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Effectiveness of Neurofeedback

It is hard to turn on the television without seeing ads for all manner of medication – especially psychiatric ones such as for anxiety and depression, because they are so profitable given that such an issue can last a lifetime and there does not have to be a cure the way infections are done away with.

All medication from aspirin on up has side effects. Let's look at some of the psychiatric drugs and their effectiveness vs. neurofeedback which is side effect free.

	Pros	Cons
Anxiety meds (e.g. Valium, Xanax, Klonopin, Ativan)	They sedate you, and may temporarily reduce anxiety in the process.	High potential for addiction, and difficulty withdrawing from usage of such drugs
		Elevated risk of causing dementia (84% increased risk of Alzheimer's if used for more than 6 months)
		Potential side effects of this class of drugs includes: *low blood pressure *loss of sex drive *lack of coordination *disinhibition (e.g. acting and/or saying stuff that is inappropriate, such as occurs when drunk) *depression *memory loss *difficulty thinking *brain shrinkage *increased risk of accidents at home, work, and driving due to issues like impaired coordination & slowed reaction times (i.e. just like alcohol can cause such problems) *rebound (i.e. after going off anti-anxiety drugs the anxiety is worse than ever)

What effect can neurofeedback have on anxiety? One study was done on 15 Vietnam veterans at a VA hospital who had PTSD (a form of anxiety) who received alpha/theta neurofeedback contrasted against 14 vets who received traditional treatment. Neurofeedback was done for thirty 30 minute sessions. Pre- and post-training assessments were done as well as 2 ½ years later.

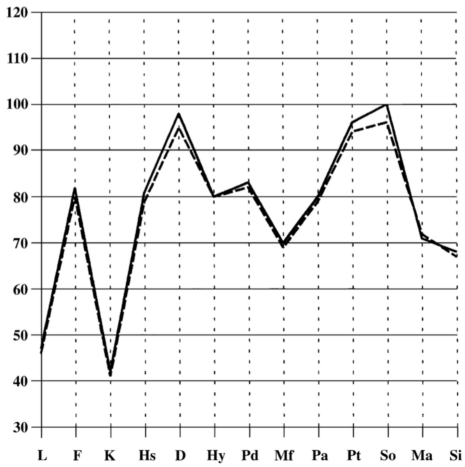

Fig. 1. Peniston-Kulkosky 1991 PTSD study. Pre- and post-MMPI changes from traditional treatment. Solid line indicates pretreatment. Dotted line indicates posttreatment.

This is a graph of the traditional treatment patients, pre- and post-treatment using the MMPI, which is a very commonly used & respected psychological test, Scores at 70 or above are high, and above 90 extremely elevated, reflecting a great deal of trouble. Scale D which is for depression, Pt (anxiety) and So (social difficulties) are all seriously high, and treatment made **no significant difference.**

This graph shows the neurofeedback group results, pre- and post-training. Scores below 70 are considered within the normal range. i.e. All ten clinical scales (ignoring L, F, & K which measure for response bias) improved significantly and sometimes dramatically.

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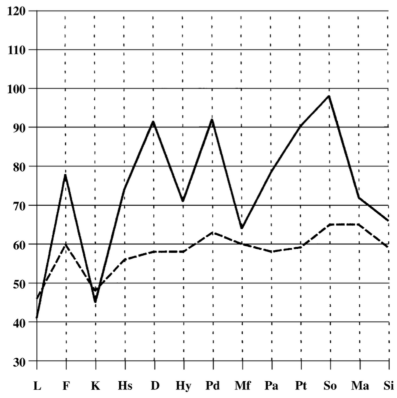


Fig. 2. Peniston-Kulkosky 1991 PTSD study. Pre- and post-MMPI changes after neurofeedback treatment. Solid line indicates pretreatment. Dotted line indicates posttreatment.

Other results of this study:

- the traditional group had a relapse rate after the study ended of 100% (14/14 people) vs. 3/15 of the neurofeedback having a relapse
- use of medication after training ended also found a dramatic difference between the two groups. The traditional group had 13 on meds at the outset, and only 1 was able to reduce meds afterward. Two stayed the same, and 10 required more meds. Neurofeedback saw 100% (14/14) reduce their meds.

What about the effectiveness of neurofeedback vs. medication for depression? There are numerous drugs in the classes called SSRI's and SNRI's (e.g. Prozac, Zoloft, Effexor, Paxil, Cymbalta), along with Abilify which is sometimes used as an adjunct for depression. It is actually in the class of drugs known as antipsychotics, such as being meant to treat schizophrenia. The 'cons' below is only a partial list.

	Pros	Cons
SSRI, SNRI	None. i.e. Any perceived benefit stems 100% from the placebo effect. If you would like information on this, read the books by or watch YouTube videos with Irving Kirsch, PhD (a psychologist), and Robert Whittaker, an investigative journalist.	*sexual impairment (e.g. erectile dysfunction in men, decreased libido in men and women, and inability to have an orgasm in women. Estimates vary but typically are around 50% of people who use these drugs experience them) *PSSD (post-SSRI sexual dysfunction), where sexual function may not return to normal after stopping the drug *sleep disturbance *weight gain *suicide risk is increased *migraines *dizziness *dry mouth *confusion *tics *Parkinson-like effects (e.g. rigid and trembling limbs, a shuffling gain, loss of fine motor control) *hallucinations *low sodium balance in older individuals which is potentially fatal *serotonin syndrome (a potentially life threatening development which include symptoms such as seizures, high fever, irregular heart beat, loss of consciousness) *difficulty stopping use of these drugs. They are not considered addictive but are hard to get off of, sometimes taking months to years to do so.

	Pros	Cons
Abilify (sometimes used as an adjunct to other antidepressants	None.	*sexual side effects (as above, plus priaprism where an erection is not lost quickly enough and can lead to permanent damage) *weight gain *involuntary and repetitive movements which are incurable once they develop (tardive dyskinesia) *seizures *agitation *elevated blood sugar and causing diabetes *elevated cholesterol *drowsiness *insomnia *choking *difficulty stopping use *neuroleptic malignant syndrome, which is a rare but potentially fatal disorder that can arise

Fig. 3. Neurofeedback for depression: Average MMPI Pre-post changes for eight cases.

This was a study done on nine men who presented with a complaint of depression, and which was confirmed by MMPI testing. Their average score was about 94 on the Depression (D) subscale. Eight of them completed neurofeedback training, averaging about 10 hours. The mean decrease on the Depression scale was almost 29 points which brought them down to a score below 70 – meaning in the normal range. About 78% of them made significant improvement.

How about sleep? It is estimated that about 4% of American adults use a sleeping pill, often for months or years. Alcohol is the most commonly used sedative to help with sleep, and the estimate is that 20% of people will drink to help fall asleep. How effective are sleeping pills and alcohol vs. neurofeedback when it comes to improving sleep? Not very. Research has found they may add some number of minutes of sleep, maybe 10-20 per night. Other research finds there is no significant improvement in total sleep time.

Sleeping pills are both prescribed (e.g. Trazodone, Ambien, Lunesta, Valium, Ativan) as well as over the counter (e.g. Tylenol PM, Benadryl).

Pros	Cons
*sedation (which is not the same as sleep) can occur	*increased risk of death e.g. due to higher rate of infection. Sleeping pills do not improve the immune function, whereas sleep does. Also, from a higher rate of car accidents (e.g. from being groggy/hung over when driving in the morning), elevated risk of heart attack, strokes, cancer, and falls (such as in the elderly and that carries a 20% risk of mortality within a year). *addiction *tolerance, so that they lose effect over time *bizarre behavior that can sometimes occur while sleep walking (when taking Ambien) *memory loss *increased risk of acid reflux *hallucinations *confusion *dizziness, loss of balance *depression *suicidal thinking *increased risk of bone fractures *increased risk of dementia including Alzheimer's

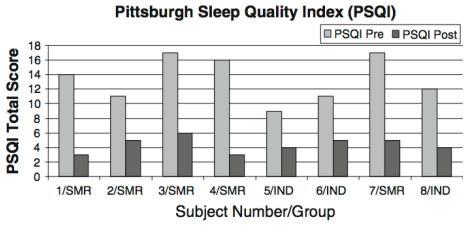


Fig. 2 PSQI pre-post change in global scores

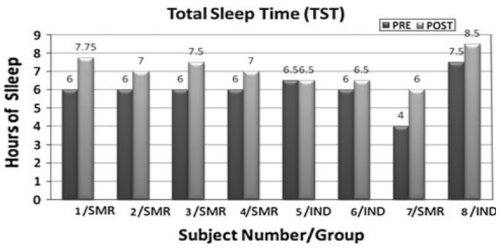


Fig. 4 Pre-post change in TST

A neurofeedback study was done with eight people who had insomnia dating back anywhere from one year to beginning back in their childhood. Fifteen neurofeedback sessions were done, using one of two protocols (SMR, sensory motor, IND, a more individualized approach). A sleep questionnaire (PSQI) was administered before and after the training. Scores higher than 5 are considered to reflect impaired sleep. As can

be seen in the first graph, all participants had unimpaired sleep by this measure after the training. Total number of hours slept was also assessed. All but one person (who had a medical problem that was interfering) improved by an average of about an hour.

PTSD can arise for many reasons in people, including those who have been in combat, raped, in catastrophic situations such as their home destroyed by natural forces like a hurricane, as well as first responders such as police, fire and paramedics who can deal with gruesome deaths in their job.

How many improve with treatment of PTSD is highly debatable. e.g. Many people may say 'I'm fine, and it's no longer a problem' – but are crying while making that statement. Or, they may say 'I'm okay' – but admit to having no friends, no social life, no job, etc. ever since the traumatic event arose. Or, people may be on a medication such as a tranquilizer which keeps them sedated, but that is not curing them of anything. This is like someone with a bad cold or flu, where they take something like Tylenol PM that takes away the pain and knocks them out – but when the drug wears off after a few hours the virus comes back full force. Or, taking meds can be like getting drunk. It may make you forget, or feel happy for a few hours, but no one has ever found a real answer at the bottom of a bottle, be it for alcohol or pills.

What has neurofeedback accomplished? Probably the most impressive study was done by the USMC at Camp Pendleton on 350 Marines.

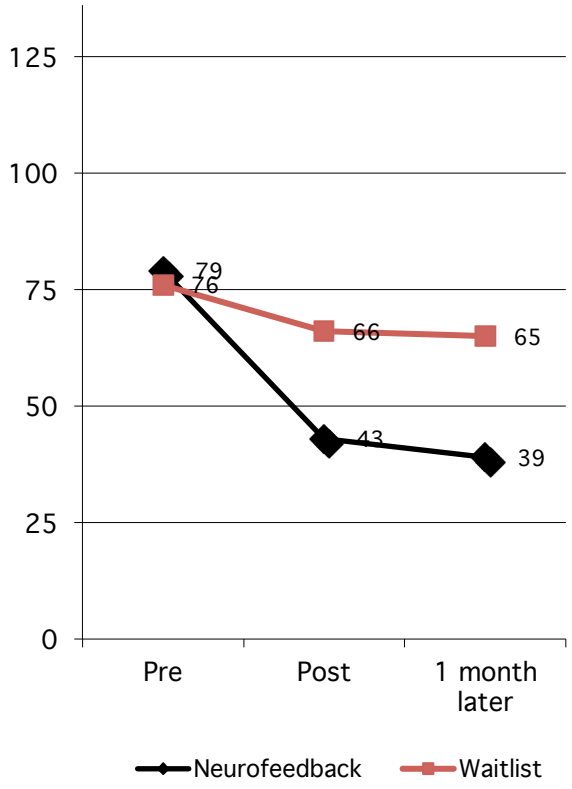
	% of military personnel who had a decrease in symptoms (comparison of before and after 5 months of neurofeedback)
Suicidal thoughts	75%
Flashbacks	70%
Panic attacks	80%
Agitation	70%
Anxiety & depression	70%
Fears/phobias	60%
Night sweats	80%
Headaches	75%

More specifically,

- about one fourth of trainees responded quite rapidly to training, within 10-20 sessions, and the improvement tends to cut across all symptom categories.
- about another half of trainees responded at a more typical rate, requiring 20-40 sessions for substantial symptom abatement.
- this left another quarter of trainees who either responded either more slowly or not at all
- the most common complaint related to sleep quality, involving 200 of the 350 subjects. Psychological research measures the impact of treatment effectiveness as 'small,' 'medium,' or 'large.' The effect on sleep was rated as 'large,' Irritability, lack of motivation and depression also showed a large effect. Migraines were affected to a medium degree.

Another PTSD study was done on 52 people who had not responded to at least six months of trauma-focused psychotherapy. They were randomized to either neurofeedback

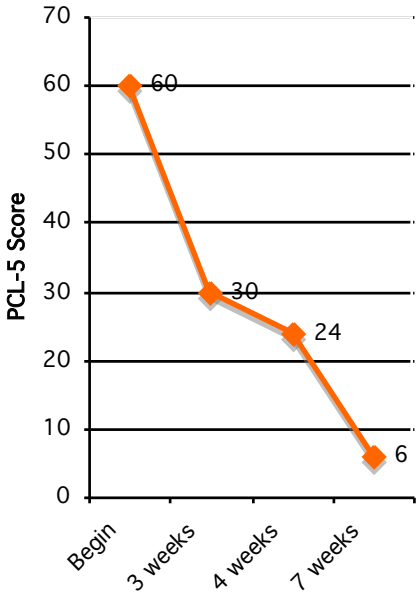
or being put on a waitlist & continued to receive treatment as usual (meds and therapy). They were assessed before, at half way through, at the end, and a month after finishing. The PTSD scale used is called the CAPS (clinician administered PTSD scale). Scores at or above 45 are considered to be indicative of PTSD. Changes of 20 or more points, meaning scores that go down, are considered significant. The most frequent traumatic events were childhood emotional abuse, sexual abuse, and domestic violence. Twenty-four neurofeedback sessions were administered.



Findings included that a month after the research ended 90% of the waitlist participants still met PTSD criteria vs. 23% of the neurofeedback, a highly significant difference.

And as can be seen, based on the averages, the wait list group did not have a significant change between the pre- and post-testing. The neurofeedback group improved significantly and on average no longer met PTSD criteria.

The degree of improvement found in this study was comparable to what has been found in other evidence based treatments, such as prolonged exposure, cognitive behavioral therapy (CBT), and EMDR. Neurofeedback subjects had significant improvements in affect regulation, identity impairment, abandonment concerns, and tension reduction activities.



This is a graph showing the response of a US Navy SEAL to neurofeedback. He had been in the special forces for 20 years, and had seen a great deal of combat and had been diagnosed with PTSD. He had developed the PTSD perhaps thirty years ago, and retired back in the 1990s, and the PTSD had persisted ever since then into the present.

The PCL-5 is a standard questionnaire used to assess for PTSD. Scores of 33 or higher are considered indicative of PTSD. As can be seen here, he no longer qualified for a PTSD diagnosis after just three weeks, and he had no symptoms whatsoever at a clinical level at 7 weeks.

Then there is autism spectrum disorder. The numbers of kids being diagnosed with it have exploded in recent years, for debatable reasons. No one talks about curing it. And behavioral treatment programs offer limited benefit. What are some of the results of neurofeedback for reducing or overcoming it?

One study in 2009 had 110 kids on the spectrum, with 85 put into neurofeedback and 25 were controls. There were no significant differences between the groups as to age, gender, handedness, race, medications, IQ or ATEC (Autism Treatment Evaluation Checklist) score. The neurofeedback group received 74 sessions. ATEC, neuropsych testing, and parent rating scales were used before and after training.

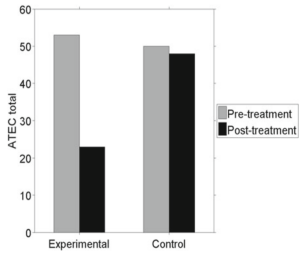


Fig. 6.1 Pre- and post-treatment ATEC scores

On the ATEC 98.8% of parents reported a reduction in autism spectrum after training. On objective neuropsych testing 100% of subjects demonstrated some degree of improvement. ANOVA revealed improvements of visual-spatial skills, language abilities, attention skills, and executive functioning.

This graph involved a study on 20 patients with autism spectrum with an average age of 9.5 years. The ATEC, Personality Inventory for Children-2 (PIC-2), Behavior Rating Inventory of Executive Function (BRIEF), and Gilliam Asperger's Disorder Scale (GADS) were administered. The graph shows how the neurofeedback group did at baseline (Time 1), after training was concluded (Time 2), and a year later (Time 3), on four measures of executive functions.

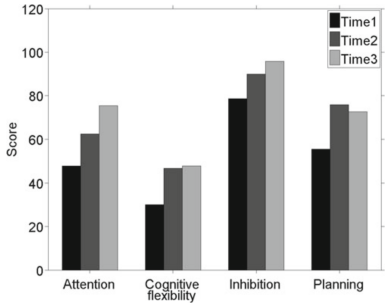


Fig. 6.2 Time1, Time2, and Time3 data of the treatment group on executive function tasks

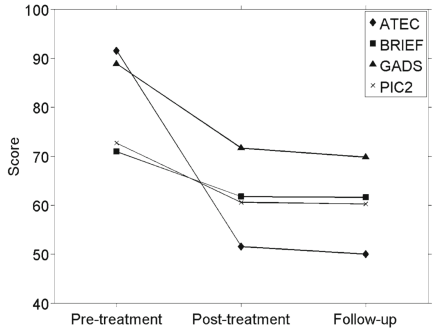


Fig. 6.6 Graph showing the clinical improvements among subjects as assessed by the parents rating scales of ATEC, BRIEF, GADS, and PIC-2 for pretreatment, post-treatment, and follow-up periods

As can be seen there were significant improvements on all four of these measures. The kids were re-assessed after anywhere from 5-22 months following training, & no significant change was found on any of the parent rating scales. That is, the improvements were stable.

ADHD is a widespread problem that affects large numbers of kids as well as adults, with estimates of it being present in about 5-10% of the population. Numerous medications exist and can be helpful. There are several problems with drugs. A fair number of parents do not want their kids on drugs, period. Or, adults do not want to take the drug. Meds also are basically covering up symptoms for some number of hours, and the drug wears off and the problem then returns. The next day the drug is used again, with the person back to square 1 as to having the same issue as before. i.e. Meds do not cure anything when it comes to ADHD. And then there are side effects.

One study looked at 142 adults (ages 19-79 with an average of about 41 years old); females were roughly half the group. None were on stimulant meds during the test. The TOVA (a test for ADHD) was used. They had a minimum of 20 neurofeedback sessions.

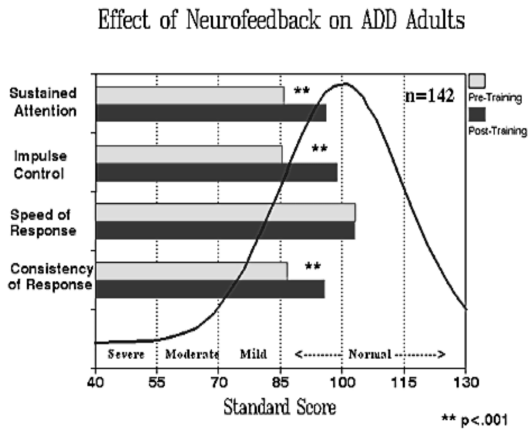


Figure 1. Pre- and post-treatment TOVA standard scores for all four dependent measures in 142 adults with attentional deficits and related disorders.

Overall, results produced clinically significant improvement (half a standard deviation increase or more, on one or more measures in 83% of all subjects. This is a result superior to the 70% response rate of stimulant meds that has been found in research.

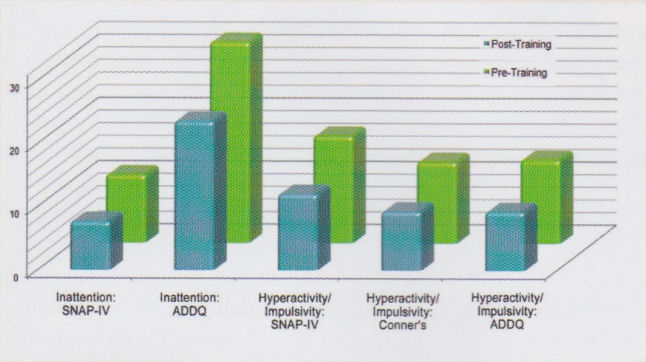


Figure 1. *Mean Score of ADHD symptoms reported on the questionnaires from pre and post training.*

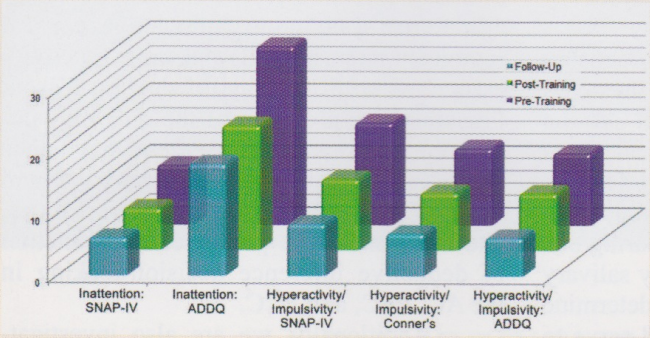


Figure 2. *Mean Score of ADHD symptoms reported on the questionnaires from post training to follow-up point.*

Another study was done on 318 people, who were diagnosed with ADHD, ages 6-17, and had 40 sessions of neurofeedback. Data was gathered through the Conner's Global Index parent version, DSM symptom list, and ADD-Q. For a subset, 110 had computerized testing as well by using the TOVA and IVA CPT's.

Results included a decrease in hyperactivity and inattentive symptoms between pre- and post- training.

Hyperactive and inattentive symptoms continued to decrease over time, indicating training lasted for at least one year.

In summary, what can be offered about neurofeedback is that it offers a useful alternative to more traditional approaches of treatment of a variety of psychological problems. Medications are not all that they are cracked up to be, and have numerous deleterious side effects, including some that can be life threatening. Talk therapy and behavioral approaches of control such as for PTSD, ADHD and autism have serious limitations as to their degree of effectiveness.

Neurofeedback is tiny in size especially when compared to the pharmaceutical industry, and does not have the money and scale of practitioners to do large scale research the way drug companies can. However, for the research that has been done there have been some good results with significant improvement in the functioning of the patients, and changes persisting for some period of time after training has concluded.