconnection of self from thoughts and body awareness, as is experienced during deep meditation. Dissociation begins in four to eight minutes from properly applied AVE, in which a *restabilization* effect occurs where muscles relax, electrodermal (sweat) activity decreases, peripheral blood flow stabilizes (hands warm up to an enjoyable temperature of approximately 31-33 C), breathing becomes deep and slow, and heart rate becomes uniform and smooth. Several studies have shown that AVE in the lower alpha frequency range (7-10 Hz), easily induces hypnosis, and it has been shown that nearly 80% of subjects entered into either a light or deep hypnotic trance within six minutes during alpha AVE (Kroger & Schneider, 1959), as shown in Figure 6. AVE in essence, provides an excellent means for achieving an altered state of consciousness.

Figure 6. Photic stimulation induction of hypnotic trance.



3) Limbic Stabilization. If we dissociate from our stressors and worries, then our brain and body will also relax. The amygdala is the part of the limbic (emotional) system of the brain that decides if we should view something as friendly and fun, sexually interesting or something to be frightened of. Most often, it is activated by fear, anxiety and stress (the fight-or-flight response). The hypothalamus, right next to the amygdala, creates the body reaction and *feeling* part of the emotional response. Physiological responses generated from fear include increased muscle tension, electro-dermal response (sweating), increased heart rate, chest-breathing, arterial tone (cold hands and feet) and blood pressure, elevated body temperature, a drop in desire to eat and often a loss of awareness as to when to stop eating. These are all necessary responses to prepare our bodies to either “fight-or-flight”. We are often not even aware that we are having a fear reaction until we notice that our body is all tensed up. White-light AVE in the alpha range typically calms the limbic system – all within 10 minutes, and therefore AVE produces hand-temperature normalization, muscle relaxation, reduced electro-dermal activity, reduced heart rate, improved heart-rate rhythm and reduced hypertension and lends itself very well to stabilizing stress, anxiety and panic.

Figure 7 shows increasing (normalizing) finger temperature in one subject. Figure 8 shows decreased electrodermal response (EDR) using white-light AVE device at alpha frequencies. Notice that the normalization effect begins following roughly six minutes of AVE.

Figure 7. Finger temperature during AVE.

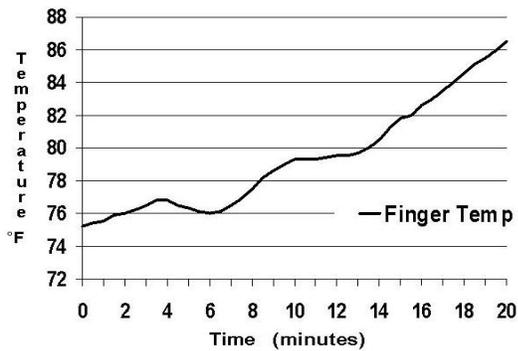
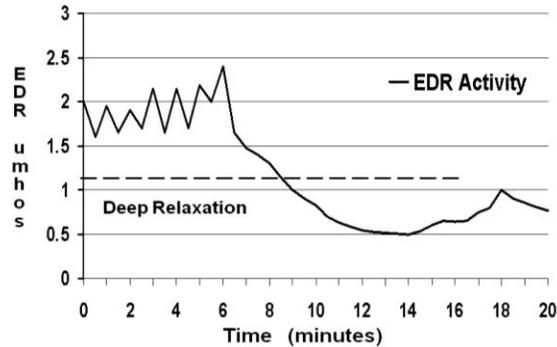
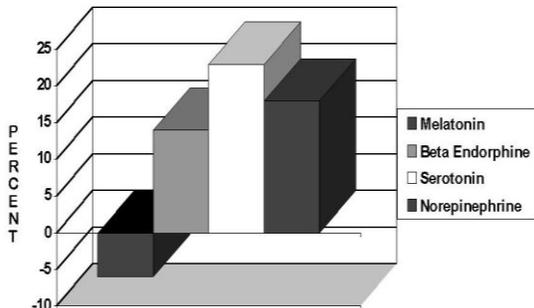


Figure 8. Reduced Electro-dermal activity during alpha AVE.



4) Improved Neurotransmitter Production. People under the influence of long-term stress eventually develop *adrenal fatigue* (hypo-adrenalism) in the body. In the brain, both serotonin and norepinephrine production shuts down and depression often results. In a 1989 study by Shealy, on the effect of 10 Hz white-light photic stimulation on neurotransmitters, it was shown that blood serum levels of serotonin, endorphine, and norepinephrine all increased significantly. (This effect is akin to the excited, happy and fun mind state that many of us experience at Christmas time or other significant holidays. It’s not possible to feel depressed or even negative in this mind state.) Daytime levels of melatonin also fell some, which is related to increased energy, as melatonin is associated with malaise and seasonal affective disorder (Figure 9). Clinical studies showed declines in depression, anxiety and/or suicide tendencies following a treatment program using AVE.

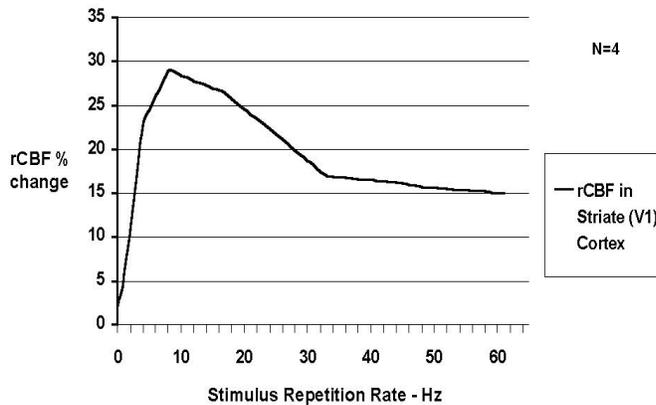
Figure 9. Neurotransmitter changes following 10Hz visual entrainment.



5) Increase in Cerebral Blood Flow and Metabolism. SPECT and fMRI imaging show that hypoperfusion (decreased blood flow) of cerebral blood flow (CBF) is associated with many forms of mental disorders including anxiety, depression, ADD/ADHD, behaviour disorders and impaired cognitive function such as with fetal-alcohol spectrum disorder. CBF also falls with age, developing into age-related-cognitive-decline in seniors.

AVE has been shown to increase brain glucose metabolism throughout much of the brain and increase CBF, peaking at a 28% increase at 7.8 Hz, (Fox & Raichle, 1985) as shown in Figure 10. This, coincidentally, is the *Schumann Resonance*, the frequency that electro-magnetic radiation propagates around the earth.

Figure 10. Regional cerebral blood flow in response to photic stimulation.



Clinical Studies with Audio-Visual Entrainment

Hundreds of thousands of people have successfully used AVE to reduce or manage the symptoms of their disorders, syndromes, and ailments. To date, many AVE studies addressing the following concerns have been completed as shown below:

Attention Deficit Disorder	4 (n=359, school children)
Academic Performance in college students	4 (n=213, college students)
Improved cognitive performance in seniors	4 (n=86)
Reduced falling in seniors	1 (n=80, seniors)
Depression	1 (n=80)
Dental – during dental procedures	2 (n=36)
Temporo-mandibular Joint Dysfunction	2 (n=43, middle-aged)
Seasonal Affective Disorder	1 (n=74, middle-aged)
Pain & fibromyalgia	3 (n= 66, middle-aged)
Insomnia	1 (n=10, middle-aged)
PTSD	~600 cases (public, police & military)
Migraine headache	1 (n=7)
Heart-rate Variability	several case reports.

Conclusion:

A great number of factors including genetics, our mother’s pre-natal stress and nutrition, emotional baggage, head injuries, childhood traumas, present-day conflicts, over-stimulation, stressors, lifestyle and nutrition all contribute to our struggle against fatigue, stress, unhappiness and burnout.

So why use neurotechnology? Neurotechnology uses natural, effective means to restabilize the brain into healthy functioning while helping us maintain a brain-state conducive with a wonderful, joyful, productive life... to live happily-ever-after.

Further Reading:

Wikipedia: http://en.wikipedia.org/wiki/Audio-Visual_Entrainment

Also go to: www.mindalive.com/PDFarticles.htm. There are several articles on the topic of AVE on this page. Click to download the articles in pdf format to view in Adobe Reader.

- 1) Audio-Visual Entrainment: History and Physiological Mechanisms
- 2) Audio-Visual Entrainment: Dental Studies
- 3) Audio-Visual Entrainment: Applying Audio-Visual Entrainment Technology for Attention and Learning
- 4) Audio-Visual Entrainment: The Neurobiology of Affective Disorders and Clinical Implications of Audio-Visual Entrainment
- 5) Audio-Visual Entrainment: The Application of Audio-Visual Entrainment for the Treatment of Seasonal Affective Disorder
- 6) Audio-Visual Entrainment: The Application of Audio-Visual Entrainment for the Treatment of Seniors' Issues
- 7) Audio-Visual Entrainment: Safety and Tru-Vu Omniscreen Eyesets

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