

# **NEUROFEEDBACK IN SCHOOLS PROGRAM**

## **BEHAVIOR ANALYSIS & THERAPY PARTNERS (BATP)**

### **TABLE OF CONTENTS**

Program Description	1
Neurofeedback:	1-4
Target Group of Trainees:	4
Logistics:	4-5
Outcomes:	5-7
Cost:	7-8
Research:	8-9

### **PROGRAM DESCRIPTION**

Behavior Analysis & Therapy Partners (BATP) has been the IBHS provider for CBH in 10 South Philly Schools since 2019. BATP is also a licensed ABA provider.

#### **Purpose and Goals**

- Expand the services we offer to our IBHS clients by adding a stress management component based on neurofeedback for these students.
- Use neurofeedback to improve our students' thinking, feeling and behaving to better respond to IBHS interventions for problems with conduct, mood, anxiety, attention, autism, etc.

#### **Neurofeedback**

All biofeedback is an operant conditioning procedure that magnifies self-awareness for greater self-control. With sufficient training there is improvement in self-regulation over an aspect of the nervous system. Biofeedback is safe, non-invasive and without contraindication. We believe biofeedback is a form of applied behavior analysis.

For example, we can use a thermometer to measure hand temperature. The biofeedback instruction is to prefer higher numbers. Trainees look and learn how to warm their fingers. The numbers rising or falling say: 'More like this'... 'Less like that'... 'More like this.' Biofeedback is learning from experience and is not a verbal modality.

Physiologically, the central and autonomic nervous systems are relaxing the nerves around the blood vessels which brings more blood and thus heat. Learning this vascular relaxation supports greater self-regulation of this autonomic response which is valuable for general relaxation, Renaud's phenomena, and preventing migraines.

In neurofeedback or EEG biofeedback, passive sensors read brain waves. No electricity enters the trainee's head. This faint signal is amplified with an EEG (electroencephalogram) and sent to a computer for processing. An EEG, computer system and protocol continuously converts brainwave signals into complex audio and dynamic visual feedback. The audio-visual feedback is designed to reinforce the client toward several assessment-defined brainwaves ranges.

For example, neurofeedback relaxes the brain for those who suffer from post traumatic stress disorder (PTSD). While the trainee's eyes are closed, slower brainwaves are reinforced with more pleasant or less pleasant sounds. This encourages a more relaxed brain state, as verified in fMRI scans.

In eyes-open neurofeedback training selected brainwaves are reinforced with complex audio and morphing fractal image feedback. This occurs dozens of times per second to encourage the trainees to stay within 8 threshold ranges. Relaxation and mental presence are also reinforced.

## **BrainPaint**

BrainPaint is an established provider of a turnkey neurofeedback system. They provide hardware, software, technician training (described in attached manual), weekly zoom support, and a button on the desktop for rapid live help. BrainPaint Systems can conduct unlimited training sessions with an occasional Wi-Fi connection.

- BrainPaint has a well-defined program with consistent criteria for a few decision points.
- BrainPaint is based on the two most evidence-based forms of neurofeedback: SMR and alpha-theta (relaxation) training.
- An enhanced IBM Watson Analytics Artificial Intelligence engine optimizes the BrainPaint software for continuous improvement by examining meta-data from the assessment, session data and progress on growth areas.
- BrainPaint technician training occurs live over 10 hours online with offline assignments.
- One BrainPaint neurofeedback technician can operate up to 3 systems on 3 clients simultaneously.
- BrainPaint is the EEG biofeedback system of choice among researchers from Harvard, UNC Chapel Hill, UNCW, UCSD and the University of Washington because it significantly reduces the risk of human error that can botch clinical trials and cause rejections from scientific publishers.

## **Assessment and Training**

In the initial assessment process, 2-4 growth areas are identified that most impact the quality of life for the client. These growth areas are quantified in statements focusing on frequency,

intensity, duration or limitation in categories e.g., PTSD: 3 nightmares per week, Depression: cry for 20 minutes a day. This is the primary tool to track progress during training.

There are just 2 initial protocol choices.

- If bipolar diagnosis (not just mood swings), a gentle non-linear protocol is used. No further assessment is required, training can begin immediately in this case only.
- In most cases we begin with 15 sessions of eyes open training followed by 15 sessions of eyes-closed alpha-theta training. But if PTSD is the prime concern, this order is switched.

We obtain the training protocol with a performance game while recording EEG. To read the EEG signals for assessment and training we use 5 sensors. We clean 3 spots on the ear lobes and 2 spots on the scalp. Two sensors are placed 4 fingers above each ear over the temporal lobe. Each spot is lightly abraded with alcohol on a paper towel. Sensors with conductive paste are applied.

During the assessment the student holds a mouse with both thumbs. They see the screen showing a big letter, one at a time: R R L R P.... Right, Left, Pause (wait for the next letter). The students are instructed to press the appropriate mouse button quickly and accurately for about 10-15 minutes. When done, the skin is cleaned with alcohol on a paper towel to complete each session.

This gives us the 8 brainwave targets for biofeedback training; e.g., Left hemisphere: inhibit 1.47-11.34 Hz, encourage 11.34-15.36 Hz, inhibit 23.14-36.76, etc. Right hemisphere: inhibit slow Hz, encourage middle Hz, inhibit fast Hz. Two such protocols are generated with a faster or slower set of frequencies encouraged. Another pair of frequency bands improve coherence or resonance.

### **Training Session Procedure:**

- Inquire and record percentage of change in growth areas, each week.
- Ask about effects during the 24 hours after the prior session.
- Clean 5 sites with alcohol and apply sensors with paste.
- Train fast protocol for 16 minutes (with 20-second breaks every 2 minutes).
- Train slow protocol for 8 minutes (enhanced frequencies are lower to balance arousal).
- For Alpha-Theta training, then 24 minutes is devoted to eyes-closed relaxation training and 10 minutes of the fast protocol. This blend balances arousal.
- Clean up with alcohol and paper towel. This procedure meets sanitary guidelines.

### **Course of Training**

- Sessions last 35-50 minutes (longer duration for eyes-closed training.)
- Train each student 2, 3, 5 up to 15 times a week. Not just once a week.
- Train 30 sessions for most students.
- Add many more sessions for autism and severe neurological issues such as brain injury.

### **Contraindications and Unwanted Effects:**

There are no contraindications. The extensive scientific literature reports no significant adverse reactions. However, after millions of neurofeedback sessions since the 1960s, we are aware of several kinds of unwanted effects which are rare, minor and self-limiting. If there is a problem, such as a headache or fatigue, which is too uncomfortable, the software suggests a change to the ratio of fast and slow protocols to balance arousal.

## **TARGET GROUP OF TRAINEES**

### **BATP CONTRACTED SCHOOLS:**

- Girard Academic Music Program. 2136 W. Ritner St, Phila., PA 19145
- Creative and Performing Arts. 901 S. Broad St, Phila., PA 19147
- Palumbo Academy. 1100 Catharine St, Phila., PA 19147
- Furness Horace High School. 1900 S 3rd St, Phila., PA 19148
- South Phila. High School. 2101 S. Broad St, Phila., PA 19148
- South Phila High School EOP 2101 S. Broad St, Phila., PA 19148
- Preparatory Charter of Mathematics, Science, Technology and Careers.  
1928 Point Breeze Ave, Phila., PA 19145
- Universal Charter at Audenried. 3301 Tasker St, Phila., PA 19145
- Mastery Charter School at Thomas. Elementary school. 814 Bigler St. Phila, PA 19148
- Mastery Charter School at Thomas. High school. 927 Johnston St, Phila., PA 19148

BATP will select clients from our cluster of 10 schools in South Philadelphia for this neurofeedback program. Although the published evidence for each particular disorder varies widely, there is a history of broad effectiveness with the disorders our clients are diagnosed with.

### **Conditions and Diagnoses**

In conjunction with our IBHS program, we will reduce the stress and symptoms of our clients and make them more receptive to IBHS interventions. Here are the diagnoses of our students:

- Depression, Bipolar, Anxiety, ADHD, Mood dysregulation
- Anger, Explosive, Conduct, Impulse Control, Disruptive, Oppositional Defiance.
- Autism, Learning Disorders, Intellectual Disability.
- Alcohol or Substance use, Pica, Stress, Adjustment, Brain Injury.
- PTSD, Trauma, history of Abuse/Neglect, Bereavement.

## **PROGRAM LOGISTICS**

### **Potential Challenges**

**School Logistics:** All the schools we have contacted expressed interest in neurofeedback and also concern about scheduling time with students at school. Coordinating schedules will require some administrative work to get students in a room with an available system and a technician prepared to train them.

There are some non-class times during the day. Schools are open after classes are dismissed. We have a clinical space in every school. Most neurofeedback sessions could be done within a classroom by using headphones. It is also possible to do home visits. Gary Ames done has both of these.

**Acceptance:** Another challenge for all parties is initial acceptance of an innovative procedure. Neurofeedback is difficult to explain and understand. Evidence of effectiveness with each condition is based on dense academic literature.

Initially acceptance will be a problem, especially for African-Americans, who are notoriously reluctant to try unknown approaches. Even 10 research study replications of an 80% success rate with long term abstinence from addictions is not compelling to the wary. The informed consent document is long and complex.

Just as extraversion is a personality variable, so is openness to new experience. Everybody wants our clients to succeed. Promoting positive results should help overcome reluctance. There are plenty of impressive success stories that may reach the students.

### **Startup Time Table**

- CBH > schools > clients > and parents must give approval to begin -- in that order.
- Clients entering the neurofeedback program will need an updated order and a request for BHT hours (if not previously prescribed) and about 1 BC hour for about 3 months. BCs must update the treatment plan.

BATP currently has one BrainPaint system that can be put to use immediately. Staffing and training a BHT to be a neurofeedback technician can be done within weeks. As soon as we have the CBH blessing, school administrative approval, and a few students ready to train with a consent form, a schedule and location -- we can begin. We envision working all the hours that schools are open and students can be available.

We will start with one or two machines in one or two schools and see how many clients we can attract and how many hours we can run sessions. Some schools have early dismissal on some days. Some schools stay open late some nights. Utilization is hard to predict at this time. We expect the visible changes in unruly behavior and reduced distress to produce powerful word of mouth.

**Scaling up:** Ideally, we can add systems per technician with volume. Note that we can pay a technician a fraction of a mobile therapist or counselor to see multiple patients in the same hour.

We hope to ramp up to an intensive program over the Summer of 2022.

### **PROGRAM OUTCOMES**

1. Every client will have 2-4 quantifiable growth areas. Frequency, intensity, duration, or life impact of the issues most detracting from the quality of their life within symptom groups. For

example--Anger: aggressive confrontation 2 times a week. Panic: heart races, can't breathe 4 times a week. Conservatively, for 80% of clients, we expect to have a 50% reduction in at least one of their growth areas.

2. The Symptom Checklist-90 is completed every 10 sessions. We expect a downward trend on the 5 scales: Somatization, OCD, Interpersonal, Depression, Anxiety.

3. All BATP clients have standard psychometric instruments such as the BASC or Vineland and we expect to find reductions in maladaptive behaviors.

4. We will have Behavior Consultant data from the treatment plans and progress reports showing attainment of goals.

5. We expect for students to avoid higher levels care and titrate down in IBHS hours, shift to lower levels of care and early discharge. We expect reduced cost for our clients of all medical expenses - both health and psychiatric. We also expect lower than normal criminal justice encounters. We ask CBH to track these.

6. Upon completion, we obtain structured stories of what life is like after neurofeedback. These are touching and heart warming.

### **Here is an example of a template story:**

19-F adopted from Colombia completed 14 sessions:

1. What was the problem before you did biofeedback?

Anxiety, depression, anger.

2. What did frustration feel like as you tried to solve the problem?

It was hard and frustrating. It seemed impossible to solve this on my own.

3. What was different about biofeedback?

Feel more at peace and calm, not as anxious and depressed.

4. Take me through the moments when you realized biofeedback was actually solving your problems?

In the first couple sessions, I could see a difference. I slowly felt like a weight was being lifting off my shoulders. Every session was taking off more weight and more weight.

5. Tell me what life like looks like now that these problems are solved?

It just feels like I can do a lot of things, that nothing is impossible. There is a saying **“Where there is a will, there is a way,” now that applies to me.** I can see things more clearly now. I've decided not to drop out of college and will be going back this Fall.

Her mother says they see a big difference. She is much more communicative and is much less angry and frustrated all the time.

### **Other Program Impacts**

We expect neurofeedback students to feel calmer all the time. They will be more comfortable being themselves and will not feel the urge to seek foolish external thrills. Based on experience

with schools and D&A facilities, we expect death from addictions and suicide will subside to zero for our clients completing at least 14 sessions. At in-patient facilities using neurofeedback, we see that enhanced well-being is contagious. Staff burnout decreases, morale and staff retention increase. Clients are less resistant to participating in programs.

Reports from dozens of schools implementing biofeedback/neurofeedback program are consistently positive. Most often noted:

- **Up:** Attention, sleep, attendance, relaxation, memory, grades, social skills, tolerance.
- **Down:** stress, impulsivity, disruptive behavior, violence, outbursts, suspensions, negativity, tardiness, LD, meds.

### PROGRAM COSTS

We estimate the cost per completed neurofeedback client to be plus or minus \$1000-2000. Actual cost depends on volume of clients. Some schools only have a few BATP clients. We estimate a range of 14-40 for most students and an average of 30 sessions per client.

- **EEG Biofeedback System:** The cost of one BrainPaint system for unlimited sessions is about \$600 per month (\$550 rent plus consumables, etc.).
- **Technicians:** We will select BHTs with good heads, hearts and hands. They will get 10-12 hours of training and get clearance by a neurofeedback supervisor before conducting sessions. They can run 1, 2 or 3 systems/clients simultaneously. One session of neurofeedback training takes less than an hour. CBH pays a BHT \$38.40/hour × 30 sessions.
- **Clinicians:** We estimate a Behavior Consultant will spend 2 additional hours per client. CBH pays a BC \$87.56/hour × 2 hours per completed student = \$175 over 1-2 months.
- **Administrator:** Scheduling, logistics. Liaison with CBH, school, parents, clients, etc. at \$50/hour.
- **Neurofeedback Supervisor:** Gary Ames, BCN is board certified in neurofeedback and is a licensed psychologist with 20-years' experience in neurofeedback training and 5-years' experience with BrainPaint. He will be on call and provide additional training, support and supervision at \$100/hour. Gary Ames will assure that each BCN is trained and competent to conduct all sessions properly.

Per capita costs of BHT, administrator and supervisor are reduced with volume.

#### **2 Months Costs with 1 system, 1 student at a time, at 3 sessions a day for 30 sessions.**

**3 students** \* 1 session a day each × 30 days over 2 months. All 3 students complete in 2 months.

4 hours of Admin = \$200

4 hours of neurofeedback supervisor = \$400

1 system rent for 2 months = \$1200

BC \$87.56 /hour × 2 hours × 3 students = \$525

BHT \$38.40/hour × 3 hours × 30 days = \$3456

**Total cost:** \$5781 over 2 months ÷ 3 students = \$1927 per completed student.

#### **2 Months Costs with 3 systems, 3 students at a time, at 3 sessions a day for 30 sessions.**

**9 students** × 1 session a day each × 30 days over 2 months. All 9 students complete in 2 months.  
 8 hours of neurofeedback supervisor = \$800  
 8 hours of Admin = \$400  
 3 systems rent 2 months = \$3600  
 BC \$87.56 /hour × 2 hours × 9 students = \$1576  
 BHT 38.40 × 3 hours × 30 days = \$3456  
**Total cost:** \$9832 over 2 months ÷ 9 students = \$1092 per completed student.

- Early summer and later summer sessions, about 60 training days.
- Assuming 2 IBHS students at a time in a morning and afternoon session each day of the Summer. Total 8 students.
- Could be 16 students if double sessions (not calculated).
- 4 sessions a day conducted 9-12 and 1-4 by a BHT from 9-4 @ \$20/hour. = 6 hours/day.
  1. 2 systems rent @\$600/month × 3 months = \$1800
  2. 10 hours of biofeedback supervisor @ \$100/hour = \$1000
  3. 16 hours of senior administration on site @ \$50/hour = \$800
  4. 30 hours of administrative support. @\$20/hour = 600
  5. 10 hours of data, research and reporting @\$40 = \$400
  6. BC \$87.56 /hour × 2 hours × 8 students = \$1400.96
  7. BHT \$38.40/hour × 6 hours × 60 days with 8 students = \$13,824
- 1. Gift card incentives every 5 sessions, \$25, \$50, or \$100 for  $\sum$  \$300 × 8 = \$2400
- SEPTA QuickTrips passes @\$2.50 each × 75 = \$600
- Rent for office space. \$400/mo. × 3 months. \$1200
- Subtotal:
- 20% for Overhead:
- 2. **\$ per completed student with 30 sessions.**
- 3. **Total \$ over 3 Summer months.**

The technical criteria for re-evaluation is: when client makes less than 10% progress in any growth area, continue for 5 sessions to consolidate long term. Then we either change the ten-20 site location on the scalp and make a new protocol or we terminate training.

### Summer School and Beyond

All other full-time contexts and populations are cheaper than \$1,000-2,000 per completion because of all day utilization.

- Summer school, incarcerated, prisoner re-entry, homeless, residential, IOP, OP+, ID, ...

## RESEARCH STUDIES

### Attached Documents

**Rack Card 4x9 BrainPaint RESULTS frontData.pdf.** Attached are the results in 12 diagnostic categories from 16,490 BrainPaint clients. The graphs show what percentage of trainees experienced progress after 2, 5, 10, 20 sessions.

**BrainPaint System Manual** attached: 86 pages cover the body of information to conduct sessions. Bill Scott has trained over 3000 technicians.

### BrainPaint Specific Research

We encourage you to contact the developer: Bill Scott, [Bill@BrainPaint.com](mailto:Bill@BrainPaint.com)

A landmark study on addiction, ~80% long term abstinence, personality benefits.

[https://www.researchgate.net/publication/7600661\\_Effects\\_of\\_an\\_EEG\\_Biofeedback\\_Protocol\\_on\\_a\\_Mixed\\_Substance\\_Abusing\\_Population/citations](https://www.researchgate.net/publication/7600661_Effects_of_an_EEG_Biofeedback_Protocol_on_a_Mixed_Substance_Abusing_Population/citations).

Here are 25 study replications and BrainPaint specific publications in the .pdf files in the link below: <https://www.calmfocus.com/research-articles/>. The first 10 are addiction related.

This article is about research with drug and alcohol abuse clinics.

<https://polysubstance-abuse.com/evidence-based-treatment-addiction>.

This report is about a school that went from having the most suicides in the nation down to zero after BrainPaint EEG biofeedback along with other interventions.

<https://education.alaska.gov/alt/yaa>.

*“...the school implemented BrainPaint, an innovative neurofeedback system. Students participating in BrainPaint have experienced increase attendance rates, increases in credits earned and in course completion, and declines in student disruptive and discipline behaviors.”*

### Research with All Neurofeedback Systems

Neurofeedback research evidence is strongest for seizures, ADHD, addictions, depression, anxiety, PTSD, migraine, *chronic* pain, and minor traumatic brain injury, etc. Here is a comprehensive bibliography with hundreds of research articles: <https://www.isnr.org/isnr-comprehensive-bibliography>.

Please request scientific research on specific issues or diagnoses, such as:

#### ADHD, Anxiety

Several meta-analyses from 7 decades of clinical research with neurofeedback for ADHD. Anxiety. Billing, acceptance.

<https://www.brainfutures.org/wp-content/uploads/2021/04/brainfutures-neurofeedback-brief-final.pdf>

## PTSD

Meta analysis of research on PTSD. Conclusion: neurofeedback is effective at reducing symptoms of PTSD in most studies.

Neurofeedback Treatment and Posttraumatic Stress Disorder and the Optimal Choice of Protocol  
Karen Reiter, MD,\*† Søren Bo Andersen, PhD,‡ and Jessica Carlsson, MD, PhD  
[https://scholar.google.com/scholar\\_url?url=https://mstarnurofeedback.com/wp-content/uploads/2020/09/2016\\_Reiter-Andersen-Carlsson\\_Neurofeedback-Treatment-and-PTSD\\_0.pdf&hl=en&sa=X&ei=HKwmYa7fL4TkmAGG0YTgCw&scisig=AAGBfm1As4JxCsNuMuYwEr1p9vxWji3Ajpg&oi=scholar](https://scholar.google.com/scholar_url?url=https://mstarnurofeedback.com/wp-content/uploads/2020/09/2016_Reiter-Andersen-Carlsson_Neurofeedback-Treatment-and-PTSD_0.pdf&hl=en&sa=X&ei=HKwmYa7fL4TkmAGG0YTgCw&scisig=AAGBfm1As4JxCsNuMuYwEr1p9vxWji3Ajpg&oi=scholar)

Effectiveness of Neurofeedback on Posttraumatic Stress Disorder A Pilot Study of Neurofeedback for Chronic PTSD Mark Gapen, **Bessel A. van der Kolk**, Ed. Hamlin, Laurence Hirshberg, Michael Suvak & Joseph Spinazzola Applied Psychophysiology and Biofeedback volume 41, pages 251–261 (2016)  
<https://link.springer.com/article/10.1007/s10484-015-9326-5>

## Criminality

Research with 2776 incarcerated violent felons finds 3-year recidivism dropped from 65% to 15% with EEG biofeedback. <https://doi.apa.org/fulltext/2010-10811-004.html>

“Eighty-eight percent (88%) had no subsequent arrests twelve months post-treatment...”  
An Open Clinical Trial Utilizing Real-Time EEG Operant Conditioning as an Adjunctive Therapy in the Treatment of Crack Cocaine Dependence  
[https://www.tandfonline.com/doi/abs/10.1300/J184v09n02\\_03](https://www.tandfonline.com/doi/abs/10.1300/J184v09n02_03)

Brain self-regulation in criminal psychopaths. <https://www.nature.com/articles/srep09426>  
NB: We are not claiming neurofeedback will develop a conscience.