Audio-Visual Entrainment: History, Physiology & Clinical Studies

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History

Clinical reports of flicker stimulation appear as far back as the dawn of modern medicine. It was at the turn of the 20th century when Pierre Janet, at the Salpêtrière Hospital in France, reported that when he had his patients gaze into the flickering light produced from a spinning spoked wheel in front of a kerosene lantern, the effect lowered their depression, tension and hysteria, (Pieron, 1982). Then, in 1934, Adrian and Matthews published their results showing that the alpha rhythm could be "driven" above and below the natural frequency with photic stimulation (Adrian & Matthews, 1934). This discovery further propagated a host of small physiological outcome studies on the "flicker following response," the brain's electrical response to stimulation (Bartley, 1934, 1937; Durup & Fessard, 1935; Jasper, 1936; Goldman, Segal, & Segalis, 1938; Jung, 1939; Toman, 1941).

Finally in 1956, W. Gray Walter published the first results on thousands of test subjects comparing flicker stimulation with the *subjective* emotional feelings it produced. And finally, in the late 50s, as a result of Kroger's work with the US military combined with the electronic knowhow of Sidney Schneider, the world's first electronic clinical photic stimulator, the "Brainwave Synchronizer" was created. It comprised an intense xenon strobe light complete with a rotating dial that could be set to the frequencies of the standard four brain wave rhythms. It had powerful hypnotic qualities and soon studies on hypnotic induction were published.

As EEG equipment improved, so did a renewed interest in the brain's electrical response to photic stimulation and a flurry of studies were completed, (Barlow, 1960; Van der tweel, 1965; Kinney, 1973; Townsend, 1973; Donker, 1978; Frederick, 1999). Studies into evoked potentials from auditory stimulation were also generating interest, although not to the degree of studies involving photic stimulation (Chatrian, 1959).

Studies involving hypnotic induction, (Kroger & Schneider, 1959; Lewerenz, 1963) as well as hypnosis used to augment anaesthesia during surgery, (Sadove, 1963) and to reduce pain, control gagging and accelerate healing in dentistry, (Margolos, 1966). Using newer terminology, studies have also been completed under the topic of dissociation induction, (Leonard, et al, 1999; Leonard, et al, 2000), which has spawned increased understanding for desensitizing dissociative pathology and for rapidly relaxing people suffering from trauma and post traumatic stress disorder (Siever, 2003).

In 1984, Comptronic Devices Limited (presently named "Mind Alive Inc") released the "Digital Audio-Visual Integration Device" (DAVID1), used for hypnotic induction and to calm anxiety and reduce stage fright in performing arts students at the University of Alberta. The "light and sound" (L&S) market as it was known at that time was in its infancy and resided primarily within the unscientific "new age" sector. However, since the time of Adrian and Matthews, a considerable number of L&S studies had been published and needed to be brought to light, prompting me to write my book "The Rediscovery of Audio-visual Entainment Technology"

(Siever, 2000). As reflected in the title, I have since re-named this phenomenon "audio-visual entrainment" or AVE, which occurs when any given frequency of stimulation is reflected in brain wave activity and observable on an EEG or at least a QEEG.

Clinical Outcomes

Many clinical studies on AVE exist today, encompassing pain (Twittey & Siever, 1998) and fibromyalgia (Berg, et. al., 1999), Seasonal Affective Disorder (Siever, 2004), attentional disorders (Carter & Russell, 1993; Budzynski & Tang, 1998; Joyce, 2001). Another study showed that treatment with AVE was more effective than psychostimulant meds such as Ritalin & Adderall (Micheletti, 1998). And yet another study showed that AVE used to treat 10 attention deficit children at a time was more effective (TOVA scores) that six leading neurofeedback studies, (Joyce & Siever, 2000). AVE has been shown to produce pronounced cognitive improvements in seniors with age related cognitive decline (Budzynski, 2002) & reduced falling in seniors (Berg & Siever, 2004). Jaw tension and degradation of the joint and its cartilage, more formally known as Temporo-mandibular Dysfunction (TMD is often a direct physiological outcome in response to stress (Yemm, 1969). AVE has been shown to directly reduce the symptoms of TMD (Manns, et. al., 1981; Thomas & Siever, 1988). AVE has also been shown to reduce jaw tension (Siever, 1992), jaw pain and patient anxiety during dental procedures (Morse & 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).

List of Studies

As mentioned, a great number of studies have been completed on the clinical applications of AVE and more are in progress. A quick list of studies with clinical implications are listed below.

Attention Deficit Disorder	4 (n=359, school children)
Academic Performance in college students	2 (n=22, college students)
Improved cognitive performance in seniors	1 (n=40, from two seniors homes)
Reduced falling in seniors	1 (n=80, seniors)
Dental – during dental procedures	2 (n=36)
TMJ	2 (n=43, middle-aged)
SAD	1 (n=74, middle-aged)
Pain & fibromyalgia	3 (n= 66, middled-aged)
Insomnia	1 (n=10, middle-aged)
PTSD	~600 cases (public, police & military)
Migraine headache	1 (n=7)
Hypertension	1 (n=28)

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 (thus duplicating it), 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 sensory-motor strip, the cortex in general and associated processing areas such as the visual and auditory cortexes. 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 auditory and visual signals are passed onto limbic structures, the visual cortex and cerebral cortexes via the *cortical thalamic loop*.

AVE achieves its effects through several mechanisms at once. These include:

1) dissociation / hypnotic induction,
2) increased neurotransmitters.
3) possible increased dendritic growth,
4) altered cerebral blood flow.
5) altered EEG activity.

Dissociation

Dissociation occurs when we meditate, exercise, read a good book, take in a movie or enjoy a sporting event. We get drawn into the present moment and let go of all thoughts relating to our daily hassles, hectic schedules, paying rent, urban noise, worries, threats, anxieties and the resultant unhealthy mental chatter. Dissociation, in the sense of AVE, is a "disconnection" of self from thoughts and somatic awareness as experienced during deep meditation. As dissociation sets in (4-8 minutes) from properly applied AVE, a *restabilization* effect occurs where muscles relax, electrodermal activity settles down, peripheral blood flow stabilizes (hand temperature normalizes to 32-33 C, and breathing becomes diaphragmatic and slow and heart rate uniform and smooth. AVE is more dissociating than other techniques such as dot staring and stimulus deprivation. 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. Additional studies have shown that AVE provides an excellent medium for achieving an altered state of consciousness (Glickson, 1987).

Neurotransmitters

People under long-term anxiety eventually develop hypoadrenalis or *adrenal fatigue* as they slip into depression and lethargy. This depressed, lethargic condition is highly correlated with a loss of both serotonin and norepinephrine. Following 10 Hz, white light Photic stimulation, blood serum levels of serotonin, endorphine, and melatonin rise considerably (Shealy, et. al 1989). Other studies show a sharp decline in depression, anxiety and/or suicide ideation (Gagnon & Boersma, 1992; Berg & Siever, 2004).

Dendritic Growth

There is evidence that stimulating neurons with mild electrical stimulation promotes growth of dendrites and dendritic shaft synapses in the cells being stimulated (Beardsley, 1999; Lee, Schottler, Oliver, & Lynch, 1980). However, studies do not yet exist on the influence of AVE on dendritic growth, although it is suspected because many people with autism, palsy, stroke and aneurysm (Russell, 1996), have regained significant motor and cognitive function following a treatment program of AVE.

Cerebral Blood Flow and Metabolism

SPECT and FMRI imaging show that hypoperfusion of CBF is associated with many forms of mental disorders including anxiety, depression, attentional and behavior disorders, and impaired cognitive function (REF*****). AVE increases brain glucose metabolism overall by 5% and increases CBF in the striate cortex dramatically, peaking at (28%) during AVE at 7.8 Hz., which is coincidentally at the *Schumann Resonance*, the frequency that electro-magnetic radiation propagates around the earth of the earth (Fox & Raichle, 1985). In addition, AVE has been shown to increase CBF throughout various other brain regions including frontal areas (Mentis, et. al., 1997; Sappey-Marinier, et. al, 1992).

Altered EEG activity

AVE primarily shows itself frontally, over the sensory-motor strip and in parietal (somato-sensory) regions. It is within these areas where executive thinking and sensory awareness take place, which is why AVE lends itself well for the treatment of such a wide variety of disorders. 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%.

Conclusion

In conclusion, AVE quickly and effectively relaxes people out of highly sympathetic activation and traumatic states of mind, bringing about a return to homeostasis. AVE may be used with hypnotic suggestions on tape/CD or live via a microphone. At the same time, AVE exerts a powerful influence on brain/mind stabilization and normalization through the means of increased cerebral blood flow, neurotransmitters and improved EEG activity. At the end of an AVE session, the user may realize that he/she has never felt so relaxed and mentally sharp for years - perhaps not since childhood.

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