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TEN YEAR STABILITY OF EEG BIOFEEDBACK RESULTS FOR A 10 YEAR OLD HYPERACTIVE BOY WHO FAILED FOURTH GRADE IN A CLASS FOR THE PERCEPTUALLY IMPAIRED

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Abstract: *Ten years ago, the first successful application of a clinical, private practice based, EEG 14Hz biofeedback training regimen for the treatment of learning disorders was performed by the author. After the 10 year old boy, with presenting symptomology including a developmental reading disorder, hyperactivity and an educational classification of Perceptually Impaired, continued symptom free for a period of two years, his case was submitted for publication. Ten years after his termination from successful treatment, his ongoingly normal social and academic functioning is noted and his EEG brainwave signature examined and compared with a population of 24 "used-to-be" learning disabled, one-half of which had a pre-treatment state including the educational classification of Perceptually Impaired. This ten year follow-up confirms the long term stability of the results of this EEG 14Hz biofeedback regimen. Current findings on recent medical research identifying a major cerebral locus of dysfunction for hyperkinesis and how it supports the electrode placements of this clinical office setting regimen is also discussed.*

Evidence of clinical efficacy is the single most important issue for the biofeedback professional. Initial results must be shown not to have been a merely a short-lived adaptation to novel stimuli within a synergistically pre-set system of Cerebro-neuro-cognitive-somatic priorities that automatically reassert themselves once the novel stimuli have been withdrawn. Long term follow-ups give us the assurance of lasting benefit and functional integration of the gains made via biofeedback therapy. The important questions to be answered are: How did this treatment regimen come about?, How did it impact on the recipient of the biofeedback training?, Is this single case study the only positive fruits of this treatment regimen? Were there long-term functional integration of the gains made via this biofeedback regime?, Are there independent sources of verification for the rationale and or technical aspects of this regimen?, and lastly, "How do the long-term follow-up measurements with respect to the current functionality of the systems previously enhanced with biofeedback training compare with those taken from a plausible comparison group?

In 1979, Joel Lubar's laboratory based group's usage of an EEG biofeedback procedure for working with hyperkinesis and epilepsy (Lubar & Shouse, 1976; Shouse & Lubar, 1979) sparked my interest. I proceeded to determine if the learning disabled could be taught to "exercise their brains" via EEG biofeedback training; and if so if it would result in a "normalization" of function and academic improvement. In search of an effective clinical regimen with the most efficacious sensor placement possible, I evolved a

technique differing from Dr. Lubar's, and in 1983, with Dr. Richard L. Bruner, Tansey & Bruner (1983) published the first successful application of a clinical, private practice based, EEG 14Hz biofeedback training regimen for the treatment of learning disorders. It is obvious that a child may have an attention deficit disorder, and/or epilepsy, and not have his/her academic functioning be impaired sufficiently to warrant any child study team involvement - much less to mandate an educational classification as learning disabled, Neurologically Impaired, or Perceptually Impaired. In fact, the child in the 1983 article had concurrent diagnoses of hyperactivity, developmental reading disorder, and had been placed in a class for the Perceptually Impaired since Grade 2 following a mandated educational classification of Perceptually Impaired. We successfully treated the hyperactivity in the first stage of treatment with EMG biofeedback, but this had absolutely no impact on his developmental reading disorder nor on his academic/neurologic delays and dysfunction at the time. The academic and neurologic delays were responsive to EEG biofeedback training.

BACKGROUND

This young man had been classified by his school's child study team as Perceptually Impaired at the age of 7 1/2. That evaluation, and subsequent classification, was prompted by the findings that he reversed letters and numbers from left to right, horizontally as well a vertically, was possessed of above-average intellectual potential, exhibited a high degree of anxiety, engaged in an unusual amount of physical activity within the classroom, and had maintained a history of behavioral and academic difficulties since entering the first grade. As of his 3rd month in the second grade, he was placed in a class for the Perceptually Impaired. After 2 months within the special education setting, he was additionally diagnosed as being Hyperactive. Ritalin was prescribed for the hyperactivity and was continued throughout his second, third, and fourth grade years - all the while in special education classes for the Perceptually Impaired. By the end of his grade 4 experience in the special education class for the Perceptually Impaired, he was found to be lagging more than 1 year behind expectancy levels for reading and word comprehension within the reduced norms for the special education setting. He was then scheduled to repeat the fourth grade in the special education class for the Perceptually Impaired. He also evidenced difficulties with saccadic fixation and ocular pursuit movements. In order to attempt reading, he had to move his head side to side in order to track the words across a line of print.

RESPONSE TO BIOFEEDBACK TRAINING

This 10-year old boy showed specific and positive responses to both EMG and 14Hz EEG biofeedback training. The initial three EMG training sessions enabled him to reduce his motoric activity level to where he was no longer adjudged by his family pediatrician to be "Hyperactive". His Ritalin had already been suspended by his pediatrician one week prior to the initiation of biofeedback training. As of his third EMG biofeedback session, to the present - over ten years later, his behavior has been marked by the absence of motoric overactivity, high distractibility, low frustration tolerance, and poor self-control which ongoingly marked his behavior for four years prior to his receiving biofeedback.

His ocular instability, his inability to read a line of print smoothly and be aware of his frequent skipping of words, commas, and periods, his perceiving and producing of reversals in letters and numbers - not to mention being unable to accurately recall the line that he had just read, all remained the same as of his third EMG biofeedback training session; unimpacted by the EMG biofeedback training which remediated his hyperactivity.

This boy's ocular and reading functioning did normalize through the course of his EEG 14Hz biofeedback training utilizing the Tansey technique (Tansey & Bruner, 1983, Tansey, 1991a). He became able to track smoothly along a horizontal axis while keeping his head stationary. He also became able to move his head from side to side while keeping his eyes fixated upon an object in front of him. His reading style became characterized by eye rather than head movements in order to track along a horizontal line of print. His first biofeedback training session coincided with the end of the school year wherein he was scheduled for retention, in a special education fourth grade class for the Perceptually Impaired, due to insufficient academic attainment and ongoing developmental delays in perceptual-motor and verbal-expressive function. As of his eighth 14Hz biofeedback training session, his parents moved and enrolled him in a normal fourth grade class due to the marked gains evidenced by him over the summer's biofeedback sessions. Specifically, he was no longer hyperactive and had been medication free since the inception of his biofeedback training regimen. He was also, for the first time ever, reading and understanding the content of the material without reversals. Upon entering the normal 4th grade curriculum and class setting, he behavior and ability were adjudged adequate -so he was allowed to continue in the first normal class setting for him since the first grade. The termination of his 14Hz EEG biofeedback training coincided with the conclusion of the first academic quarter within his now normal class setting. He manifested good academic achievement for the first quarter with a C in reading and a B in spelling with a total of 3 A's, 3 B's, and 4 C's, no D's and no F's. His second quarter's report card showed an A in spelling and a B in reading with 3 A's, 4 B's, and 3 C's. His third marking period's report card showed 4 A's, 5 B's and 1 C in a regular fourth grade class setting (Tansey & Bruner, 1983).

Biofeedback training was terminated as of his first report card with concrete evidence of normal function and solid academic success in a normal class setting. We then followed his progress throughout that school year as mentioned above. Submission to Biofeedback and Self-Regulation for publication was postponed until two years post-termination to ensure that this boy's improved functioning was not a temporary treatment effect which may break down over time or under prolonged stress. When he showed ongoing behavioral normalcy and academic success over a two year period, we felt sure of our results and of the efficacy of our technique. Naturally, such marked gains were met with skepticism mixed with protests that our sensor placements and technique differed from that of some other pioneering investigators. Naturally, the question of the long-term permanency of such marked effects also arose. Ten years post-termination, this young man continues to succeed academically and personally all through grade school, Jr. High and High School, was voted to a position of honor and responsibility in High School, and is currently earned a 2.50 grade point average last semester in college.

METHOD

EEG biofeedback training of the 14HZ brainwave rhythm, for this boy, was conducted in weekly, 30 minute training sessions. A single channel Nova Systems Biofeedback EEG was used to assist him in orienting on the 14HZ neural discharge rhythm as monitored over the central Rolandic cortex. In monitoring 14Hz brainwave production, three Nova Systems saline sensors were used (impedance in saline of 1K ohm). To monitor, and subsequently train, bilateral 14Hz discharge patterns, the active sensor was placed so that its 6.5 cm x 1.3 cm contact surface lay lengthwise along the midline of the top of the skull (overlaying the cerebral longitudinal fissure), centering about 2.6 cm behind Cz (10/20 system). It was held in place with two elasticized headbands with velcro on the ends. One band is placed about the head, parallel to the eyebrows, across the middle of the forehead. A second band goes across the top of the head and the active sensor, attaching at either end on the other headband, near each ear. In this position, the active sensor is kept in place and centers over the central Rolandic cortex (pre- and post-central gyri) of both the right and left cerebral hemispheres; extending anteriorly over the upper portions of the bilateral Supplementary Motor Area (Goldberg, 1985). The reference and ground sensors are randomly placed on opposite ears via comfortable earclips (See Figure 1). The placement of the sensors and headband takes approximately 30 seconds.

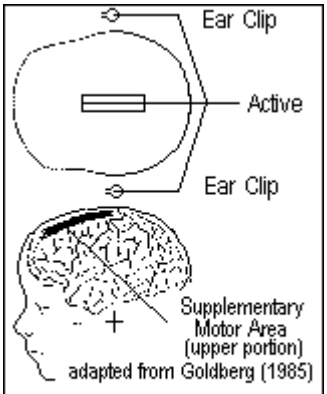


Figure 1
EEG Electrode Placement

The single channel EEG unit provided both amplitude and frequency modulated feedback. The feedback tone was modulated so that the greater the amplitude of the brainwave, the louder the tone. In addition, the repetition rate of the tone (number of beats per second) co-varied with the rate of occurrence of the monitored brainwave energy as it exceeded threshold (set a 3 microvolts Peak-to-Peak). Evaluations of changes in the 14Hz brainwave rhythm amplitude (energy) were recorded across each session as a performance measure of the operant task: autostimulation/normalization (recruitment of sluggish brain cells operating at 7HZ to normalize to a 14HZ posture) of the functioning of the central cortex, resulting in increases in the amplitude levels (energy) of the 14HZ discharge pattern.

Ten years later, the methodology insofar as the sensors, their placement, and instructions to the recipient of EEG biofeedback training remain the same (Tansey, 1991a). The

means of evaluating the operant task; i.e. the recruitment of increasingly larger numbers of brain cells to increase their rate of firing and rectify a developmental delay in activation levels, has changed significantly. My ongoing studies are now using the T.H.E. Biofeedback Systems software on the NeXT computer which incorporates a powerful built in digital signal processor for immediate fast-fourier transforms of all biologic/EEG data in the 0 to 90Hz range. In this manner, the total EEG signal is available to be sampled by the computer at a selectable rate of 8,000 to 40,000 times a second, with the Fast-fourier transforms ensuring the exactness of the wavebands selected for monitoring and reinforcement.

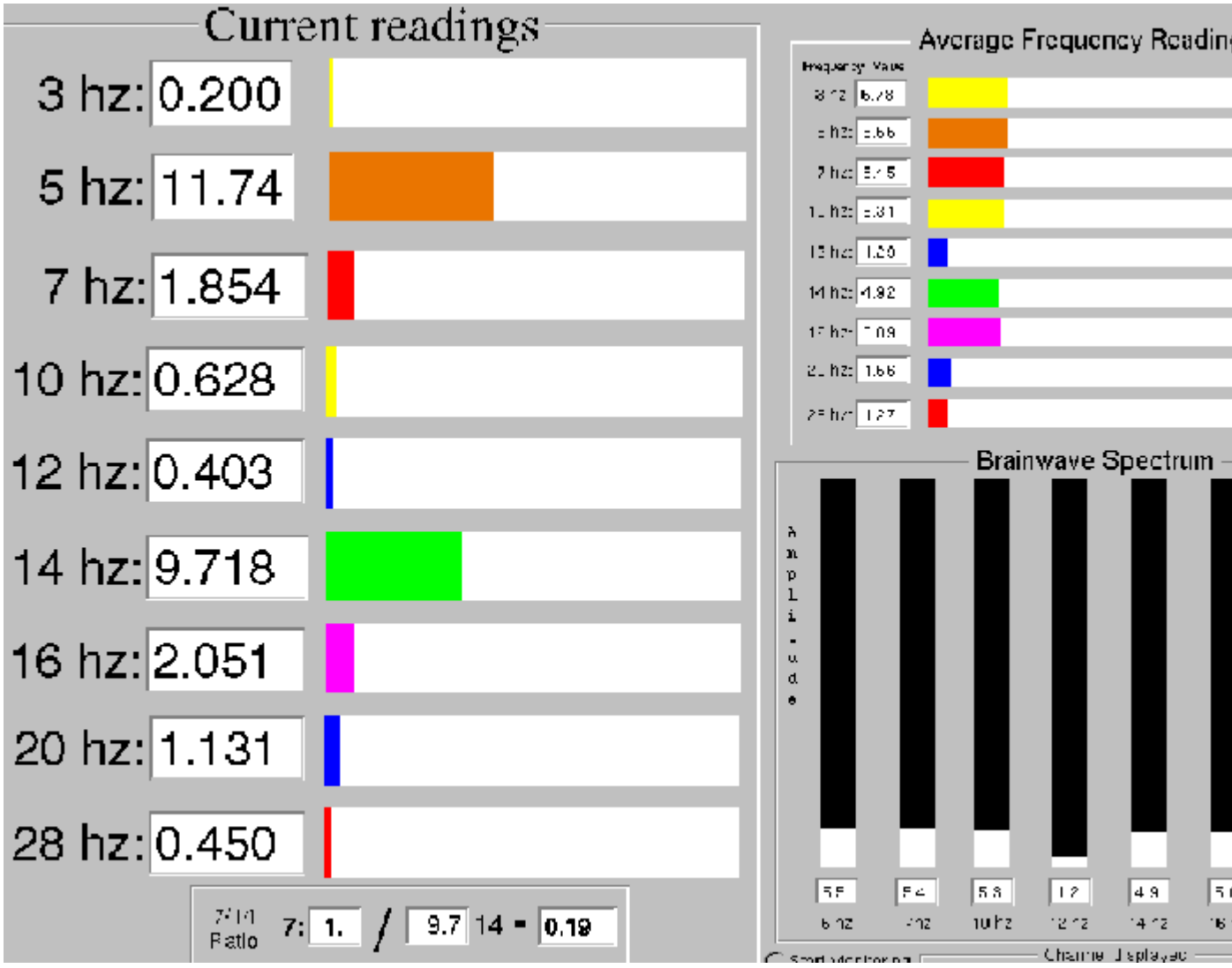
DISCUSSION

Since 1982, I have published on the positive impact of this clinical office-based regimen for the treatment of disorders reflecting underactivation of brain function, on a wide variety of disorders; including asthma (Tansey, 1982), larger populations of learning disabled youngsters with diagnoses of Neurologically Impaired (NI), Perceptually Impaired (PI), and learning disabled with Borderline FSIQ levels (Tansey, 1984; Tansey, 1985a), Petit Mal epilepsy (Tansey, 1985b); Giles de la Tourette's Syndrome (Tansey, 1986), Migraine (Tansey, 1991b), and with a population of twenty-four youngsters (11 PI, 11 NI, 2 ADD) with pre-biofeedback brainwave signature patterns reflective of a brain-based learning disability (Tansey, 1990). The impact/normalization of such a wide variety of brain-based disorders by "exercising" the SMA cortex (See Figure 1) lies in this cortical region's attributes; specifically its being well documented over the past 20 years as a central, bilaterally co-responsive, cortical "executive" region, providing a crucial link for a widely arrayed matrix of verbal-expressive and perceptual-motor functions. In sum, the well documented cerebroneural substrate for adapting thought into action and action unto some end, and the accurate execution of same.

I have been reporting observations of "underactivation" of this medial bilaterally organized premotor system (SMA) for hyperactives, and learning disabled with-and-without hyperactivity, via EEG brainwave training (Tansey, 1983, 1984, 1985, 1990) for the past eight years. This state of affairs has recently received independent medical verification in the New England Journal of Medicine's November 15, 1990 issue. Therein was presented evidence of frontal hypometabolism in hyperactives - significant global and regional reductions of cerebral glucose metabolism; with the largest reductions in the pre-motor cortex and superior pre-frontal cortex (Zametkin, Nordahl, Gross, King, Semple, Rumsey, Hamburger & Cohen, 1990). It is noteworthy that the bilateral instrumentality of the SMA is a large and significant aspect of the cortical region referred to as the pre-motor cortex.

Tansey (1990), with a population loaded heavily with Perceptually and Neurologically Impaired (11 each) youngsters and 2 hyperactives, seems an ideal comparison group against which to measure the current "normalized" functioning of my first learning disabled client - ten years post-termination. Figure 2 shows the pre and post EEG biofeedback 5 channel brainwave signatures of the Tansey (1990) group compared against the 8 channel brainwave signature obtained from my ten-year follow-up case. The

operational definition of "brainwave signature" was introduced in Tansey (1984) and has been used in all subsequent publications. It is noteworthy that the amplitudes of the 10Hz, 12Hz, and 14Hz post-treatment brainwave bands correspond very closely. In fact, his eight band EEG brainwave signature as monitored with this procedure, matches the pattern obtained from non-learning impaired individuals.



In sum, over the past ten years, the first learning disabled recipient of this EEG 14Hz biofeedback regimen had "exercised" his brain out of a dysfunctional posture which enabled him to personally and academically prosper from grade 4 up to and into college. At the end of the same ten years, medical research yielded findings identifying the site of my active electrode as a primary focus of functional hypometabolism for hyperactives.

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