A brief Introduction to Audio-Visual Stimulation and Neurofeedback

Fereshteh Sedaghat M.D. Ph.D.

Sedaghat Outpatient Cognitive Neuroscience Clinic, Mashhad, Iran,
fereshsedag@yahoo.com
“I think, therefore I am…”

Rene Descartes
(1596-1650)

Descartes identified being with thinking, as fundamental element of existence

It seems that we are a thinking thing. What is a thinking thing? Is one thing which doubts, designs, promises, denies, wants, imagines, feels and forgives.

What can we do to have a better quality of this thinking thing and thus a better quality of life?
Our thoughts, feelings, actions, memories, learning and imaginations are the result of what happens in our synapses.

Communication between brain cells is a bio-electro-chemical event taking place in synapses.
Functional Normal Brain

• Good balance of
  Brain waves, CBF, oxygen and glucose metabolism, Neurotransmitters

• Ability to organize its different states
Spectograms of brain waves in different regions in normal relaxed adult
Dysfunctional Brain

- Imbalance of
  Brain waves, CBF, oxygen and glucose metabolism, Neurotransmitters and chemicals
- Impaired ability to shift from one mental state to another
• By using different methods of neuromodulation as magnetic, electric, photic, audial, .. We mainly try to improve the functional imbalance of the brain:

• CBF and metabolism

• Brain waves frequency and amplitude

• Neurotransmitters and chemicals
Audio Visual Entrainment

• AVE is a technique in which lights flash into the eyes while tones pulse into the ears.

• The frequency of the lights and tones is in the brain wave frequency range, typically from 1 to 40 Hz.
Audio Visual Entrainment

- The brainwave synchronizer works on the principle of entrainment.
- When the lights and sound from the synchronizer pulse at the speed of normal brainwaves when a session begins, they quickly synchronize.
- Our brainwaves will then follow as the light and sound stimulation shifts into the frequencies of another mind state. This is called the frequency following effect.
• At the beginning of 20th century Pierre Janet, in France, reported that when he had his patients gaze into the flickering light produced from a spinning spoked wheel, the effect lowered their depression, tension and hysteria,
The American physician Dr. William S. Kroger (1906-1995) spent his career in obstetrics and in psychology. He had a life-long interest in hypnosis, and was a founding member of several organizations in hypnosis.

During WWII he observed that the pulsing lights on a radar screen mimicked the frequencies of brain waves, and could cause a trance in some operators.
They introduced the Brain Wave Synchronizer in 1959. It uses a light that flashes at the frequencies of alpha, beta, or delta brain waves. In the 1960s, the device was used both to provide analgesia to women in labor, and as an aid to general anesthesia in surgery.
Physiology of Audio-Visual Entrainment

- All sensory information, except that of smell must pass through the thalamus to gain access into other brain regions.

- By definition, entrainment occurs when an EEG reflects the brain wave frequency of the stimuli, be it audio, visual or tactile, in which the person is experiencing.

- In order for entrainment to occur, a constant, repetitive stimuli of the proper frequency and sufficient strength to “excite” the thalamus must be present.

- The thalamus then passes the stimuli onto the cortex in general and associated processing areas such as the visual and auditory cortex.
For instance, induced visual stimulation travels from the retina of both eyes down the optic nerve, through the optic chiasm, and into the lateral geniculate of both thalami. From here, the visual signals are passed onto limbic structures, then visual cortex.
Outcomes of AVE

• Dissociation / hypnotic induction,

• Modulation of neurotransmitters.

• Modulation of cerebral blood flow.

• Modulation of brain wave activity
Dissociation

• Is a “disconnection” of self from thoughts and somatic awareness as experienced during deep meditation.
Visual entrainment alone, in the lower alpha frequency range (7-10 Hz) has been shown to induce 80% of subjects into a hypnotic trance within six minutes.
Modulation of Neurotransmitters

- We know that neurotransmitters such as serotonin, norepinephrine, dopamine and melatonin play an important role in our arousal and mood state.
- Studies show a fast improvement of depression and anxiety after AVE

(Gagnon & Boersma, 1992; Berg & Siever, 2004)
Following 10 Hz, white light Photic stimulation, blood serum levels of serotonin, endorphine, and norepinephrine rise considerably while daytime level of melatonin is decreased (Shealy, et. al 1989).
Cerebral Blood Flow and Metabolism

AVE has been shown to increase CBF throughout various brain regions including frontal areas (Mentis, et. al., 1997; Sappey-Marinier, et. al, 1992).

Figure 4. CBF at various photic entrainment repetition rates (P. Fox & Raichle, 1985).
Altered EEG activity

• AVE at 18.5 Hz has been shown to produce dramatic increases in EEG amplitude at the vertex (CZ), where it was found that eyes-closed 18.5 Hz.

• Photic entrainment increased 18.5 Hz EEG activity by 49% and eyes-closed auditory entrainment increased 18.5 Hz EEG activity by 21%.
Auditory stimulation

Autonomic calming:

- McConnel, et al (2014) demonstrated that auditory “driving” of nervous system reactivity resulted in increased parasympathetic nervous system calming.
Brainwave Synchronizer has shown to be helpful in:

- Relaxation
- Sleep induction
- Improved ability to learn
- Improved memory
- Pain relief
Many clinical studies on AVE exist today, encompassing:

- Pain (Twittey & Siever, 1998) and fibromyalgia (Berg, et. al., 1999),
- Seasonal Affective Disorder (Siever, 2004),
- Producing pronounced cognitive improvements in seniors with age related cognitive decline (Budzynski, 2002) & reduced falling in seniors (Berg & Siever, 2004).
- Reduce Jaw tension, more formally known as Temporo- mandibular Dysfunction AVE has been shown to directly reduce the symptoms of TMD (Manns, et. al., 1981; Thomas & Siever, 1988). & Chow, 1993).
- AVE has been shown to reduce and eliminate migraine headache (Anderson, 1989).
- Sub-delta AVE as been shown to reduce hypertension (Berg & Siever, 2001)
Neurofeedback

- Neurofeedback (NFB), also called neurotherapy, uses real-time displays of brain activity (usually EEG), as a video display or game, to teach self-regulation of brain function.

- With positive feedback (reward) for desired brain activity and negative feedback for brain activity that is undesirable.
Neurofeedback allows the patient to view the levels of his own brain waves on a screen and attempt to alter them, usually by integrating brain waves into a video game.
Neurofeedback began in the late 1950s by work of both Dr Joe Kamiya at the University of Chicago and Dr Barry Sterman at UCLA and discovered that by using a simple reward system, people could learn to alter their brain activity.
In 2010, a study provided some evidence of neuroplastic changes occurring after neurofeedback.

What is neuroplasticity?

The ability of the brain to change and reorganize itself and its function. An increase in brain cell connections has been observed.
Neuroplasticity “… is an intrinsic property of the human brain and represents evolution’s invention to enable the nervous system to escape the restrictions of its own genome and thus adapt to environmental pressures, physiological changes, and experiences.”

Dr. Alvaro Pascual-Leone
Plasticity-based therapies

- Non-invasive and
- Drug-free

These innovative “neuroplastic” therapies often work by “strengthening” or retraining the brain through repetitive and challenging activities.
Application of Neurofeedback

• ADHD and Learning Disorders;
• Anxiety and Panic Disorders;
• Depression;
• Epilepsy;
• Insomnia and Sleep Disorders;
• Migraines and Chronic Headaches;
• Traumatic Brain Injury and Stroke.
Mental health may be on the verge of a whole new era...

Thank you