



Transcript of “Andrew Hill: Hacking Autism, Seizures, & Migraines with Neurofeedback - #230”

Bulletproof Radio podcast #230



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Dave Asprey: Hi everyone, it's Dave Asprey with Bulletproof Radio. Today's cool fact of the day is that Piracetam, which is probably the original nootropic other than coffee, was actually developed to be a sedative.

It's a derivative of GABA, which is an amino acid that's also an inhibitory neurotransmitter so scientists figured it would slow the transmission of signals across your neurons and that it would be a sleeping pill.

They were a little surprised that it enhanced learning, alertness, memory and cognitive ability and I've been taking Aniracetam or some of its more powerful analogs just about every day for ... Since 1997, 1996, somewhere around there. What a difference it makes. In fact, I'm on Aniracetam right now as we speak.

Andrew Hill: Nice. I'm on Piracetam and Oxiracetam right now as we speak.

Dave Asprey: Nice. By the way, that was none other than Andrew Hill and Andrew Hill is today's guest, obviously. He's a neuroscientist, director of the Alternatives Brain Institute and working at UCLA. No, you're working at UCLA, but you trained at UCLA with a PhD in Cognitive Neuroscience, right?

Andrew Hill: I still teach for them occasionally. Just finished two days ago or three days ago, teaching a course called the Psych of Aging.

Dave Asprey: Very, very cool. The fact that you're still teaching there and that you're looking at neuroscience and looking at what do we do to make the brain work better is exactly why I wanted to have you on Bulletproof Radio today.

Andrew Hill: Great. Thanks, Dave.

Dave Asprey: One of the things that you spend a lot of time looking at is EEG acquisition and analysis and looking at biofeedback and all that. That's an area of really strong interest for me. I have several EEG machines floating around here and spent eight weeks of my life doing, many hours a day, of neurofeedback with profound results.

Let's start there. How did you get into EEG and what is it and for someone listening, really why should they spend their time listening to us talk about EEG? What is it, why's it important?

Andrew Hill: Sure, so EEG of course is just brainwaves, brain electricity. You mentioned Piracetam affecting GABA. It actually affects Glutamate. The synthesis initially was for GABA, but we found it binds to Glutamate receptors, which is a little odd, but it seems to affect the EEG in that way.

EEG is essentially electrical firing of brain activity. We don't really understand what EEG is still, is the dirty little secret within EEG land. We understand the cellular level, how cells produce different firing rates and we understand at the scalp what some of these electrical patterns mean, but between cells and scalp, it's a bit of a gray area. No pun intended.

I started off in EEG, probably about 15 years ago. Before that, I had been working in a lot of different mental health and human services jobs.

I spent about six or seven years working in group homes with profoundly disabled adults who were multiply disabled. Retarded, nonverbal. I also worked in crisis inpatient psychiatric facilities for several years.

In both of those environments, I got a little bit frustrated. In group homes, retarded adults don't change very quickly. They don't have brains that are intact largely so they're very difficult to teach new skills. I think I spent a year teaching a guy to use a fork. That was my big accomplishment one year in a home.

I felt great about it and I think he felt great about it, but a year later I had stopped working with him and he lost the ability and went back to using his hands.

I was a little bit frustrated. A lot of my clients were nonverbal and I was always puzzled about what's actually going on in the brains of these people that are having profound challenges. I went from working in group homes to inpatient environments with psychiatric populations, which is a much more aggressive dynamic, if you will, environment.

I was really impressed by all the bizarre things that can happen to brains and a little bit disheartened by our lack of ability with psychiatric drugs to really do much. We don't really have all that much control over psychiatric problems using modern medicine.

In spite of it being somewhat powerful, it's not precise. It's not necessarily accurate. We don't know how one brain's going to respond to psychiatric meds.

I left the psychiatric inpatient environment and went and worked for a gentleman in Providence, Rhode Island doing work with autistic spectrum in ADHD people. He was primarily a neurofeedback practitioner.

Over the next couple of years, I saw amazing things. I saw ADHD get resolved again and again and again. I saw autistic kids become social, become verbal. Drop away a lot of the anxiety and ruminations they often have.

I saw these amazing things happen to brains and to address the question of why should listeners care about EEG, when you're making changes in your brain or your body, we often think of these things as a slow process.

It's going to take 10,000 hours to become an expert in a subject material, for instance, which is many, many years, but in technologies like neurofeedback, you can change brain activity incredibly quickly.

I did my PhD thesis at UCLA on what's actually happening in the brain while you do neurofeedback and I found that within about 10 minutes, the brain is picking up the signal. It's noticed what you're asking it to make more of. Within a few minutes, the brain is echoing back changes and activity relative to what it is you are rewarding.

Should probably back up and unpack what neurofeedback is for any of your listeners who haven't followed you.

Dave Asprey: I want you to define it before that.

Andrew Hill: Sure.

Dave Asprey: I want to share a story as well because one of the reasons that neurofeedback has become such a big part of Bulletproof and what I do is that when I first heard about this somewhere around 1996, 1997 and when I was really first realizing I wanted to hack my own brain, I went to a local neurofeedback practitioner.

Andrew Hill: Mm-hmm.

Dave Asprey: I walked into the front office. There's this little chiropractic, a little bit sketchy office and this kid maybe six years old runs up to me, screams, runs in a circle around me dozens of times screaming at the top of his lungs. Clearly this kid was on the autistic spectrum.

Andrew Hill: Sure.

Dave Asprey: I was kind of like ew, this is really weird and not very pleasant, to be honest. I went back six weeks later, only six weeks later. I was doing this once a week and the kid walks up to me and he goes hi there, my name's Jimmy or whatever his name was.

I, to this day, was just blown away because clearly that was an out of control brain and out of control kid who literally became verbal and focused and eye contact and everything in six weeks.

I just couldn't believe it. Okay, this stuff has merit. It's worth paying attention to and it certainly has changed a lot of the way my brain works, but that kind of thing is not usually possible, but with this stuff it is.

Talk about how it works and all that. People, I'm sure, are interested.

Andrew Hill: Right, so effectively, we are training. We are exercising different frequencies in the brain, either more or less of them. One thing people often aren't aware of is we're making all of our brain waves all of the time. You're making things we call delta, theta, alpha, beta, gamma all of the time, but the amount of different frequencies you make track your states and your abilities to some extent.

You can also train or reinforce things like connections between regions of the brain or phase relationships between regions of the brain. We understand to some extent what some of these things do.

Largely when you are training the brain, you are measuring. Let's say, let me give you a concrete example. There's a brain wave called theta, which is often not a great brainwave to have lots of so people that make lots of theta are typically fairly impulsive or restless or hyperactive.

You can think of theta, a large amount of theta like the brakes being off the car so everything is just reactive and there's very little inhibitory ability in the brain when you have high amounts of theta.

If I was able to show you folks, stick an electrode to my head and measure theta moment to moment, it's not a static level of some resource. It's fluctuating moment to moment. Up a little, down a little, up a little and that's key to the way neurofeedback works as a mechanism.

You measure the fluctuating level of some brain parameter like your theta amplitude. Whenever theta trends down, which is the "good direction", you make something happen that is visually or auditorily perceptible.

Maybe a chime happens or a Pac-Man eats some dots on a screen or a spaceship bursts ahead in the solar system on an animation, but the next, but the next moment your brain trends in the wrong direction.

The theta goes back up and the game stops and the brain goes hey wait, where's my input, where's my beeps? Where's my spaceship flying, where's my Pac-Man eating dots? The next moment the brain naturally trends back down as theta and the game resumes.

Essentially, you reinforce or you catch all of the proper, if you will, trends in brain activity and give the brain a little bit of applause, a little feedback, a little visual, auditory tactile, simatic cue in some way and brains being being information processing machines will largely choose input when given the option.

You start changing the environment such that the brain only gets interesting input when it's doing one thing and you withhold that input when it shifts away from that mode and the brain starts to spend more and more time doing the thing that produced more stuff on the screen.

Often, decreased theta will happen over many, many sessions and over 15 or 20 or 30 sessions of training, at the end of that time, you have dramatically different brain activity and that translates to differences in resources and abilities as well.

Dave Asprey: Here's a question, though. I've learned that all brain waves have uses.

Andrew Hill: Right.

Dave Asprey: Theta, for instance, that's dreaming and there's the suppression of a certain brain wave, which can be good if it's pathological, but oftentimes simply making it an orderly, coherent way that is not chaotic can have different effects.

As I've learned to train ... For instance, I have orderly theta in my brain rather than disordered theta. Coherent theta, front to back, left to right. The same thing with alpha and the same thing even with some things like delta can happen.

As they happen in different parts of the brain, but teaching the brain to at first be able to just be in one state versus another is a big thing, but then teaching it to be able to be in whatever that state is, but to be able to be in that state in an orderly, self-directed way.

It's like training your dog. First it has to sit, but eventually you want the dog to be able to sit with popcorn on its nose and wait and then throw the popcorn up and catch it, although you shouldn't give your dog popcorn, let's face it.

Andrew Hill: Right.

Dave Asprey: You know the perspective there. With neurofeedback, one of the concerns I have is that you could train the brain to do the wrong thing. Can you hurt someone with neurofeedback?

Andrew Hill: You can. You can produce adverse effects. It's not exactly the same type of adverse effects you would produce with a medication.

With the medication, you've got weird side effects. That's a sign it's the wrong med. With neurofeedback, you've got weird side effects, it's a sign that the protocol, the frequencies are rewarding or where in the head you're training the EEG might just be a little bit ... A bad fit for this particular brain.

The type of adverse effects you'd get actually tells you what protocol might work better. Weird side effects are A, useful in that way and B, they're transient so if I pushed on your brain today and got you to produce, let's say, more theta and you were feeling more alpha and you were feeling kind of spacey.

The next day, you come back in and you say okay, Andrew that didn't work. I actually didn't feel better. I felt a little bit checked out, I wasn't doing real well and I go okay, great, let's try a different protocol and different frequency.

The problem comes when you train your brain in a specific way. It produces weird effects and you don't tell the practitioner who's guiding your training.

I have one colleague. She's now a colleague in the field, but when I first met her, I met her because she brought her autistic son in to work with my mentor and she and me had done a lot of home training.

She had met with a neurofeedback practitioner initially, got a brain map, a QEEG. Got some protocols to try and a home training kit. Went home and did about 50 or 60 sessions on her son with no supervision over six months or so.

At the start of that time, he was mildly autistic. Verbal, but socially awkward, had some problems. At the end of that time, he was under a chair, self-stemming and non-verbal so he basically regressed several years back in function because they were training the wrong way.

Now generally that doesn't happen in neurofeedback because if you get adverse effects, you spot them and you steer the brain in a different direction, but if you are somebody training yourself with no supervision and no sense of what's actually happening in the brain, absolutely you can produce negative side effects and if you keep doing it, you can produce permanent, if you will, negative effects.

There's a good end to the story about this kid. We did more assessments, did a few training sessions and then stayed really checked in with his mom over the next couple of months. This was about 12 or 13 years ago and about a year ago, the kid graduated from college towards the top of his class.

It was a mainstream school so he's no longer ... We undid, if you will, the progression in the wrong direction and were able to then build on our understanding of his brain and help him actually meet some real serious goals.

It's powerful, but not as negative, if you will. The side effects are a bit more manageable than drug side effects.

Dave Asprey: I've used many different modalities in neurofeedback over the years and one of the groups I went to did some stuff that really made ... My emotional regularity wasn't there. I was just off for quite a while.

When I used the main form that I use, which is basically an eight channel thing. It's a week program with a different signal analysis than normal it's called 40 Years of Zen.

When I did that, I went in after having done this other stuff and some of the things I have like an ordered theta were just gone and it actually took another three weeks of work for me to get it back and when I got it back, I felt like myself again.

Andrew Hill: Sure.

Dave Asprey: It was one of those things where wow, you could do some harm and this is tinkering with the wiring of who you are. If your brain does some stuff and it does it well and then you train your brain not to do what it does well, all of a sudden wait, I used to be able to write really well and now my writing isn't what I wanted it to be.

Or my sleep quality. Another friend, who's been a guest on the show. Same thing. He did some neurofeedback for five sessions and his ability to sleep went away, for months.

How do we know what's safe and what isn't safe with neurofeedback?

Andrew Hill: Yeah, there are a few answers to that question. Most important, I think, is actually getting a snapshot of what brain you're starting with.

When I do a brain map, a QEEG. It's defined, for your listeners, is a quantitative EEG. We gather a full head of electrodes, usually 19 plus electrodes and then we take some baselines. Eyes closed and eyes open baselines and then compare that data to a normative database that tells me how unusual your brain is in a bunch of different metrics and parameters. That will often tell me things to avoid. Oh, I see this pattern in this person. Okay, don't train beta up here because that will disrupt sleep. I see that they already have excess alpha and theta in this portion so don't do deep relaxation work because it will make attention problems worse.

The QEEG gives you starting places for both things you want to improve and also things to avoid. Potential hot spots and potential negative consequences you might produce. That's really important to have a good sense of what brain you're actually working with.

The other very important thing is, as I alluded to earlier, it's really critical to know what a specific training protocol is doing.

When your friend had five sessions and it disrupted his sleep, it probably disrupted his sleep after the first or second session and the practitioner should have gone oh, your sleep is disrupted, let me do a different frequency or change the location on your head.

Dave Asprey: That group didn't have super-trained practitioners. It was one of those out of the box things.

Andrew Hill: Okay. Yeah, and that is the risk here, is that there is really no one size fits all neurofeedback. There's no magical cap you put on your head and sit back and it just works, period.

I joke that neurofeedback isn't rocket surgery. Anyone can stick electrodes on heads and play a computer game and set up frequencies in a signal processing algorithm, but knowing what to do, where in the head to train, what frequencies to train up and down, how to train amplitude.

Or coherence or other more complicated metrics and why to do these things and what to do when you get adverse effects or sub optimal effects, that's really why you need a neurofeedback practitioner to guide training or you need to be really technically minded yourself and have some neuroscience perspective.

Otherwise, you're going to get, at best, suboptimal effects and at worse, potentially adverse effects that are long term.

Dave Asprey: That's one of the reasons where there's this tension between okay, you want to work with a top professional, but you don't necessarily know who's got the skills and who's going to be best for your brain or which technology do you use. Then there's also it's really expensive.

Andrew Hill: It's really expensive, yeah.

Dave Asprey: Yeah, but then okay, so let's get a muse or a melon headband. These are sub-\$300 things. What's your take on those things?

Andrew Hill: I'm really opposed to those things for many reasons. One is the forehead is almost never the right place to train EEG.

Dave Asprey: Yeah, occipital region is a little stronger for alpha, isn't it?

Andrew Hill: The occipital regions are better, but you rarely want to train in the occiput, either. Some deeper relaxation work, the occipital works.

Parkinson's, you can train at the occiput. There's some ADHD regions back there that seem to work, but for the most part it's the motor strip, the sensory motor strip that goes from ear to ear across the top of the head.

These locations called C3, CZ, C4, those are the primary. First place you often want to train people and they tend to focus on a specific magic bullet frequency in neurofeedback called SMR, sensorimotor rhythm, which is a low beta between 12 and 15 hertz, but it functionally acts a lot like alpha on the attention system so a calm motor system is essentially a SMR state.

If you've ever seen a cat lying in a window sill looking out the window at birds and its body is like liquid, but its eyes are laser-like focus, that's the SMR state. In fact, the field of neurofeedback to some extent was founded because somebody discovered that if you train SMR up in cats, it makes their brains ultra stable.

It actually makes them very resistant to seizures, it turns out. This is one of these serendipitous mistakes that were made in the field. In the late 1960s, Barry Sterman was testing cat's exposure to rocket field vapor.

He found that most of them had a very nice linear dose curve, a little bit of rocket field vapor and they pant, a little more and they cry, a little more and they stumble. A little more and they salivate and then seizure/coma/death in this really linear curve.

Except one sub-group of the subjects is cats refused to have seizures and the whole curve was pushed really far to the right. They needed two to three times the exposure to have these problems and he couldn't figure out why until he realized oh, wait a minute, I used these same

cats on a proof of concepts experiment several months before to raise SMR, to see if I could give them a milk dropper reward for biofeedback.

Months later these cat had meta stable brains that refused to have seizures.

Dave Asprey: For people listen to this.

Andrew Hill: Yeah.

Dave Asprey: Bulletproof is about building resilience like people who can handle what life throws at them and that's just profound. These animals were able to handle higher toxic exposures because their brains are trained. That's all how important is.

Andrew Hill: Now the story gets even better. Barry had a ... Dr. Sterman had a lab assistant who is a medication uncontrolled epileptic. She was having tens of seizures per month and she was on vast amounts of anticonvulsant. Things like Tegretol and dilantin old school major major neuroleptic tranquilizers. She was still having tens of seizures a month and she basically demanded that he build her a biofeedback machine to train SMR and he built her a machine. Over the next couple of years they trained her SMR off and on and eventually she want off all of her medication and remain injury free for a year.

So Barry was able to take this research immediately turn it into human practical interventions and that was really in the late sixties and we've been sort of running ever since with making brains more resilient more stable and a lot of the field is still focused on different ways to use SMR. The twelve to fifteen hertz low beta as a core frequency of the brain in terms of training up. We think that there are recurrent connections between the cortex on the top and the thalamus deep inside the brain which is the sort of switchboard for all sensory experience.

There's recurrent connections between those two locations and it looks like training up SMR makes that network of thalamic and cortical neurons much more stable and the whole brain becomes less prone to things like reactivity, seizures, migraines. It just adds a sense of integration if you will to the brain.

Dave Asprey: So if people want to get neurofeedback I think there is some degree of value from the head band sensors because it's better than just, well I hope I'm meditating right right now. It's giving you at least some directional things but it might be okay at least you're facing



north and you want to be facing north when you're meditating. I don't mean actually facing north meditating in the right direction-

Andrew Hill: Yeah.

Dave Asprey: But the signal acquisition and processing and the analysis it's easy to get something to stick to your forehead but it's maybe not as often as you can get. Then we have the very expensive ... hundreds of dollars or at least a hundred dollars per session for your forty plus sessions for a lot of these things. Then what I recommend for people who are looking for something in the middle is I want this to be affordable. I think every school should have neurofeedback as part of their curriculum to teach our kids how to use their brains. So they have better control and better regulation.

Andrew Hill: Yeah.

Dave Asprey: And you shouldn't be able to graduate without. That's my vision for neurofeedback.

Andrew Hill: Okay. Sounds great.

Dave Asprey: What I do on the Bulletproof side is I work with neuroptimal. It's a headset that uses C3 and C4 but you can do it at home and it runs about eighteen bucks a session because it's the cheapest one I know that won't break your head.

Andrew Hill: Yeah.

Dave Asprey: Because it's not up or down training something it's just telling your brain when it moves from one phase state to another so that you can stick in one phase state. Like oh I'm paying attention I can do it more or I'm paying less attention. It feels like we have guys like you who are total experts in this and now we have these cheap headsets that can get even like twenty four channels of data.

Andrew Hill: Yeah.

Dave Asprey: There's a huge massive gap around-

Andrew Hill: Absolutely.

Dave Asprey: How do we process all the data? I could send you a real time stream of my brain right now from one of these devices but I would need you to use your software and your algorithms and your analysis to do this. How are we going to get it so that millions of people can train their brain instead of doing something that is not as effective to try to calm themselves or to focus?

Andrew Hill: Really good question. Yeah and I think that there is emerging technology right? We're having proliferation of headsets and EEG systems. The cost is coming down. When I got involved in neurofeedback, to buy one system cost about ten thousand dollars now you can buy a really decent system for a three or four thousand dollars. In fact I have a consumer a system I like which is about fifteen hundred dollars that I think works as well just about as clinical system. The cost is gradually-

Dave Asprey: Does it tell you what to do or-

Andrew Hill: No.

Dave Asprey: You still have your analysis right? That's the tough part. Quality and price have come down. My first home unit was 1997 and it was several thousand dollars and I didn't know to do with it so I go, "I try training some alpha but what else? It's the, "I don't know what to do with it" that is holding back everyone listening to this from just going home plugging in and saying I needed to relax for twenty minutes I did this and I actually got to be a better person as a result of that.

Andrew Hill: I think what's happening is if you look at neurofeedback as a field, it's actually not young. It's been around since the mid sixty's but it's been a bit nichy. It's been a small player if you will in technology and there're only ... there's probably only about six or ten hardware and software big players in the field.

On the other hand if you look at the other brain science areas there's this area called the BCI (brain computer interface) and that is not a nichy field. That's an exploding mass of billions and billions of dollars pouring into in the past decade. Well I'm of the opinion that neurofeedback and BCI are actually the same thing-

Dave Asprey: They are.

Andrew Hill: It's the same loop between the brain and the computer just run in the opposite direction. So in neurofeedback changes in the computer are shaping brain activity and in BCI changes in the brain activity are shaping the environment; writing a letter, turning your lights on and off in your house, whatever it is. It's the same real time connectivity and same old processing that is trying to control something. Shaping the environment, shaping the brain.

I'm of the opinion that all of the money pouring in to be BCI is actually making neurofeedback much more accessible. We're just about to the point where we're going to be able to provide cheap headsets that do qEEG's in real time and have algorithms for different frequencies and different protocols that we can then build some of the skill of the clinician into the automated systems.

I don't think we're quite there yet and most users who are able to spend lots of money or to go see practitioners are better served with intermediate devices I would say. Those would include things like HEG which I know you're a big fan of.

Dave Asprey: Yeah.

Andrew Hill: HEG is training hemoencephalography. Hemo meaning blood and there's really two forms of HEG. One is NIR (Near Infrared) which I think is the one you like. I tend to prefer PIR (Passive Infrared) only because PIR works really well for migraines and I often work a lot with migraineurs.

Dave Asprey: So for people listening who are one level of technology around brain science down from what you just said I'm going to translate that a little bit.

Andrew Hill: Thank you.

Dave Asprey: What that means is basically either you shine the light or just use natural light to look at how much blood is in a part of your brain and you reward the brain when there's more blood there.

Andrew Hill: Exactly.

Dave Asprey: So I managed to learn how to pay a lot more attention because I taught myself to move more blood to the front of my brain which makes it easier to pay attention. I used to carry a device called the Upgraded Focused Brain Trainer. Unfortunately the guy who was custom making those for people who wanted to get them just quit doing it and became unavailable. Just like wouldn't answer messages so I'm looking for another HEG system that I could carry for people who want to spend a few minutes every day or every week just teaching the brain to move blood around because it is profound what you can do and it's so much safer and easier-

Andrew Hill: And it's simple. You do one thing. You're measuring perfusion dynamics, blood flow. In NIR you're shining infrared light through the brain. In theory blood absorbs the light and then the red light bounces back out and there's an emitter on the outside and you measure the change in red level-

Dave Asprey: Yeah.

Andrew Hill: And that's the level of oxygenation. The other form of HEG is simply an infrared camera strapped to your head measuring the temperature of the frontal lobe. In both cases it's funny we are training the brain but it's actually trained like it's peripheral biofeedback. What I mean by that is in central biofeedback train the brain directly in the central nervous system. To a very large extent it's a non-voluntary process you are shaping the brain by thresholding by giving the brain feedback only when it's doing certain things.

In most forms of classic bio feedback you actually must learn to feel the experience and learn to try and until you learn what it feels like and can reproduce it, it's called skill transfer. You don't have that ability and for things like HEG even though you're training the head it actually is trained like peripheral biofeedback so it's effortful training.

We strap an infrared sensor to your head you actually think concentrated thoughts or happy thoughts. In both cases blood rushes to the frontal lobe and perfusion changes and a signal goes up. I use audio rewards and animations and things. Over time you can make more capillaries and produce much more stable blood flow so that when you get stressed out you don't have this drop in metabolism. Or when you have a migraine, one of the theories of migraines is a called a spreading cortical depression. A metabolic sort of slump that crosses across-

Dave Asprey: Right.

Andrew Hill: The cortex and as it passes through blood vessels the vasculature contracts and that's one of the things you feel. The brain itself has no sensory nerve endings. The brain cannot feel believe it or not. So there's no ability ... when you have a headache you're not feeling your brain. There's something on the outside of your brain is what you're actually feeling but if you can make the vasculature more robust things like headaches tend to not knock you over quite as much. In blood flow and also you have the ability to use more metabolic activity in your prefrontal cortex which as you Dave is the most human part of the brain.

All of the things we think about as human, you know planning and nuanced emotions and things like that are all very much a pre-frontal resource and HEG is wonderful for training prefrontal resources. The other way that I used HEG a lot is in Asperger's. There's this cognitive flexibility thing that's often not there in Asperger's. You can have very very intelligent people who are Asperger's they're doing fine until the moment things violate their expectations. Until the bus doesn't come when it was supposed to and then it's, "Ah I'm freezing" when things violent my expectations. That is a drop in frontal function and we can bring that back up often with frontal blood flow or HEG training.

Dave Asprey: I did the Daniel Amen's spect scan about thirteen years ago, twelve ... thirteen years ago and it showed when I was trying to concentrate that I had zero metabolic activity in my pre frontal cortex. I had it turns out mold toxicity in my house at the time and I saw Daniel about a month ago and got a new brain scan and it was smooth and he looked at my old one and said, "Dave this brain looks like someone who has a hard core street drug addict. This was one of the most toxic brains I've seen." It was interesting because I also even before that had a lot of the symptoms of Asperger's syndrome.

I was never formally diagnosed because I had already figured out massive nutritional changes that I can make it turn my brain on and let me pay attention and change my personality and dropped food and dropped the autoimmune things. And stuff like that where it changed the fundamental wiring of who I am but neurofeedback has been a part of that as well.

I've gone from someone who was always pretty intelligent at least I'd like to think so to someone who's not just intelligent but has cognitive regularity and cognitive control which is

profound and it's so teachable. It kind of irritates me when people say, "oh neurofeedback doesn't work and there's no evidence". I'm like, are you awake? By the way if we hooked the electrodes up to your head, would we see a little bit too much beta in the wrong part of your brain that makes you so oppositional and defiant and skeptical of things that don't deserve skepticism or support. They're just questions, they don't have a value and when you place a value on it like that there's something wrong in your brain and we can fix that.

Andrew Hill: Right.

Dave Asprey: And now there's probably a hundred thousand people are hearing this episode and they're driving in their cars and going, all right well so I want to try this but I hear it's expensive.

Andrew Hill: Mm-hmm (affirmative).

Dave Asprey: What do you recommend? Someone says I like to train my brain. Instead of spending an hour every day meditating I want to spend a certain amount of time with the computer teaching me to do it so that when I do meditate will be more effective. Let's say that's a goal.

Andrew Hill: Sure.

Dave Asprey: How would they go about doing this?

Andrew Hill: I think that there's multiple ways. Folks just want some improvement and they have no deficits to remediate, I think that going after things like HEG some of the newer headsets that are coming out might have some utility. I do think finding a practitioner is usually a good idea and a lot of folks ask me for referrals and my threshold for how to find a good practitioner is what are they doing assessments? Are they actually looking into your brain? Because if they're just kind of sitting down slapping wires to your head and seeing what happens then they're probably training off of recipe books and don't have a really broad sense of what's happening for you.

Every brain is different and so I encourage folks that are thinking about trying to get deeply into neurofeedback and want practitioners to find somebody who uses qEEG to assess brains at

least to get a snapshot of what's happening on your way in. I do think that HEG is wonderful for the home user I also think that there's EEG available for the home user.

I think that if you want to start doing your own training and you want to train SMR on the motor strip that's relatively safe thing to do produce a lot of adverse effects. Some are training one of these I have an issue with headband device because the forehead produces the most dramatic side effects.

Dave Asprey: Oh that I didn't realize.

Andrew Hill: And it also produces delayed effects. You can train three or four times the forehead before you get the effect from the frontal lobe and then you often get dramatic side effects from frontal training so-

Dave Asprey: I get the guys from Muse and from Melon on because I really like consumer EEG. The idea that you can have access to this technology and you're the one who controls what's going in your head. Yeah I agree. There are all sorts of questions about what algorithms to run because it's like installing the wrong software on your computer. Like it never quite work right after I installed that weird package and right these are not small changes we're talking about.

Andrew Hill: Yeah and if you get a strange effect once or twice and don't repeat the effect you're probably not going to produce permanent changes. But what's going to give an underlying this disorder that's significant. Underlying seizure disorder, underlying depression and underlying OCD? These things are completely triggerable of all with neurofeedback if you do the wrong protocol.

What is often a good protocol for the average brain less theta and more beta. Take somebody who's anxious or OCD and can just release that phenomena profoundly for them so I think you have to be a little cautious. If there's things that are that need remediation, if there's deficits that need to fixed then I think going to work with a professional is much more critical.

Dave Asprey: Do you actually know people who don't have deficits?

Andrew Hill: Well I have people to come to see me and I ask them what their goals are and they can't describe what their goals are. I don't know nothing's really wrong. Other folks give

me ten pages of details they would like to fix. Sometimes folks that can't describe deficits that's the deficit right there. The lack of ability to describe internal space-

Dave Asprey: It's really weird because you get a lot of well a lot of people say well these are pretty good and then you're like well how would you know because you don't have nerves in there and you're unlikely to be that self-awareness. Unless you have a great self-awareness practice to know but if you were to say interview the family members of anyone who says that things are pretty good here the odds of things actually being pretty good are about zero.

Andrew Hill: Yeah yeah and family often knows more about the person than the person does to. A lot of as I mentioned earlier a lot of the success. After their feedback is predicated on getting a sense of what each protocol is doing and then tweaking the protocol to get better effects.

Especially with kids but sometimes with adults I get better information from the family around the person than I do from the person. Definitely early on the family often notices that little Jimmy is sleeping better or is less aggressive or is quieter in tone of speech or something. Well before the kid or the evening adult can tell me what's going on. So that is true that your people around you often know what's going on better than you do because subjective assessment is so poor we just aren't very good at the determining where our performances is. This is the true across all domains of psychological performance. Humans are notoriously bad at noticing a deficit.

Sleep deprivation people will swear up and down they're performing at their best and they made no mistakes and they look at their actual behavior it was horrible. The ability to monitor where your performance drops as your resources drop not just your performance but the ability to meta monitor the performance drops faster.

Dave Asprey: What I notice in one of the things that really got me going and getting a spect scan was that when I was getting my M.B.A. at Wharton I would sit down for a test ride felt reasonably well prepared and the first question I get one hundred percent and the second question I get seventy percent. The third question I get thirty percent and after that I got like zero because I was basically dysfunctional and it was not my awareness of this happening but me noticing the quantitative decline. Wait there's a pattern these past four tests and why do I feel so stupid and of course it's probably because I'm not trying hard enough or just maybe I'm

actually stupid. Who knows but when I looked at the blood flow stuff like wait a minute when I try to concentrate I have no blood flow and that would make sense right?

Andrew Hill: Yes.

Dave Asprey: Then it becomes trainable and you can modify it with vitamins and drugs and training kinds of stuff. That wasn't something that I was aware of. I just I was tired right or I thought I was just not smart enough. It's a very subtle thing to be able to walk into a brain scientist and say hey like I recognize that there's this thing I want to tweak and especially if you're already at the time I was working at a startup that we sold for the hundreds of millions. I had an Ivy League school it's not like I was a slacker here. It wasn't like I wasn't already in a high performance level but I wasn't at the right high performance level for what I was capable of.

Andrew Hill: Yeah and this is a lot of what I do is help people take their amorphous complaints and really operationalize it. We sit and talk about brain maps and couple hundred pages of data when I do a brain map and then we sit and chat. It's really important to know the brain maps are not diagnostic.

I joke that there prognostic they get me to guess about what might be happening in your brain. Brain masculinities are statistical analysis of one person's brain compared to a population. Just because you're different than some average arbitrary mean doesn't really mean something wrong, something unusual and then the sort of heavy lifting of the neuroscientist neurofeedback practitioner is trying to figure out which of these brain maps statistical patterns are really what you're you are describing as the things you want to change in your life.

So spotting the sleep issue, the anxiety, the OCD, the ADHD, whatever it is but I have folks come in and say I'm fine but I'm sixty five and I don't want to not be fine in five years. We still are able to improve even with nothing quote unquote wrong. The average individual could probably stand to sleep better, transition out of sleep better, have less emotional reactivity, better sustained attention even if they're already normal. Already supernormal, you can still improve those subtle things and have dramatic quality of life improvements.

Dave Asprey: The thing is what's normal for everyone has nothing to do with what they're capable of. It's just whatever you have so far. I really did not know that you were supposed to

be able to walk without pain until I was twenty three. I had arthritis my knees and I was fourteen I lived in a basement with toxic mold. I just thought that you were supposed to ache and creek all the time and that's just normal.

It wasn't even something that I would have considered treating and then somebody like got me orthotics. I was like wow and I walked across campus and I don't like want to kill people because I'm in so much pain. This is so neat because whatever normal is for you is very likely so sub optimal because you've never felt a perfect day, right.

Andrew Hill: Yeah.

Dave Asprey: Or if you did you thought it was when I was skiing or I was in a flow state or it's because of something else. Maybe even that was only halfway to what you're capable of on a regular basis and that's been the whole like a point of Bulletproof the state of high performance.

There are so many levers and knobs we have that aren't listed and that aren't available and you've made a science of studying the stuff specifically in the brain to do that. How do you go about, someone walks in the door and says oh I feel pretty good like what's neurofeedback got for me. I run a few miles a week. I feel good, I have a great job, I'm happy with my relationships. What's in it for me. What was used to say to someone like that?

Andrew Hill: Well I would talk to them and ask lots of questions about how their function to A. figure out if what they're describing is actually fine is actually fine. And I often ... the person comes in and says nothing is wrong but I want some brain work is usually this high powered executive. That's the classic individual who thinks they're great but wants to be better. There's sort of an entrepreneur, a silicon beach type. Someone who's getting a little older and wants to maintain high levels of performance but when talking to these folks I do find that okay, two-three in the afternoon you have less stamina than you had at 10am.

Okay that's not necessarily normal or not necessarily desirable to have your stamina drop after lunch. I find that folks say nothing is wrong with their sleep but they're only getting four or five hours a night and waking up three, four, five times in those five hours. And so people just don't necessarily know as you alluded to what a high performance really can be. I help them unpack what they're saying is true.

We usually find something that needs to be tweaked and then I typically, my sales approach is pretty soft I don't aggressively sell. I talk about brains. People often really want to get a peek under the dome so to speak and figure out what's going on in their brain that's really exciting even if nothing is wrong. The other thing is you can do things like improve reaction time and improve stamina and improve the sustained attention piece so it can only be fine but wouldn't it be great if it's a little bit better. And more changes are big quality of life improvements often so.

Dave Asprey: This is a kind of a similar approach to what I do with clients when I do forty years of Zen. It's like a seven day kind of residential of neurofeedback thing. And part of what I found is brains exhaust very quickly when you're training them and so there's a whole protocol around what do you do sleep wise what do you do specifically with supplements and smart drugs, biochemistry. What do you eat? What do you avoid in order to put yourself in a state where your brain can do this? It's like running a marathon right. You know before you've run a marathon you feel properly and before you're going to do an hour neurofeedback like in fact if you've ever noticed this do you see a difference in someone who's had a Diet Coke versus a sugary snacks versus a fatty snack before they do brain training?

Andrew Hill: Yeah. Depends on the individual's habits and I find that if they violate their habits they have weird stuff happen. Many people get a little bit tired during neurofeedback because I'm asking them to actually make more metabolic activity in their brains. Typically the fatigue that happens within session is sort of like going to the gym. After you leave the gym your muscles are sore and tired and warm and a couple hours later you actually have more energy. You feel lose fluid and springy.

That often happens in neurofeedback where you get wiped out in session but in a couple hours later you're raring to go. You're right if you come in sleep deprived, dehydrated, having had a lot of alcohol the night before or a handful of other things, A. your brain looks horrible something really weird sense of who you are. B. you're not going to get the learning effect if you have dramatic sleep deprivation dehydration and there are a few drugs that also seem to shut down the neurofeedback process a little bit. And those include benzodiazepines and significant opiates onboard.

Dave Asprey: I have to cut down the use of those then.

Andrew Hill: So pull back on the Xanax. Those things stop learning of any form to some extent and it's not surprising that blunts the neurofeedback effect a little bit.

Dave Asprey: There's another one that's interesting in the formal training that I've done the most work with and that's the THC. THC tends to inhibit your ability to learn alpha training. THC raises alpha brain waves which feels good but if you're trying to learn to raise them yourself and you're using THC the learning won't stick.

Andrew Hill: Alpha's many things. There are at least five different things in the brain called alpha at least and I'm probably under counting. The kind of alpha that is produced by chronic large amounts of cannabis long term is general cortical alpha and its eyes open alpha.

Dave Asprey: That you don't want.

Andrew Hill: Yeah. that you don't want. Earlier you mention that theta can be good. Thetas in dreaming, visualization, memory access. It looks like right around six to seven hertz there's this access piece of theta for pulling things out of your mind.

Dave Asprey: Yeah.

Andrew Hill: That's wonderful. You don't want that when you're trying to focus. You want that we're trying to creatively pull from the well. Alphas like that too. When your eyes are closed you want alpha in the back of your head. That's the visual cortex. Alpha is an idling rhythm to a very large extent. It's sort of going into neutral going to a quiescent resting mode when your eyes are closed the visual cortex should be resting.

Dave Asprey: Yeah.

Andrew Hill: I often see in people who are anxious the visual cortex stays in a beta mode that's called hyper vigilance when you're standing environment even with nothing to process it. Contrariwise when you open your eyes alpha should block. It very much suppressed across the cortex. You shouldn't make lots of it and if you maintain a high level of alpha throughout the cortex especially frontal cortex that's inattention, spaciness, sluggishness, slow cortical temper, slowed reaction times and so you can essentially smoke yourself into a spacey brain long term with too much THC.

Dave Asprey: So the idea that THC can do that, we've found that even just within twenty four hours before training if you're doing if you're smoking at that your training will be less effective for teaching arrays alpha. I've gotten to the point where my eyes closed alpha is very high amplitude and my eyes open alpha is very low amplitude. I turned out in my career and also because I train all the stuff and people if you're ever going to hack. Here's the deal if you go back 50 years our conversation would be something like this, dude I got a V8 in a car and I put on new headers okay and I've got an extra amount of horsepower and all we're doing now is the same thing. You go back twenty years or maybe fifteen years. Hey you know what I just restarted the circuit board on my computer and I put on blue LED's because they just invented those and I added RAM and got a new hard drive and a new video card and so cool.

We're just doing that to the human brain but it's the same hacking that's been going on since we started making low riders like in 1950. It's just that. There's nothing crazy about what we're saying. We're just applying this upgrading philosophy to the head instead of something else.

Andrew Hill: Of course the only sort of inflection that's different is when you change the brain you change everything. You change your entire experience your processing how you the world can change. The brain is the filter through which you experience absolutely everything. And so subtle changes in your processing machinery can be dramatic changes in your experience.

Dave Asprey: There's an example for me that really stands out. I used to have like some pretty powerful road rage like I actually have extra muscles around my middle finger as a result. I would get really mad and it was going to cut me off. Part of this is that I have very rapid signal processing I read traffic really well and I tend to like to speed. I'm an adult now and I don't have those that like I did. Even as a young man I was like look if there's an open road I'm going to accelerate because like it's not unsafe. It's just not something you're supposed to be doing.

After I did a little bit of this neurofeedback, exactly the same situation instead of being like I want to kill that guy in front of me. I was able to be all right like for all I know the guy's like going to get fired just make it work or he has ruined like giving birth in the back seat. I just have no clue so it really had nothing to do with me whether you speed or not. To be able to make that change then I don't think I had that cognitive flexibility and I get a heart rate variability training also help to turn off my sympathetic.

Andrew Hill: Sure.

Dave Asprey: No one likes to have road rage and you feel like a jerk after you've had it especially with like what was in the car with you is like, do you realize what you were just doing? So you're not helping the world. You're not being nice to anyone, you're not being nice to yourself. It doesn't make you feel good when you get home from work. If it's a behavior that you have and you could hack it by training your brain to behave itself. That was for me a really kind of big thing.

Andrew Hill: Yeah. Yeah sure and impulse that's a form of impulse right? Impulsivity or what I begun calling inhibitory tone affects decision making, planning execution of almost every behavior. My business partner, the company that I do the brain training at alternatives has a substance abuse program. We actually do a lot of work with people who are actively using alcohol, cannabis other drugs.

Dave Asprey: I didn't have that down in my ... I was going to ask Alternatives Brain Institute but I totally misunderstood what that was then. Okay, tell me about that.

Andrew Hill: We have Alternatives Substance Abuse Treatment and Alternatives Brain Institute and actually they're not the same program.

Dave Asprey: Okay.

Andrew Hill: The Brain Institute works with all of the substance clients but that's about a third maybe a quarter of the client and the rest are general neurofeedback clients.

Dave Asprey: Okay.

Andrew Hill: Autism to ADHD, sleep issues and whatever. Everything neurofeedbackers work with.

Dave Asprey: What's your youngest autism what kind of age that you would work with?

Andrew Hill: I start with four. I have two people right now there are five that I've been working with for a few months. One of which was no longer a diagnosable as autism which is nice.

Dave Asprey: Congratulations. Some people consider that to be impossible and it's just not.

Andrew Hill: It's not typical doesn't happen every spectrum kid but it happens maybe five percent of the time. It happens so I had parents want to give me three year olds to work with and I sort of start at four. I would have younger kids if I allowed younger kids in my chair so to speak. For my starting age. On the substance side people are using THC, using alcohol and so we're actually going after the acquired brain patterns there. They have produced from the substances as well as training all the things that are driving substance abuse like impulsivity, anxiety, discomfort with your emotions. Things like that.

I wanted to mention on the THC side. I trained people who are active smokers. Medical or recreational smokers. It does seem to blunt the effects a little bit but I've developed a set of training techniques to abolish tolerance to THC.

Dave Asprey: Oh that's interesting.

Andrew Hill: I can eliminate in one or two weeks usually at most. Usually sometimes the first session, usually it's three to five sessions.

Dave Asprey: So you get higher on less. Is that what you are saying? So people can be more economical in the use of pot?

Andrew Hill: You're actually right. That's a hit to your wallet, less hit to your-

Dave Asprey: That's meaningful.

Andrew Hill: And so I have chronic long term hardcore stoners are like yeah shut up dude, I know what I'm talking about. And they go home and smoke and come back in the next day. You weren't kidding I was on the couch I couldn't talk to my girlfriend drooling because they didn't listen to me that the tolerance was being suppressed. You can pretty much keep the brain in a reduced tolerance state with neurofeedback long term. And that means using tiny amounts of THC to get the same medical or recreational effect you were going after which may have been vast amounts of plant matter before that.

Dave Asprey: Can you also reduce things like dopamine resistance I have a lot of people who use internet porn or play video games all the time. They'll get resistant to dopamine and they just don't get excited by things that excite normal brains. Can you fix that?

Andrew Hill: I don't know is the short answer. I would imagine so because all my clients on psycho stimulants which are doubling emergent get increased effect from their stimulants once they start training. So that does suggest we're sensitizing the dopamine system in some significant way. In fact most of my clients who have attention problems or who don't who take stimulants have to really quickly ratchet down their stimulant use as their brain becomes more robust.

Dave Asprey: Now this is profound stuff and this is medical but it's also kind of quasi medical where it crosses the boundary from oh I'm treating a pathology to know I'm actually just helping a brain that's already pretty strong do its own thing.

Andrew Hill: Yeah I sort of view myself as a personal trainer for your brain. Some people come to me because they have deficits that need very specific training. Other folks come to me because they just want more of what they already have. Both cases the gym metaphor works I show up we work with you one and one we really meet your specific tailored needs. That sort of removes the idea, is this medical, is this recreational, is this a peak performance deficit. It's all the same it's all about your brain and drugs.

Dave Asprey: I've had an amazing time talking with you because you're a true brain scientist and there's actually one question I want to ask you and then we can get to our final question in the show. You mentioned in the beginning that you were taking Piracetam and Oxiracetam these smart drugs and I mention I take them too but Amazon quit selling the smart drugs. They're legal in the US. but every time companies try to get like attacked from regulatory authorities even though they're not illegal. What makes these racetam family of drugs that are so safe and effective. What makes them this weird red headed stepchild out there?

Andrew Hill: Yeah a lot of the issue in nootropics is around claims to some extent. I think that's really what the FTC and the FDA gets angry at is when you make claims. The reason they went after Red Bull for Red Bull give you wings. That was a claim the FDA is now angry at Red Bull about. It's a little bit ridiculous. Clearly Red Bull does not give you wings right.

People selling racetam based compounds over the past five or so years have actually run afoul of this. Many of the players and I would say there's not very many good companies in the nootropic space. There are small niche players fly by night. One guy in his basement or garage. They pop up, they vanish. There's no third party testing available. It's very unclear and a lot of

these small shops have aggressive claims and aggressive marketing and say their products are going to do X, Y and Z. I think that's really what's catching the attention of the FDA is the claims.

Dave Asprey: People have no idea that I have three quality control professionals and one person whose job is just to make sure that we're telling the truth and that all of the stuff like we have cryptographically signed scientific studies showing. The amount of work you go through just to be able to say this stuff works is ridiculous.

Andrew Hill: The stuff is safe. We spend a lot of money testing every single batch of synthetics that we have produced. Every single batch of tested by third party lab.

Dave Asprey: You just have to do it.

Andrew Hill: We have to do it because the one time we didn't do it some lead or arsenic gets in and that's it. The threshold for a consumer product is so high in terms of safety advocacy that I don't think the average fly by night guy stuffing powders in the capsule can handle that degree of overhead. I think that that combined with bad marketing language has really undermined the nootropic space a little bit plus we're talking about racetams and things like being thiamine and magnesium. Very safe things.

The nootropics sort of Wild West is also starting to embrace dangerous research chemicals with no efficacy research and no history research and very unclear ideas about what they do to the brain. There's the sort of pirated nootropics now people find a formula in a research paper and have it manufactured start selling it.

Dave Asprey: Yeah that's a little sketchy.

Andrew Hill: Very sketchy and very dangerous so I think that kind of behavior is why the FDA very concerned about things like racetams.

Dave Asprey: Now there's a final question in the show and then I've asked everyone and given all the stuff you know not just as a neuroscientist but just as a human being your top three recommendations for people who want to perform better at life.

Andrew Hill: Yeah let me frame this with an assertion and the assertion is that shift happens. Whether or not you want to shift happens. Your brain changes it does change. Its whole job is the pattern itself against the demands of your environment to minimize pain and maximize gain. Ultimately seeking to things like reproduce and not starve. Ultimately than the knowledge that your brain is going to shift should be empowering and that means that things you can do to shift it's faster become very important.

For a top three I would say that a daily meditation practice of even fifteen or twenty minutes in the morning is a huge massive life altering brain improving intervention. Other big things eliminate sugar from your diet and maximize good good fat so I think you and I are on the same page there. I think that you can get into the more technologically advanced things like nootropics neurofeedback and some of the more technical if you will interventions. Some things are very accessible.

Meditation is free. There's no reason not to do it except if you don't have the knowledge of how but it's not very difficult to do so. Meditation and of course things like sleep hacking and other interventions but shift does happen. How's it going to happen? Are you going to steer the direction of your change or is going to be momentum? That's really the emphasis I try to have people leave my clinic with is they have control. Let's figure out how to actually use that control in day to day life style.

Dave Asprey: Okay. Sounds like a great list. I really appreciate having you on Bulletproof radio and where can people find out more about what you're doing?

Andrew Hill: Great well thanks for having me Dave. I really appreciate it. If folks want to follow up with me on Twitter is really good Andrew Hill Ph D. is my Twitter handle. Folks can hunt me down at True Brain dot com TRU brain dot com or Alternative Brain Institute dot com. I'm always happy to hear about interesting and unusual brain hacks, what people are doing to themselves. I'd love to get a sense of who's out there doing what to their noggins so.

Dave Asprey: Awesome and you're based out in LA obviously so next time I'm down there for the Bulletproof coffee shop, I will look you up and see if we can meet over a cup of wonderful coffee.



Andrew Hill: I love too and you know what Dave True Brain just moved their office. They use to be underneath the Third Street Promenade and we're now in thirty one ten.

Dave Asprey: You're actually my neighbors.

Andrew Hill: We're upstairs from you. Actually in the same lot now.

Dave Asprey: That's awesome.

Andrew Hill: You can actually just walk upstairs and say hi and that we'll have some coffee. It'll be great.

Dave Asprey: Very cool. Have an awesome day. Thanks for being on Bulletproof Radio.

Andrew Hill: Alright Dave. I appreciate it. Take care, see you.

Dave Asprey: Bye.

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