Helping ADHD Children with Music Therapy & EEG Neurofeedback: Brain-jamming for focus

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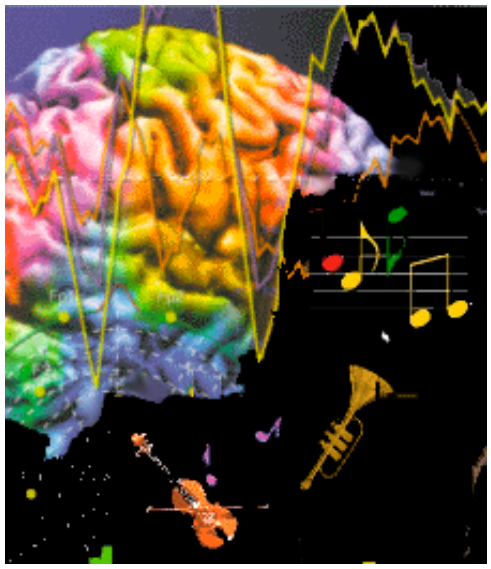
The Biofeedback Network

www.Biofeedback.net

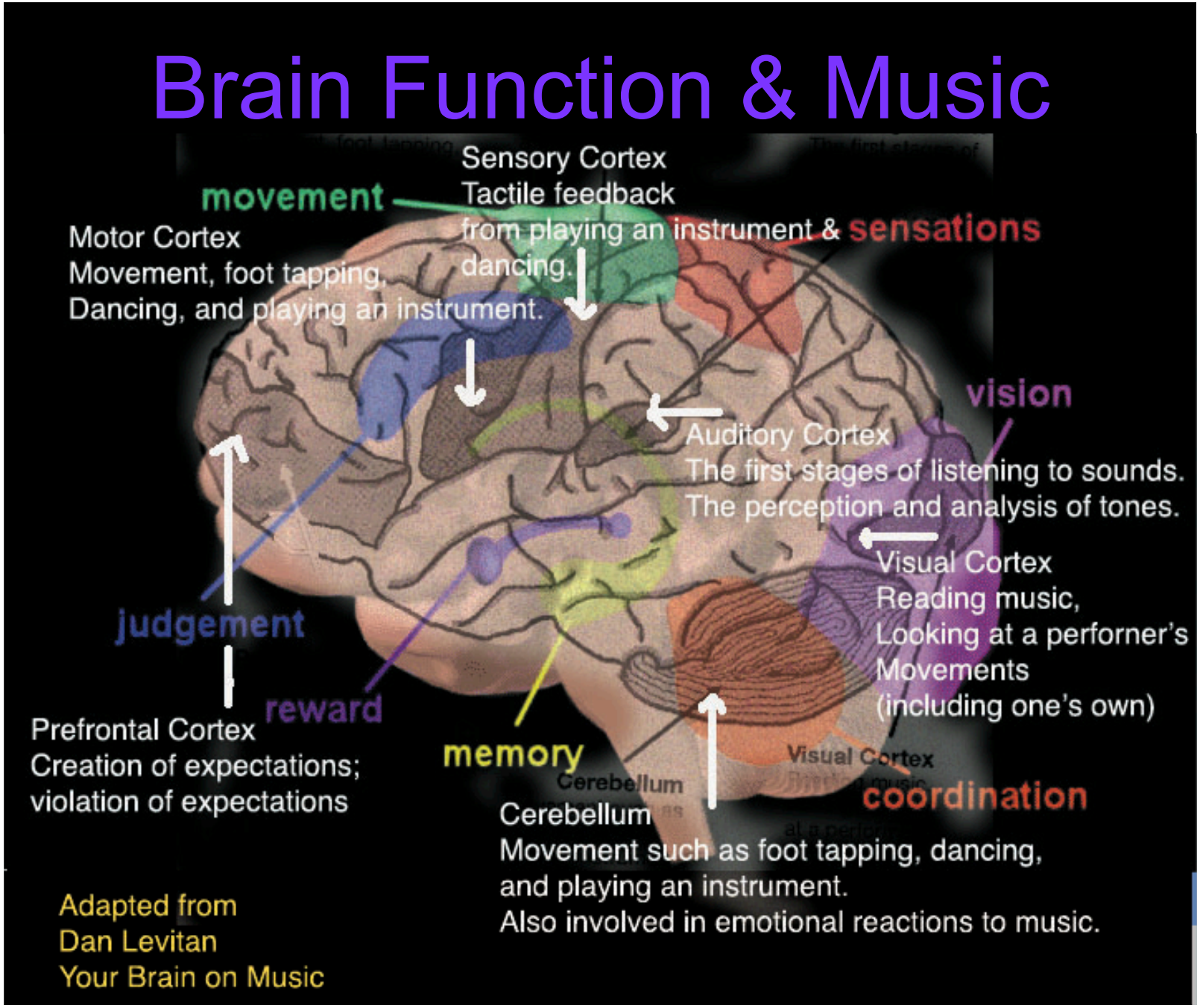
Expressive Therapy Concepts

www.ExpressiveTherapy.org



Courtesy of an NIH mini-grant via Immaculata University

Brain Function & Music



The Center for Disease Control & Prevention (CDC) describes ADHD as "a neurobehavioral disorder characterized by pervasive inattention and/or hyperactivity-impulsivity and resulting in significant functional impairment" (CDC, 2005, p. 1).

Star Wars Neurofeedback

Inclusion Criteria

♦**8-14 years old** & collateral data from their parents, teachers, healthcare professionals.

♦**Formally diagnosed** with ADHD by a licensed psychologist, psychiatrist or medical doctor with or without the “H”.

♦**Does Not have other axis 1 Dx**

♦**Not taking medications** that would confound the EEG

Measures

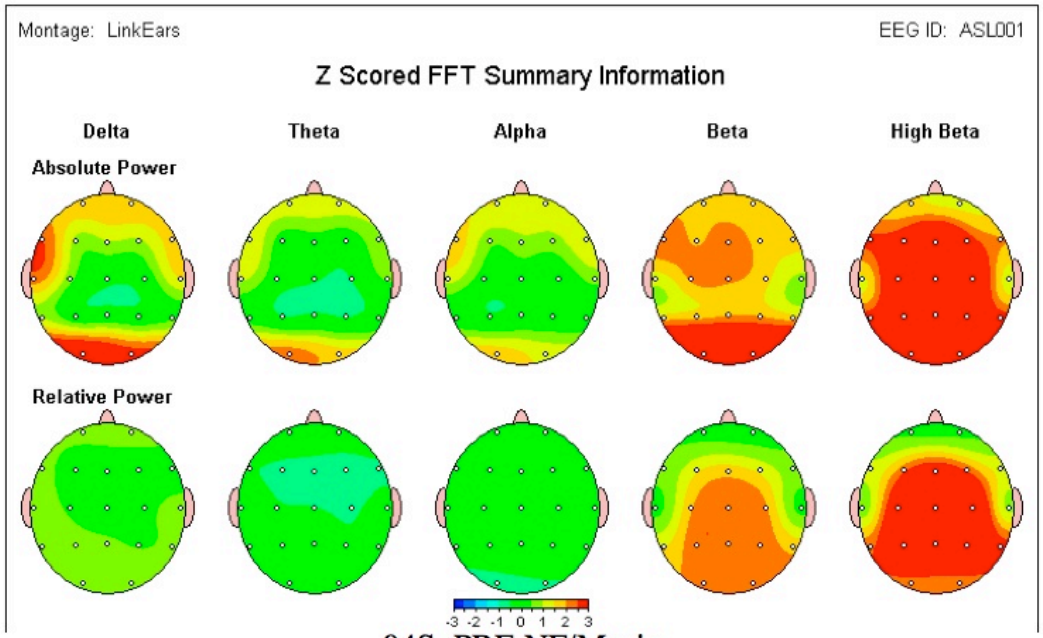
- **The Conners’ CPT**
- **Stroop, Nepsy exec sub-scale, Toni-3**
- **Quantitative electroencephalography (QEEG)**
- **Monopolar EEG session data**
- **Pre, mid and post-session questionnaires**
- **Qualitative interviews**

Brain-Maps

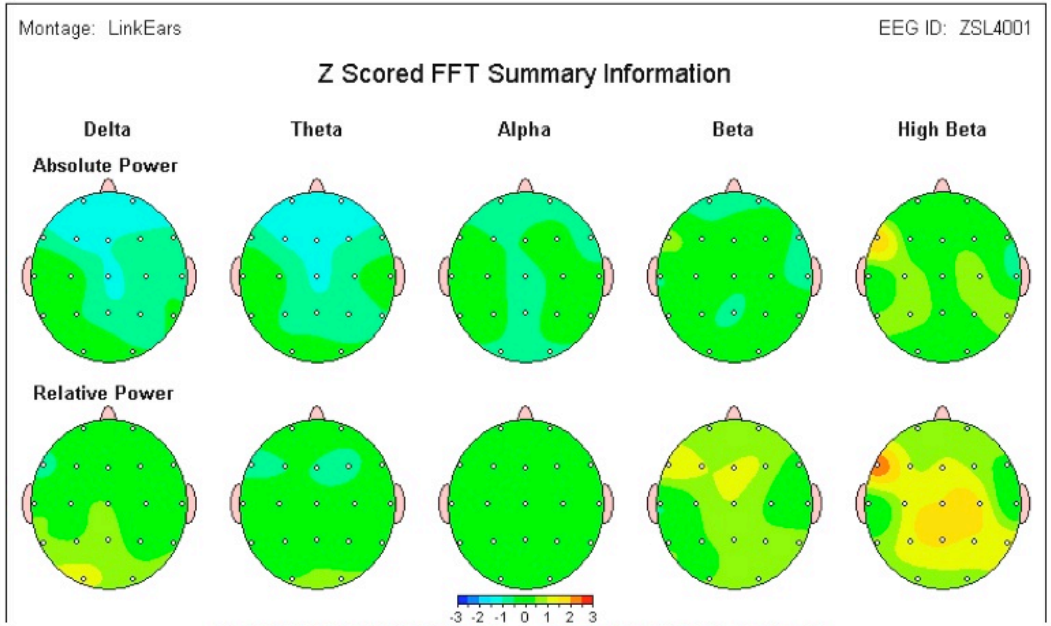
QEEG

Pre-Post

Note a pattern of normalization across all bands, with significant reduction in significantly "hot" Delta, Beta and high Beta rhythms.



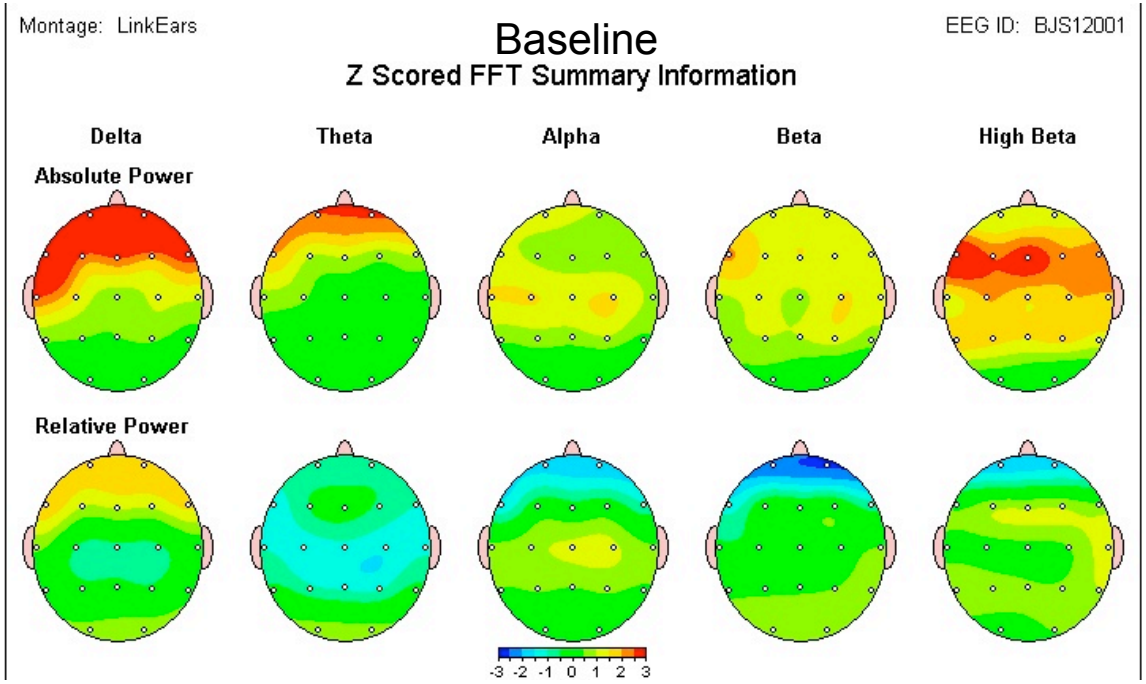
$04S_1$ PRE NF/Music

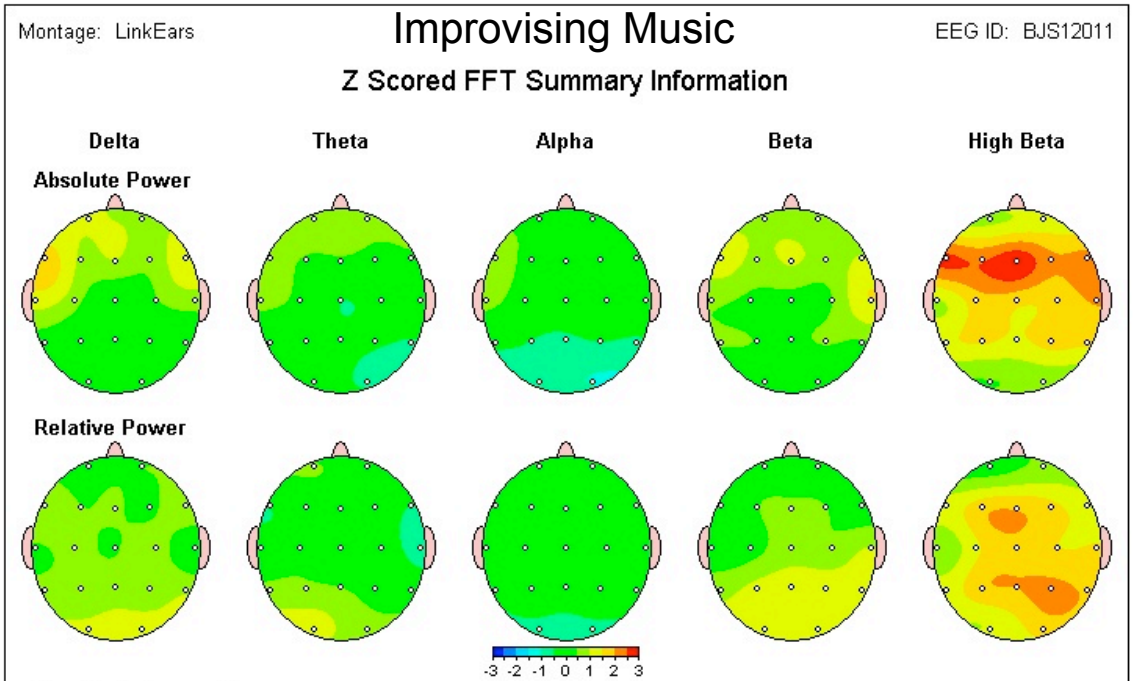


$04S_1$ POST NF/Music – from 2004 Pilot Study

Brain Maps

Single-subject QEEG BASELINE vs. IMPROV MUSIC





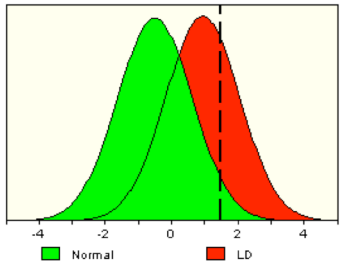
Discriminant Analysis

Montage: LinkEars EEG ID: AJS9001

Learning Disability Discriminant Analysis*

LD DISCRIMINANT SCORE = 1.46 LD PROBABILITY INDEX = 99.0%

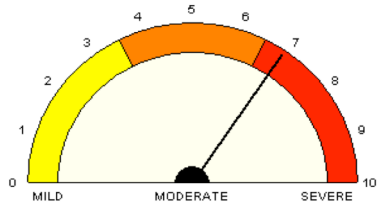
The Learning Disability Probability Index is the subject's probability of membership in the Learning Disability (LD) population.



			RAW	Z
F8	RATIO	T/B	1.05	-0.85
P3	AP	Theta	10.62	-1.28
Cz-C4	AMP	Theta	34.31	-0.35
F7-T6	AMP	Alpha	-110.42	0.28
T5-O2	COH	Theta	32.85	0.97
F3-Fz	COH	Alpha	81.00	-0.15
FP1-T5	PHA	Beta	21.38	
T4-T6	PHA	Delta	6.75	-0.03
F8-T3	PHA	Delta	-30.37	
T4-Pz	PHA	Theta	7.10	-0.01
FP1-Pz	PHA	Delta	75.18	
F8-Pz	PHA	Beta	20.93	
C3-O2	PHA	Alpha	-6.87	
FP1-F4	PHA	Alpha	-16.64	

LD SEVERITY INDEX = 6.89

This severity score places the patient in the SEVERE range of severity.



The LD Severity Index is an estimate of the neurological severity of Learning Disability.

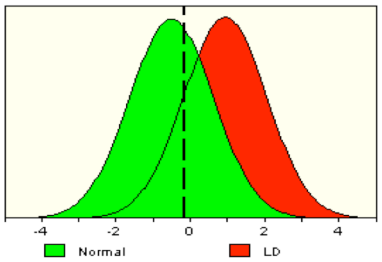
Note that the probability of inclusion in the LD population has decreased from 99% to 60%.

Montage: LinkEars EEG ID: BJS12001

Learning Disability Discriminant Analysis*

LD DISCRIMINANT SCORE = -0.18 LD PROBABILITY INDEX = 60.0%

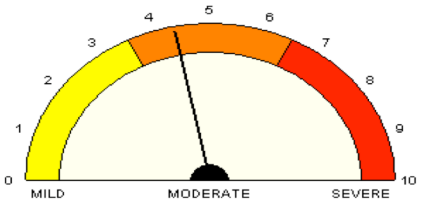
The Learning Disability Probability Index is the subject's probability of membership in the Learning Disability (LD) population.



			RAW	Z
F8	RATIO	T/B	0.93	-1.11
P3	AP	Theta	18.22	-0.48
Cz-C4	AMP	Theta	16.24	0.42
F7-T6	AMP	Alpha	-75.70	1.19
T5-O2	COH	Theta	49.18	1.81
F3-Fz	COH	Alpha	64.88	-0.96
FP1-T5	PHA	Beta	-13.53	
T4-T6	PHA	Delta	6.51	-0.07
F8-T3	PHA	Delta	26.68	
T4-Pz	PHA	Theta	14.71	
FP1-Pz	PHA	Delta	-11.35	
F8-Pz	PHA	Beta	-32.30	
C3-O2	PHA	Alpha	3.78	
FP1-F4	PHA	Alpha	0.69	0.31

LD SEVERITY INDEX = 4.36

This severity score places the patient in the MODERATE range of severity.



The LD Severity Index is an estimate of the neurological severity of Learning Disability.

Pre vs. Post-Intervention

Discriminant Analysis

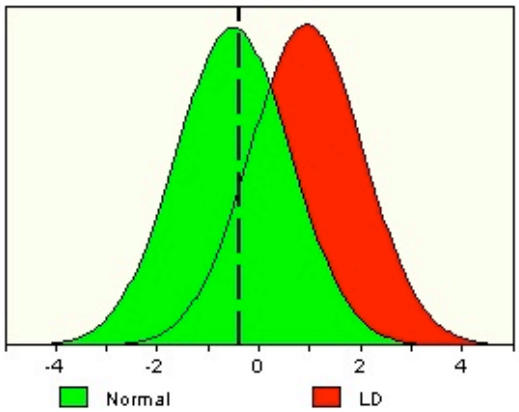
During IMPROV music (playing) LD probability drops to “not significant” at Post-Intervention.

Montage: LinkEars EEG ID: BJS12011

Learning Disability Discriminant Analysis*

LD DISCRIMINANT SCORE = -0.43 LD PROBABILITY INDEX = Not Significant

The Learning Disability Probability Index is the subject's probability of membership in the Learning Disability (LD) population.



			RAW	Z
F8	RATIO	T/B	1.26	-0.53
P3	AP	Theta	23.93	-0.08
Cz-C4	AMP	Theta	4.99	0.90
F7-T6	AMP	Alpha	1.82	3.21
T5-O2	COH	Theta	61.52	2.35
F3-Fz	COH	Alpha	80.57	-0.17
FP1-T5	PHA	Beta	-17.48	
T4-T6	PHA	Delta	8.44	0.19
F8-T3	PHA	Delta	-7.55	
T4-Pz	PHA	Theta	16.47	
FP1-Pz	PHA	Delta	-5.25	
F8-Pz	PHA	Beta	14.24	
C3-O2	PHA	Alpha	13.59	0.06
FP1-F4	PHA	Alpha	6.76	0.83

Between Group Differences

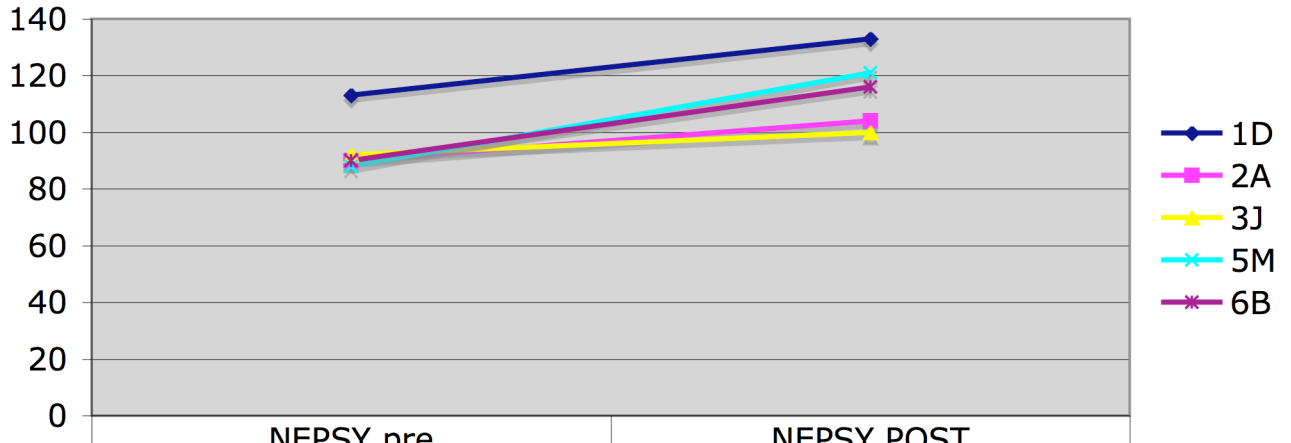
Control vs. 3 NF Groups

Between Group Differences

Condition	0- Control	1- NF1	2- NF2	3- NF+MUS		
Dependent Variable						
CONPOPP 1	60.67	72.42	68.67	62.75		
CONPOPP 2	62.78	70.75	66.08	54	F Value	0.71
					P Value	0.55
CONPCOG 1	66.63	64.42	56.42	67		
CONPCOG 2	65.78	59.42	59.25	52.5	F Value	**3.05**
					P Value	**0.04**
CONPHYP 1	73.78	77.92	72.42	68		
CONPHYP 2	73.67	71.33	68.25	47.25	F Value	**2.46**
					P Value	**0.08**
CONPADD 1	68.67	68.75	62.17	70.5		
CONPADD 2	67.67	66	64	52.5	F Value	**4.03**
					P Value	**0.02**
NEPAUD 1	8.22	8.67	7.75	11.8		
NEPAUD 2	7.89	8.42	8.17	13.75	F Value	**4.4**
					P Value	**0.01**
NEPVIS 1	6.78	9.82	9.55	6.8		
NEPVIS 2	7.67	10.92	11.08	12.25	F Value	**2.7**
					P Value	**0.06**

NEPSY Results NF-MUS group

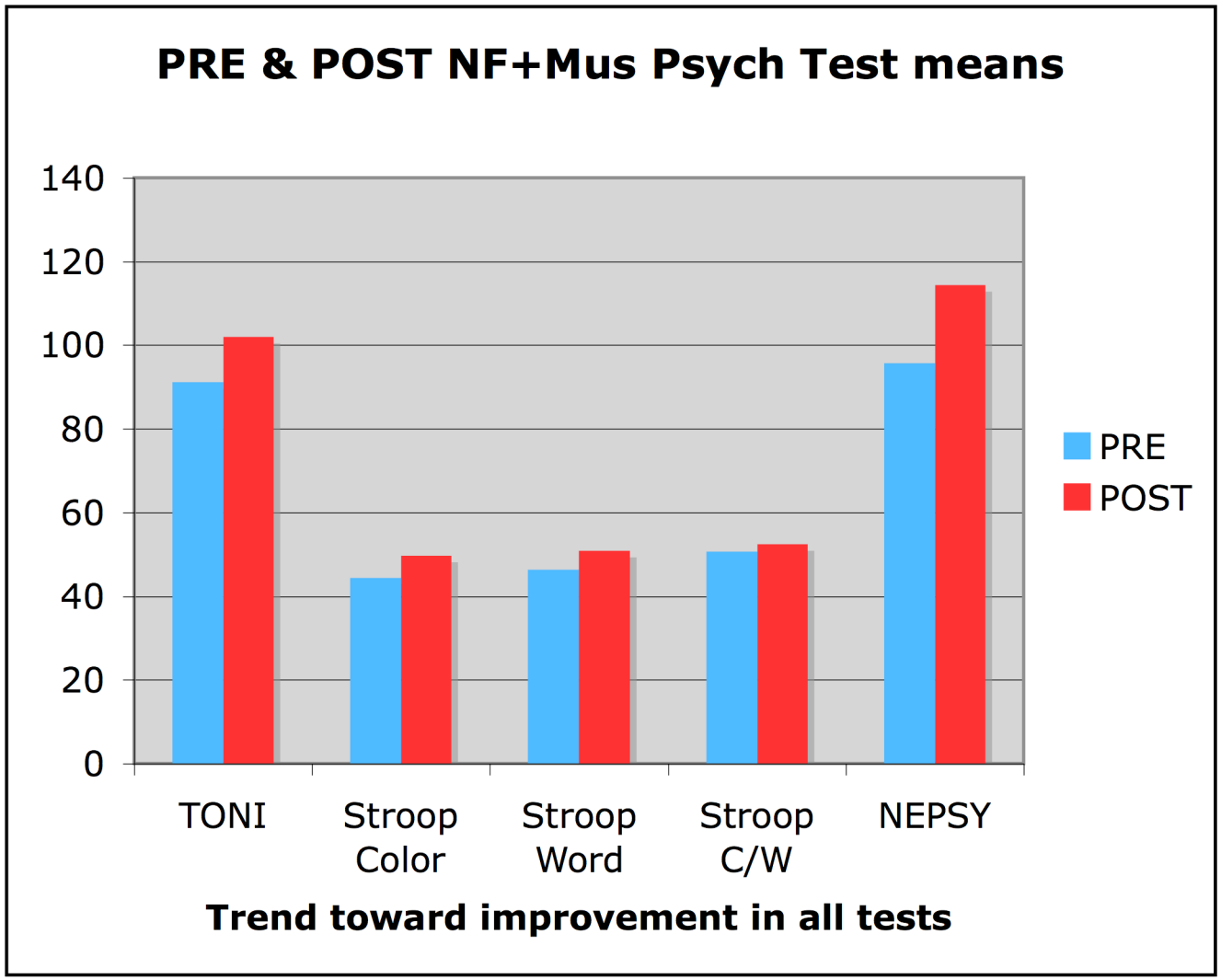
NEPSY Attention/Executive function
Core Domain Scores



	NEPSY pre	NEPSY POST
1D	113	133
2A	90	104
3J	92	100
5M	88	121
6B	90	116

All scores improve
Following Neurofeedback + MUS

Trend toward improvement



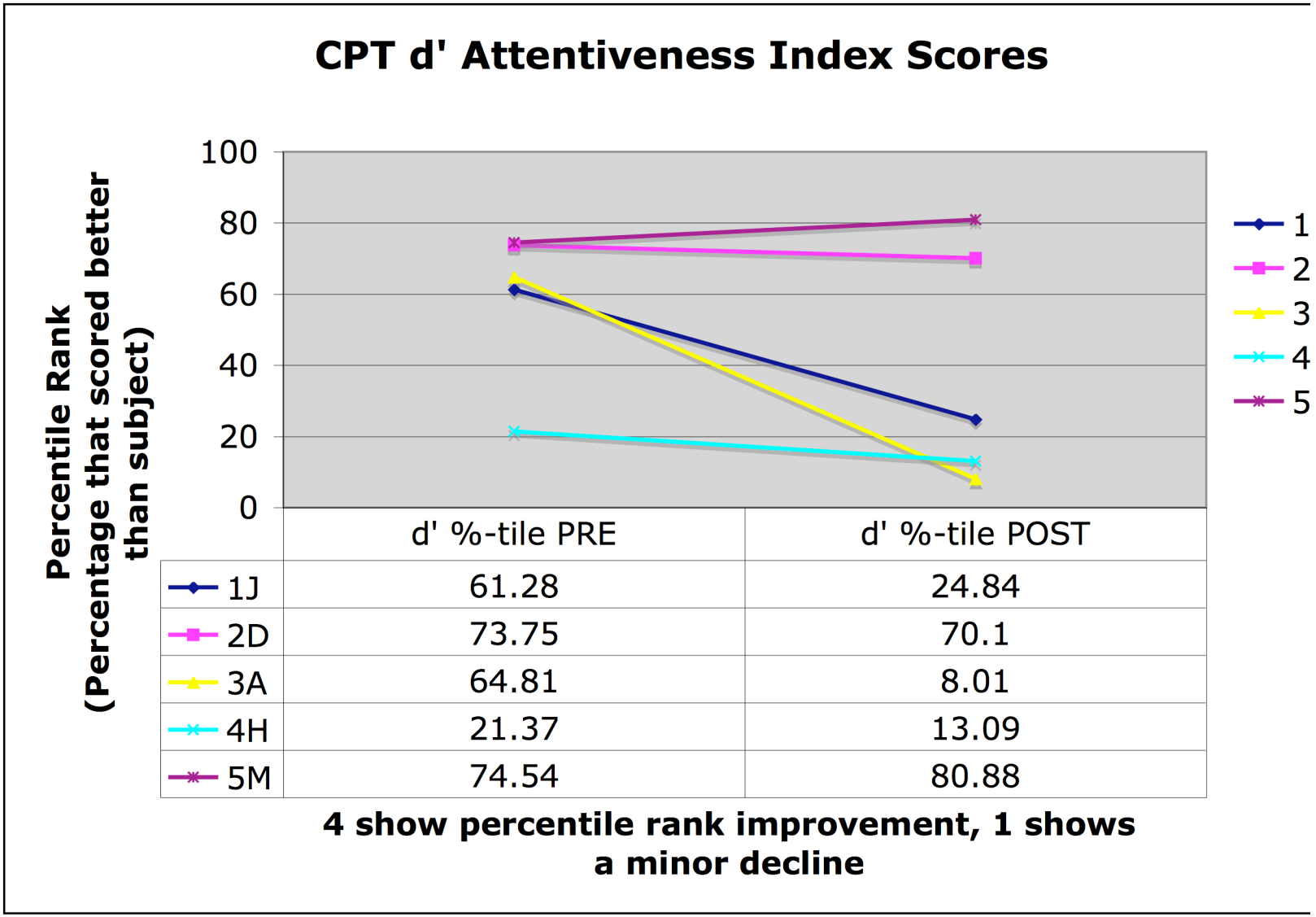
TONI-3 Results NF-MUS group

TONI-3 Results

			Percentages				
Name	**Date**	**Raw**	**Quotient**	**Rank**	**D.Q.**	**Descrip.**	**SEM**
1D	6-Oct	24	110	74	90-110	Average	5
	19-Dec	26	115	84	111-120	Above Avg.	5
2A*	6-Oct	6	72	3	70-79	Poor	5
	19-Dec	24	108	70	90-110	Average	5
3J	6-Oct	14	81	10	80-89	Below Avg.	4
	19-Dec	13	80	9	80-89	Below Avg.	4
5M	6-Oct	21	102	55	90-110	Average	5
	19-Dec	23	105	63	90-110	Average	5

All TONI-3 scores are at the 95% level of confidence +/-* 2SEM
*Statistically significant change in score

CPT Results NF-MUS group



	d' %-tile PRE	d' %-tile POST
1J	61.28	24.84
2D	73.75	70.1
3A	64.81	8.01
4H	21.37	13.09
5M	74.54	80.88

4 show percentile rank improvement, 1 shows a minor decline

GETTING FROM PSY-PHY (PSYCHOPHYSIOLOGY) TO MEDICAL POLICY VIA MUSIC AND NEUROFEEDBACK FOR ADHD CHILDREN

Eric B. Miller

Abstract

Within the backdrop of a societal healthcare paradigm swing, this study of EEG neurofeedback with music therapy protocols added an experimental group (NF-MUS) to an existing Philadelphia Office for Mental Health multi-site study of two traditional neurofeedback (NF) protocols. Thirty-eight subjects completed the pre- and post intervention assessment comprised of the Stroop, Toni-3, NEPSY Attention/Executive core domain score, Conners CPT and ADHD Parent and Teacher Rating Scales Revised (S). NF-MUS subjects also received pre- and post-quantitative EEG (QEEG) topographical brain-mapping. NF-MUS utilized a Theta/Beta protocol variation, incorporating brain-triggered musical tones assigned to Theta amplitude in key with background musical selections.

Individual results within the NF-MUS group showed improvement on NEPSY core domain scores and improvement individually on the Stroop Color and Word tests, but showed mixed results on the combined Stroop Color/Word test. Three out of four NF-MUS subjects improved their TONI quotient. CPT results were mixed, with some individuals displaying dramatic improvement on the CPT's ADHD index score. A paired samples T-test showed no significant differences between pre- and post-Toni-3 scores or Stroop Color/Word scores. Significant improvement was found for the Stroop Color and Stroop Word scores individually and for the NEPSY Executive Function/Attention subscale index scores.

Between-group analysis showed the NF-MUS group significantly superior to the other NF groups and control subjects on three measures: the NEPSY audio subtest ($p = .01$); the Conners Parent Rating Scale ADHD index ($p = .015$); and, the Conners Parent Survey Cognitive subscale ($p = .043$).
Differences in QEEG brain maps ranged from very little change pre- and post-intervention to noticeable normalization patterns. NF-MUS subjects decreased their Theta/Beta ratio ($p=.004$) and increased their SMR ($p=.012$) as hypothesized. Theta reduction alone, however, was not significant ($p=.189$).

These results indicate that a brain-triggered musical component to neurofeedback protocols may yield superior remediation of ADHD symptoms than standard neurofeedback protocols. Acceptance of these results and incorporation of findings into clinical practice, however, is unlikely until further investigation corroborates these results, and medical community attitudes continue to shift in the direction of holistic therapies.

Dr. Eric Miller is a psychotherapist, certified biofeedback therapist and board-certified music therapist with experience in inpatient, outpatient, corporate and educational settings. He instructs in capacity of adjunct faculty and guest lectures at such institutions as Immaculata University, Antioch University, Bryn Mawr College, Harcum College, Allegheny University (formerly Hahnemann) and at the Naropa Institute. He is a published author and presents internationally on music & healing. Dr. Miller was appointed Executive Director of Music for People in 1997 and has served as President of Expressive Therapy Concepts since 1993. He also directs the Association for Integrative Medicine and the Biofeedback Network.

Dr. Miller can be reached at miller@biofeedback.net

Eric Miller

All subjects Baseline vs. Improv