

AN INTRODUCTION TO THE SCIENCE OF BIOFEEDBACK AND THE ART OF SELF-REGULATION

Dan Chartier, Ph.D.
Licensed Psychologist

Certified Biofeedback and Neurofeedback Provider
Q.E.E.G. Diplomate

©Dan Chartier, Ph.D. Life Quality Resources, Raleigh, NC
www.lifequalityresources.org

APA REQUIRED STATEMENT

"Materials that are included in this course may include interventions and modalities that are beyond the authorized practice of mental health professionals. As a licensed professional, you are responsible for reviewing the scope of practice, including activities that are defined in law as beyond the boundaries of practice in accordance with and in compliance with your professions standards."

Who am I? How did I get here?

- Undergrad UNC-CH
 - Lab assistant for Fogle Clark – NASA
 - Rats, pigeons, squirrel monkeys
- Masters degree UNC
 - Raja Yoga
- Ph.D. NCSU – First experience with BFB, last elective courses in bio-electronics.

Learning to do this work

- 1983 – Starting private practice
 - Psychotherapist
 - Biofeedback practitioner
- Psychophysiological Therapy
 - My patients/clients taught me the most important things I would like to share with you.

OBJECTIVES

Upon successful completion of this workshop

Participants will:

- Understand what BFB is and is not.
- Acquire knowledge re: the history and science of BFB.
- Describe the 5 most common forms of biofeedback training used in clinical practice

OBJECTIVES (2)

- Understand applications/indications for BFB – evidence based practice.
- Identify contraindications for biofeedback training.
- List the elements of a comprehensive initial intake evaluation in preparation for a course of BFT.

OBJECTIVES (3)

- Describe the steps – expectations for normal progress in BFT.
- Explore methods for managing/resolving emotional reactions that can occur during BFB-SRT.
- Provide examples of ethical considerations in the practice of BFB-SRT.

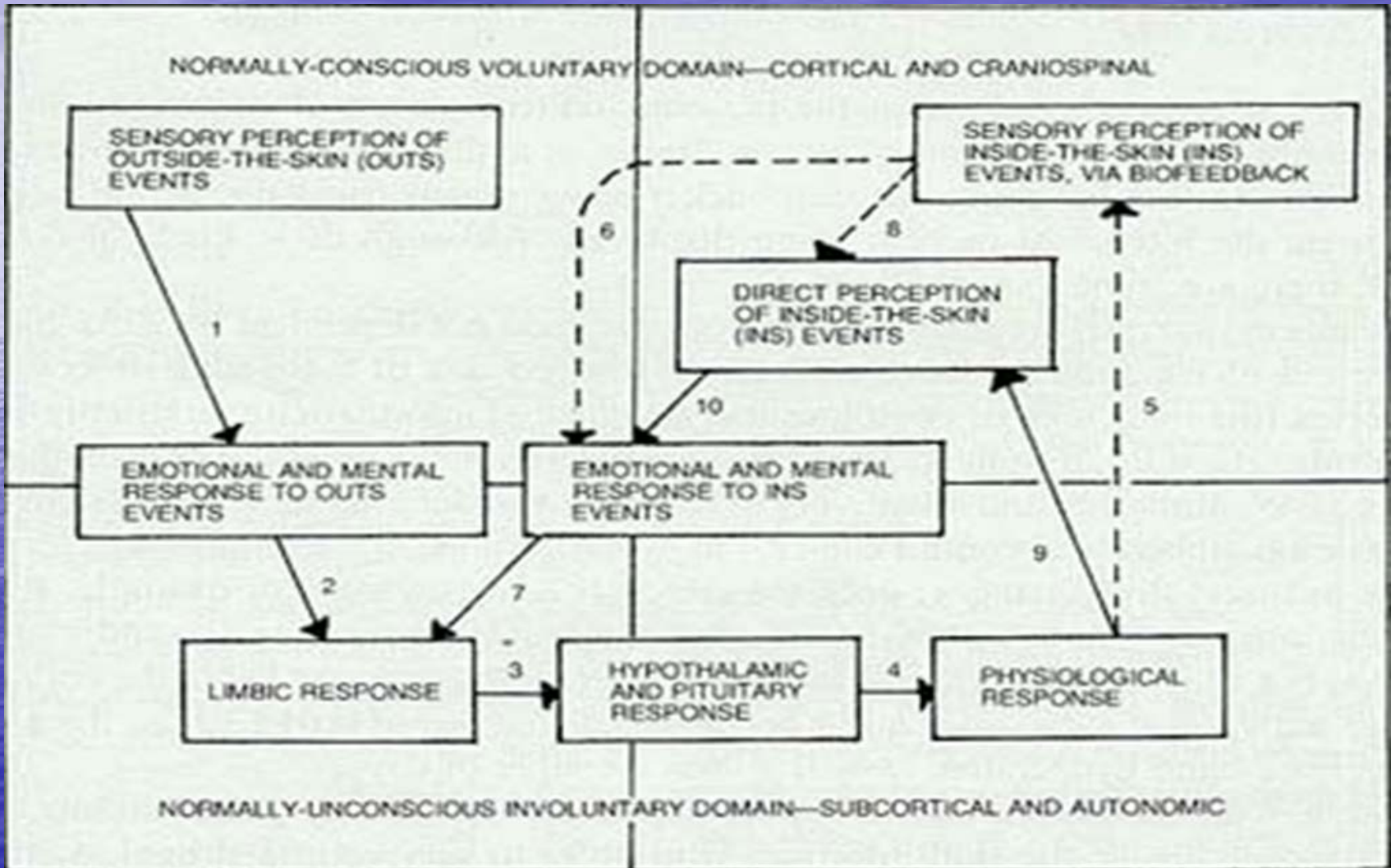
OBJECTIVES (4)

- Discuss interesting clinical variants in BFB-SRT
- Identify elements of case presentation – grand rounds
- Locate Sources and Resources: training and equipment for BFB-SRT
- Describe practice organization models.
- OTHER???

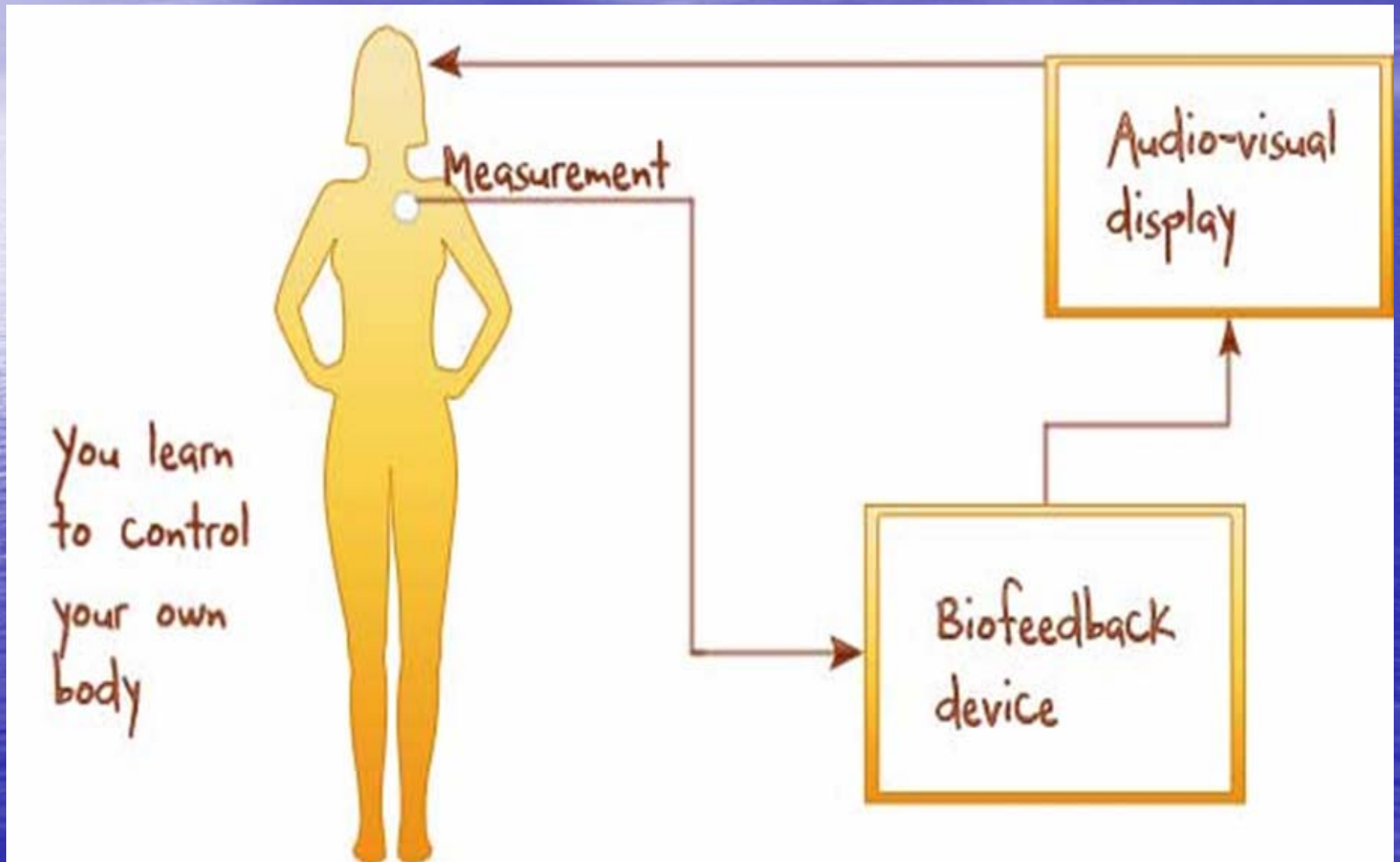
BIOFEEDBACK

- A training process in which a subject's biological activity is monitored by some type of device/instrument and...
- The information from that monitoring is made available to the subject in some understandable form such as a changing sound, visual display or physical sensation.

Historical Diagram of BFB



Simple Diagram of BFB



Instrument Measuring a Bio(logical) Signal and Presenting Representation-Feedback of that Signal



BIOFEEDBACK IS NOT:

- Invasive – imposed control
- Guided Imagery*
- Listening to Relaxing Music*
- Hypnosis or Self-Hypnosis*
- Meditation*

* May be used as adjunctive methods during BFB – SR training.

BIOFEEDBACK IS:

Grounded in the Science: The Law of Operant Conditioning:

When a behavior (operant) is followed by a stimulus there will be an increase in the frequency of occurrence of that behavior.

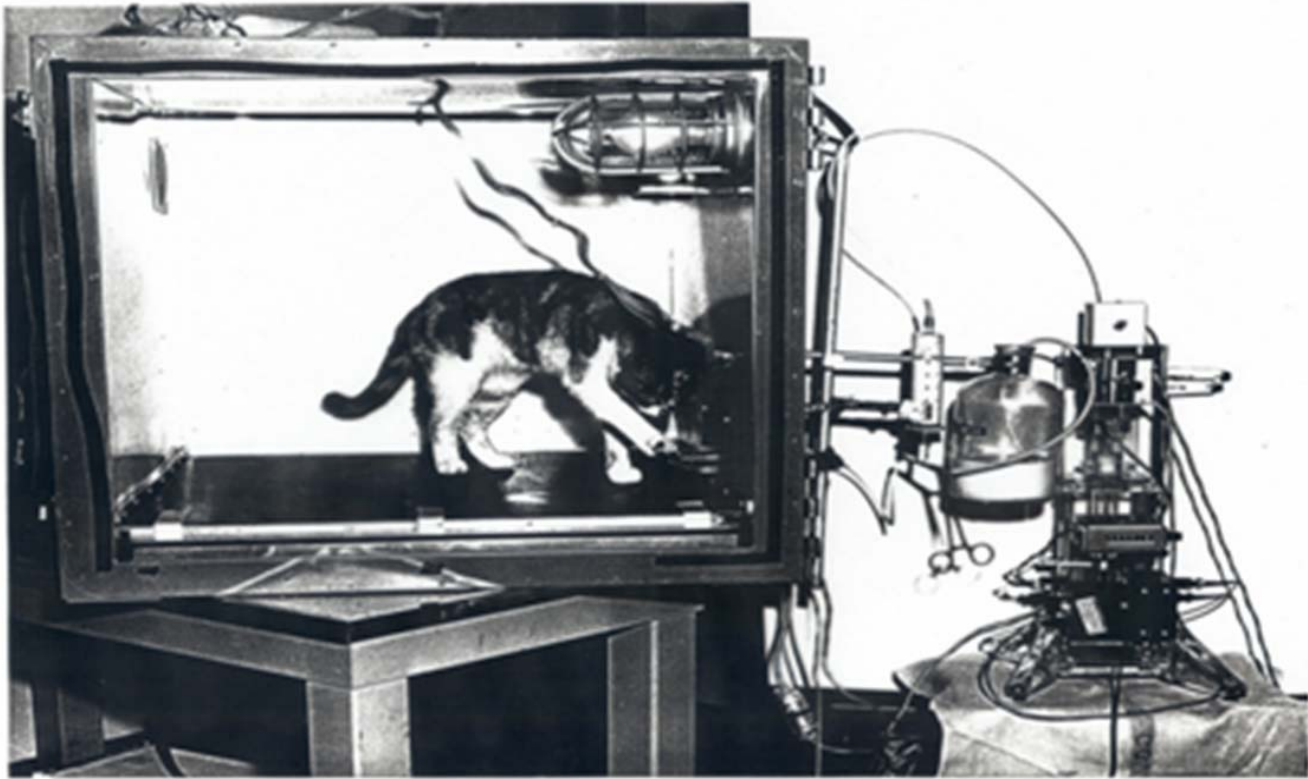


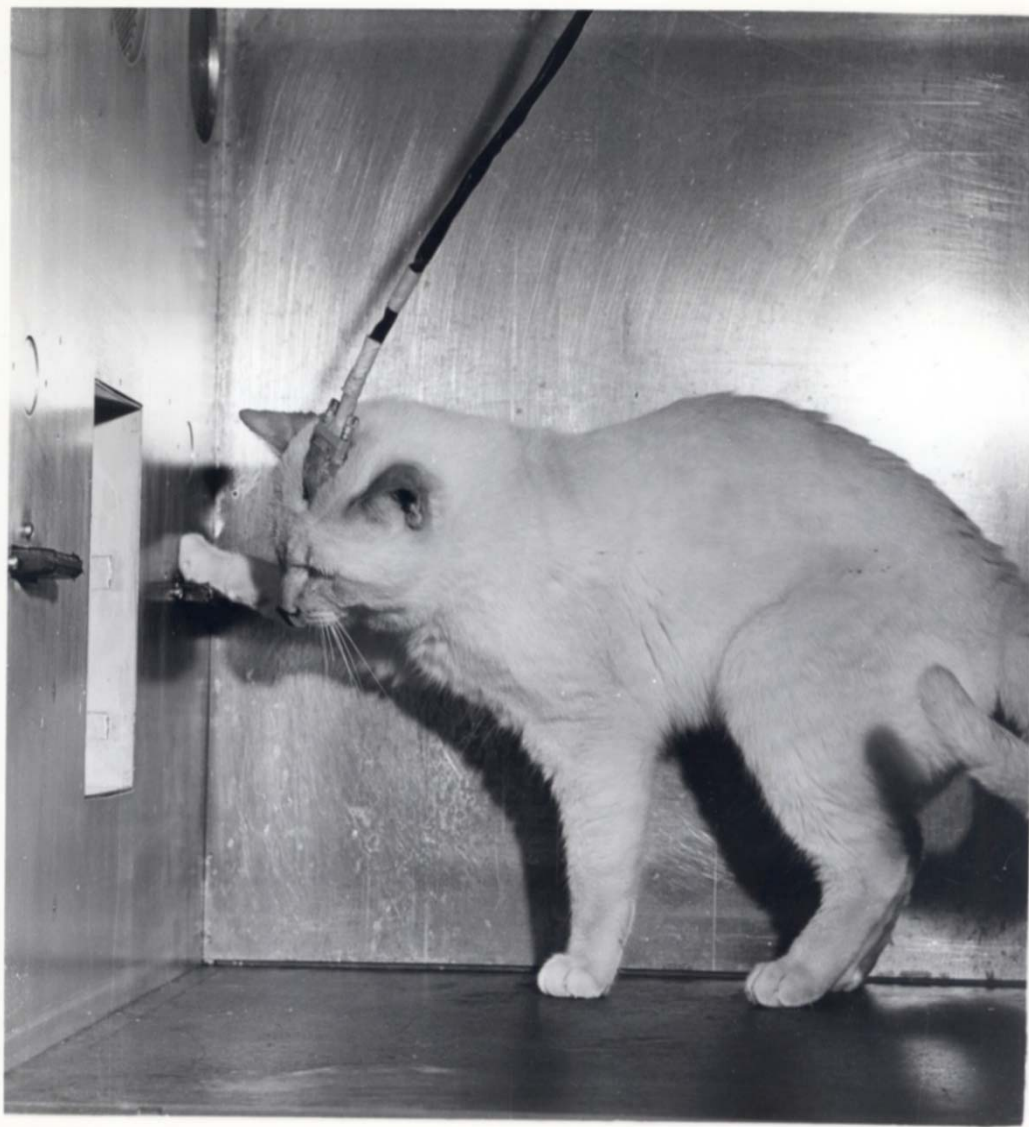
WILL PRESS
LEVER
FOR
FOOD

BFB History: Convergence of Medical Technology and Space Exploration

- Development of medical monitoring equipment: HR, BP – bored hospital patients learning they could alter/exert control over basic biological functions.
- NASA's need to monitor physical function of animals then humans being sent into space.

Sterman's Cats: UCLA – NASA





BIOFEEDBACK is used to facilitate: SELF -REGULATION

- Biofeedback (and Neurofeedback) provide technology and information to facilitate...
- SELF-REGULATION: Volitional control or influence of some biological activity.
- The patient becomes an ACTIVE PARTICIPANT in directed self-care.

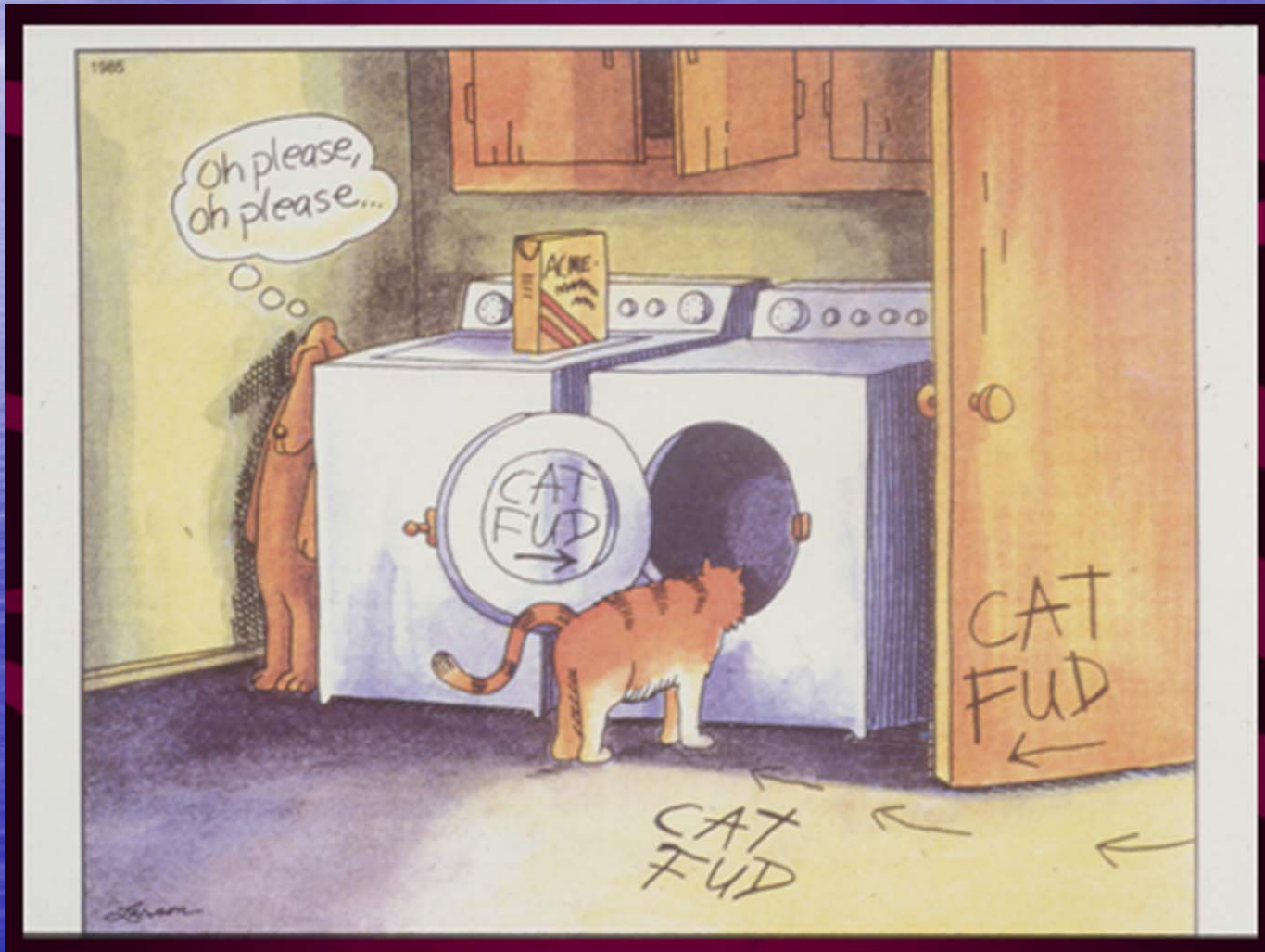
BFB: Complex and Simple







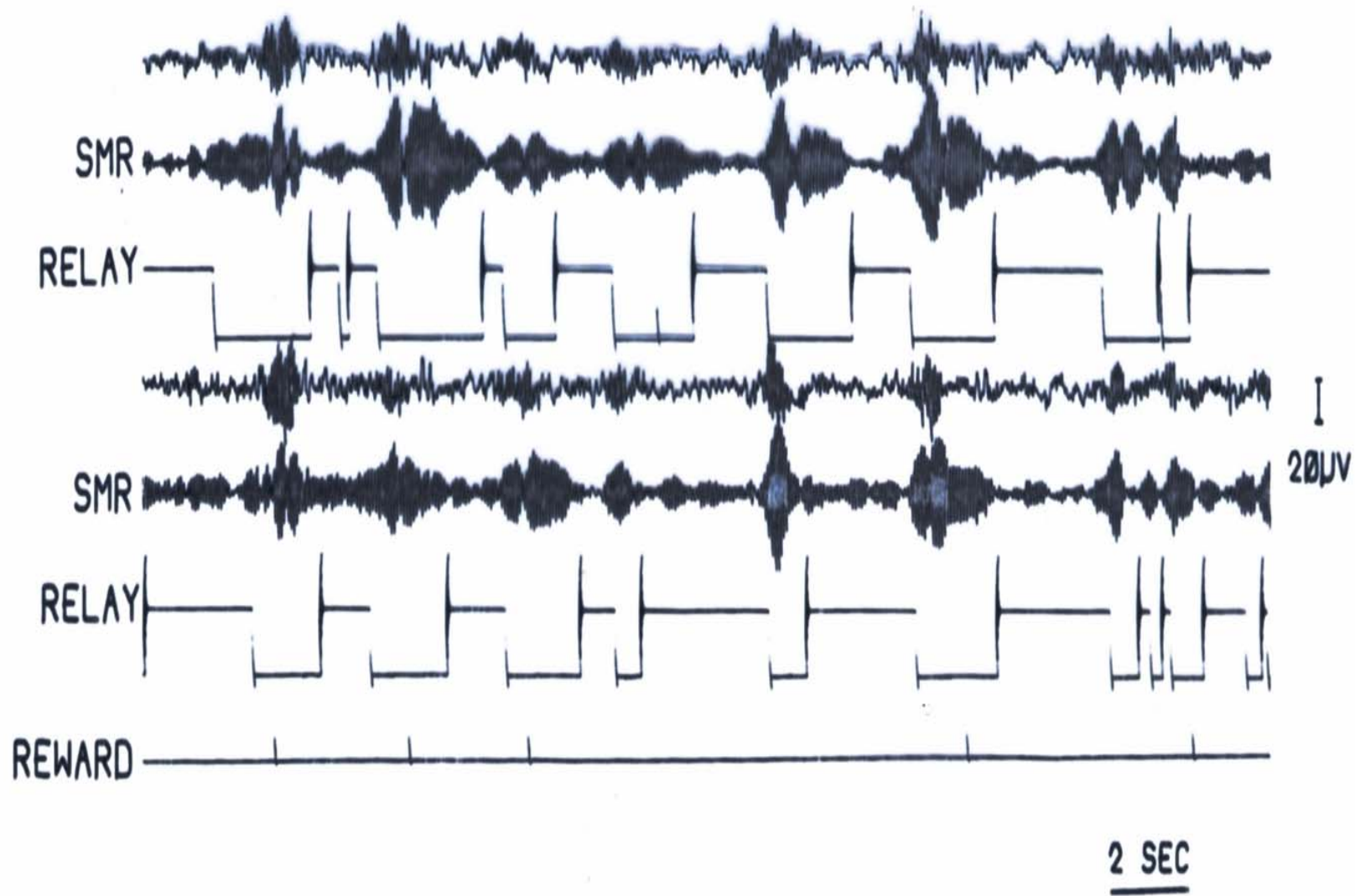
THE CHALLENGE of BFB



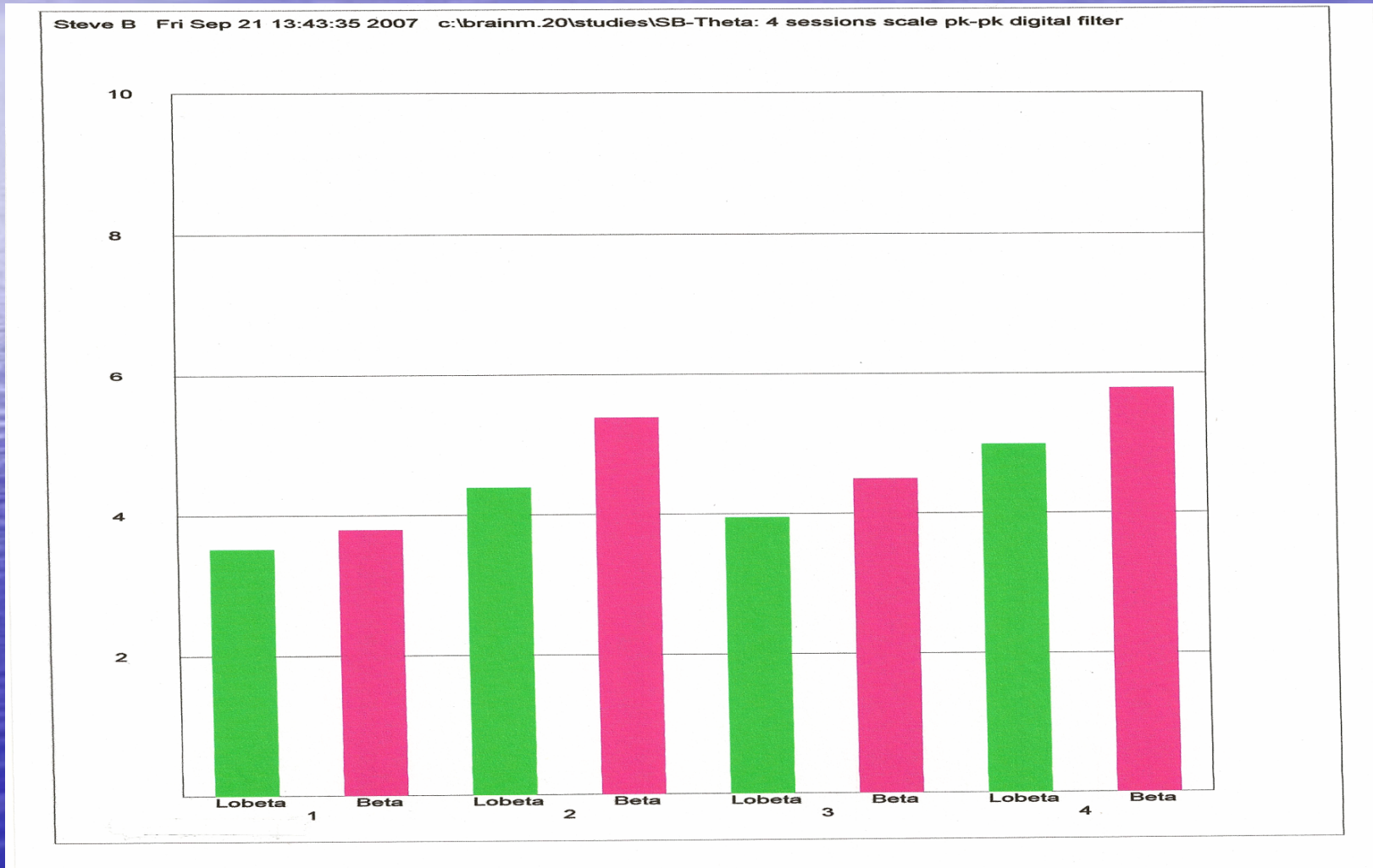
NEUROFEEDBACK

- A.K.A. EEG biofeedback.
- Sensors are placed on the scalp (or elsewhere) to pick up EEG/Brainwave activity.
- Auditory and/or visual feedback assists the individual in learning to alter brainwave components: dominant frequency, amplitude, coherence, ratio etc.





Feedback Leads to Learning – Skill Acquisition



"Learning Curves" from Operant Conditioning

Electroenceph. clin. Neurophysiol., 1972, 33: 89-95

M. B. STERMAN AND L. FRIAR

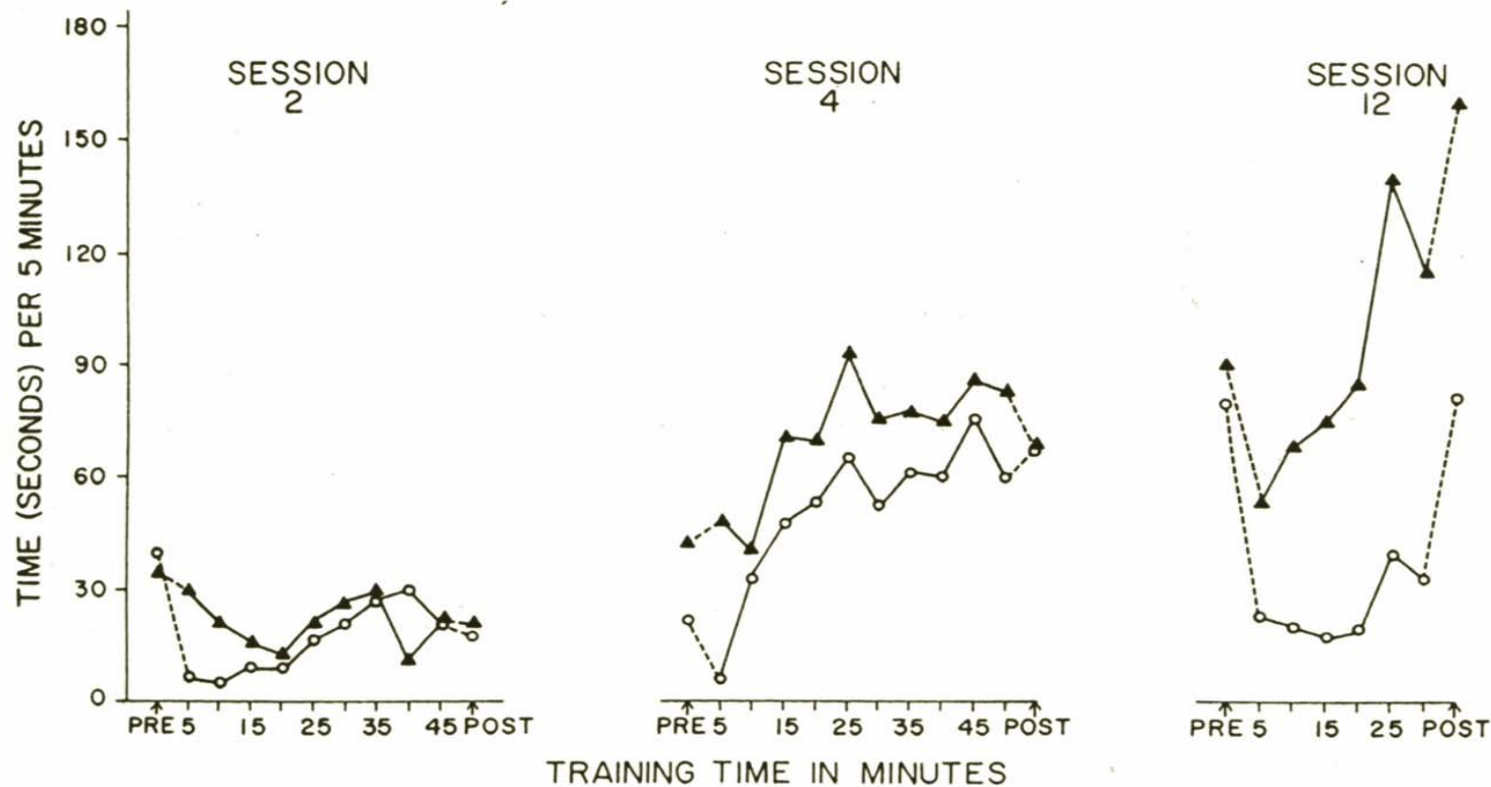


Fig. 2. Plot of SMR (solid triangles) and alpha rhythm (open circles) production during SMR training and pre-post baseline recordings at three points in the training sequence. Output is expressed in terms of the total occurrence of these rhythms, at criterion amplitude and duration, in pre- and post-training 5 min samples and in sequential 5 min epochs during training. Transitions between training and pre-post measures are indicated by broken line.

Why Feedback Works to Change Behavior

Gary Lynch, Ph.D. – UC Irvine

RE: Rats running maze - cued by scent for correct path.

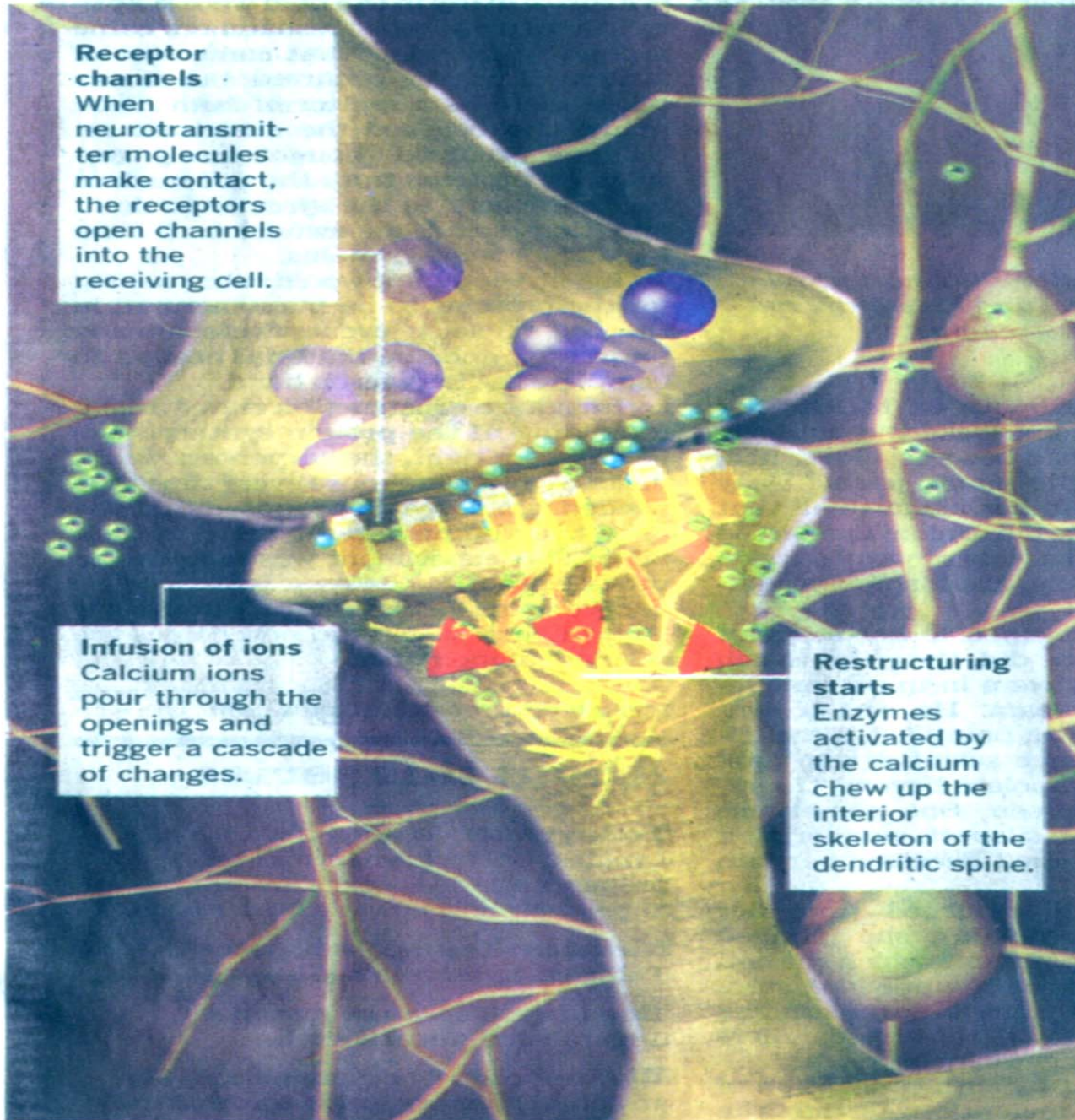
“Our studies sought to use rat brain networks that include these same areas and to find behavioral tasks that sample memory systems which correspond to those described for humans. These constraints led our search to the little-studied olfactory system in the rat brain. Thus far we have found that the relevant circuitries in rat brains bear a surprising resemblance to networks designed by theorists in the computer sciences to accomplish human-like recognition and associative memory.”

The signal triggers changes

Receptor channels
When neurotransmitter molecules make contact, the receptors open channels into the receiving cell.

Infusion of ions
Calcium ions pour through the openings and trigger a cascade of changes.

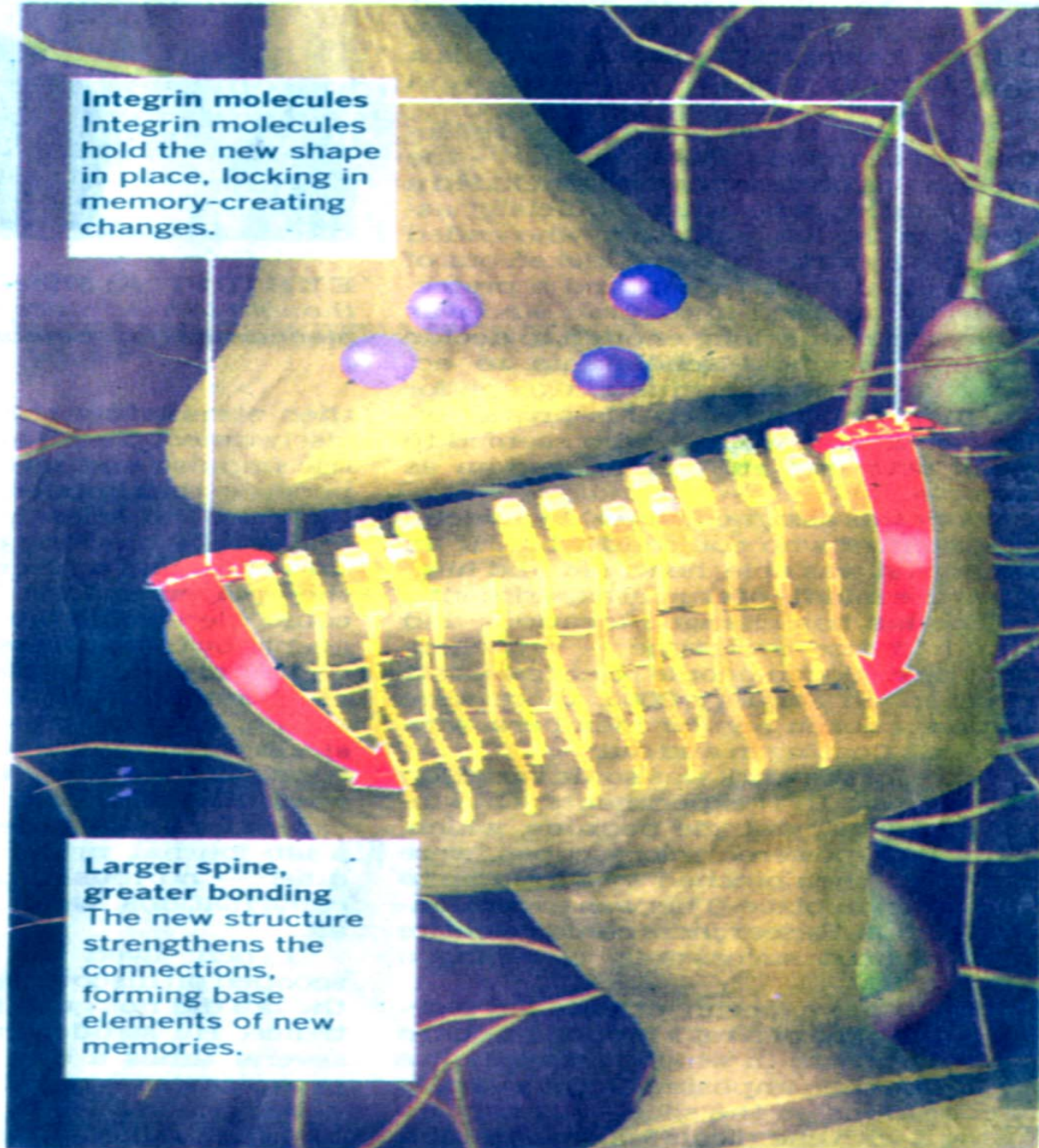
Restructuring starts
Enzymes activated by the calcium chew up the interior skeleton of the dendritic spine.



Keeping memories

Integrin molecules
Integrin molecules hold the new shape in place, locking in memory-creating changes.

Larger spine, greater bonding
The new structure strengthens the connections, forming base elements of new memories.



Neurons that fire together -

WIRE TOGETHER!

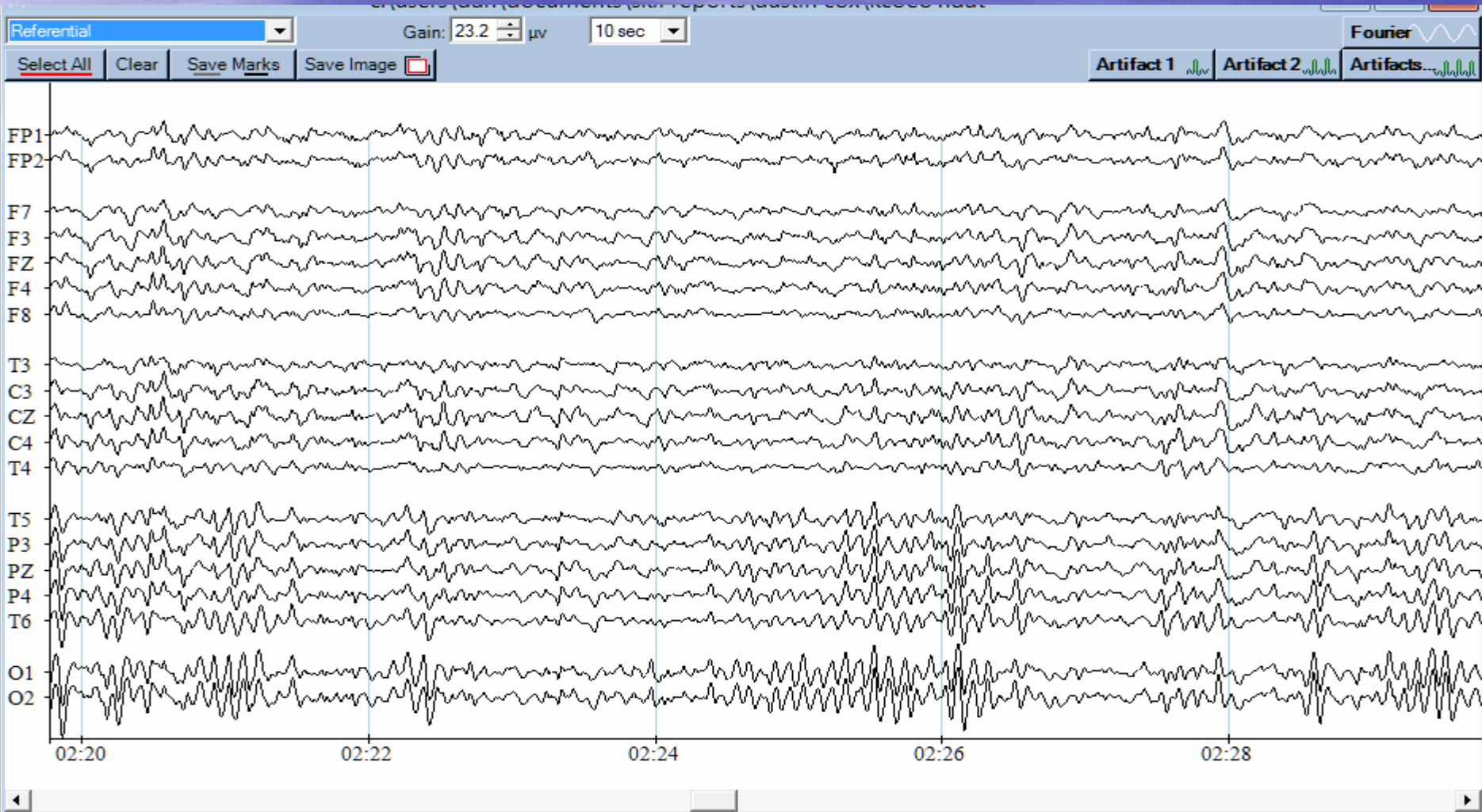
QEEG

An illustration of data driven
assessment and treatment
planning – for doing BFB/NFB

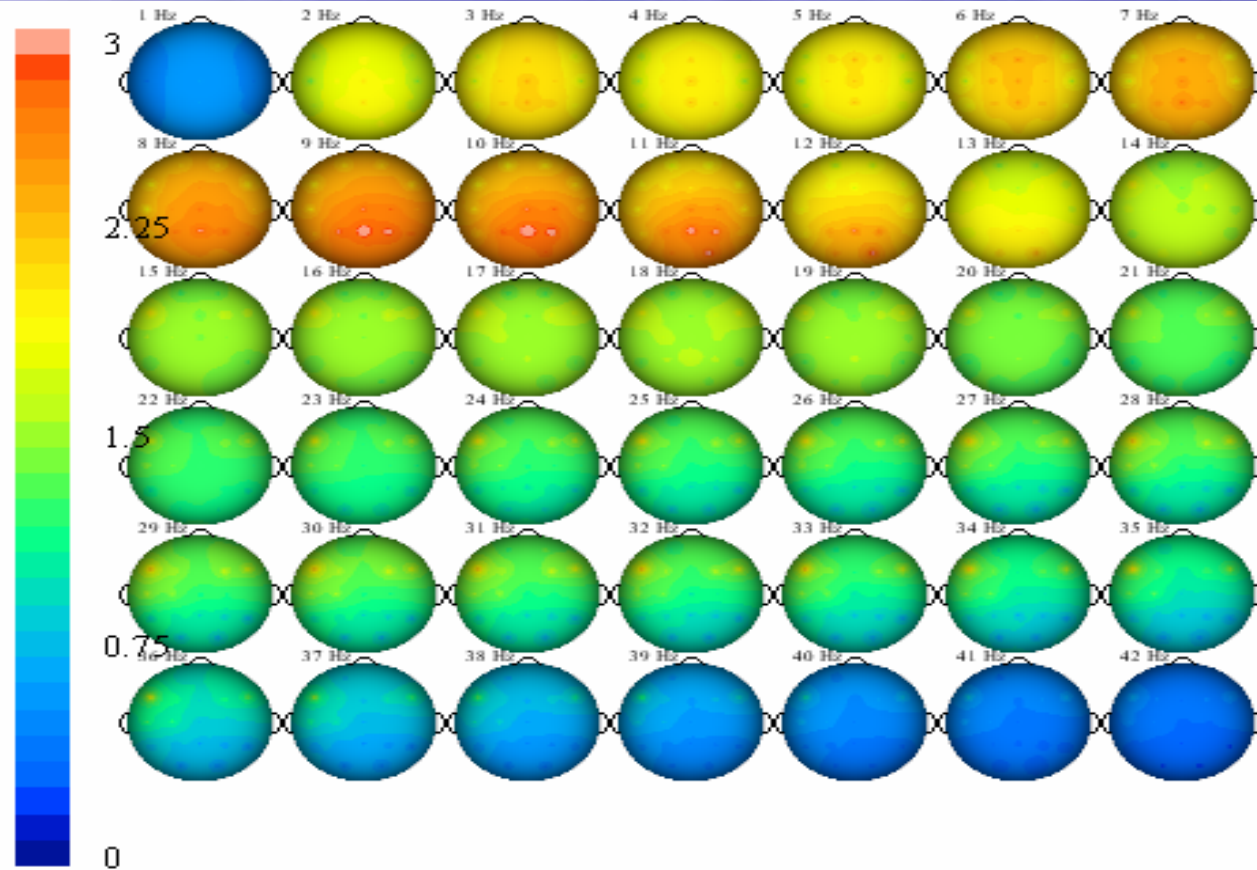
QEEG ASSESSMENT

- Multi-channel EEG data collection.
- Digital storage of EEG data.
- Quantitative analysis of stored data.
- Normative and discriminant database comparison.

STARTING WITH EEG RECORDS



Quantitative Analysis of the EEG data - QEEG



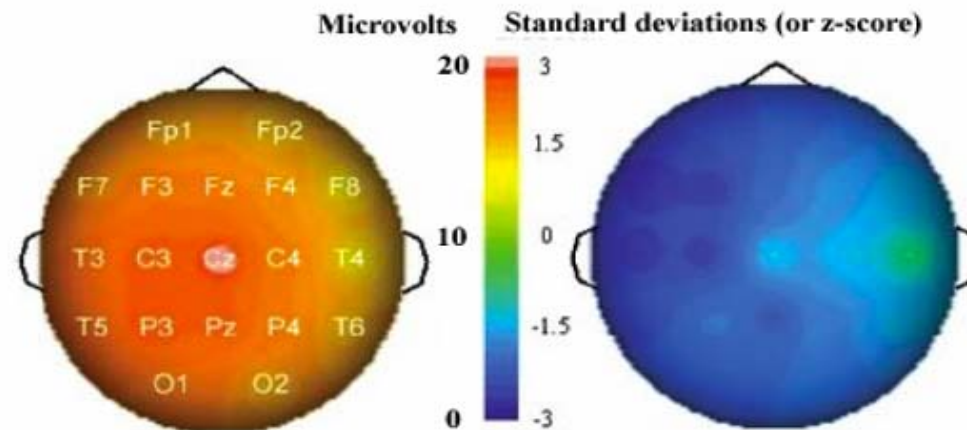
Eyes Closed (Referential)

Single Hz, Magnitude

[File: 647ec1]

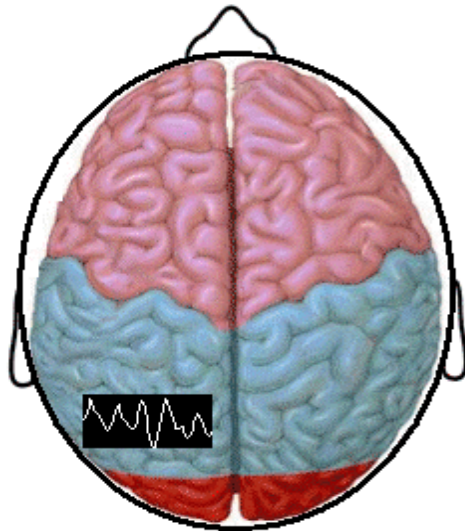
Example of Topographic Analysis

Data on the left-----Statistical Comparison (z-score) on right



Evaluation of cortical activity. Each brain map consists of 19 electrode sites evenly spaced across the head. Color indicates microvolts (data or raw view) or statistical deviation from a comparison group average (stat view). Spectral magnitude coefficients that exceed ± 2 standard deviations are indicative of localized hyper- or hypo-excitability in cortical neuronal pools, depending upon the frequency of interest

Two general forms of assessment

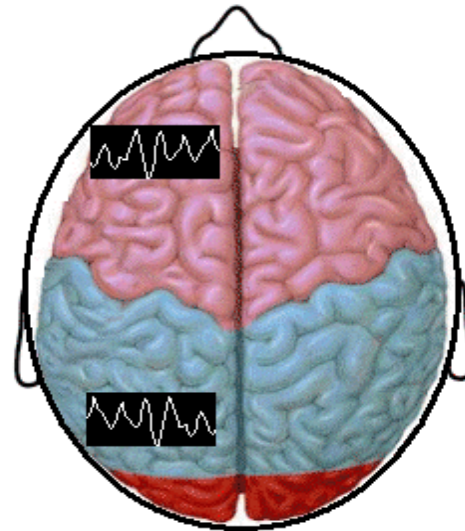


Modules

(local structures)

Activity

spectral magnitude



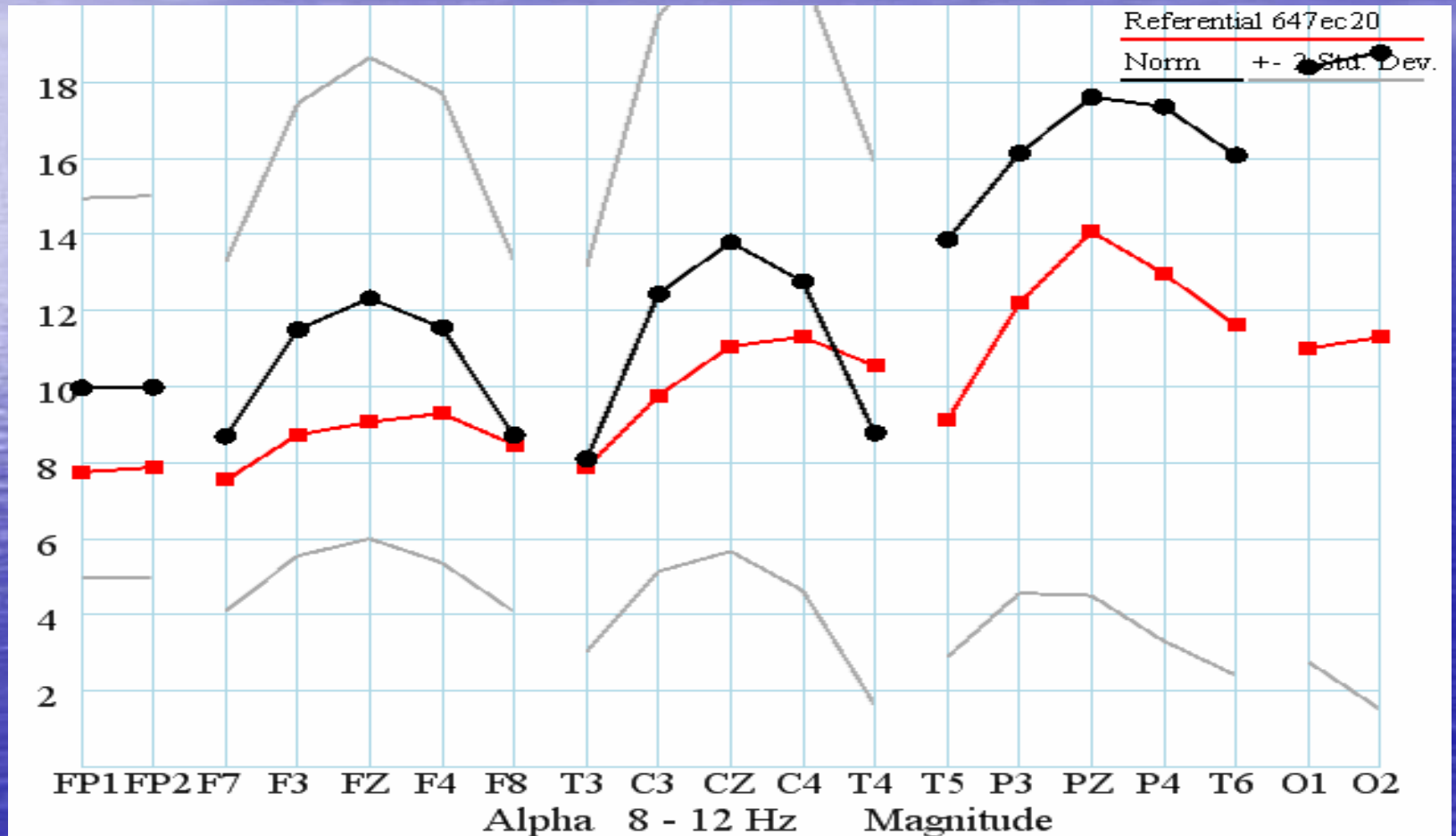
Networks

(distributed structures)

Shared Activity

comodulation, coherence

Topometric Analysis



TREATMENT MANAGEMENT

Getting Well
or at least
Better

From first contact to end-of-training –
managing the expectations of a
patient/client.

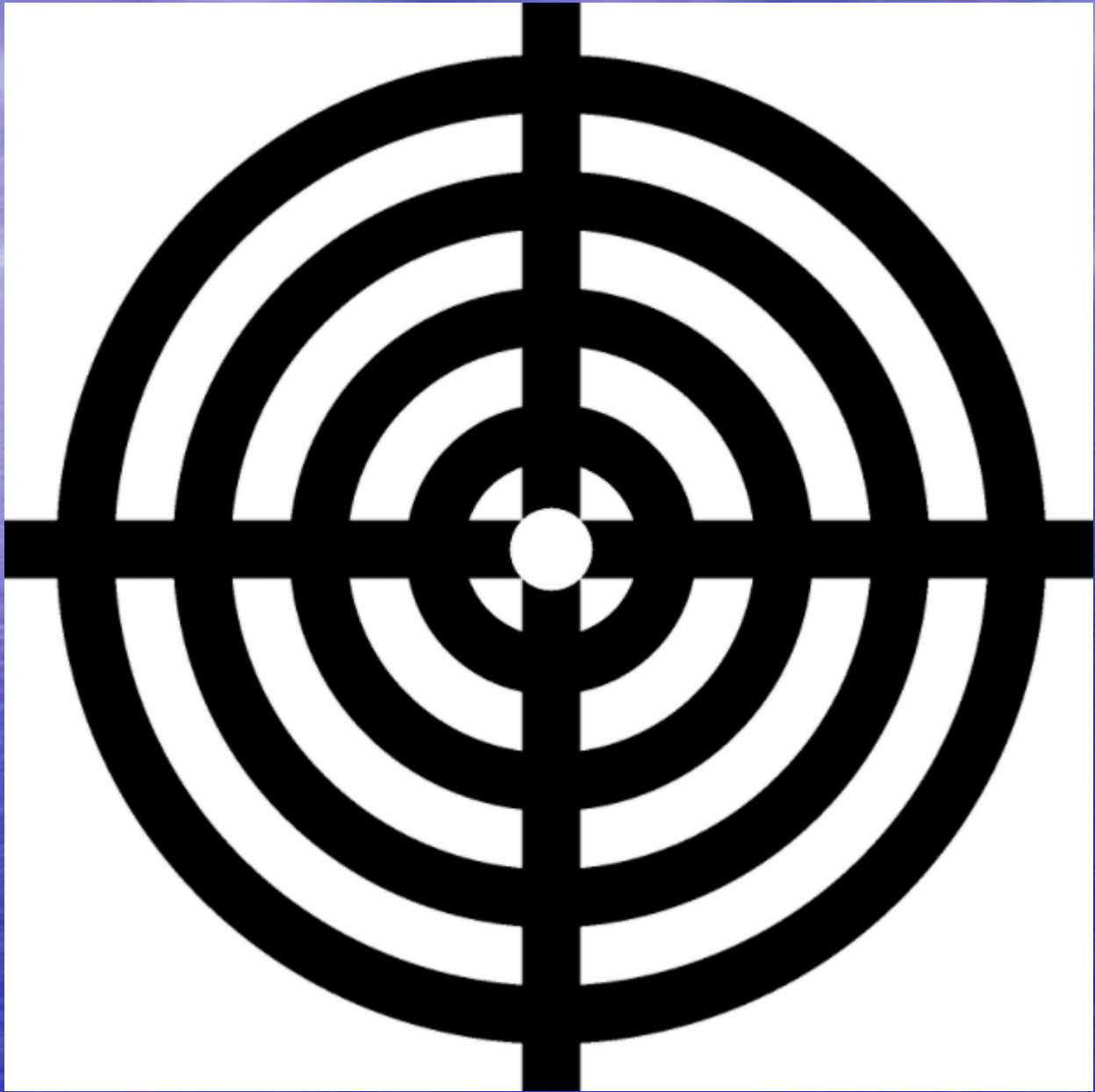
- Openness and clarity re goals – expectations
- Referral – records –diagnostic workup
- Scope of practice
- Treatment team communication
- Steps / training phase expectations
- “Graduation” criteria
- Home practice – follow up

The essence of assessment

- What is the presenting symptom, concern, goal?
- How long?
- Demographic details
- Prior DX assessments, evaluations
- Medications
- Previous TX, What helps, What hurts?

Assessment (2)

- Life style assessment
 - Diet
 - Sleep
 - Exercise
 - Stress management (+ and -)
 - Leisure time use
 - Support system



Matching symptom/goal to equipment/protocol options

- peripheral temperature
- sEMG
- electro-dermal response/GSR
- Heart Rate Variability
- EEG-neurofeedback
- Cranial blood flow

In-office protocols for psychophysiological self-regulation

- Intention
- Awareness
- "Awhereness"
- Influence of response
- Practice
- Mastery

Adjunctive methods – support

- EFT
- EMD/R
- NET
- DBT
- PSYCH-K
- Metaphoric (David Grove – *Resolving Traumatic Memories*)
- Meditation

Concluding treatment/training

- Home training
- Graduation criteria
- Managing flare-ups
- Follow-up TX
- Referral??

Standards of record keeping

- Keep general demographic records and treatment specific session notes such that any other BFB practitioner could take over treatment and would know exactly what to do in a next session re: which protocol, what modality, where to place sensors, what thresholds, etc.
- Notes re client comments, strategies etc.

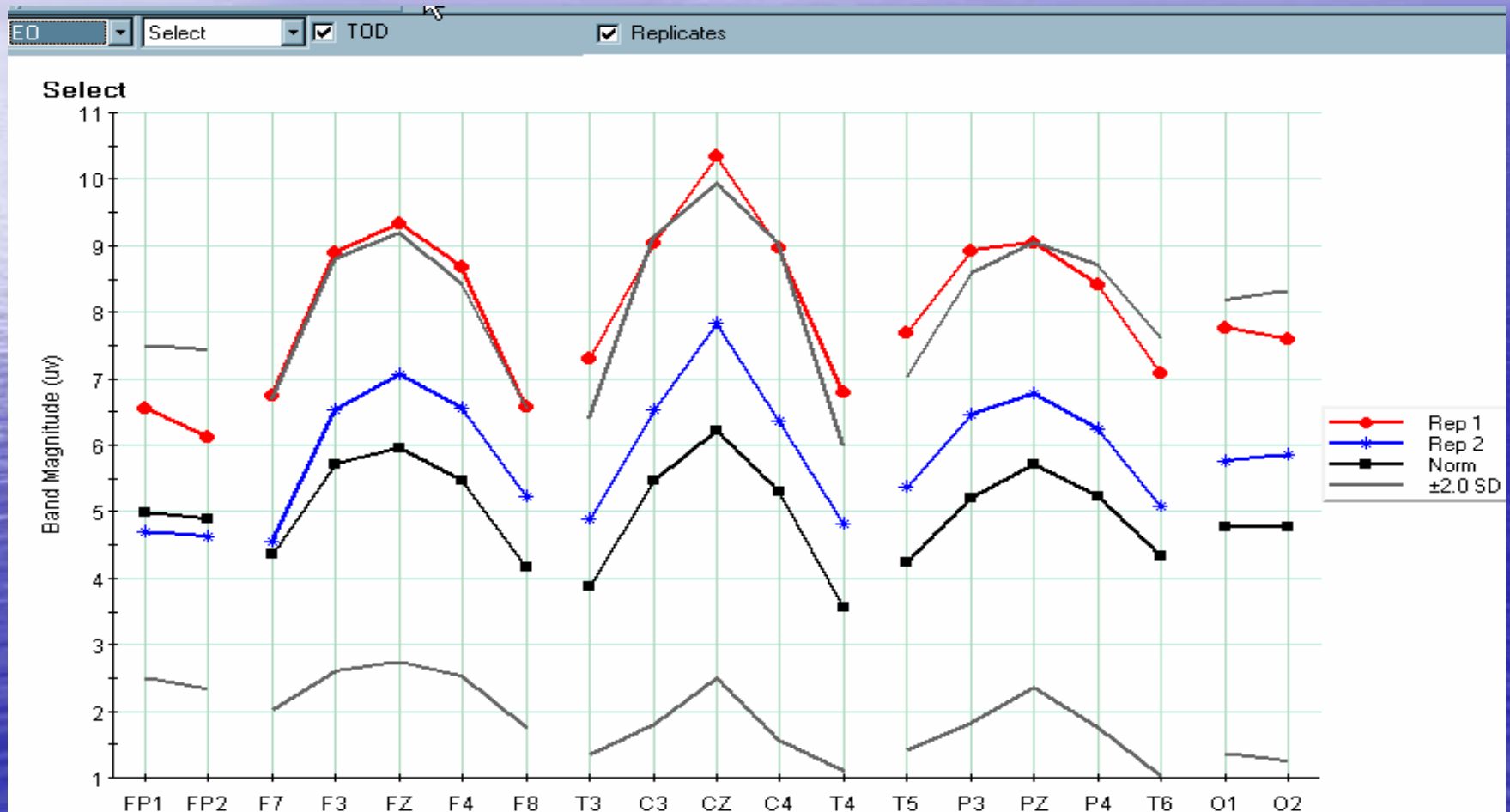
CASE PRESENTATION

ANOXIC BRAIN INJURY

Chip R. Anoxic Brain Injury

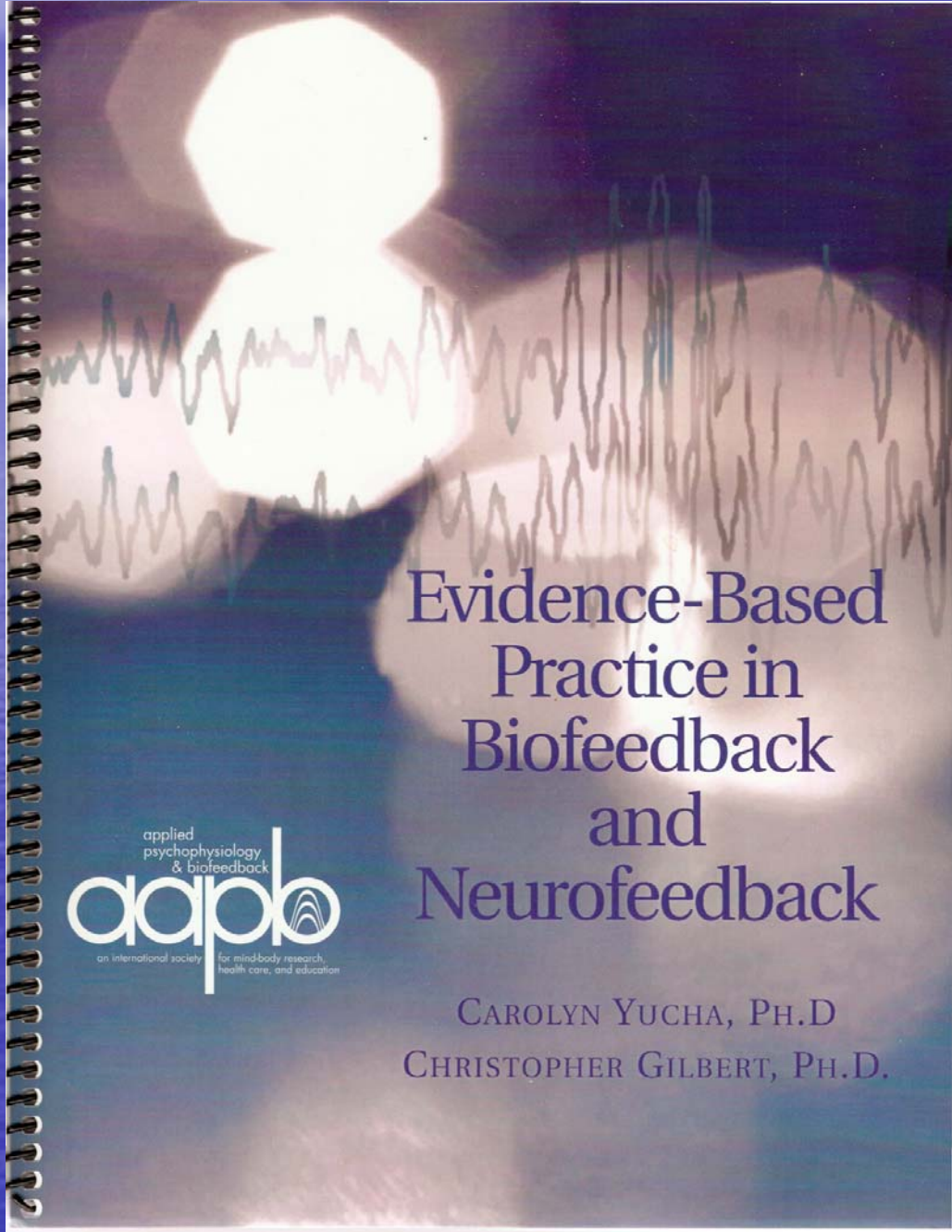
- Premorbid history of ADHD
- Early childhood history of ODD.
- Desipramine Toxicity resulting in..
- Cardiac Arrest at age 7.5
- Hypoxic for appprox. 25 min.
- Resulting in severe CNS damage/disability

Chip R. EO Pre – Post Topographic analysis: From a very abnormal brain (red) to normal (blue)



Chip's Treatment Outcomes

- Graduated from high school
- Got his driver's license
- Able to work
- Successful relationships
- Some impairments – but generally a normal life.



Evidence-Based Practice in Biofeedback and Neurofeedback

applied
psychophysiology
& biofeedback
aapbo
an international society for mind-body research,
health care, and education

CAROLYN YUCHA, PH.D
CHRISTOPHER GILBERT, PH.D.

Biofeedback is a mind-body therapy using electronic instruments to help individuals gain awareness and control over psychophysiological processes (Gilbert & Moss, 2003; Moss, 2001; Schwartz & Andrasik, 2003).

Biofeedback instruments measure **muscle activity, skin temperature, electrodermal activity, respiration, heart rate, heart rate variability, blood pressure, brain electrical activity, and brain blood flow.**

Research shows that biofeedback, alone and in combination with other behavioral therapies, is effective for treating a variety of medical and psychological disorders, ranging including headache, hypertension, temporo-mandibular pain, and attentional disorders (ADD/ADHD).

Neurofeedback is a specialty field within biofeedback, which devotes itself to training control over electro-chemical processes in the human brain (LaVaque, 2003; Evans & Abarbanel, 1999).

Assessment uses a baseline EEG, and sometimes a multi-site quantitative EEG (QEEG), to identify abnormal patterns (LaVaque, 2003). Many neurological and medical disorders are accompanied by abnormal patterns of cortical activity.

Neurofeedback uses a feedback electroencephalogram (EEG) to show the trainee current electrical patterns in his or her cortex. Clinical training with feedback EEG then enables the individual to modify those patterns, normalizing or optimizing brain activity.

Neurofeedback practice is growing rapidly, with the widest acceptance for applications to **attention deficit hyperactivity disorder (ADHD), learning disabilities, seizures, depression, acquired brain injuries, substance abuse, and anxiety** (Clinical EEG, 2000).

Biofeedback and Neurofeedback Efficacy

- **Level 5: Efficacious and specific:**
- **Level 4: Efficacious:**
- **Level 3: Probably Efficacious:**
- **Level 2: Possibly Efficacious:**
- **Level 1: Not empirically supported:**

Level 5 Efficacious and Specific

The investigational treatment has been shown to be statistically superior to credible sham therapy, pill, or alternative bona fide treatment in at least two independent research settings.

Urinary Incontinence in Females

Level 4: Efficacious:

In a comparison with a no-treatment control group, alternative treatment group, or sham (placebo) control utilizing randomized assignment, the investigational treatment is shown to be statistically significantly superior to the control condition or the investigational treatment is equivalent to a treatment of established efficacy in a study with sufficient power to detect moderate differences. The superiority or equivalence of the investigational treatment has been shown in at least two independent research settings

Level 4: Efficacious:

Conditions Treated:

- Anxiety
- Attention Deficit (ADD) & Hyperactivity (ADHD) Disorder
- Headache – Adult
- Hypertension
- Temporomandibular Disorders (TMD)
- Urinary Incontinence in Males

Level 3: Probably Efficacious:

Multiple observational studies, clinical studies, wait list controlled studies, and within subject and intra-subject replication studies that demonstrate efficacy.

Alcoholism/Substance Abuse,

Chronic Pain,

Fecal Elimination Disorders,

Pediatric Migraine HA,

Traumatic Brain Injury,

Arthritis,

Epilepsy

Insomnia

Level 2: Possibly Efficacious:

At least one study of sufficient statistical power with well identified outcome measures, but lacking randomized assignment to a control condition internal to the study.

- Asthma
- Cancer and HIV, Effect on Immune Function
- Cerebral Palsy

Level 2: Possibly Efficacious: Continued

- Chronic Obstructive Pulmonary Disease
- Cystic Fibrosis
- Depressive disorders
- Diabetes Mellitus
- Fibromyalgia
- Foot Ulcers
- Hand Dystonia

Level 2: Possibly Efficacious: Continued

- Irritable Bowel Syndrome
- Mechanical Ventilation (weaning)
- Motion Sickness
- Myocardial Infarction
- Post-Traumatic Stress Disorder
- Raynaud's Disease
- Repetitive Strain Injury
- Stroke
- Tinnitus
- Urinary Incontinence in Children

Level 1: Not empirically supported:

Supported only by anecdotal reports and/or case studies in non-peer reviewed venues.

- Autism
- Eating Disorders
- Multiple Sclerosis
- Spinal Cord Injury

HOW CAN BFB – NFB BE HELPFUL IN TREATING SO MANY CONDITIONS?????

- The amazing healing capacity of the human body and mind and,
- The significant power in the Law of Operant Conditioning.
- These two factors make it possible for patients to directly participate in recovering health and developing WELLBEING.

Ethical considerations in the practice of BFB-SRT

- Informed consent –formal and informal.
- Scope of practice – clinical training and expertise.
- Appropriate referral (medication?)
- Dual Relationships – NOT!
- Confidentiality
- Duty to Inform

Practice - Organization Models

- Collaboration v. solo
- Medical office
- Psychiatric practice
- Education support (test anxiety, focus, attention....)
- Physical Therapy practice
- Sports facility

PEAK PERFORMANCE TRAINING



- 15 subjects - 3 skill levels
- NFB Training – 20 sessions
- “Perfect Performance” scripts
- Average of 7.6 stroke reduction - post training
- Improved psychological – emotional function.

HEAD in the GAME

THE MENTAL ENGINEERING OF THE
WORLD'S GREATEST ATHLETES



BRANDON SNEED

A Glimpse of the Future

Biofeedback – Neurofeedback

via

Smartphone apps

Pip – GSR app



Pip GSR

Frontiers in Psychology. 2016; 7: 832. Published online 2016 Jun 17.

Smartphone Applications Utilizing Biofeedback Can Aid Stress Reduction

- Alison Dillon, Mark Kelly, Ian H. Robertson, and Deirdre A. Robertson

Neurosky-----MUSE



Throw Trucks With
Your Mind



Focus Pocus

HeartMath Inner Balance



Lumo Lift Posture Trainer



VERSUS

EMOTIV



“Resistance is futile: you will be assimilated”

For cognitive training



For Athletic Performance



For health and wellbeing

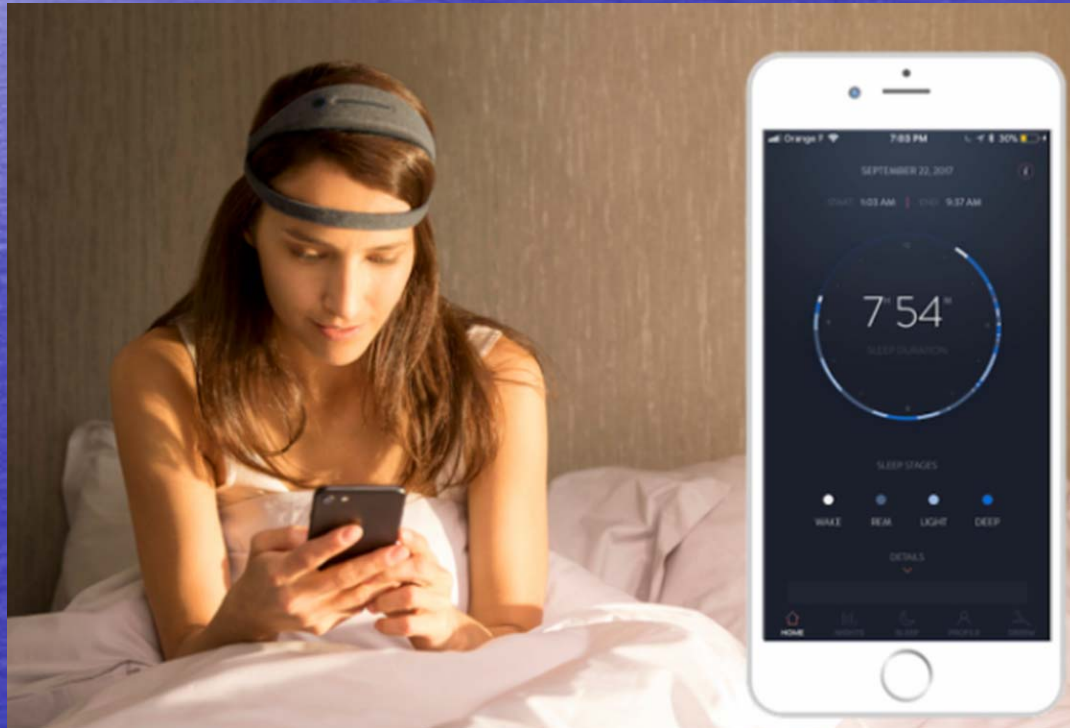


NeuroPlus – Durham, NC





NEUROSCIENCE
MEETS ADVANCED
TECHNOLOGY.





The US Department of Defense (DoD), coordinator and supervisor of all agencies and functions of the US government, has released BioZen, a free smartphone application to help service members use the therapeutic benefits of biofeedback. The app was developed as a pilot project to study the feasibility of using smartphones to receive signals from biosensor devices.

BioZen continued:

“Mastering biofeedback successfully is difficult and frustrating for many people,” said Dr. David Cooper, T2 psychologist. “This app takes many of the large medical sensors found in a clinic and puts them in the hands of anyone with a smart phone. BioZen makes it easier for anyone to get started with biofeedback.”

The system can display Delta, Theta, Alpha, Beta, and Gamma brain waves. It can also combine the brain waves to show meditative and attentive cognitive states. Users can document their session with biofeedback data recorded in the phone or tablet. BioZen generates graphical feedback from the recording sessions to show the user’s progress over time.

BioZen has been built on an open source framework and it is currently available free for Android devices. The app requires the purchase of compatible biosensor devices. Among many other products BioZen is compatible with the [NeuroSky MindWave](#) and the [BrainAthlete](#) brain-computer interface headsets. A [list of compatible sensors](#) is available on the BioZen website.

Source: [defense.gov](#)

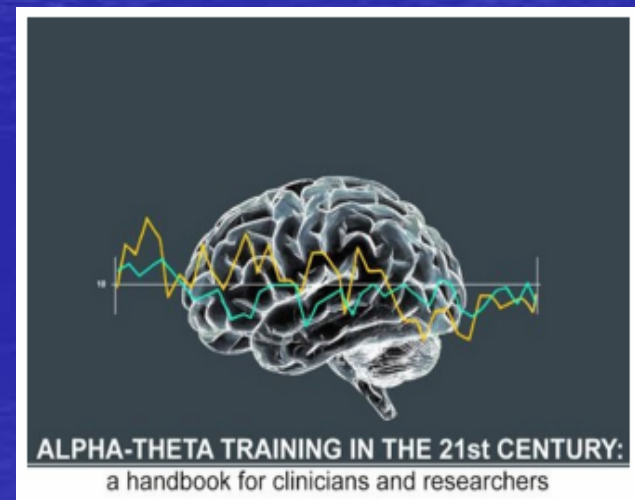
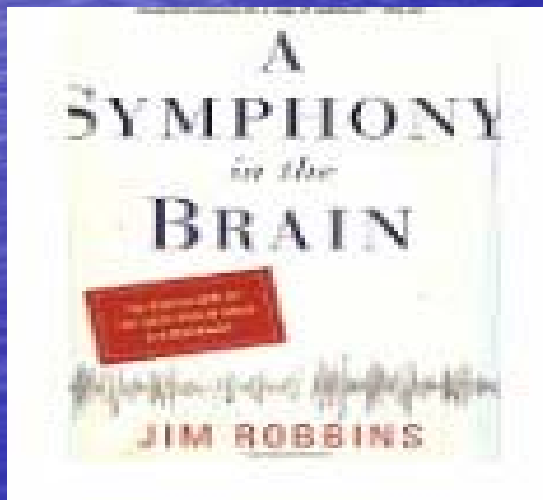
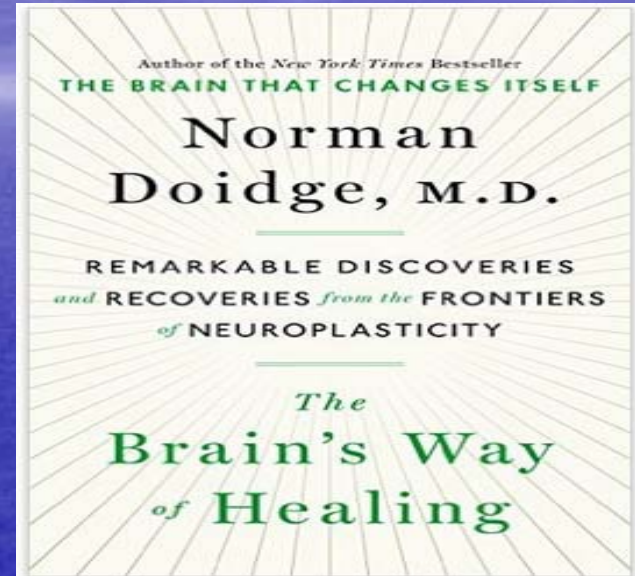
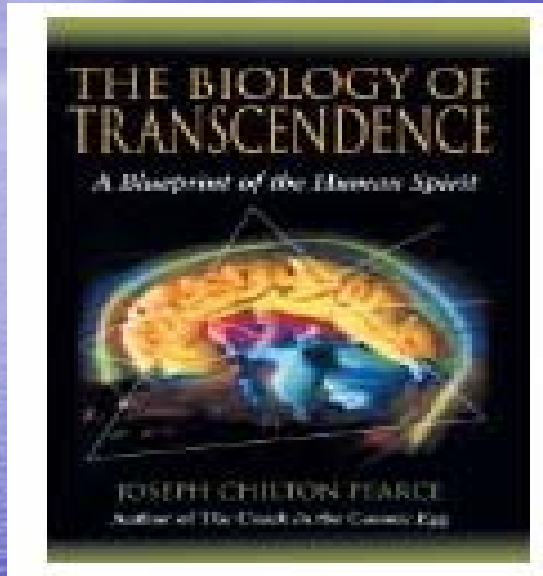
Information About Biofeedback, QEEG and Neurofeedback

- Websites:
 - AAPB.org - Association for Applied Psychophysiology & Biofeedback
 - ISNR.org - International Society for Neurofeedback and Research
 - BFE.org – Biofeedback Federation of Europe

READING

- Erik Peper, Hana Tylova et.al.
Biofeedback Mastery: An Experiential Teaching and Self Training Manual.
A.A.P.B., 2008
- Richard Soutar, Robert Longo. *Doing Neurofeedback: an Introduction.*
ISNR Research Foundation. 2011

Good Introductory Reads



HEAD in the GAME

THE MENTAL ENGINEERING OF THE
WORLD'S GREATEST ATHLETES



BRANDON SNEED

Continuing Education and Supervision

- Adjunctive therapies – modalities
- Self-training
- Supervision - mentoring
- List-serve, forums, webinars
- Annual Conferences
- Workshops

Professional Certification

- Biofeedback Certification International Alliance – Biofeedback and Neurofeedback
bcia.org
- QEEG Certification Board
qeegetcercificationboard.org

Hardware and Software Considerations

- Thought Technology
- Stens
- BrainMaster
- HeartMath
- BioMedical Instruments

- Demonstrations.....

DISCUSSION

questions???