Why Not Go to the Source?

Direct Brain-Based Interventions For Addiction Disorders

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Neurotherapy as Adjunct Treatment

• Neurotherapy interventions most effective when part of comprehensive treatment programs
• Require strong support systems for best effect
• Appear to be beneficial in regard to:
  – Improving cognitive function
  – Improving insight and self-awareness
  – Reducing anxiety and correcting predisposing factors
  – Helping the client become ‘more available’ for the treatment experience
  – Reinforcing effect on cognitive control over limbic drive mechanisms – 8 Hz. phase reset and phase synchrony/lock

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So, What is the Source?

• The brain/central nervous system (CNS)
  – Primarily concerned with function and homeostasis
  – Includes the body
    • Body/mind interaction mediated by CNS
  – Drives behavior
  – Learns behavior
  – Chooses or fails to choose behavior – ‘default’ choices
  – Is self-aware and/or lacks self-awareness
  – Has the capacity to change
  – Resists change
  – Attempts to maintain current functional status

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Where is the Source?

- Distributed network
- Consists of hubs or nodes linked into networks via glial gap junction connections
- Mediated by typical brain rhythms in ‘nested’ relationships

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Dysfunction of the prefrontal cortex in addiction: neuroimaging findings and clinical implications, Goldstein, R, Volkow, N; Nature Reviews Neuroscience, vol. 12, November 2011

'Cold or controlled' behavioral self control (Dorsal PFC incl. dIPFC, dACC, inferior frontal gyrus)

'Hot or Drive' based behaviors (Ventral PFC, incl. mOFC, vmPFC, rvACC)

‘Drive’ based behaviors dominate

Strong control

Increasing influence

Stop!

Stop?
Compromised sensitivity to monetary reward in current cocaine users: An ERP study

**Figure 1.** Grand averaged waveforms for control subjects (top) and individuals with current cocaine use disorders (bottom) reflecting 200 ms before to 800 ms after the target stimulus (S1) for each monetary reward condition (45¢, 1¢, 0¢) during the go trials (*n* = 18 in each group).
Motivated attention to cocaine and emotional cues in abstinent and current cocaine users – an ERP study
Dunning et al., European Journal of Neuroscience, pp. 1–8, 2011
Motivated attention to cocaine and emotional cues in abstinent and current cocaine users – an ERP study
Dunning et al., European Journal of Neuroscience, pp. 1–8, 2011
“Typical” Alcoholic EEG Pattern

• Decreased alpha amplitudes generally
• Lack of alpha activation during “rest”
• High amplitude beta and gamma
• True for non-using alcoholics, non-using children of alcoholics and other 1\textsuperscript{st} order relatives
• EEG normalizes with challenge dose of alcohol
Alpha and Alcoholism

• Abnormalities in resting EEG readings may show a pre-disposition to alcoholism
  – Decreased alpha and increased beta activity in frontal and occipital areas in offspring of alcoholics (n=64) compared to controls with no history of familial alcoholism (n=66)
    • Effect sizes 0.37-0.57
    • P-values 0.04-0.002
      – Both depending upon sensor location
    • Finn, et. al. (Alcohol Clin Exp Res 1999 Feb;23(2):256-62)
Chromosome 5q13-14: Convergence of Linkage Peaks for Alpha (8–13 Hz) and Beta (13–30 Hz) EEG power

http://www.plosone.org/article/info:doi/10.1371/journal.pone.0003620

CRH-BP = corticotrophin releasing hormone-binding protein gene
Brain Based Interventions

- EEG Biofeedback (Neurofeedback)
- Audio Visual Entrainment (AVE)
- Cranial Electrotherapy Stimulation (CES)
- Repetitive transcranial magnetic stimulation (rTMS)
- Transcranial DC stimulation (tDCS)
- General biofeedback interventions
Neurofeedback

• EEG biofeedback or neurofeedback
  – Protocol based approach following publications by Peniston, Scott and Kaiser, Burkett
    • Peripheral temperature training to criteria followed by Alpha/Theta training using behavior change scripts
    • Single channel bipolar montage training to correct cognitive dysfunction followed by Alpha/Theta training, again using behavior change scripts
  – Z score training based upon quantitative EEG (qEEG) assessment followed by Alpha/Theta or other deep states training, with or without behavior change scripts
APPLICATIONS OF NEUROFEEDBACK
Protocol Based Training

- Pre-training to promote generalized relaxation or to correct cognitive deficiencies – 10-15 sessions
  - Temperature training
  - Heart rate variability training (HRV)
  - Beta/SMR EEG training

- Alpha/Theta training using scripts and guided imagery to promote behavior change, insight, self-awareness and integration of treatment based concepts and experiences

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Research Publications


Reduced cue response reactivity to drug imagery in target and non-target conditions
CRI-Help Study

• 121 participants, randomly assigned:
  – 58 experimental
  – 63 control

• Experimental program
  – SMR/beta
  – Alpha/theta
  – Minnesota model treatment

• Control
  – Minnesota model treatment
  – Attention control exercises (computer based)
Program Retention

Remaining in Treatment (%)

Weeks

Ctrl
Exp
TOVA results

• Significant improvement (p < 0.005)
  – Impulsivity
  – Variability

• Improvement in Inattention, but no significant treatment interaction
No Contact
Aborted Study
Relapse
Abstinent

Control n=48
Experimental n=55
Southwest Health Technology Foundation

- EEG Biofeedback as an Adjunctive Therapy in the Treatment of Crack-Cocaine Dependence
  - Burkett, Cummins, Dickson, Skolnick
  - 9 month, residential, homeless mission based treatment program
  - 5 year study begun in 1999
  - Published in 2005

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Crack-Cocaine Dependence

• Typical relapse rates of 80% post treatment (Alterman, et al., 1998; Higgins, et al., 1995; Kang, et al., 1991)

• Length of treatment retention is single most important factor to subsequent relapse (Hubbard, et al., 1989 reporting on several long term studies)
Changes in Depression & Anxiety (n=178)
Self Report Drug Use @ 12 Months (Correlated with UA) (n=87)
Retention in days as Variable of EEG Training
(n=402)
Pros and Cons of Neurofeedback

• Pros
  – Non-invasive
  – Drug free
  – Improves multiple areas of function – not just addiction behaviors
  – Easy to target specific areas of dysfunction
  – Generally pleasant and well tolerated by most clients
  – **Excellent results documented and published**

• Cons
  – Requires well trained, experienced clinician to administer
  – Initial costs are substantial – in the range of $5,000 - $10,000 for equipment
  – Time intensive process requiring 20-40 sessions
  – Unlikely to be reimbursed by 3rd party payers
  – Can cause temporary negative effects
Audio Visual Entrainment (AVE)

- Relies on the evoked response of the brain to sensory input
- Repetitive sensory input such as a light flashing at a specific frequency produces a brain response to each ‘event’
- Evoked frequency response in the brain can be defined from 0.5-25 Hz. (typical EEG frequencies)
THERAPEUTIC EFFECTS OF AVE

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CHRONIC PAIN RELATED STRESS MONITORS RELATING TO BWE

Frederic Boersma Ph.D 1990

Graph showing changes in pain level, medication use, suicide ideation, and anxiety/stress over months with TENS only.
CHRONIC PAIN - QUALITY OF LIFE MONITORS WITH AVS

Frederic Boersma Ph.D. 1990

Graph showing changes in various ratings over time. The x-axis represents months, and the y-axis represents a rating scale from 0 to 10. Different lines represent different categories:
- Red: Coping Ability
- Yellow: Hopefulness
- Purple: Self-Esteem
- Blue: Family Stability
- Pink: Rest/Sleep

Legend in the graph illustrates the categories and their respective colors.
Audio-Visual Entrainment (AVE) as a Treatment Modality for Seasonal Affective Disorder, Berg, K; Siever, D; *Journal of Neurotherapy*, Volume 13, Number 3. 2009, pages 166 - 175

Beck Depression Inventory

Score >9 indicates mild depression
Audio-Visual Entrainment (AVE) as a Treatment Modality for Seasonal Affective Disorder, Berg, K; Siever, D; Journal of Neurotherapy, Volume 13, Number 3. 2009, pages 166 - 175

Anxiety Severity Index

Score >15 significant for anxiety in males
Score >20 significant for anxiety in females
Audio-Visual Entrainment (AVE) as a Treatment Modality for Seasonal Affective Disorder, Berg, K; Siever, D; *Journal of Neurotherapy*, Volume 13, Number 3. 2009, pages 166 - 175

Life Change Effects

Changes in Neurotransmitters from 1 session of 10 Hz. AVE
Audio-Visual Entrainment: A Novel Way of Boosting Grades and Socialization While Reducing Stress in the Typical University and College Student, Siever, D, Nov 2011
Photic Stimulation Increases regional Cranial Blood Flow
Fox & Raichle, 1985; Sappy-Marinier et al., 1992

- N=4
- 5% Whole brain
- $O_2$ increase (1988)

- $rCBF$ in Striate (V1) Cortex

AVE Effects on Memory & Concentration, Wuchrer, V. (2009)

AVE = 8  C = 9  
AVS = 15 min 
@ 14 & 22 Hz

AVE Group  Control Grp.

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Pros and Cons of AVE

**Pros**

- Inexpensive
  - Units from $300-$500
  - Each unit can be used by two clients concurrently
  - Sessions last 20-40 minutes
  - Clients can self administer with minimal training
- Easy to administer
  - Doesn’t require extensive training or experience
  - Simple, easy to follow protocol guide
- Clients can continue to use following discharge
- Generally well tolerated
- Good compliance

**Cons**

- No published studies directly addressing SUD
- Contra-indicated in cases with seizure Hx
- Can produce temporary negative effects

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CES, rTMS, tDCS

• Cranial electrotherapy stimulation
  – Very low power AC current between ears or mastoids
  – Similar to TENS in concept
  – Better units have EEG frequency selection for enhanced effects
  – Mild effects, little chance of negative symptoms
  – Can be self-administered by client and can be used in home training approach with clinical guidance

• Repetitive transcranial magnetic stimulation and transcranial DC stimulation
  – Quite invasive
  – Needs location guidance from CT or MRI
  – Must be administered by medical personnel
Using Neurotherapy in a Clinical Setting

• AVE and CES are most practical and easiest to administer
  – Ideal usage is once or twice daily
  – Will generally be needed for 3-6 months or longer
  – Can be used at home following discharge

• Neurofeedback has good evidence basis and is highly effective for many co-morbid conditions
  – Ideal intervention is twice daily, five days per week for 20-40 sessions
  – Minimal need for continued or follow-up sessions
  – Continued training must be done in clinical setting
General Biofeedback Applications

- Heart rate variability and respiration training
  - HRV
    - Lots of stand alone devices
    - Can be used clinically or at home
    - General health benefits
    - Evidence based – exhaustive research
- Temp, GSR, EMG, etc.
  - General relaxation effects
  - Mostly clinical settings but a few handheld devices
  - Specific applications for certain conditions
  - No direct evidence of SUD effects
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