

BIOFEEDBACK TO RELAX AND REEDUCATE THE CILIARY MUSCLE: MILESTONES IN RESEARCH

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VISION FUNCTION	PARAMETERS	REFERENCE
MYOPIA	Biofeedback of ciliary muscle relaxation and reeducation training, with the Accommotrac® Vision Trainer (AVT) substantially reduced myopia.	Trachtman, Joseph N., Pelcyger, Scott M., and Venezia, Catherine M. Myopia reduction with biofeedback training of accommodation. <u>Journal of Behavioral Optometry</u>, 1999, 10(4), 87-93 This is a landmark paper reporting the summary of 1,334 patients treated with the AVT for myopia reduction by 22 independent hospital centers, clinics, optometrists, and ophthalmologists. The results demonstrated consistent and significant reductions in myopia.
VISUAL ACUITY: Long-Term Effects	The improved visual acuity after AVT treatment was found to be retained after seven years.	Trachtman, Joseph N. Biofeedback of accommodation to reduce myopia: A seven year follow-up, presented at the American Academy of Optometry 1984 Convention, St. Louis, 1984 This presentation documented the long term benefits of the myopia reduction treatment on visual acuity with the AVT.
CONTRAST SENSITIVITY FUNCTION (CSF)	In athletes, the improvement in CSF is more in the high spatial frequencies than the low spatial frequencies.	Trachtman, Joseph N. <u>The etiology of vision disorders: A neuroscience model</u>. Anaheim, California: Optometric Extension Program Foundation, 1992 This book reported most of my research on biofeedback of accommodation with the AVT, and was published by the world's largest organization devoted to vision training.
VISUAL FIELD	After one training session, it is expected that the visual field will increase at least 10 degrees horizontally.	Trachtman, Joseph N. Biofeedback dell'accomodazione per migliore la performance sportiva (Biofeedback of accommodation as a means of improving athletic performance). in <u>Sports Vision</u>, Vittorio Roncagli (editor), Bologna, Italy: Calderini, 1990, 196-213 This book chapter reports the research on the beneficial effects on athletic performance as a result of biofeedback of accommodation with the AVT.

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COLOR VISION	An improvement in color vision is expected after one AVT session.	Central foveal fixation and color vision. Jim Chung, Aviation High School and Joseph N. Trachtman, presented at the New York Academy of Sciences published in Trachtman, Joseph N. The etiology of vision disorders: A neuroscience model . Anaheim, California: Optometric Extension Program Foundation, 1992 This study reported on the change/improvement in color vision after AVT training.
FINGER TEMPERATURE (AS A INDEX OF GENERAL RELAXATION)	When comparing pre- and post-AVT treatment finger temperatures, post-AVT treatment temperatures were higher.	Visual accommodation and hand temperature. Kinga Cieloszyk, Brooklyn Technical High School and Joseph N. Trachtman, presented at the New York Academy of Sciences published in Trachtman, Joseph N. The etiology of vision disorders: A neuroscience model . Anaheim, California: Optometric Extension Program Foundation, 1992 This study reported on the general relaxation response noted with the AVT.
ALPHA BRAIN WAVES AND PARALLEL PROCESSING I	With Theta brain waves being related to the periphery, and Beta brain waves to the center, it was suggested that Alpha brain waves occur during parallel processing	Beta brain waves and accommodation: Analysis of Parvo-Magno Mechanisms and the EEG. Wilson Chow, Clara Barton High School and Joseph N. Trachtman, presented at the New York Academy of Sciences published in Trachtman, Joseph N. The etiology of vision disorders: A neuroscience model . Anaheim, California: Optometric Extension Program Foundation, 1992 This study demonstrated that Theta brain waves are related to peripheral visual processing, and Beta brain waves are related to central visual processing.
ALPHA BRAIN WAVES AND PARALLEL PROCESSING II	Alpha brain waves were related to parallel processing, and slow motion perception.	Trachtman, Joseph N. and Kaseno, Stanley L. Electroencephalogram biofeedback for the 1992 U.S. Olympic Pistol Team, presented at the 1993 International Academy of Sports Vision meeting, Las Vegas, Nevada, April 24, 1993 This was the first report relating Alpha brain waves, accommodation, athletic performance, and slow motion perception.

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VISION AND THE HYPOTHALAMUS	The myriad interconnections among the vision system and other bodily functions are described in detail. Thus, explaining the multiple beneficial effects of AVT treatment.	Trachtman, Joseph N. Vision and the Hypothalamus. <i>Optometry</i> 2010 81(2): 100-15 This article represents 10 years of thought on the innumerable connections among the vision system, the hypothalamus, and the rest of the body. I consider this article my <i>Magnum Opus</i>. Incidentally, it is the 7th most downloaded article from the official journal of the American Optometric Association.
SPORTS VISION I	The importance of the role of relaxation and reeducation of the ciliary muscle in sports vision is explained.	Trachtman, Joseph N. Visual demands of minor league baseball players. <i>Sports Vision</i>, 1991, 7 (2), 8-11 Presented in the article are the various visual skills associated with good athletic performance.
SPORTS VISION II	Parallel processing of the brain waves, and relaxation and reeducation of the ciliary muscle are described in producing a high level perceptual state.	Trachtman, Joseph N. and Giambalvo, Vincent Training vision for Mach I - Vision training for jet fighter pilots, presented at the International Academy of Sports Vision, Las Vegas, June 8, 1991 By simultaneously providing biofeedback of the brain waves, relaxation of the ciliary muscle, and jaw and shoulder muscles, patients were train to process one visual stimulus, and four audio stimuli. The result was that the patients receiving the training were able to parallel process with a greatly expanded field of view.

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SPORTS VISION III	Recovery of lost vision functions by biofeedback training of relaxation of the ciliary muscle and the brain waves.	Trachtman, Joseph N. Rehabilitation of vision loss due to trauma to eye or brain: A preliminary report. International Journal of Sports Vision, 1998, 5(1), 19-25 A report of two patients who had a loss of vision as a result of vehicle accidents. One patient had a homonymous hemianopsia, and the other a contusion of the optic nerve. Each patient received 17 training sessions with ciliary muscle relaxation, and brain wave biofeedback. The results showed a completion restoration of their lost visual field.
SPORTS VISION IV	Future technological advances and training for peak athletic performance.	Trachtman, Joseph N. and Kluka, Darlene A. Future trends in vision as they relate to peak sport performance. International Journal of Sports Vision, 1993, 1(1), 1-7 Although written in 1991, the author were able to predict some future technological developments applicable to sports vision. One of the predictions was the development of mobile technology.
EMOTIONS	Via connections to the hypothalamus the vision system and the limbic system interact with each other.	Trachtman, Joseph N. and Venezia, Catherine M. Be happy see better or see better and be happy. Proceedings of the 1991 Association for Applied Psychophysiology and Biofeedback, Wheat Ridge, Colorado: Association for Applied Psychophysiology and Biofeedback, 1991, pp. 192-4 Trachtman, Joseph N. and Venezia, Catherine M. Be happy and see better or see better and be happy. Biofeedback and Self-Regulation, 1991, 16(3), 324-5 These articles explain the relationship between the vision and limbic systems.

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INTRAOCULAR PRESSURE (IOP)	Patients with IOP greater than 14 mm/Hg, has statistically significant lower pressure after biofeedback to relax the ciliary muscle.	Trachtman, Joseph N. The influence of accommodative biofeedback training on intraocular pressure. in Bioprovenya - Theory and Practice, Shtark, M. and Kall, R. (eds.), Novosibirsk, Russia, 1993 The proposed mechanism for the lowering of the IOP is the relationship between the sympathetic nervous system fibers in the eye and in the hypothalamus.
ACCOMMODATIVE MICROFLUCTUATIONS (OSCILLOPSIA)	Rapid blurring or jumping of objects in the field of vision is known as oscillopsia. Using biofeedback these visual disturbances can be markedly improved.	Trachtman, Joseph N. Accommodative microfluctuations: Diagnosis and treatment with biofeedback - A pilot investigation. International Journal of Sports Vision, 1995, 2(1), 36-44 Oscillopsia can manifest itself in various forms. One such manifestation is the coming in and out of focus of objects that are being viewed. The cause is an irregularity of the normal tremor of the ciliary muscle. Training with biofeedback to relax the ciliary muscle showed to be successful in eliminating the oscillopsia.
TINNITUS	Tinnitus, more commonly known as ringing in the ears, can be reduced by relaxation of the ciliary muscle.	Trachtman, Joseph N. Accommodation and Tinnitus, presented at the College of Optometrists in Vision Development, Bellevue, WA, April 12, 2018 One theory of tinnitus is that there is a dysfunction of the sympathetic nervous system. Relaxation of the ciliary muscle is accomplished by sympathetic nervous system stimulation. By training biofeedback to relax the ciliary muscle, there was a decrease in the incidence and magnitude of the tinnitus.

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HYPEROPIA	Biofeedback to relax and reeducate the ciliary muscle has benefits for hyperopic patients.	Trachtman, Joseph N. The etiology of vision disorders: A neuroscience model. Anaheim, California: Optometric Extension Program Foundation, 1992 Surprisingly just as there is a reduction in myopia with biofeedback training of the ciliary muscle, there was a reduction in hyperopia as well.
PRESBYOPIA	For a sample of 15 patients, there was an improvement in accommodation via biofeedback to relax and reeducate the ciliary muscle.	Trachtman, Joseph N. and Pelcyger, Scott M. Biofeedback of accommodation for presbyopia. presented at the American Academy of Optometry Meeting, December 15, 1986, Toronto, Ontario, Canada The most popular theory of presbyopia is that the lens of the eye becomes inflexible resulting in a loss of ocular accommodation. This theory is questioned in relation to the positive results of biofeedback training to relax and reeducate the ciliary muscle.
LEARNING PROBLEMS ● A.D.D./A.D.H.D. ● AUSTIC SPECTRUM DISORDER (ASD) ● DYSLEXIA	Many learning problems are a result of uncorrected vision disorders, with improper ciliary muscle function being one of these disorders.	Trachtman, Joseph N. Learning problems: Theoretical and practical considerations of information processing. Journal of Behavioral Optometry, 2000, 11(2), 35-39 Two of the most common vision disorders related to poor learning skills are improper accommodation function and diplopia.