

CAMP PENDLETON'S DEPLOYMENT HEALTH CLINIC

Clinical Practice and Observations of Infra-Low Neurofeedback as an Adjunctive Treatment

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Presentation by: Maj. Michael Villanueva, MSC, USA(Ret.), Ph.D.;
Anna Benson, Ph.D.; Tamsen LaDou, GS, Ph.D.

The following information, presented at the COSC Conference 2011, by clinical psychologists from Camp Pendleton detailed results of their work in neurofeedback with over 350 active duty service members.

The first part of the presentation, by Michael Villanueva, described the neurofeedback method being employed and the Default Mode Network. This was followed by a description of how neurofeedback is incorporated within the overall program at the Deployment Health Clinic, by Anna Benson. Two case reports were then presented by Tamsen LaDou. Finally, Michael Villanueva showed videos documenting rapid recovery from PTSD and TBI in a soldier at Fort Hood. These videos are available on-line at youtube.com/homecoming4vets. Subsequently, he showed results of a preliminary analysis of the cumulative tracking data that have been gathered at Camp Pendleton.

Description of Neurofeedback and the Default Mode Network

Michael Villanueva, Ph.D.

We wanted to be here today to share our experience working with Neurofeedback to treat active duty service members. We feel this is a relevant story and we wanted to share some suggestive trends from our work. We hope you will agree there is something here worth exploring

Neurofeedback is a specialty form of biofeedback. It started in the 60s through 70s and into mid 80s with Barry Sterman at UCLA in studies on uncontrolled epilepsy. Alpha training started even earlier to reduce anxiety and matured into Alpha Theta.

Neurofeedback is conducted in the same manner. There are three approaches:

1. Targets known mechanisms of brain regulation at specific EEG frequencies.
2. Targets deviations from "normal" brain activity as discerned in quantitative EEG analysis (QEEG).
3. By analogy to traditional biofeedback, the brain witnesses its own activity at infra-low frequencies (ILF Training) and thus alters its own function.

The Quantitative Electroencephalogram was first introduced to neurofeedback in the 90s. The QEEG evaluates overall brainwave function and the resulting waveforms are statistically analyzed. Z scores are compared to a normative

database matched on age and gender. As Hammon (2006) notes: neurological and medical disorders have concomitant non-typical EEG patterns.

The Infra-Low Frequency (ILF) approach was introduced at the 2008 COSC conference by Siegfried Othmer, Ph.D. Here, he referenced the CRI-Help Study, based on Peniston protocols. Infra-Low is a different approach from QEEG, and more relevant to our population, where state changes required active clinical monitoring and clinical response. As in CBT, ILF is clinician-based training, as opposed to a treatment. This training is rooted in bipolar placement, where three electrodes are used. The amplifier subtracts the activity of one site from the other and feeds the difference back to the patient.

What are we physically doing? We select two sites, place three electrodes and subtract one signal from the other, while feeding the difference back to the brain real time. The clinician monitors state changes. The task the patient is doing during Infra-Low neurofeedback is simply to watch movement and hear sounds from a screen. The brain has the task of relating what it experiences to its own internal processes.

THIS is the singular most important key to Infra-Low neurofeedback.

Infra-Low Neurofeedback

Why are so many of our patients highly attentive to repetitive (and frankly boring) movement, and sound keyed in real time to their EEG? Clinical work supports Marcus E. Raichle's argument against a reflexive brain model:

“The function of the brain is fundamentally intrinsic, involving information processing for interpreting, responding to and predicting environmental demands.”

The brain loves to see its influence in the world and is always asking: Did I cause that? The brain's fundamental currency is information.

Default Mode Network (DMN)

Low frequencies may affect a series of interconnected large networks / regions which increase activity when the brain is in a resting state and decrease its activity transitioning from a resting state during goal-directed tasks. This network is called the Default Mode Network (DMN).

Reference: Marcus E. Raichle (Mar 2010) Two views of Brain Function

DMN represents the brain's internal state in the absence of active engagement with the outside world. DMN appears preparatory - it facilitates a smooth transition to more engaged states. We are “tilting” the brain's DMN and it uses its regulatory resources to react.

Unknown Causal Mechanisms

Why is the frequency so important? We absolutely have not the slightest idea. We do know that the lower the frequency, the faster symptoms resolve and the more a person's state will shift in session. Thus, the clinician must be finely tuned to the patient.

Clinical Implementation: Neurofeedback within Deployment Health

Anna Benson, Ph.D.

In our Standard Intake Process, an entering service member (SM) is given an education on COSC and on PTSD, and is presented with treatment options. Referral is made to COS groups and psychiatric care as needed. Evidence-based treatments are offered. Adjunctive therapies of biofeedback and neurofeedback are offered if appropriate.

Appropriateness is judged on several criteria. The SM must be able to commit to 20 sessions of training. Neurofeedback

is particularly recommended if the SM refuses medication, or if there is resistance to the therapeutic process. Also it is recommended in the event of cultural or language barriers. Finally, it is recommended in the case of severe insomnia, of symptoms of hyper-arousal, or if alexithymia is identified.

The positive aspects of Neurofeedback include a high retention rate in SM's receiving Neurofeedback. Unrecognized mTBI symptoms are treated through this therapy. Overall cognitive functions are enhanced and it appears to assist in the overall regulatory regime. Also, it is non-invasive.

Symptoms are reviewed at the first session, and the SM is oriented to the instrumentation and the process. All SMs begin with the same initial starting conditions with respect to protocol (.0001 Hz). If unpleasant sensations arise, the protocol is altered accordingly. In this manner, the training becomes individually optimized for the SM. The majority of trainees is comfortable with the starting protocol and are given a homework sheet.

Basic Neurofeedback Sites and Infra-Low Reward Frequencies

For People with:	Starting Sites	Add Next	Add Other Basic Sites	Reward Frequency Rules
Early Development or Attachment Issues Autism, CP Attachment disorders Personality disorders Addictions, PTSD				Start T4-P4 0.0001Hz and go up only as needed Add next T4-Fp2 with RF same as T4P4 Add other basic sites as needed T3-T4 RF same as R-side L-side RF = 2 x R-side RF*
Instabilities (And No Attachment Issues) Migraines, vertigo, seizures, panic, asthma, mood swings, irritable bowel, hypoglycemia, traumatic brain injury, etc.		 OR 	 OR 	Start T3-T4 0.0001Hz and go up only as needed Add other L and R-side basic sites as needed Or- Add inter-hemispheric sites for more stabilizing effect Fp1-Fp2 RF = T3-T4 RF / 2 P3-P4 RF = T3-T4 RF / 4
Other Issues (And No Instabilities or Attachment Issues) Physical calming Emotional calming Mental calming				Start T3-T4 0.0001Hz and go up only as needed Move next to T4-P4 and T3-Fp1 T4-P4 RF same as T3-T4 T3-Fp1 RF = 2 x R-side RF* Add other L and R-side basic sites as needed

For all groups: Add other placements as needed for specific symptoms. Some people need reward frequency = 0.0001 Hz at all sites.*

EEG Institute 7/2011

The current state of the SM is established in the first training session, on the basis of response to the reinforcement. This is referred to as 'awake-state' training, to contrast it with respect to the Alpha-Theta training to follow. Session duration is 30 minutes, irrespective of the number of placements trained (ranging from one up to four or even five). Sessions 10-20 combine the awake-state training with Alpha-Theta. Physiological state is monitored throughout the session, as the SM is prompted to share information about ongoing state shifts. Alertness and drowsiness are monitored throughout. Although immediate clinical results are not expected, they are often observed. The SM is charged with reporting on changes in symptoms, behavior, and level of function from session to session. The SM is thoroughly debriefed at every session.

The provider plays an integral part in the clinical administration of infra-low frequency neurofeedback. With respect to the actual training, the provider selects the target frequency and decides upon appropriate electrode placement. Both target frequency and placement may be changed within the session and from session to session as needed.

Neurofeedback training results in self-regulation. Although not a cure, it helps the CNS to re-regulate. We suspect that we are building resilience as the brain is exercised. This is a training, not a treatment. As we experiment with the optimal number of sessions and alternative electrode placement, our method is continually being refined.

Two Case Presentations

Tamsen LaDou, Ph.D.

Case 1 (Female Naval Officer)

2 deployments in Iraq, most recent in 2008

Worked in STP's with little difficulty prior

Critical incident: Family member at home while deployed

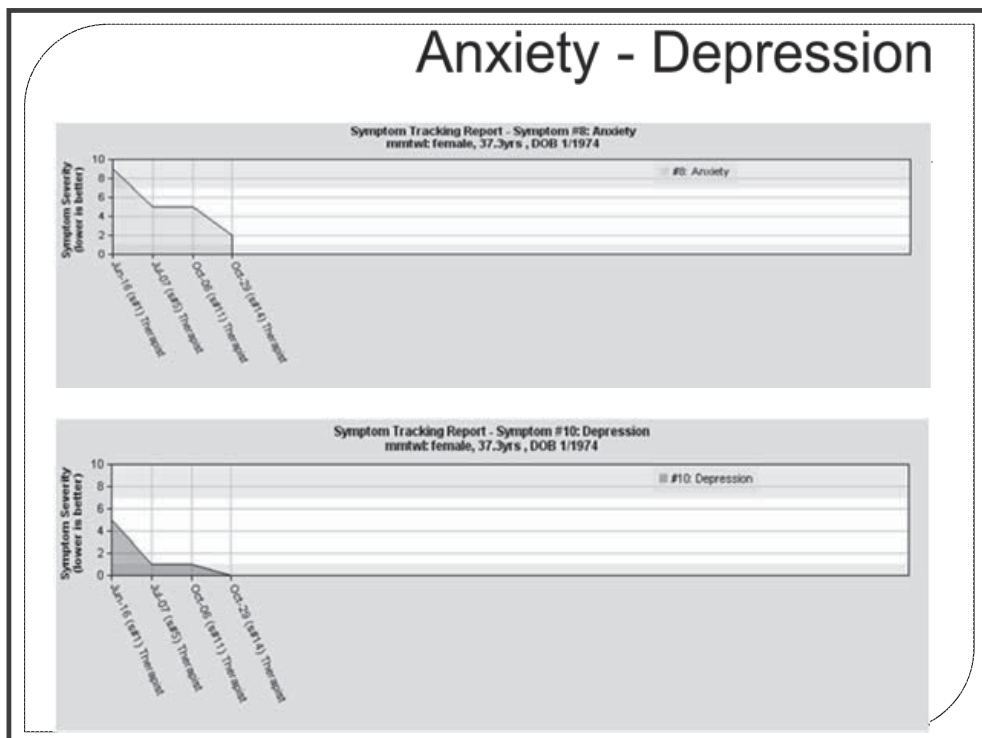
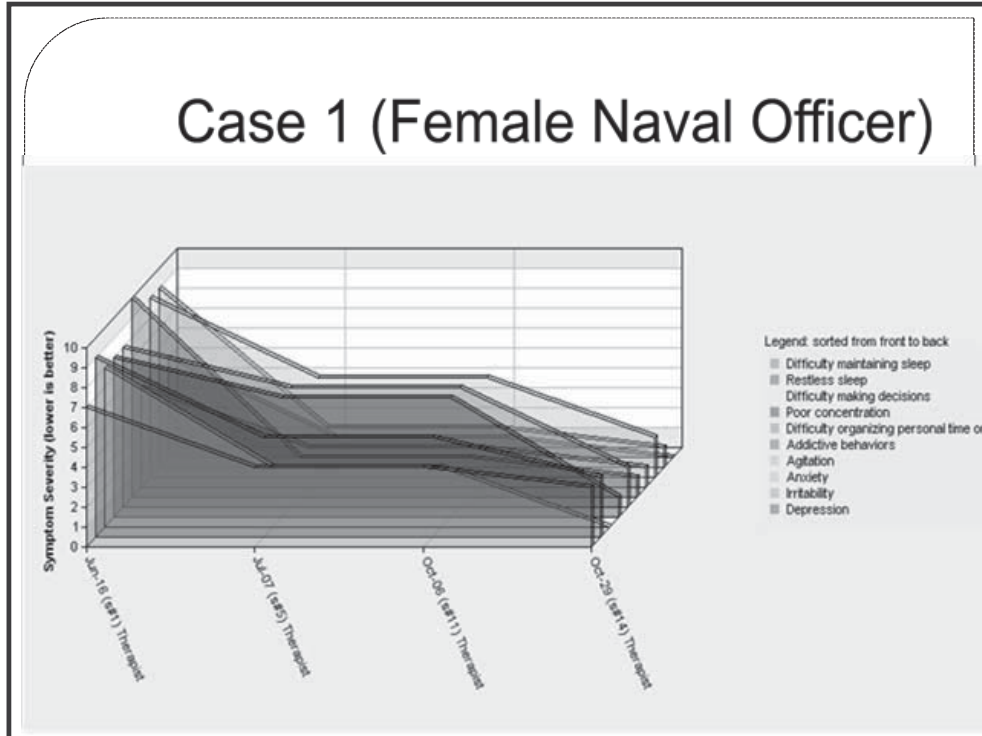
Sx presented on deployment: panic, anxiety, depression and irritability

Medications:

SSRI

Ambien prn for sleep

Xanax prescribed prn for panic attacks.



Irritability



Medical History Case 2 (M)

Post-deployment from Iraq 2007 experienced a fall from a vehicle that resulted in a frontal lobe injury and depression fracture - Surgical repair of fracture

Two weeks later experienced severe H/A 4-5x/wk that became chronic over next several yrs.

Presented at DHC with chief complaint: irritability

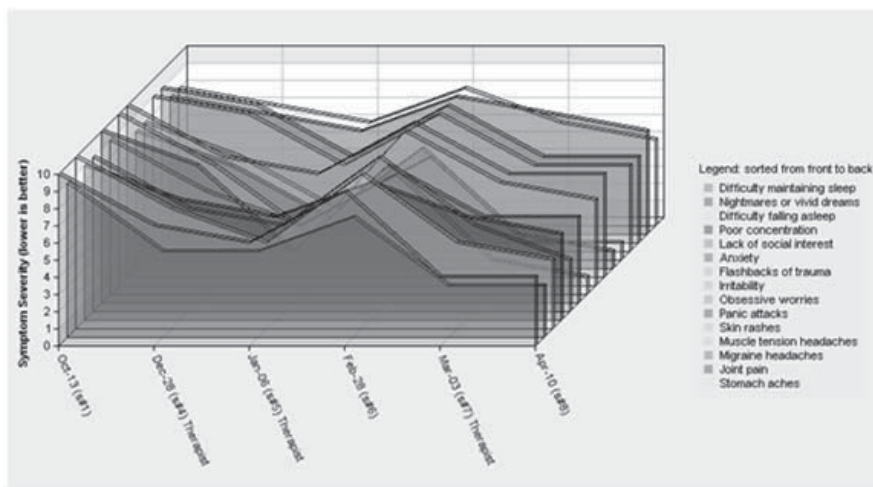
MEDICATIONS: (current)

Amitriptyline

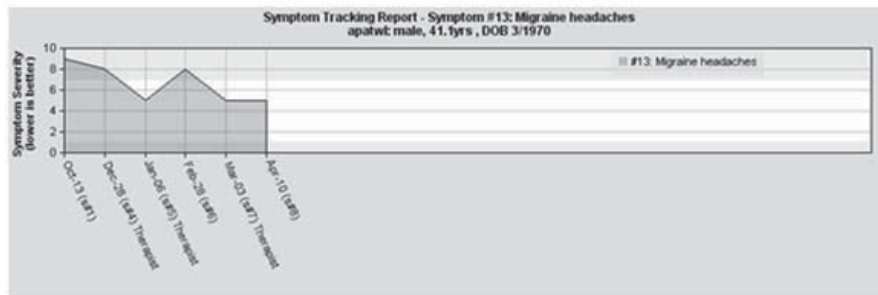
Trazedone for sleep

Medication for treatment of migraine headaches

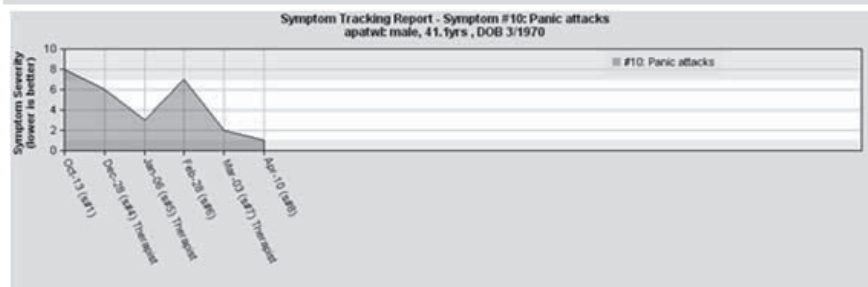
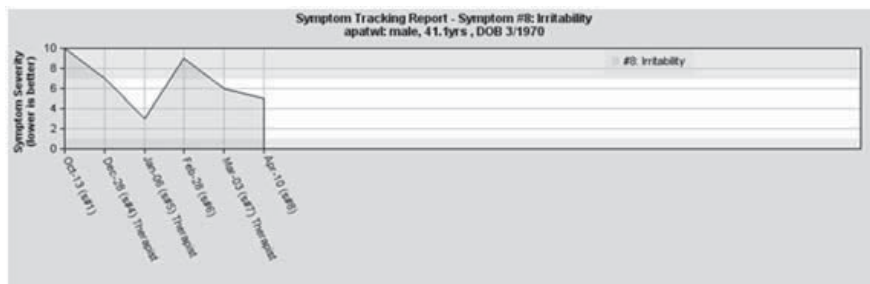
Case 2M symptom graph



Chronic Headaches



Irritability – Panic attacks



Fort Hood - Sergeant Roberts Videos

Michael Villaneuva, Ph.D.

- Put a face on infra-low neurofeedback
- Two videos, both about 2 minutes long
- None were pre-planned
- First shot after 4 sessions

Second shot at the end of the 10th session immediately after patient had watched his first video

Fluidity of movement?

Prosody / tonal quality in voice?

How many facial expressions?

How attractive is he?

Scale of 1-10 rate his humanity: 1= Zombie 10 = Someone you would hang with

Roberts at four sessions



Roberts after 10 sessions



Michael Villaneuva: "I don't think there is any assessment tool that we have in psychology that can capture the emergence of that humanity."

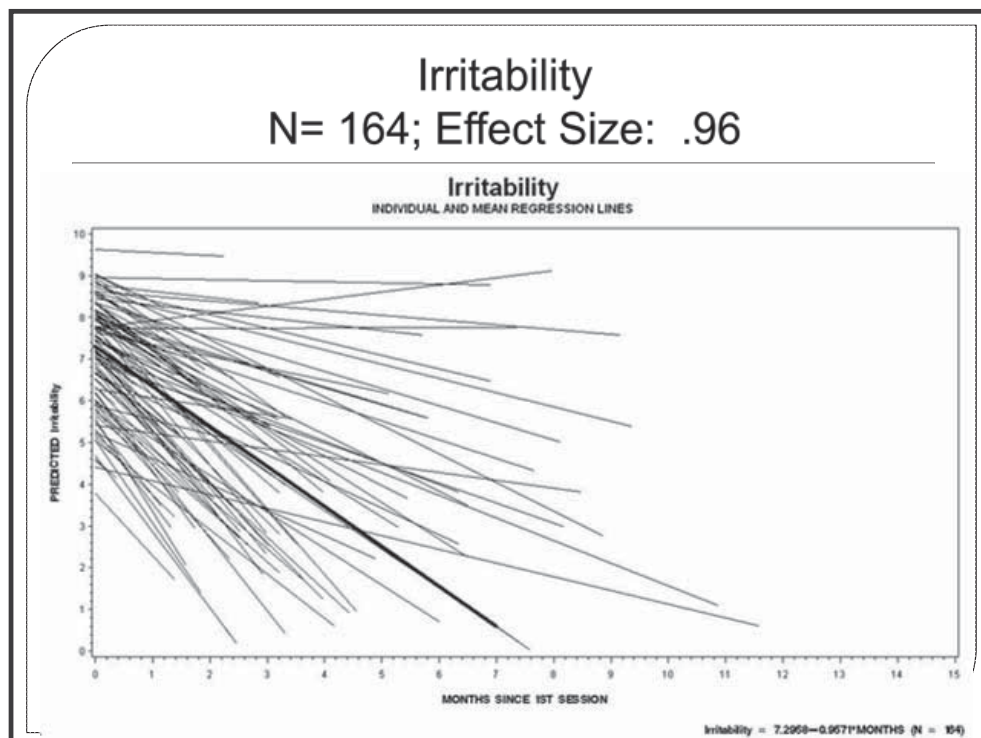
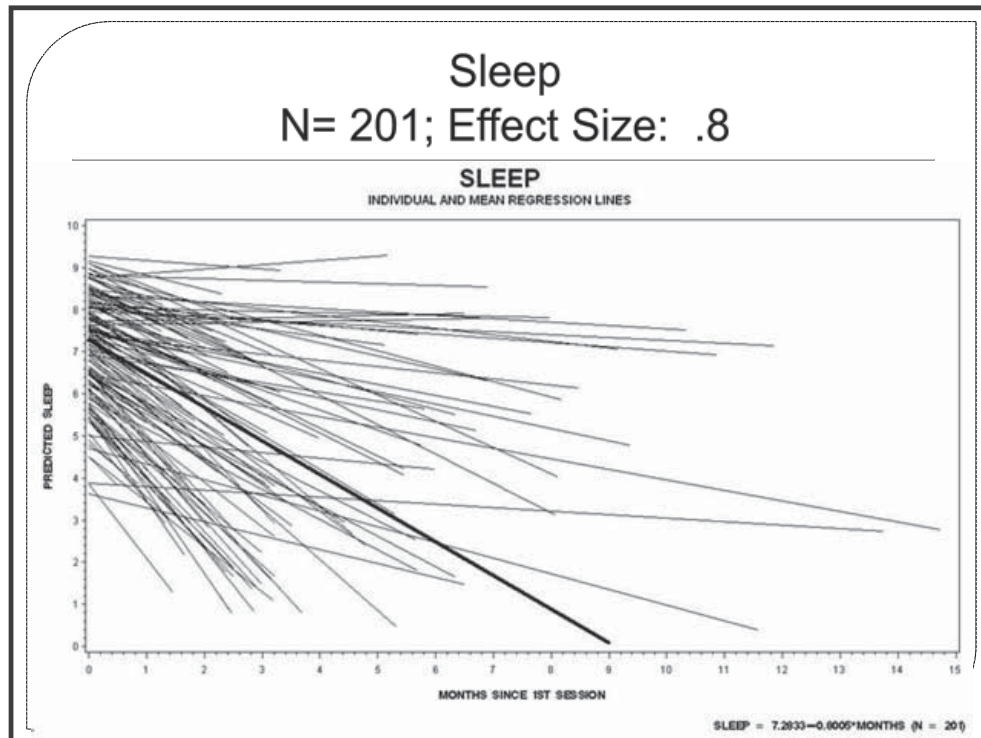
Qualitative and Quantitative Observations of Infra-low Neurofeedback

We never set out to do research but what we saw caused consistent wonder and disbelief. We played with a few numbers to see if the trends suggested a rigorous clinical study.

The structure of the Symptom Tracker and manner in which symptoms were selected for inclusion proved problematical to do a traditional analysis. Therefore, we reviewed trends for approximately 350 cases.

Hierarchical Random Coefficient Model

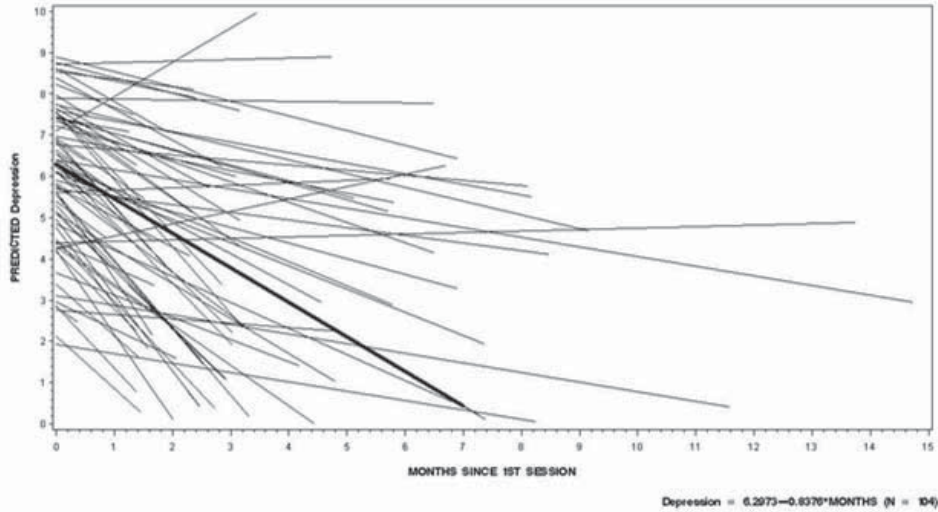
Linear mixed models handle data where observations are not independent and correctly model correlated errors. The random coefficient model mashes everyone's data. It estimates each person's regression line as a random deviation from the mean and finds the average regression line using ALL data points.



Depression

N= 104; Effect Size: .84

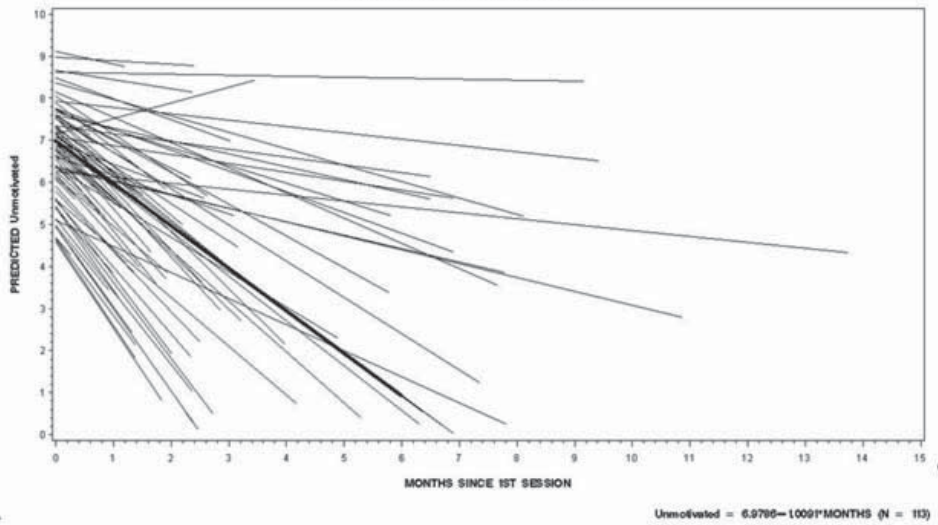
Depression
INDIVIDUAL AND MEAN REGRESSION LINES



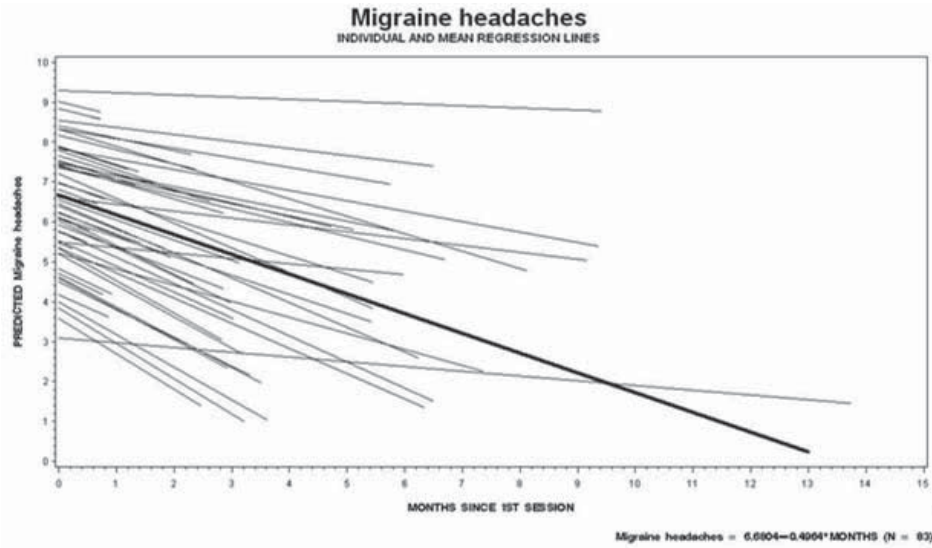
Unmotivated

N= 113; Effect Size: 1

Unmotivated
INDIVIDUAL AND MEAN REGRESSION LINES



Migraine Headaches N= 83; Effect Size: .5



Regression Effects Across a Few Variables

PENDELTON MIXED MODEL SUMMARY

DV	Effect	Estimate	StdErr	DF	tValue	Probt
Difficulty maintaining sleep	Intercept	7.2931	0.1711	156	42.62	<.0001
Difficulty maintaining sleep	MONTHS	-0.9526	0.116	105	-8.21	<.0001
Nightmares or vivid dreams	Intercept	6.9288	0.2024	105	34.23	<.0001
Nightmares or vivid dreams	MONTHS	-0.971	0.1372	72	-7.08	<.0001
Night sweats	Intercept	5.9065	0.3315	44	17.82	<.0001
Night sweats	MONTHS	-1.0092	0.1856	32	-5.44	<.0001
Poor short-term memory	Intercept	7.2958	0.167	141	43.7	<.0001
Poor short-term memory	MONTHS	-0.5765	0.08474	99	-6.8	<.0001
Unmotivated	Intercept	6.9786	0.1943	112	35.91	<.0001
Unmotivated	MONTHS	-1.0091	0.136	76	-7.42	<.0001
Irritability	Intercept	7.2958	0.1567	163	46.56	<.0001
Irritability	MONTHS	-0.9571	0.1001	110	-9.56	<.0001
Agitation	Intercept	6.7656	0.2122	91	31.88	<.0001
Agitation	MONTHS	-0.6074	0.1102	57	-5.51	<.0001
Depression	Intercept	6.2973	0.2412	104	26.11	<.0001
Depression	MONTHS	-0.8376	0.1289	82	-6.5	<.0001
Flashbacks of Trauma	Intercept	6.4916	0.2683	59	24.19	<.0001
Flashbacks of Trauma	MONTHS	-0.5092	0.1366	40	-3.73	0.0006
Migraine Headaches	Intercept	6.6804	0.2528	82	26.43	<.0001
Migraine Headaches	MONTHS	-0.4964	0.09372	56	-5.3	<.0001

Multiple Caveats and Substantive Trends

These results are despite multiple dataset weaknesses, despite self-selected sample, and despite the argument about regression to the mean. Nearly all regression slopes show exceptionally powerful and provocative trends, with effect sizes across 45 symptoms averaging about .8.

In Sum: What We See We are Doing

We show the brain its own activity and it responds! It self regulates. As it regulates, it calms itself. As it calms itself, sleep deepens and is more restful. As sleep deepens, mood & cognition improves, anger and irritation subside, motivation returns, energy levels increase, and the cognitive fog clears.

Contact Information Questions

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KEY POINTS

Over 350 cases of PTSD with or without TBI were tracked through neurofeedback training.

Over 60 symptom categories were tracked.

The video of Sergeant Roberts demonstrates quick training effects for PTSD/TBI combination.

45 symptom categories were analyzed quantitatively.

Average effect size of 0.80 was found for the 45 symptom categories.

This is a large effect size.