

The Use of Audio-visual Entrainment for Recovering Cognitive Performance in the Elderly

Introduction

In 1990, we began experimenting in our clinic with audio-visual entrainment (AVE) in elderly patients. Initially, we chose 14Hz as the stimulation frequency because of research and clinical results relating to the activity in the narrow bands of 14 Hz or 12 – 15 Hz, based on Giannitrapani's findings on the positive correlations between 13 and 14Hz single band power and I.Q. (1988). Several years later it was concluded that the use of AVE could enhance neurofeedback training in the area of reversing age-related cognitive decline (Budzynski, 2000). We went on to design a pseudo-random AVE protocol with the rationale of maximizing cerebral blood flow and neuronal excitation through constantly changing and randomized light/sound stimuli; in other words, minimizing adaptation effects. Combined with neurofeedback and other supplemental interventions, we had continued success with several patients who tried this intervention.

We conducted a controlled AVE study on cognitive enhancement in the elderly (Budzynski, Budzynski and Tang, (in press). Thirty sessions of group AVE (20 minutes each) were given to an elderly group of individuals (N=31). Within this group was a woman with rapidly progressing Alzheimer's as described below.

AVE Case Study on Alzheimer's Disease

In late November of 2000 we (Budzynski & Sherlin) began a case study of a 57 year old woman with a diagnosis of Alzheimer's Disease (AD). Both her mother and father had succumbed to the disease. KW agreed to participate in an initial study in which we would do a series of QEEGs (Q) to document the effects of AVE. The AVE device was a DAVID Paradise XL, manufactured by Mind Alive Inc., of Edmonton, Alberta, Canada. We designed a pseudo-random AVE protocol, with the rationale of maximizing cerebral blood flow through constantly changing and randomized light/sound stimuli. A baseline Q was done, followed by 20 minutes of a pseudo-random AVE protocol, during which data for another Q was taken. A third Q was taken after the stimulation, and finally a fourth followed after a 15 minute rest period. The time course of all the Qs in this study was: Q1 baseline Oct 3/00, Qs during, after, and post AVE in this first session; then Q2 (Jan 9/01) after 30 days of daily AVE; Q3 follow-up-1 (Jun 11/01); Q4 follow-up-2 (Dec 28/01).

KW was offered our clinic's 30-day group AVE training, and she decided to take it. It should be noted that KW showed significant improvements during her AVE training: KW began walking alone to the training even though it was some blocks away. Also, her walking style changed from the flatfooted gait of the typical AD patient to a normal style. Friends noticed that she was speaking better, i.e., finding words and annunciating more clearly. KW decided to use an AVE unit at home after she finished the training, however, we were later informed that she only used the unit intermittently and stopped using it altogether between Q2 and Q3.

KW's QEEG Analyses

KW's EEG was collected from all 19 sites of the 10/20 International System and then quantified (QEEG) into various frequency band power/magnitudes. The analyses of KW's Qs were revealing. During the first session, the Q spectral analysis showed that the AVE resulted in decreased theta at T3 (left temporal) at the 15-minute post Q (Figure 1). However, in subsequent Qs, theta at T3 did not differ much from baseline Q1. Theta at T4

(right temporal) improved greatly, however. The values during the first session were unusually high, indicating that this right hemisphere area was quite probably more affected by the AD than the left. Interestingly, the theta at T4 decreased in Q2 and Q3 although KW had stopped using the home unit sometime after Q2. In Qs 2, 3 and 4 the level of theta at T4 remained low and similar to that at T3. The overall result was that the theta band power decreased from the baseline at Q1 to the final Q4.

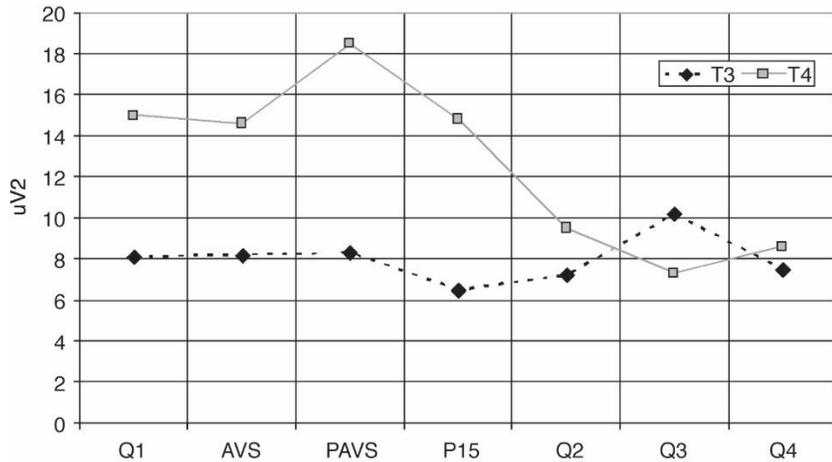


Figure 1. Theta power at T3 and T4 across Qs. Client: KW.

Lesley Sherlin used the scanning technique called LORETA (Low-Resolution Electromagnetic Tomography) (Pascual-Marqui, 1999) to determine deeper structural brain changes (Budzynski and Sherlin, 2002). LORETA data from several images can be subtracted to study the change that has taken place. Figure 2 shows the subtraction of Q1 from Q2 and the resultant image indicates a reduction in the theta band current density in both temporal areas, but primarily on the right side. This decrease was maintained in Q2 after the 30-day training, some 12 weeks later. The difference LORETA Q2-Q1 shows a decrease (blue) in theta in the right and left temporal areas and in the middle temporal gyrus after the 30-day training.

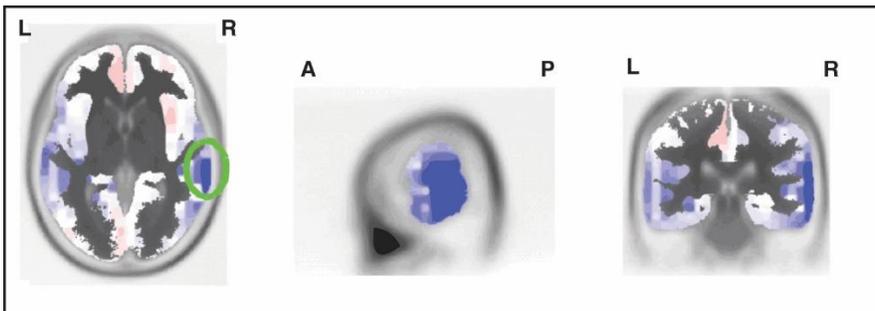


Figure 2: Q2-Q1 Theta. Theta decreased. Brodmann Area 21, Middle Temporal Gyrus, Temporal Lobe.

The next two images (Figures 3 and 4) show difference LORETAS comparing Q3 and Q4 with the Q1 baseline. In both cases the right temporal area indicates less theta than at baseline.

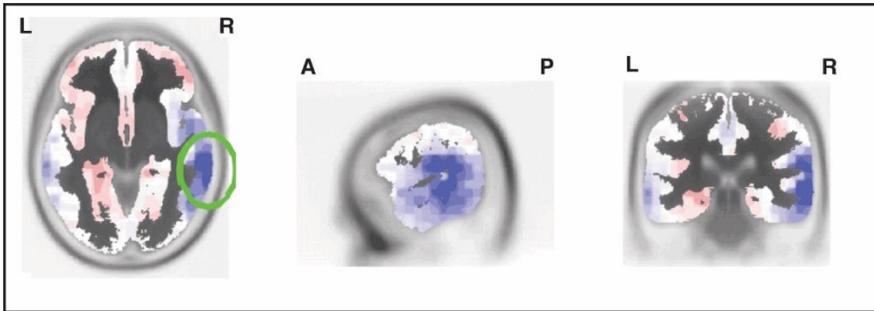


Figure 3: Q3-Q1 Theta. Theta decreased since Q1 and Q2. Brodmann Area 21, Middle Temporal Gyrus, Temporal Lobe.

When the final Q4 was compared to baseline Q1, the temporal theta had decreased even more than at Q3. The pinkish color in Figure 8.8 indicates a slight elevation of theta in more medial areas. However, it is not apparent in Figure 4 when Q4 was compared to Q1.

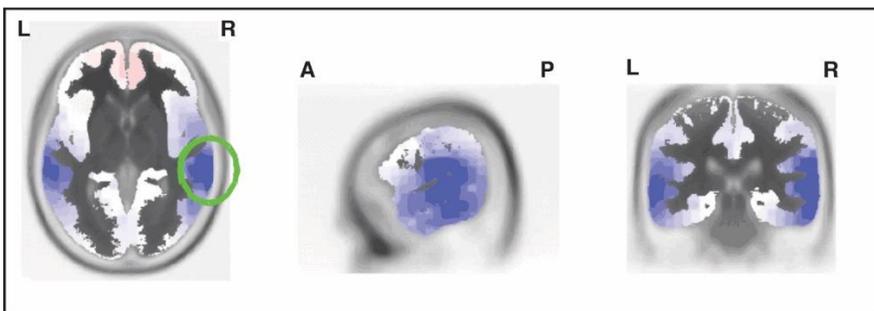


Figure 4: Q4-Q1 Theta. Theta decreased. Brodmann Area 21, Middle Temporal Gyrus, Temporal Lobe.

These results are encouraging because theta and delta increases are among the earliest EEG changes seen in Alzheimers Disease (Babiloni et al., 2007; Ponomareva et al., 2007; Prichep, 2007). One can only wonder what would have happened if KW had been able to keep using the AVE regularly at home. One other EEG result is worth mentioning: Peak Alpha Frequency (PAF) is an important indicator of brain health and performance (Nakano et al. 1992; Matousek et al, 1967; Obrist, 1979). Most AD patients show very little alpha even in the eyes closed condition (Pricep et al., 1994) and such was true of KW in Q1. But Figure 5 shows that at least in the central parietal area (Pz) the Q3 analysis showed alpha peaking at 10Hz, whereas the Q1 showed only a slight increase at 6 Hz. This is consistent with the work of Siever on diffuse axonal brain injury, where there is a break in the thalamocortical loop (2017). Also, notice that activity in the delta band decreased at least to the time of Q3. Note also that the slow frequency 2-6Hz band power is decreased.

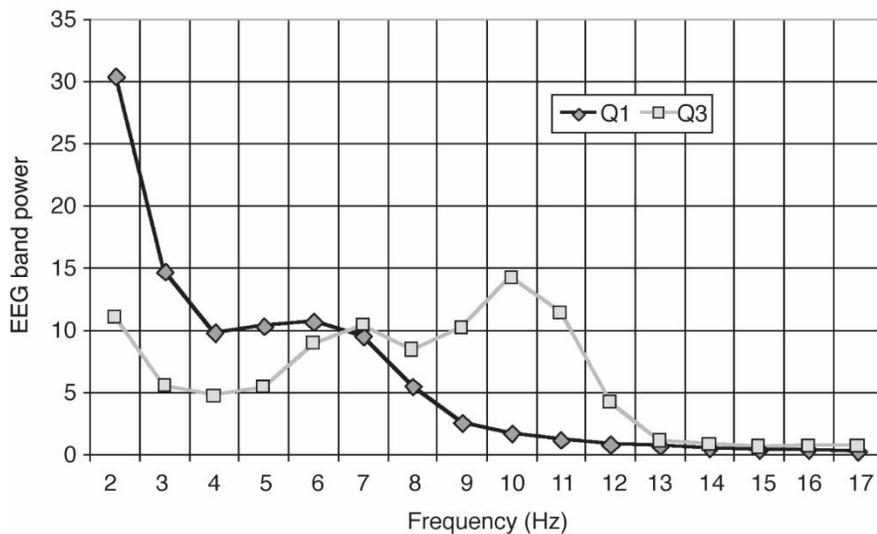


Figure 5: Frequency spectrum at Pz in Q1 and Q3. Subject: KW.

In keeping with her subjective report of an increased ability to multi-task and remember where she put things, her Memory score showed the greatest improvement of all 9 scales of the Micro-Cog CPT test. Taking this in sum, the AVE training did appear to produce several positive changes in KW's brain.

Tentative Conclusions about AVE and Alzheimer's

1. AVE seems to produce some enhancement of memory ability even in a moderately severe AD patient.
2. AVE seems to restore, at least temporarily, some degree of spatial ability. For example, KW noted, as a result of the training, she was able to accurately find her way around a several block radius including the distance from her home to the site of the AVE training.
3. Her walking style improved from the shuffling, flatfooted stride of many AD patients to a more normal gait.
4. She reported that the cognitive fog lifted after her training.
5. EEG changes included decreases in the delta band in the frontal, temporal and parietal areas. These lasted at least 15 minutes after stimulation, and in fact, the Q3 delta was reduced compared to Q1.
6. The theta EEG power at T4 was initially significantly increased over that at T3 however, after the AVE training (and some home AVE use), the theta at T4 came down to the lower level shown at T3.
7. Peak alpha frequency (PAF) was increased in the parietal area with continued use of the home AVE up to Q3.
8. Finally, the Microcog Reasoning/Calculation scale was improved in the post score of KW as well as in the larger group of elderly people used in the previous study (presented above).

Chapter 8: Audio-Visual Stimulation: Research and Clinical Practice (Tom Budzynski & Leslie Sherlin)
From: Music, Science, and the Rhythmic Brain: Cultural and Clinical Implications (Routledge Research in Music-2011; by
Berger & Turow) (Reedited by Dave Siever, 2017). **For educational purposes.**

Stroke and Photic Stimulation

We were able to test the effects of photic stimulation (PS) on the brain of an aphasic individual (Rozelle and Budzynski, 1996). JY had suffered a massive left hemisphere stroke more than 6 months before. As part of the treatment we used an early EEG Driven Stimulation (EDS) prototype (Ochs and Berman, 1994; Larsen, 2006). The second part of the treatment was neurofeedback based on activity at F7. The client himself requested a return to the EDS protocol for the final part of his training. The client's recovery was so successful that he wrote a book, *Up From the Ashes: There is Life After a Stroke*, (Young, 1995) and spent the next few years offering workshops on successful stroke recovery.

Testimonial

Thank you again for your suggestion in 2013 of my husband Kelly possibly benefitting from the Mind Alive product. Kelly had suffered two massive strokes in February 2011. For many months, he was in speech therapy and a class in re stimulating his brain activity. The day before we received the Mind Alive Kelly had stormed out of his therapy session in tears because he could not understand a problem. When the DAVID Delight device arrived, I read the manual which was very insightful and helpful and followed the directions and put to use on Kelly. We started on the first setting. After an hour it had helped keep his mind calm and had boosted his physical energy. It was quite clear after one session that this product was extremely helpful in gently guiding the brainwaves towards a more relaxed state. From that day forward Mind Alive become a useful part of my husband's daily routine that not only helped his personal well being but mine as well.

The next day we went to Kelly's class and the therapist asked Kelly if he was done throwing his tantrum and Kelly said yes. She presented the same problem and this time Kelly was much more patient and he was able to focus and solved the complication.

The Mind Alive device helped Kelly stimulate areas of the brain to work together in a healthful and harmonious way. Mind Alive has also helped Kelly with his anxiety, severe depression and fatigue. He has also been in a much better mood, relaxed, focused and speaks with more clarity.

Although my husband is on permanent disability people who meet him are surprised when he references he suffered two strokes. Mind Alive was the best purchase I ever made and certainly a primary factor on his incredible road to recovery.

Thanks again Rick, for caring about Kelly and recommending this product which truly did keep his Mind Alive.

Sincerely,

Mrs. A. Jordan
Richardson, Texas

A Final Word

Audio-visual stimulation will continue to be an important part of our therapy protocols and we will no doubt be applying cautiously a number of frequency, LED color, and sound variations in the clinic. Increasing use of fMRI, MEG, and the new high resolution SPECT scanners will enable researchers to delineate very specific areas activated or suppressed by AVE. It is also quite probable that as AVE protocols are compared at conferences and through internet communication they will become increasingly more selective and effective.

Audio-visual entrainment (AVE) is another form of AVE. AVE is the more common form of light and sound stimulation which the stimulation is much more tightly controlled in frequency than AVE. However, this study, utilizing randomized AVE, in other words, AVE, shows that there are intrinsic properties of audio-visual stimulation of itself. These properties include increases in cerebral blood flow, neurotransmitters, neuronal excitation, restoration of the thalamocortical loop and glial activation.

Effects of AVE and AVE show brain enhancements similar to that seen in concussion and multiple head injuries of the diffuse axonal type. A recent study by Iaccarino, et al (2016) found that Alzheimer's mice were lacking gamma brain wave activity. AVE stimulation for one hour at 40 Hz, produced a 60% reduction in beta-amyloid deposits, four hours later and micro-glia diameters swelled by 167%. For reasons not yet known, gamma AVE activates microglia to rapidly consume beta-amyloid deposits. A recent A national protocol and treatment database is badly needed to encourage standardization of treatments, both to encourage the safe use of AVE and to make systematic research in this field more viable and practical.