FEATURE

The Application of Audiovisual Entrainment for the Treatment of Seniors' Issues, Part 2

David Siever

Mind Alive Inc., Edmonton, Alberta, Canada

Keywords: older adults, audiovisual entrainment, cognitive deficits, depression, falls

As the North American population continues to age, cognitive decline in older adults is becoming an ever-growing concern. Aging is accompanied by a decrease in cerebral blood flow, slowing of the brain's alpha rhythm, and increased theta activity. These changes correlate with cognitive decline—spanning memory, problem-solving ability, difficulty with language, and speech—and with impairments in locomotion. The left hemisphere of the brain loses functionality before the right side, and coupled with fears and feelings of helplessness, this produces depression. Preliminary studies of audiovisual entrainment (AVE) have shown this technique to be promising in the treatment of age-related issues common in senior citizens. AVE appears to rehabilitate cognitive function in seniors, improve mood, and reduce the risk of falls. The best application of AVE may be as a prophylactic against these maladies of aging.

Studies Utilizing Audiovisual Entrainment for Improving Cognitive Ability and Balance

One of the first studies utilizing audiovisual entrainment (AVE) for improving cognition in a senior was by Tom Budzynski (2000). He used both neurofeedback and AVE to improve mental function in a 75-year-old man. In a further study using an AVE unit (the DAVID Paradise XL) and a 10-station multiple system delivering the same audiovisual stimulation to 10 individuals simultaneously, Budzynski and Budzynski (2001) treated 31 seniors from two seniors' homes in Seattle, Washington. They used audiovisual stimulation (AVS) sessions in the form of random-frequency stimulation from 9 to 22 Hz over an average of 33 treatments to rejuvenate brain function. Because 10 people were treated at a time, treatment was very cost-effective as compared with one-on-one therapy such as cognitive rehabilitation or neurofeedback. A computer-based continuous performance test, the Microcog (Harcourt Assessment, San Antonio, TX; www.harcourtassessment.com), was used to assess mental function (Elwood, 2001).

The Microcog measures attention, reasoning ability, memory, spatial ability, reaction times, processing speed, processing accuracy, cognitive function, and cognitive proficiency. Roughly 60% to 70% of all seniors in the study (Figure 1) showed improvements on these measures. Figure 2 shows the average group improvements on the various measures within the Microcog.

Within the group was one woman with rapidly progressing dementia of the Alzheimer's type. Because of the

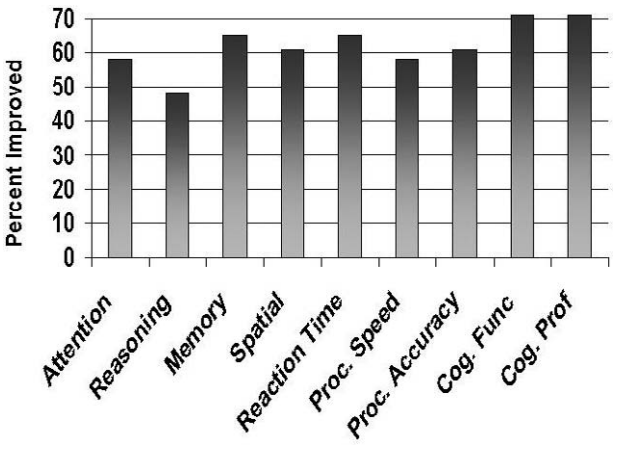

Figure 1. Microcog results following audiovisual entrainment: percentage of seniors with improvement.

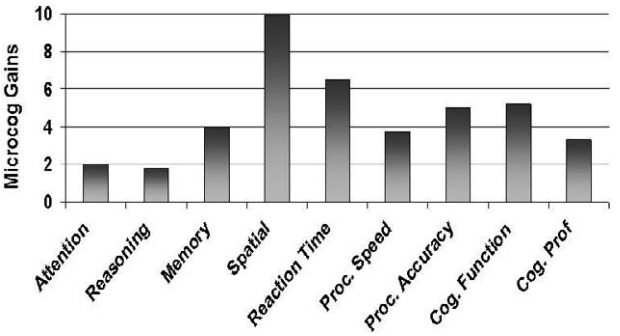

Figure 2. Microcog results following audiovisual entrainment: amount of improvement.

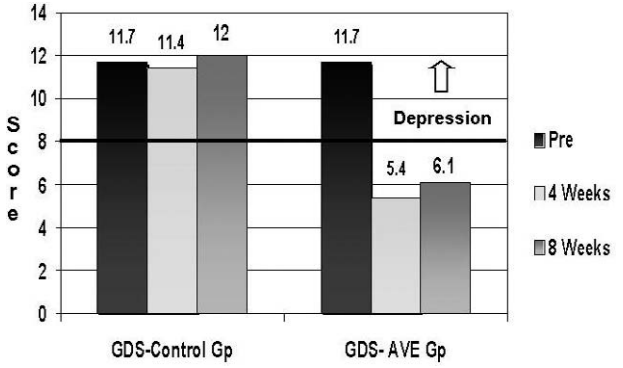

Figure 3. Geriatric Depression Scale.

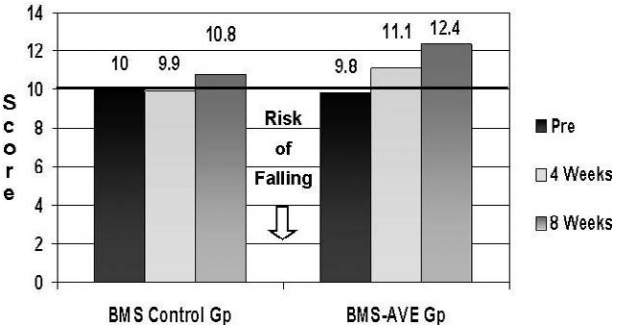

Figure 4. Balance mean scores.

severity of her dementia, a full quantitative electroencephalogram and low-resolution brain electromagnetic tomography (LORETA) assessment was performed. The LORETA is a technique that provides a three-dimensional view into the subcortical structures of the brain (Pascual-Marqui, 2002). According to the LORETA, the AVS appeared to produce improvement in various brain regions that are involved in the progression of dementia of the Alzheimer's type (DAT). The results appeared during the first AVS stimulation period and lasted through the continuation of the 30-session treatment period (Budzynski, Budzynski, & Sherlin, 2002). Specifically, the LORETA showed decreases in abnormal delta in the left temporal lobe and in the superior temporal gyrus, and these changes continued beyond the 30-session treatment. In other words, AVS halted the progression of her DAT and reversed its effects to some degree. This is the first evidence that AVS and perhaps AVE could be used as a prophylactic against age-related dementia.

Seniors and Locomotion

Experts in geriatric health frequently hypothesize a link between depression and a higher incidence of falling. Interventions to eliminate falling and the risk of falls by reducing depressive symptoms have been only partly successful among the elderly living in the community. Successful studies have used multifaceted approaches including exercise programs, home modifications, fall-prevention education, improvements in vision and hearing, alcohol abuse awareness, and introduction of safer footwear (Rubenstein, Robbins, Josephson, Schulman, & Osterweil, 1990; Steinberg et al., 2000; Tinetti et al., 1994). However, a perceived problem with interpreting the findings of multifactorial interventions is that it is not always possible to determine which component of the intervention program was more effective in reducing depressive symptoms (Cumming, 2002). This is a particular concern for public health professionals who want to plan cost-effectiveness fall-prevention strategies for whole populations of elderly persons.

This author and a colleague conducted a study to develop and assess the effectiveness of a single intervention, particularly one that will decrease depressive symptoms and reduce falls in the elderly living in the community (K. Berg & D. Siever, unpublished data). This intervention, which involves entraining brain waves, is commonly known as audiovisual entrainment (AVE). AVE differs from AVS in that AVE involves stimulation for several minutes of a nonchanging or only slightly changing frequency whereas AVS often employs fairly random frequencies. When using AVE, the frequency of the auditory and visual stimulation is clearly visible in the EEG of the brain of the person who is receiving the stimulation, whereas this is not true for AVS.

Evidence in the literature demonstrates a link between AVE and the reduction of depression (Berg & Siever, 2000; Kumano et al., 1996). However, the precise relationship between AVE and falling remains unclear. It is plausible that a cognitively intact older person who falls or almost falls could reduce his or her chances of future falls by improving his or her precipitating depressive symptoms. The most common origin of depression is related to hypoactivation of the left frontal lobe function (Davidson, Abercrombie, Nitschke, & Putnam, 1999; Rosenfeld, 1997), which is observed as heightened alpha activity. This heightened left alpha creates an alpha asymmetry between the left and right frontal lobes, resulting in the right side being hyperactivated in relation to the left, with the outcome being anxiety (Davidson et al., 1999). It is plausible that AVE adminis-

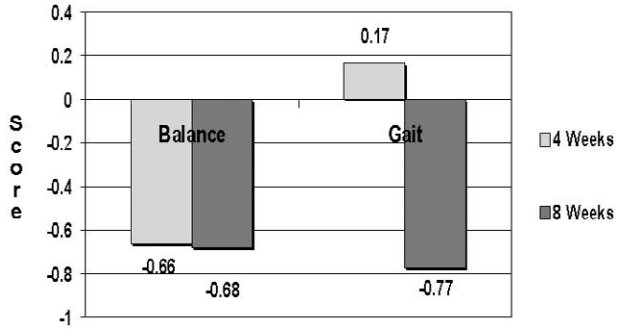

Figure 5. Correlation of balance and gait in relation to initial depression scores.

tered in such a way that inhibits left frontal lobe alpha will improve cognition simultaneously while reducing depression and anxiety. In this study, that is exactly what was done (anxiety, however, was not measured).

The study by Berg and Siever (unpublished), shown in Figures 3 and 4, used a stimulus at 18 Hz in the right visual fields and right headphone (left-brain stimulation) and provided a stimulus at 10 Hz in the left visual fields and left headphone (right-brain stimulation) during a 30-minute preprogrammed session. This approach apparently normalized the asymmetry in brain alpha activity that is typical of depression (Rosenfeld, 1997). As a result, depression recorded on the Geriatric Depression Scale was reduced significantly (Figure 3).

Balance and gait were measured using the Tinetti Assessment Tool (Tinetti, 1986). Figure 4 shows the improvement in balance as seen on the balance mean scores. As depression lifted, so did balance.

In the first month, balance improved considerably (p = .0055), which is seen as a negative correlation (Figure 5). Gait did not improve within the first 4 weeks (p = .112). However, gait did improve once the fear of falling was reduced and confidence was restored. On average, about 4 weeks were required before the participants trusted themselves enough to begin walking with a straighter gait. Their gait continued to improve throughout the 8 weeks (p = .0001).

Conclusion

AVS has a fairly significant impact on cognitive function, as shown on the Microcog. AVE applying beta frequency stimulation from 18 to 20 Hz to the left hemisphere of the brain and alpha frequency at 10 Hz to the right hemisphere of the brain has a very significant impact in reducing depression while also simultaneously reducing the risk of falling by improving balance and gait. Further research using both AVS and AVE is warranted to develop additional applications in the elderly population and to further document the effectiveness of such technologies for cognitive rehabilitation, reducing depression, and reducing the risk of falling.

References

Berg, K., & Siever, D. (2000). *Audio-visual entrainment as a treatment modality for seasonal affective disorder*. Paper presented at the 31st annual meeting of the Association for Applied Psychophysiology and Biofeedback, Denver, CO.

Budzynski, T. (2000). Reversing age-related cognitive decline: Use of neurofeedback and audio-visual stimulation. *Biofeedback*, *28*, 19–21.

Budzynski, T., & Budzynski, H. (2001). *Brain brightening—Preliminary report, December 2001*. In-house manuscript, Edmonton, Canada, Mind Alive Inc.

Budzynski, T., Budzynski, H., & Sherlin, L. (2002). Short and long term effects of audio visual stimulation (AVS) on an Alzheimer's patient as documented by quantitative electroencephalography (QEEG) and low resolution electromagnetic brain tomography (LORETA) [Abstract]. *Journal of Neurotherapy*, *6*, 1.

Cumming, R. G. (2002). Intervention strategies and risk-factor modification for falls prevention: A review of recent intervention studies. *Clinics and Geriatric Medicine*, *18*, 175–189.

Davidson, R., Abercrombie, H., Nitschke, J., & Putnam, K. (1999). Regional brain function, emotion and disorders of emotion. *Current Opinion in Neurobiology*, *9*, 228–234.

Elwood, R. W. (2001) MicroCog: Assessment of cognitive functioning. *Neuropsychology Review*, *11*, 89–100.

Kumano, H., Horie, H., Shidara, T., Kuboki, T., Suematsu, H., & Kindschi, C. L. (1996). Treatment of a depressive disorder patient with EEG-driven photic stimulation. *Biofeedback and Self-Regulation*, *21*, 323–334.

Pascual-Marqui, R. (2002). Standardized low resolution brain electromagnetic tomography (sLORETA): Technical details. *Methods and Findings in Experimental and Clinical Pharmacology*, *24*(Suppl. D), 5–12.

Rosenfeld, P. (1997). EEG biofeedback of frontal alpha asymmetry in affective disorders. *Biofeedback*, *25*, 8–12.

Rubenstein, L. Z., Robbins, A. S., Josephson, K. S., Schulman, B. L., & Osterweil, D. (1990). The value of assessing falls in the elderly population: A randomized clinical trial. *Annals of Internal Medicine*, *113*, 308–316.

Steinberg, M., Cartwright, C., Peel, N., & Williams, G. (2000). A sustainable program to prevent falls in an elderly population: A randomized clinical trail. *Journal of Epidemiological Community Health, 54,* 227–232.

Tinetti, M. E. (1986). Performance-oriented assessment of mobility problems in elderly patients. *Journal of the American Geriatric Society, 34,* 119–126.

Tinetti, M. E., Baker, D. I., McAvay, G., Claus, E. B., Garrett, P., Gottschalk, M., et al. (1994). A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *New England Journal of Medicine, 331,* 821–827.

David Siever

Correspondence: David Siever, Mind Alive Inc., 9008-51 Avenue, Edmonton, Alberta, Canada, T6E 5X4, e-mail: info@mindalive.com.