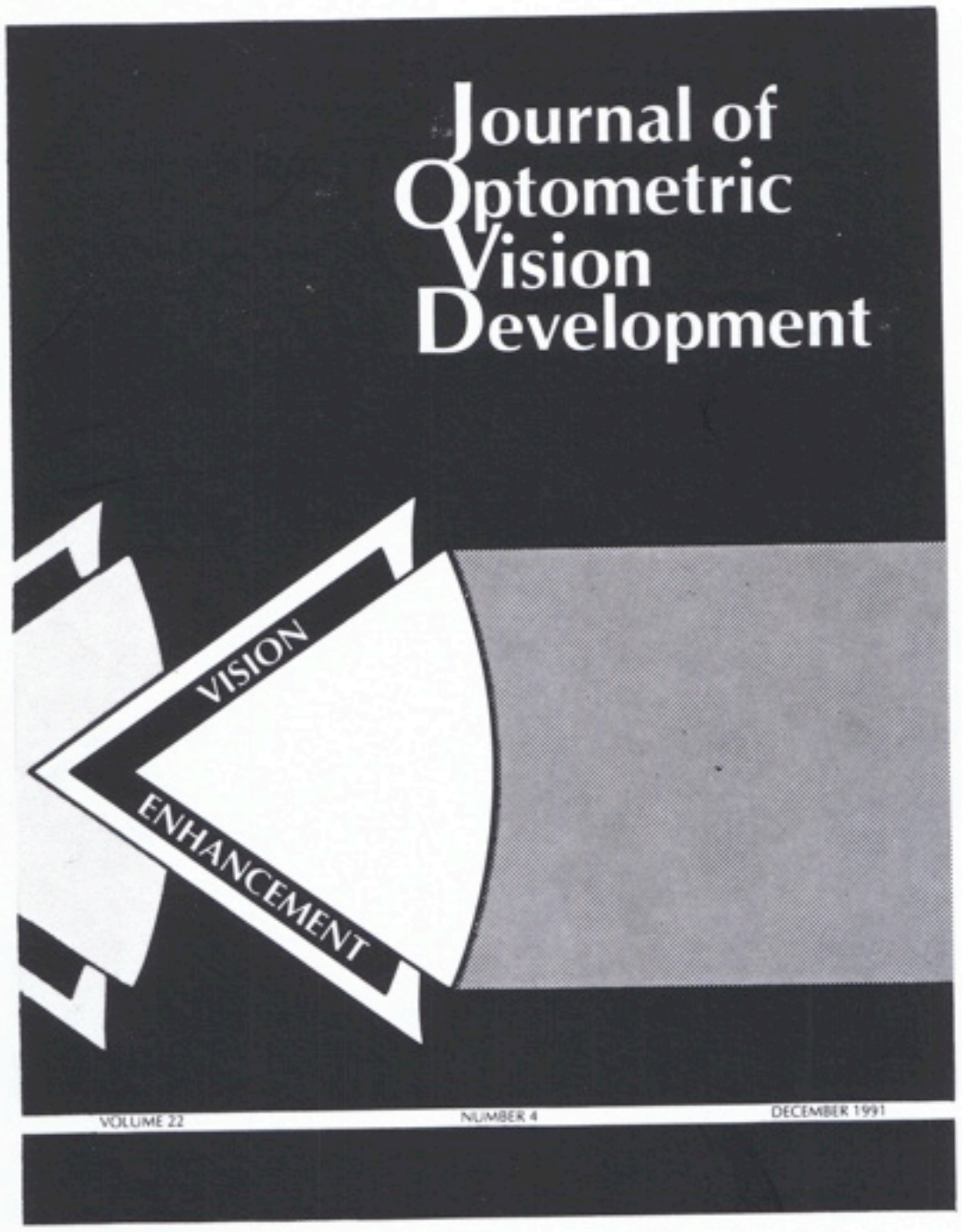

BIOFEEDBACK AND VISION
AN ANNOTATED BIBLIOGRAPHY

College of Optometrists in Vision Development
Biofeedback Committee

Joseph Trachtman, O.D., Ph.D. - Chairman
Richard Apell, O.D.
Richard Kavner, O.D.
William Ludlam, O.D.

Dr. Joseph N. Trachtman has received a Doctor of Optometry degree from the Pennsylvania College of Optometry, a Master of Education degree from Johns Hopkins University, and a Master's in Vision Science degree from the State University of New York, College of Optometry. He also holds a Ph.D. in Experimental Psychology from Yeshiva University, where the topic for his research was the use of biofeedback to reduce functional myopia.

He continues his research into environmental causes of nearsightedness at the City College of the City University of New York. Currently, Dr. Trachtman is engaged in private practice, and in several research projects dealing with relating vision to other brain activity. The most recent research project is investigating access to hypothalamic activity via the vision system.

He regularly contributes articles to professional journals and has himself been written about - in the books 20/20 IS NOT ENOUGH by Drs. Seiderman and Marcus and THE GAME ACCORDING TO SYD by Syd Thrift as well as in numerous magazines, inlcuding GO, OMNI, and CITY SPORTS. He and his work are the Health and Medicine feature in the 1990 SPINOFF, an annual NASA publication.

Richard J. Apell, O.D. retired fron the Gesell Institute of Human Development at the end of 1989. He was head of the Optometric Department and Co-Associate Director at the time of his retirement. He was avticely involved with the institute since 1950 and had served as co-director of the institute and treasurer in the past. He is currently Associate Director, Emeritus of the Gesell Institute.

Dr. Apell is the OEP Foundation's Northeast Regional Chairman and has served as OEP State Director of Connecticut as well.

Dr. Apell has authored numerous articles for optometric publications, including co-authoring with John Streff, O.D., "Lens Application" which appeared in the OEP Foundation's Curriculm II courses. Together, with Ray Lowry, O.D. they authored the book, Preschool Vision, published by the A.O.A.

Dr. Apell has won the Association of Optometric Editor's Award for Best Article of the Year, the G.N. Getman Award for Excellence in Developmental Optometry, and was chosen the Connecticut Optometrist of the Year in 1978. In addition to these honors Dr. Apell was also the H. Ward Ewalt Lecturer for the Pennsylavia Optometrists Association and the Lawrence W. MacDonald Lecturer.

In his retirement, Dr. Apell is an Optometric Consultant and supplies equipment and behavioral optometry materials to the profession.

Richard S. Kavner, O.D., F.A.A.O., is the author of Pleoptic's Handbook; Published by the Optometric Center of New York - 1967 Total Vision - A&W Publishers 1978 Your Child's Vision - Simon & Schuster 1985

He is a fellow of the American Academy of Optometry - 1965 to Present and a member of the American Optometric Association and the Optometric Extention Program

He served as Optometric Consultant to Liberty School System, Liberty, New York 1967 Optometric Consultant - St. Joseph's Home for the Deaf 1967 Professional Advisory Board - Brain Injured Children's Association 1968 Chairman of Vision Therapy Department - Optometric Center of New York 1966 - 1970 Consultant of N.Y.C. Board of Eucation District #11 1976 - 78 First Chairman Diplomate Program in Binocular Vision - American Academy of Optometry Chairman of Sports Vision Section - American Optometric Association 1982 - 1984

Dr. William M. Ludlam received his undergraduate education at New York University and his optometric education from Columbia University and Massachusetts College of Optometry.

He was one of the founders of the Optometric Center of N.Y. which opened its doors to patients in 1956. He served as Director of the Orthoptic Clinic at Harlem Eye and Ear Hospital from 1958 to 1964. He was also on staff at St. Lukes Hospital during this time period. Bill was Chief of vision training services at the Optometric Center of N.Y. from 1956 to 1968 and begining in 1965 headed up the research department until he left to relocate in Oregon in 1973.

During this time period he began publishing papers in scientific and professional journals and has over 50 articles in print as well as being a contributing author in several books.

Private practice has always been a priority and Bill has been in private practice since 1954, first in New York and for the past 14 years in Oregon.

When the Optometric Center of New York began offering residents in specialty areas Bill was involved in teaching. Later when the N.Y. legislature mandated the State University of N.Y. State College of Optometry he was one of the original faculty. He now is a professor of Optometry at Pacific University College of Optometry in Forest Grove Oregon. He served as visiting Professor, Massachusetts College of Optometry from 1971 to 1973 and adjunct Professor at Southern College of Optometry from 1979 to 1981.

Bill serves as vision consultant to insurance companies and businesses. He has been heavily involved in professional optometry through the AOA, his state and local associations, the American Academy of Optometry, the Optometric Extension Program Foundation and C.O.V.D. He is a fellow of C.O.V.D., a fellow of the American Association for the Advancement of Science and a fellow of the Optical Society of America. He has served on the State Board of Examiners in New York and is currently on the National Board of Examiners. Bill served on the editorial council of the American Journal of Optometry and Archives of the American Academy of Optometry from 1968 to 1973. He was appointed by the Governor of Oregon to the Oregon Commission for the Blind from 1979 to 1985.

The first award he received was for research at Columbia University in 1954. His profession further recognized his contributions by the Distinguished Service Award, N.Y. Academy of Optometry 1965, Scientific Article of the year (Optometric Editors) 1966, N.J. chapter American Academy Optometry Scientific Contribution 1971, Distinguished Service Award, N.Y. State Optometric Assoc. 1972, Optometrist of the Year, Oregon Optometric Assoc. 1975, Skeffington Award for Excellence in Scientific Writing from C.O.V.D. in 1977, and a Founder of National Academy of Practice in Optometry 1985.

Bill and his wife-vision therapist Diana travel extensively conducting seminars and lecturing on functional Optometry. They have addressed groups in most of the 50 states as well as Australia, New Zealand, South Africa, Japan, Canada, Mexico, Germany and England.

Woodcarving occupies some of his spare moments and he has had a one-man showing of his sculptures at Pacific University. Bill also enjoys his horses, working with his Herefords and managing the woodland preserve he and Diana and Mandie call home.

All this not withstanding, Optometry remains his avocation as well as his profession.

INTRODUCTION

The following review is provided as a guide to published articles on the topic of biofeedback and vision. Each topic was reviewed by a computerized literature search of the Dissertation Abstracts International, Medline, National Technical Information Service, and Psychological Abstracts data bases. The key words entered for the searches were biofeedback with: accommodation, amblyopia, myopia, nystagmus, strabismus, and vision. An additional section was placed in the accommodation section, where articles from other sources were inserted. Two authors, whose works have not appeared in the optometric literature, were also given a separate listing. An extensive bibliography of reports on the topic of biofeedback and vision is provided at the end of the review.

Key Words: Biofeedback, Accommodation, Amblyopia, Myopia, Nystagmus, Strabismus, Vision

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BIOFEEDBACK WITH ACCOMMODATION (DISSERTATION ABSTRACTS INTERNATIONAL)

AN UNIVERSITY MICROFILMS ORDER NUMBER ADG78-13485. 9000.
AU TRACHTMAN-JOSEPH-NORMAN.
TI BIOFEEDBACK OF ACCOMMODATION TO REDUCE FUNCTIONAL MYOPIA.
IN YESHIVA UNIVERSITY (0266) PH.D. 1978, 114 PAGES.
SO DAI V39(02), SECB, PP1021.
YR 1978.
DE PSYCHOLOGY-EXPERIMENTAL (0623).

BIOFEEDBACK WITH ACCOMMODATION (MEDLINE)

AU Trachtman-J-N.
TI Biofeedback of accommodation to reduce myopia: a review.
SO Am-J-Optom-Physiol-Opt. 1987 Aug. 64(8). P 639-43. (Review).
JT AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS.
LG EN.
AB Since the first report in 1970 of biofeedback to train voluntary control of accommodation, the use of biofeedback to train accommodation has progressed from basic research demonstrations to the clinical treatment of myopia. The initial reports showed that voluntary control of accommodation could be trained easily and accurately. The next series of investigations were into the efficacy of the technique for training low (less than 1.00 D), functional myopes. The research showed that functional myopia could be reduced with biofeedback training of accommodation. Finally, the technique has expanded into training for a wide range of myopes from children to senior citizens. The results demonstrate the effectiveness of biofeedback in reducing myopia by training voluntary control of accommodation. Author-abstract. 43 Refs.

AU Gallaway-M. Pearl-S-M. Winkelstein-A-M. Scheiman-M.
IN Pennsylvania College of Optometry, Philadelphia.
TI Biofeedback training of visual acuity and myopia: a pilot study.
SO Am-J-Optom-Physiol-Opt. 1987 Jan. 64(1). P 62-71.
JT AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS.
LG EN.
AB Biofeedback training of accommodation was performed with nine subjects using the Accommotrac Vision Trainer to attempt to improve visual acuity (VA) and reduce myopia. A single-subject research design was used. Improvements in VA were seen with some subjects, but it is not clear whether the improvements were due to the biofeedback training alone, or to a learning effect observed during repeated measurements of VA. There was no change in refractive error. Implications for future research are discussed. Author-abstract.

* Trachtman, J., Giambalvo, V. and Pelcyger, S. A critique of Gallaway et al. Accommotrac Vision Trainer, Clinical Instruction Manual, 2nd Edition, New York:Biofeedtrac Inc., 1988

A critical evaluation of the report published by Gallaway et al. (1987),

which was refused publication by the American Journal of Optometry as a Letter to the Editor. The critique points out that according to the data reported, there were reductions in myopia as a result of the biofeedback training. Additional flaws in the paper, including numerous methodological errors are discussed in detail.

AU Trachtman-J-N. Giambalvo-V. Feldman-J.
IN The City College of the City University of New York.
TI Biofeedback of accommodation to reduce functional myopia.
SO Biofeedback-Self-Regul. 1981 Dec. 6(4). P 547-62.
JT BIOFEEDBACK AND SELF REGULATION.
LG EN.
AB Functional myopia may be defined as the refractive condition of the eye due to spasm of the ciliary muscle. As a result of the ciliary muscle spasm, the crystalline lens becomes more convex, creating a myopic refractive condition. The normal increase and decrease in the refractive power of the crystalline lens is know as accommodation and is controlled by the autonomic nervous system innervation to the ciliary muscle. Previous studies have reported that voluntary control of accommodation is possible by biofeedback training (Cornsweet & Crane, 1973; Randle, 1970). The present research investigated the application of biofeedback control of accommodation to reduce functional myopia. A double-reversal, multiple-baseline design was used to conduct the experiment. The results revealed that the three adult male subjects achieved the preset criterion, a 1/2-diopter reduction from initial baseline to a subsequent baseline. Further analysis of the data revealed even greater changes between initial baseline and feedback periods. Although generalization to a nonexperimental environment was not trained, each subject showed a reduction in myopia and an increase in visual acuity. The results of the experiment clearly demonstrated that functional myopia is subject to voluntary control. Author-abstract.

AU Trachtman-J-N.
TI Biofeedback of accommodation to reduce functional myopia: a case report.
SO Am-J-Optom-Physiol-Opt. 1978 Jun. 55(6). P 400-6.
JT AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS.
LG EN.
AB A 30-yr-old man received biofeedback training of his accommodation to reduce his functional myopia. There were seven training sessions for a total time of 34 min. Each training session consisted of a baseline-level recording period followed by a feedback period, a second baseline-level recording period, and then a second feedback period. Reduction of the functional myopia was learned within a few minutes. Since the training was conducted in a dark environment, myopia reduction was not expected in an illuminated environment. Nonetheless, some generalization was demonstrated with a reduction in the subjective measures of myopia (about 1 D for the right eye, 0.50 D for the left eye) and improvement in unaided visual acuity (from about 20/50 to 20/30 for each eye). Author-abstract.

BIOFEEDBACK WITH ACCOMMODATION (NATIONAL TECHNICAL INFORMATION SERVICE)

AU CUSHMAN-W-B.
IN NAVAL AEROSPACE MEDICAL RESEARCH LAB., PENSACOLA, FL.
065612000 406061.
TI SCHEINER-PRINCIPLE POCKET OPTOMETER FOR SELF-EVALUATION AND BIOFEEDBACK ACCOMMODATION TRAINING.
NT INTERIM REPT. 1987-1988. 14 PAGES.
YR 19 APR 1989.
AB MOST HUMANS TEND TOWARD MYOPIA WHEN PRESENTED WITH A VISUAL FIELD WITHOUT SUFFICIENT DETAIL TO STIMULATE FOCUSING MECHANISMS. THIS MEANS THAT A PILOT FLYING IN DARKNESS, OR IN AN 'EMPTY FIELD' SUCH AS EMPTY SKY, WILL BE LIKELY TO FOCUS NEARER THE WINDSCREEN THAN AT THE OPTICAL INFINITY REQUIRED TO FOCUS ON VISUAL TARGETS OF PROBABLE INTEREST.
BIOFEEDBACK TRAINING TO COUNTER THS PROBLEM HAS BEEN LIMITED IN PRACTICAL APPLICATION BY EXPENSIVE AND CUMBERSOME INSTRUMENTATION.
A SCHEINER-PRINCIPLE OPTOMETER HAS BEEN DEVELOPED FOR SELF-EVALUATION OF ACCOMMODATIVE STATE AND BIOFEEDBACK TRAINING. THE SPECIFIC ADVANTAGES OF THE NEW INVENTION OVER EARLIER OPTOMETERS ARE: (A) SIMPLICITY OF DESIGN; (B) HAND HELD, PORTABLE IMPLEMENTATION; (C) LIGHT WEIGHT; (D) SMALL SIZE; (E) LOW MANUFACTURING COST; (F) THE USE OF A MONOCHROMATIC LIGHT SOURCE TO ELIMINATE THE EFFECTS OF CHROMATIC ABERRATIONS IN THE SUBJECT'S EYE; AND (G) EFFECTIVENESS AS A TRAINING AID. FOUR PROTOTYPES OF THE POCKET OPTOMETER HAVE BUILT AND WERE USED TO IMPLEMENT BIOFEEDBACK TRAINING TO CORRECT NIGHT MYOPIA IN 12 NAVY AVIATION CANDIDATES. ALL SUBJECTS WERE EMMOTROPIC IN FULL LIGHT. TRAINING WAS LIMITED IN DURATION DUE TO THE TRANSIENT NATURE OF SUBJECT AVAILABILITY BUT WAS REASONABLY SUCCESSFUL IN 10 OUT OF THE 12 CASES.

AU JONES-D-R. HARTMAN-B-O.
IN SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TX.
023467000 317000.
TI BIOFEEDBACK TREATMENT OF AIRSICKNESS: A REVIEW.
NT 4 PAGES THIS ARTICLE IS FROM 'THE AEROSPACE MEDICAL PANEL SYMPOSIUM ON MOTION SICKNESS: MECHANISMS, PREDICTION, PREVENTION, AND TREATMENT HELD AT WILLIAMSBURG, VIRGINIA ON 3-4 MAY 1984,' AD-A152 548, P42-1-42-4.
YR NOV 1984.
JN U8518.
AB THE AIM OF BIOFEEDBACK IS TO ASSIST THE PATIENT IN FOCUSING ON THE AWARENESS OF SOME CLUSTER OF INTERNAL STATE OR EVENTS, IN DEVELOPING SKILLS TO MODIFY OR MODERATE THAT CLUSTER, AND THEN, IN THE SERVICE OF

BIOLOGIC UTILITY, TO ALLOW THAT AWARENESS TO FADE AWAY, SO THAT THE CLUSTER ONCE AGAIN HAS BEEN INTERNALIZED, WHILE THE SKILLS FOR ITS MODIFICATION OR MODERATION ARE MAINTAINED. IT IS THE ENHANCEMENT AND CONTROL OF BIOLOGICAL AWARENESS AS A STATE OF CONSCIOUSNESS. THE END PRODUCT, THEN, IS SELF-REGULATION OF INTERNAL EVENTS OR STATES WHICH PREVIOUSLY RESULTED IN DISTRESS. THE PROCESS IS MUCH LIKE THAT OF LEARNING A MOTOR SKILL, WHEREIN THE CONSCIOUS AWARENESS OF THE SEQUENCE OF MOTOR EVENTS IS HIGH EARLY IN THE LEARNING, BUT PROGRESSES TO AN INTERNALIZED, COORDINATED RESPONSE AS PROFICIENCY IS ACHIEVED. ACTIVE CONTROL OF AIRSICKNESS BY BIOFEEDBACK TRAINING IS POSSIBLE, AND OFFERS A NEW APPROACH TO THE CONTROL OF THIS DISTRESSING SYNDROME BEYOND PASSIVE ACCOMMODATION AND BEYOND MEDICATIONS.

BIOFEEDBACK OF ACCOMMODATION (OTHER SOURCES CHRONICALLY ARRANGED)

* 1970 * National Aeronautics and Space Administration (NASA) scientist, Robert Randle found that empty field myopia of NASA pilots could be put under voluntary control utilizing biofeedback of accommodation. SEE BIBLIOGRAPHY RANDLE (1970)

* 1973 * Professors Tom Cornsweet and Hewitt Crane, Stanford Research Institute, reported in Vision Research that utilizing a similar paradigm as Randle, they could teach subjects voluntary control of accommodation within a few hours. SEE BIBLIOGRAPHY CORNSWEET AND CRANE (1973)

* 1975 * Dr.Jay Enoch and his colleagues, noted that during an experiment measuring the Stiles-Crawford Effect, a patient learned to voluntarily control his entire amplitude of accommodation. SEE BIBLIOGRAPHY PROVINE AND ENOCH (1975)

* 1977 * Professor and Nobel Laureate Torsten Wiesel and his co-worker Professor Elio Raviola published in Nature their first report of experimentally produced myopia. SEE BIBLIOGRAPHY WIESEL AND RAVIOLA (1977)

* 1978 * Dr. Joseph Trachtman published his first article on the sucess of using biofeedback of accommodation to reduce functional myopia. The experiments utilized real-time computer recording of an objective, infra-red optometer. SEE BIBLIOGRAPHY TRACHTMAN (1978)

* 1983 * A review of biofeedback for ophthalmologic disorders is published in Survey of Ophthalmology by Michael Rotberg, M.D. SEE BIBLIOGRAPHY ROTBERG (1983)

* 1988 * Robert Randle once again demonstrated the ability of biofeedback of accommodation to produce a decrease in myopia. This particular demonstration was via completely objective measures. SEE BIBLIOGRAPHY RANDLE (1988)

* 1988 * Drs. McLin and Schor, conducting research at the University of California, Berkeley, reported that voluntary control of accommodation is readily learned and that it is dominant over convergence in the near response. SEE BIBLIOGRAPHY MCLIN AND SCHOR (1988)

* 1988 * The most recent research with myopia was a double-blind, control- group study by Daniel Gallagher, Ph.D., Fairliegh-Dickinson University, New Jersey. He reported that there was an average 0.50 diopter reduction in myopia in 8 training sessions. SEE BIBLIOGRAPHY GALLAGHER (1988)

BIOFEEDBACK WITH ACCOMMODATION
(PSYCHOLOGICAL ABSTRACTS)

AU TRACHTMAN-JOSEPH-N.
TI BIOFEEDBACK OF ACCOMMODATION TO REDUCE FUNCTIONAL MYOPIA.
SO DISSERTATION ABSTRACTS INTERNATIONAL.
1978 AUG VOL 39(2-B) 1021-1022.

AU ROSCOE-STANLEY-N.
COUCHMAN-DONALD-H.
IN ILLIANA AVIATION SCIENCES, LAS CRUCES, NM.
TI IMPROVING VISUAL PERFORMANCE THROUGH VOLITIONAL FOCUS CONTROL.
SO HUMAN FACTORS. 1987 JUN VOL 29(3) 311-325.
CD HUFAA6..
AB INVESTIGATED WHETHER IT IS POSSIBLE TO TRAIN GOOD EYES TO SEE BETTER, USING 9 UNDERGRADUATES WITH 20/20 VISION OR BETTER, WHO WERE TRAINED TO CONTROL EYE ACCOMMODATION VOLITIONALLY AND, BY EXERCISING THAT ACQUIRED ABILITY, TO IMPROVE BY VARYING AMOUNTS THEIR VISUAL ACUITY, CONTRAST SENSITIVITY, AND FLASH TARGET RESOLUTION. SIX SS RECEIVED AUDITORY BIOFEEDBACK OF FOCUSING RESPONSES MEASURED AUTOMATICALLY BY A COMPLEX INFRARED TRACKING OPTOMETER AND MONOCULAR FOCUS STIMULATOR; 3 SS USED A RELATIVELY SIMPLE POLARIZED VERNIER OPTOMETER THAT PROVIDES VISUAL FEEDBACK OF EYE ACCOMMODATION AND A SIMPLE BINOCULAR FOCUS STIMULATOR. RESULTS SHOW THAT PERFORMANCE IMPROVEMENTS WERE ELICITED BY BOTH METHODS, BUT LARGER GAINS WERE ATTAINED IN LESS TIME WITH THE SIMPLER APPROACH, IN WHICH TRAINING WAS MAINLY SELF-ADMINISTERED.

AU ROSEN-RAYMOND-C.
SCHIFFMAN-H-R. COHEN-ALAN-S.
IN UNIVERSITY OF MEDICINE & DENTISTRY OF NEW JERSEY-RUTGERS MEDICAL SCHOOL, PISCATAWAY.
TI BEHAVIOR MODIFICATION AND THE TREATMENT OF MYOPIA.
SO BEHAVIOR MODIFICATION.
1984 APR VOL 8(2) 131-154.
AB REVIEWS THE LITERATURE ON MYOPIA (NEARSIGHTEDNESS), A PREVALENT DISORDER OF VISION THAT HAS TRADITIONALLY BEEN MANAGED BY MEANS OF CORRECTIVE LENSES. RECENTLY, THERE HAS BEEN AN UPSURGE OF INTEREST IN THE USE OF VISION TRAINING PROGRAMS AS AN

ALTERNATIVE FORM OF TREATMENT AND IN THE APPLICATION OF BEHAVIOR MODIFICATION TECHNIQUES TO IMPROVE VISUAL ACUITY. THE MOST IMPRESSIVE EXPERIMENTAL WORK HAS BEEN IN THE AREA OF OPERANT CONDITIONING METHODS (PRINCIPALLY FEEDBACK AND FADING) ON MODIFICATION OF ACUITY, AND THIS RESEARCH IS REVIEWED IN DEPTH. ALSO CONSIDERED ARE RELEVANT STUDIES ON THE USE OF HYPNOSIS AND BIOFEEDBACK TRAINING OF ACCOMMODATION. RESEARCH IN THIS AREA IS TIMELY IN VIEW OF THE INCREASING INTEREST IN THE ROLE OF LEARNING FACTORS IN THE DEVELOPMENT AND MAINTENANCE OF MYOPIA. DESPITE A NUMBER OF METHODOLOGICAL PROBLEMS IDENTIFIED IN THIS REVIEW, THERE APPEARS TO BE CONSIDERABLE PROMISE IN THE APPLICATION OF BEHAVIOR MODIFICATION TO DISORDERS OF VISION. (61 REF).

BIOFEEDBACK WITH AMBLYOPIA
(MEDLINE)

AU Halperin-E. Yolton-R-L.
TI Ophthalmic applications of biofeedback.
SO Am-J-Optom-Physiol-Opt. 1986 Dec. 63(12). P 985-98. (Review).
JT AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS.
LG EN.
AB Biofeedback therapy has been shown to be of value in the treatment of numerous psychological and physiological problems. In this paper, applications of biofeedback for correction of oculomotor abnormalities including strabismus, nystagmus and amblyopia, refractive error correction, reduction of intraocular pressure (IOP), and blepharospasm suppression are reviewed. Author-abstract. 68 Refs.

AU Ciuffreda-K-J. Goldrich-S-G.
IN Department of Vision Sciences, State College of Optometry, New York.
TI Oculomotor biofeedback therapy.
SO Int-Rehabil-Med. 1983. 5(3). P 111-7. (Review).
JT INTERNATIONAL REHABILITATION MEDICINE.
LG EN.
AB Biofeedback therapy refers to the process of gaining voluntary control over some bodily function by the immediate use of information regarding its physiological state. In this paper we review the use of oculomotor biofeedback therapy in three common ocular disorders: nystagmus, strabismus, and amblyopia. Experimental and clinical test results have been encouraging. We believe oculomotor biofeedback therapy should be attempted, either alone or in conjunction with orthoptic and/or surgical procedures, in these and other ocular disorders manifesting an abnormal oculomotor component. Author- abstract. 49 Refs.

BIOFEEDBACK WITH MYOPIA
(DISSERTATION ABSTRACTS INTERNATIONAL)

AN UNIVERSITY MICROFILMS ORDER NUMBER ADG90-03805. 9005.
AU GALLAGHER-DANIEL-HUGH.
TI PERCEPTUAL AND PERSONALITY CORRELATES OF VISION GAINS FOR MYOPIC INDIVIDUALS RECEIVING BIOFEEDBACK TRAINING

(PERCEPTUAL CORRELATES).
IN FAIRLEIGH DICKINSON UNIVERSITY (0287) PH.D. 1988, 161 PAGES.
AR ADVISER: MASSOTH-NEIL.
SO DAI V50(11), SECB, PP5314.
YR 1988.
DE PSYCHOLOGY-CLINICAL (0622).
AB A review of the literature concerning the use of biofeedback in the treatment of myopia reveals inconsistent findings and a number of methodological flaws. Additionally, research to date suggests that perceptual and personality variables may predict treatment outcome of accommodative biofeedback. The current study examined acuity gains and refractive error decreases of biofeedback versus placebo groups. Further, the ability of several paper and pencil perceptual and personality tests were examined for predictive ability in vision improvement: Closure Speed Gestalt Completion, Hooper Visual Organization, Perceptual Speed, Embedded Figures, and Rotter's Locus of Control scales. A total of 24 adults (13 men and 11 women) were screened for myopia by an optometrist and then administered the pencil and paper tests. Participants were randomly assigned to true accommodative biofeedback or quasi-random feedback training. Eight training sessions took place over an average of fourteen weeks; pre- and post-session acuity measures were recorded using Landolt C slides. Pre- and post-treatment subjective refractive error and Snellen Letter acuity scores were recorded by an optometrist who was blind to group assignment. Participants who completed placebo training were offered true accommodative biofeedback; seven subjects completed this procedure.

MANCOVA analysis revealed that subjects who were trained on accommodative biofeedback achieved superior acuity gains and decreases in refractive error to placebo trained participants on all vision measures. Participants who received true biofeedback following placebo training demonstrated significant improvement on all acuity but not refractive error measurements. It was concluded that direct biofeedback of accommodative status is an effective treatment of myopia for adults.

An insufficient sample size limited interpretability of multiple regression analysis. Closure Speed Gestalt Completion and Perceptual Speed results were predictive of acuity gain scores but not refractive error decreases. Embedded Figures results were predictive of Refractive error improvement while Locus of Control scores predicted acuity gains. An interaction between Embedded Figures and Locus of Control was found to be predictive of both acuity and refractive error improvements thus supporting the usefulness of a higher order congruence- incongruence variable.

AN UNIVERSITY MICROFILMS ORDER NUMBER ADG78-13485.
9000.
AU TRACHTMAN-JOSEPH-NORMAN.
TI BIOFEEDBACK OF ACCOMMODATION TO REDUCE FUNCTIONAL MYOPIA.
IN YESHIVA UNIVERSITY (0266) PH.D. 1978, 114 PAGES.
SO DAI V39(02), SECB, PP1021.
YR 1978.
DE PSYCHOLOGY-EXPERIMENTAL (0623).

BIOFEEDBACK WITH MYOPIA (PSYCHOLOGICAL ABSTRACTS)

AU ROTBERG-MICHAEL-H.
SURWIT-RICHARD-S.
TI BIOFEEDBACK TECHNIQUES IN THE TREATMENT OF VISUAL AND OPHTHALMOLOGIC DISORDERS: A REVIEW OF THE LITERATURE.
SO BIOFEEDBACK & SELF REGULATION.
1981 SEP VOL 6(3) 375-388.

AU TRACHTMAN-JOSEPH-N.
TI BIOFEEDBACK OF ACCOMMODATION TO REDUCE FUNCTIONAL MYOPIA.
SO DISSERTATION ABSTRACTS INTERNATIONAL.
1978 AUG VOL 39(2-B) 1021-1022.

BIOFEEDBACK WITH NYSTAGMUS (PSYCHOLOGICAL ABSTRACTS)

AU ROTBERG-MICHAEL-H.
SURWIT-RICHARD-S.
TI BIOFEEDBACK TECHNIQUES IN THE TREATMENT OF VISUAL AND OPHTHALMOLOGIC DISORDERS: A REVIEW OF THE LITERATURE.
SO BIOFEEDBACK & SELF REGULATION.
1981 SEP VOL 6(3) 375-388.

BIOFEEDBACK WITH STRABISMUS (MEDLINE)

AU Halperin-E. Yolton-R-L.
TI Ophthalmic applications of biofeedback.
SO Am-J-Optom-Physiol-Opt. 1986 Dec. 63(12). P 985-98. (Review).
JT AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS.
LG EN.
AB Biofeedback therapy has been shown to be of value in the treatment of numerous psychological and physiological problems. In this paper, applications of biofeedback for correction of oculomotor abnormalities including strabismus, nystagmus and amblyopia, refractive error correction, reduction of intraocular pressure (IOP), and blepharospasm suppression are reviewed. Author-abstract. 68 Refs.

AU Ciuffreda-K-J. Goldrich-S-G.
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TI Oculomotor biofeedback therapy.
SO Int-Rehabil-Med. 1983. 5(3). P 111-7. (Review).
JT INTERNATIONAL REHABILITATION MEDICINE.
LG EN.
AB Biofeedback therapy refers to the process of gaining voluntary control over some bodily function by the immediate use of information regarding its physiological state. In this paper we review the use of oculomotor biofeedback therapy in three common ocular disorders: nystagmus, strabismus, and amblyopia. Experimental and clinical test results have been encouraging. We believe oculomotor biofeedback therapy should be attempted, either alone or in conjunction with orthoptic and/or surgical procedures, in these and other ocular disorders manifesting an abnormal oculomotor component. Author- abstract. 49 Refs.

AU Rotberg-M-H. Surwit-R-S.
IN Duke University Medical Center.
TI Biofeedback techniques in the treatment of visual and ophthalmologic disorders: a review of the literature.
SO Biofeedback-Self-Regul. 1981 Sep. 6(3). P 375-88. (Review). JT

BIOFEEDBACK AND SELF REGULATION.
LG EN.
AB The literature on the use of biofeedback techniques in the treatment of visual and ophthalmologic disorders is reviewed. Although this consists mainly of case studies, there is mounting evidence that biofeedback may be applicable to the treatment of strabismus, nystagmus, blepharospasm, elevated intraocular pressure, and myopia. because of the success in applying biofeedback techniques in the treatment of other neuromuscular disorders, it is concluded that the use of these techniques in the treatment of blepharospasm and strabismus shows the most promise. Author-abstract. 41 Refs.

AU van-Brocklin-M-D. Vasche-T-R. Hirons-R-R. Yolton-R-L.
IN Pacific University College of Optometry Forest Grove, Or.
TI Biofeedback enhanced strabismus therapy.
SO J-Am-Optom-Assoc. 1981 Sep. 52(9). P 731-6.
JT JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION.
LG EN.
AB Previous work, conducted under laboratory conditions, has shown that biofeedback using infrared eye position monitoring can be used to successfully treat strabismus. For the present study, seven matched pairs of strabismic patients were selected. One member of each pair received biofeedback enhanced vision therapy while the other member received traditional vision therapy. Cover test data obtained during each training session showed an advantage in using biofeedback enhanced training in several but not all cases. It is suggested that the optimum use of biofeedback may be prior to traditional training rather than integrated with it. Author-abstract.

AU Hirons-R. Yolton-R-L.
IN Pacific University, College of Optometry, Forest Grove, Or.
TI Biofeedback treatment of strabismus: case studies.
SO J-Am-Optom-Assoc. 1978 Aug. 49(8). P 875-82.
JT JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION.
LG EN.
AB This project demonstrates the use of neuromuscular reeducation biofeedback as a treatment for strabismus. Of the three subjects treated, an exotrope and an esotrope were cured according to pre-defined criteria and an exotrope with a dense monocular cataract was improved. Treatment consisted of monitoring eye positions using infrared sensors and feeding back information on relative ocular deviations coded in the form of a tone. Author-abstract.

BIOFEEDBACK WITH VISION
(MEDLINE)

AU Abplanalp-P. Bedell-H.
IN College of Optometry, University of Houston, Texas.
TI Visual improvement in an albinotic patient with an alteration of congenital nystagmus.
SO Am-J-Optom-Physiol-Opt. 1987 Dec. 64(12). P 944-51.
LG EN.
AB Biofeedback techniques were used to alter congenital nystagmus (CN) in an albino. In response to auditory cues, the patient was able to reduce the amplitude of the nystagmus by 50% or more. In response to a combination of auditory and visual cues, the patient

was able to alter the waveform of the nystagmus in such a manner that progressively larger portions of each cycle of the nystagmus were spent with the eye relatively stationary. Presumably as a consequence of this alteration in waveform, the patient's visual acuity (VA) improved from 6/35 to 6/25. The results indicate that, although VA in albinos is limited ultimately by the presence of foveal hypoplasia, other components of the typical albinotic syndrome (such as the accompanying nystagmus) can add to the acuity reduction and should, therefore, be treated. Author-abstract.

AU Mezawa-M. Yamada-T. Ukai-K. Ishikawa-S.
TI [Congenital nystagmus waveform and foveation observed using infrared television fundus camera].
SO Nippon-Ganka-Gakkai-Zasshi. 1987 Feb. 91(2). P 270-6.
LG JA.

AU Halperin-E. Yolton-R-L.
TI Ophthalmic applications of biofeedback.
SO Am-J-Optom-Physiol-Opt. 1986 Dec. 63(12). P 985-98. (Review).
LG EN.
AB Biofeedback therapy has been shown to be of value in the treatment of numerous psychological and physiological problems. In this paper, applications of biofeedback for correction of oculomotor abnormalities including strabismus, nystagmus and amblyopia, refractive error correction, reduction of intraocular pressure (IOP), and blepharospasm suppression are reviewed. Author-abstract. 68 Refs.

AU Timsit-C.
TI [These vestibular problems in the absence of gravity.].
TT Ces problemes vestibulaires sans gravite.

SO Ann-Otolaryngol-Chir-Cervicofac. 1986. 103(4). P 235-43.
JT ANNALES D OTO-LARYNGOLOGIE ET DE CHIRURGIE CERVICO-FACIALE.
LG FR.
AB For a few years, more and more astronauts complain to endure space motion sickness during the two or three first days of their mission. This is due to the repetition of shifting and sudden head movements, which becomes possible by the increasing of volume of the new space stations. To avoid that payload specialists onboard be obliged to renounce to conduct planned experiments, it has been necessary to find effective solutions to detect by ground based tests the candidates sensitive to space motion sickness and perfect therapeutic means able to avoid unexpected arrival of these symptoms, and even to treat them. The best results are undeniably obtained by the "Biofeedback" and the "tolerance" training, but we base wide hopes on ginger roots and on tolerance with sensorial deprivation lockers. However, we must not disregard the trigger action of emotional factors and anxiety in space motion sickness. The European mission SPACELAB-1 has been marked by the display of a caloric nystagmus during the vestibular experiments in weightlessness. If no explanation is given to this phenomenon, it will be necessary to call in question the role of the thermal convection described by Barany in the appearance of the caloric nystagmus. Author-abstract.

AU Ciuffreda-K-J. Goldrich-S-G.

IN Department of Vision Sciences, State College of Optometry, New York.
TI Oculomotor biofeedback therapy.
SO Int-Rehabil-Med. 1983. 5(3). P 111-7. (Review).
JT INTERNATIONAL REHABILITATION MEDICINE.
LG EN.
AB Biofeedback therapy refers to the process of gaining voluntary control over some bodily function by the immediate use of information regarding its physiological state. In this paper we review the use of oculomotor biofeedback therapy in three common ocular disorders: nystagmus, strabismus, and amblyopia. Experimental and clinical test results have been encouraging. We believe oculomotor biofeedback therapy should be attempted, either alone or in conjunction with orthoptic and/or surgical procedures, in these and other ocular disorders manifesting an abnormal oculomotor component. Author- abstract. 49 Refs.

AU Kirschen-D-G.
IN Jules Stein Eye Institute, Ucla School of Medicine.
TI Auditory feedback in the control of congenital nystagmus.
SO Am-J-Optom-Physiol-Opt. 1983 May. 60(5). P 364-8.
LG EN.
AB The control of oscillatory eye movements in congenital nystagmus was studied in five human subjects. Auditory feedback of eye position and eye motion was given to each subject to aid in controlling the abnormal eye movement. Less than one hour was needed for all the subjects to learn to use the auditory information. Reductions in eye movement amplitude ranged from 41 to 73%. Sensory functions like visual acuity and contrast sensitivity also improved under the auditory feedback condition. Auditory feedback of eye position is thought to have potential usefulness in the treatment of congenital nystagmus. Author-abstract.

AU Rotberg-M-H.
IN Duke University Eye Center, Duke University School of Medicine, Durham, North Carolina.
TI Biofeedback for ophthalmologic disorders.
SO Surv-Ophthalmol. 1983 May-Jun. 27(6). P 381-6.
JT SURVEY OF OPHTHALMOLOGY.
LG EN.
AB The possible applications of biofeedback to the treatment of ophthalmologic disorders is reviewed. Studies have suggested utility in the management of blepharospasms, strabismus, nystagmus, and other eye movement disorders as well as the training of voluntary control of accommodation. Limitations of the current literature are discussed, as are prospects for the clinical use of biofeedback in ophthalmologic practice. Author-abstract.

AU Ciuffreda-K-J. Goldrich-S-G. Neary-C.
IN State University of New York, State College of Optometry, Department of Vision Sciences, New York, New York.
TI Use of eye movement auditory biofeedback in the control of nystagmus.
SO Am-J-Optom-Physiol-Opt. 1982 May. 59(5). P 396-409.
JT AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS.
LG EN.
AB Eye movement auditory

biofeedback was used in weekly training sessions to control nystagmus in five adult patients. Within the 1st hr of training, all patients were able to reduce nystagmus. Average maximum group reduction of nystagmus amplitude, peak slow-phase velocity, and frequency achieved during training with auditory biofeedback was 82, 86, and 34%, respectively. At periodic intervals during training, audio information was withheld and patients were able to maintain reduced nystagmus for several minutes. In addition, patients were able to reduce nystagmus upon command without audio cues but with conscious effort while engaging in conversation and other tasks with the experimenters. Visual acuity improvement with conscious patient effort to control nystagmus but without auditory biofeedback averaged 10% Snell-Sterling. One of two patients who returned for post-training reevaluation was able to reduce his nystagmus quickly without auditory biofeedback to 50% of the pretraining level, and both patients were able with the aid of auditory cues to reduce their nystagmus rapidly to the level achieved during training. In addition to the improvement in vision, cosmetic and psychological benefits accrued. Eye movement auditory biofeedback should be considered in the treatment of nystagmus, either alone or in conjunction with orthoptic and/or surgical procedures.

AU Abadi-R-V. Carden-D. Simpson-J.
IN Visual Sciences Laboratories, Department of Ophthalmic Optics, U.M.I.D.T., Manchester, U.K.
TI Listening for eye movements.
SO Ophthalmic-Physiol-Opt. 1981. 1(1). P 19-27.
JT OPHTHALMIC AND PHYSIOLOGICAL OPTICS.
LG EN.

AU Rotberg-M-H. Surwit-R-S.
IN Duke University Medical Center.
TI Biofeedback techniques in the treatment of visual and ophthalmologic disorders: a review of the literature.
SO Biofeedback-Self-Regul. 1981 Sep. 6(3). P 375-88. (Review).
JT BIOFEEDBACK AND SELF REGULATION.
LG EN.
AB The literature on the use of biofeedback techniques in the treatment of visual and ophthalmologic disorders is reviewed. Although this consists mainly of case studies, there is mounting evidence that biofeedback may be applicable to the treatment of strabismus, nystagmus, blepharospasm, elevated intraocular pressure, and myopia. because of the success in applying biofeedback techniques in the treatment of other neuromuscular disorders, it is concluded that the use of these techniques in the treatment of blepharospasm and strabismus shows the most promise. Author-abstract. 41 Refs.

AU Genter-C-R 2d. Kandel-G-L. Geri-G-A.
TI Coincidence eye position device with applications in clinical psychophysics, eye-position training and visual evoked response recording.
SO Med-Biol-Eng-Comput. 1981 Jul. 19(4). P 509-13.
JT MEDICAL AND BIOLOGICAL ENGINEERING AND COMPUTING.
LG EN.

AU Ciuffreda-K-J. Goldrich-S. Neary-C.
IN State College of Optometry, State University of New York.
TI Auditory biofeedback as a potentially important new tool in the treatment of nystagmus.
SO J-Am-Optom-Assoc. 1980 Nov. 51(11). P 1037-9.
JT JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION.
LG EN.

AU Ciuffreda-K-J.
IN State College of Optometry State University of New York New York.
TI Auditory biofeedback as a potentially important new tool in the treatment of nystagmus.
SO J-Am-Optom-Assoc. 1980 Jun. 51(6). P 615-7.
JT JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION.
LG EN.

AU Abadi-R-V. Carden-D. Simpson-J.
IN University of Manchester Institute of Science and Technology, Department of Ophthalmic Optics, Manchester.
TI A new treatment for congenital nystagmus.
SO Br-J-Ophthalmol. 1980 Jan. 64(1). P 2-6.
JT BRITISH JOURNAL OF OPHTHALMOLOGY.
LG EN.
AB Congenital nystagmus is a disorder of eye movement with an associated reduction in visual acuity. The latter is mainly due to the intensity of the nystagmus (amplitude times frequency) allowing the object of regard to spend only a short time on the fovea. Training patients by an auditory feedback technique to control the nystagmus enables visual sensitivity to improve. This method is compared with present alternatives, and further studies are suggested. Author-abstract.

AU Abadi-R-V. Carden-D. Simpson-J.
IN The University of Manchester Institute of Science and Technology, Department of Ophthalmic Optics, England.
TI Controlling abnormal eye movements.
SO Vision-Res. 1979. 19(8). P 961-3.
JT VISION RESEARCH.
LG EN.

AU Zucha-I. Samak-I.
IN Psychiatric Clinic, Bratislava, Czechoslovakia.
TI A possibility to influence oculomotor activity by feedback.
SO Act-Nerv-Super (Praha). 1976. 18(3). P 204-6.
JT ACTIVITAS NERVOSA SUPERIOR.
LG EN.

RANDLE-ROBERT-J.AU.
(PSYCHOLOGICAL ABSTRACTS)

AU RANDLE-ROBERT-J.
TI RESPONSES OF MYOPES TO VOLITIONAL CONTROL TRAINING OF ACCOMMODATION.
SO OPHTHALMIC & PHYSIOLOGICAL OPTICS.
1988 JUL VOL 8(3) 333-340.
LG EN..
AB 12 LOW-MYOPIC VISION SS (AGED 13-25 YRS) WERE TRAINED TO CONTROL VOLITIONALLY THEIR ACCOMMODATION RESPONSES AND TO ACHIEVE CLEAR FOCUS ON VISUAL TARGETS MOVED PROGRESSIVELY OUTWARD IN OPTICAL DISTANCE. THE TRAINEES PARTICIPATED IN 15-40 DAILY TRAINING SESSIONS (MEAN

= 28 SESSIONS). ALL DEMONSTRATED VOLITIONAL CONTROL WITH VARYING DEGREES OF CONTROL AUTHORITY. THOUGH 3 OF THE SS WERE UNSUCCESSFUL, THE GROUP ACHIEVED A STATISTICALLY RELIABLE EXTENSION OF THEIR FAR POINTS. POSTTRAINING OPTOMETRIC EXAMINATIONS WERE RELIABLY IMPROVED OVER PRETRAINING EXAMINATIONS BUT DID NOT APPEAR TO BE COMMENSURATE WITH THE LARGE GAINS IN FAR-POINT EXTENSION. IT IS HYPOTHESIZED THAT THE LEARNED SKILL MAY HAVE BEEN INSTRUMENT-SPECIFIC (I.E., IT MIGHT NOT FULLY GENERALIZE TO SIGNIFICANTLY IMPROVED POSTTRAINING BINOCULAR PERFORMANCE UNLESS IT WERE ACCOMPANIED BY CLINICAL ASSISTANCE TO TRANSFER THE TRAINING). (PSYCINFO DATABASE COPYRIGHT 1989 AMERICAN PSYCHOLOGICAL ASSN, ALL RIGHTS RESERVED).

AU MALMSTROM-FREDERICK-V.
RANDLE-ROBERT-J.
IN OKLAHOMA STATE U.
TI EFFECTS OF VISUAL IMAGERY ON THE ACCOMMODATION RESPONSE.
SO PERCEPTION & PSYCHOPHYSICS. 1976 MAY VOL 19(5) 450-453.
LG EN..
YR 76..
AB TESTED 27 NORMALLY SEEING 17-25 YR OLD MALES TO DETERMINE WHETHER THEY COULD EFFECT APPROPRIATE ACCOMMODATION CHANGES IN AN EMPTY FIELD BY ''THINKING NEAR'' AND ''THINKING FAR.'' EVIDENCE INDICATED THAT NAIVE SS COULD EFFECT SIGNIFICANT AND APPROPRIATE ACCOMMODATION CHANGES, BUT ONLY ABOUT A STEADY-STATE VALUE OF 1.0 DIOPTER. ADDITIONALLY, DATA SUPPORT THE HYPOTHESIS THAT THE RESTING STATE OF ACCOMMODATION IS NOT AT THE VISUAL FAR POINT, BUT, RATHER, AT ABOUT 1.0 DIOPTER.

ROSCOE-STANLEY N.
(PSYCHOLOGICAL ABSTRACTS)

AU ROSCOE-STANLEY-N.
COUCHMAN-DONALD-H.
IN ILLIANA AVIATION SCIENCES, LAS CRUCES, NM.
TI IMPROVING VISUAL PERFORMANCE THROUGH VOLITIONAL FOCUS CONTROL.
SO HUMAN FACTORS. 1987 JUN VOL 29(3) 311-325.
AB INVESTIGATED WHETHER IT IS POSSIBLE TO TRAIN GOOD EYES TO SEE BETTER, USING 9 UNDERGRADUATES WITH 20/20 VISION OR BETTER, WHO WERE TRAINED TO CONTROL EYE ACCOMMODATION VOLITIONALLY AND, BY EXERCISING THAT ACQUIRED ABILITY, TO IMPROVE BY VARYING AMOUNTS THEIR VISUAL ACUITY, CONTRAST SENSITIVITY, AND FLASH TARGET RESOLUTION. SIX SS RECEIVED AUDITORY BIOFEEDBACK OF FOCUSING RESPONSES MEASURED AUTOMATICALLY BY A COMPLEX INFRARED TRACKING OPTOMETER AND MONOCULAR FOCUS STIMULATOR; 3 SS USED A RELATIVELY SIMPLE POLARIZED VERNIER OPTOMETER THAT PROVIDES VISUAL FEEDBACK OF EYE ACCOMMODATION AND A SIMPLE BINOCULAR FOCUS STIMULATOR. RESULTS SHOW

THAT PERFORMANCE IMPROVEMENTS WERE ELICITED BY BOTH METHODS, BUT LARGER GAINS WERE ATTAINED IN LESS TIME WITH THE SIMPLER APPROACH, IN WHICH TRAINING WAS MAINLY SELF-ADMINISTERED. (PSYCINFO DATABASE COPYRIGHT 1988 AMERICAN PSYCHOLOGICAL ASSN, ALL RIGHTS RESERVED).

SUMMARY

Biofeedback applications have grown from a demonstration of its efficacy for empty field myopia by Randle (1970) to applications for a full spectrum of vision problems including accommodation, amblyopia, myopia, nystagmus, and strabismus. Future applications could address the treatment for the ever growing vision problems associated with computers, and some problems related to aging such as presbyopia and macular degeneration.

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long term maintenance of improved acuity. Behaviour Research & Therapy. 1981 19(3). 265-8.

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