Episode 252: How to Activate Peak Brain Performance with Neuroscientist Dr. Andrew Hill

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Katie: Hello and welcome to the welcome to the Wellness Mama podcast. I'm Katie from wellnessmama.com and in this episode we dive deep into all things brain health Because I'm here with Dr Andrew Hill who is one of the top Peak Performance coaches in the country. He holds a PhD in cognitive neuroscience from UCLA's Department of Psychology and continues to do research on attention and cognitive performance. He is also the founder of the Peak Brain Institute, host of the Head First Podcast with D. Hill. He lectures at UCLA, teaching courses in psychology, neuroscience and gerontology, and he scanned my brain and all of my family, which we're going to talk about today. And he shares how he is able to help things like attention, anxiety and sleep problems very quickly using this fascinating new technology. Dr. Hill, welcome and thanks for being here.

Dr. Hill: Yeah. Thanks for having me. So great to talk to you.

Katie: Oh, likewise. And like I mentioned in the intro, I got to spend some time with you when we were in LA, actually, with our entire family, and originally, we were just gonna have my husband's brain scanned because he's been having some things he wanted to work through, and then after seeing how cool it was, we decided I wanted to do it too. And then all of our kids who are old enough, we had all of their brains scanned as well. So, since we're gonna talk about that, let's start by talking about what does that mean, a brain scan.

Dr. Hill: Sure. So, a brain scan or we call them a brain map colloquially, the official term for them is qEEG, quantitative EEG, and as people may know, an EEG is simply brainwaves. And so, a quantitative EEG, we record all the locations on your head at once, a full head cap, we call it. And then to gather the data, we squirt the

cap full of gel and have you sit with eyes closed and opened for several minutes, and get some baseline recordings of your brain. And we take those baselines and compare them to a normative database of several thousand people, and essentially see how unusual you are compared to the average person your age. And brain mapping gives us a bunch of, you know, real date in terms of how different you are, but then making meaning of it is more of a hypothesis generator process. So, there's patterns in the brain map data that might suggest certain regulatory features of stress, sleep, mood, attention, injury, aging, etc. But we don't sort of say, "Ah, here's what's true for you." It's more like, "Oh, here's a pattern and this might mean issues with falling asleep, staying asleep, impulsivity, something." And then the client helps me understand which of the brain patterns we're finding for them are the most relevant to the bottlenecks they want to work on.

Katie: It's so fascinating, and it's one of those things I'm so glad I got to experience because it's...and it's something I would encourage anyone listening to experience if you ever can because it was fascinating. What are some of the specific things that you're measuring in the qEEG?

Dr. Hill: Yeah. So, the EEG is measuring essentially electricity being generated from your brain, and we label these patterns, these brainwaves with things like Delta, Alpha, Theta, Beta, those are different frequencies or speeds of brainwaves. And we might look at the amount of brainwaves you have relative to the average person your age or how fast they are. So, for instance, your Alpha waves are your sort of idling frequency or resting frequency in your brain, and if I look at your Alpha waves and they are running slower than they should for your age, let's say you're 45 or 50, and instead of running at 10Hz, which is standard, they run it like 9.5Hz or something, then I would go, "Oh, you have some internal processing speed that might be a little slower than average, and if this is true for you, if this is actually slower than you should be, then you're experiencing some afternoon word finding issues and short-term memory issues."

And so, I would hypothesize based on a slowed processing speed there's some functional limit, and ask the person if that's true. Or maybe we'll see high Theta brainwaves with the eyes open, which is impulsivity, or high Alpha brainwaves, the amount, the amplitude of the Alpha with eyes open, which is inattention, or maybe with your eyes closed parts of your brain aren't disengaging from the environment. We see lots of Beta waves in areas when we see anxiety markers, so the back of the brain is the visual system. If you close your eyes and it doesn't shut down, then your brain's sort of staying checked in just in case and kind of hyper-vigilant. Or maybe one of the switching systems of your brain, which decides what's important to pay attention to or if the environment is safe, those can be a little overactive. It might suggest that you get stuff stuck in your head, or you are a little bit fear-driven, or you may have some worry or some anxiety. Or maybe I'll see that your Delta waves, which are deep, resting waves you make a lot of when you're deeply asleep, maybe those are running really high when you're wide awake, which might suggest you aren't getting enough deep sleep or maybe you have a concussion or two historically. So, we go through a bunch of features. Often about 30 features I'm looking for, and I might find 4 or 5 or 10 for any individual, and then we kind of predict to the person what's going on and try to get a sense of where really the inflection points are, what you wanna go after to change your experience, change your resource, because anything we can find, we can actually make a change in your brain over time.

Katie: And you mentioned that it's not just a strict diagnostic black and white, like a number tool like a lab test would be, but from what I'm remembering, there actually are a couple of parts of it that are... There are some studies or some data backing them up, actually, in a diagnostic way. Am I remembering that correctly?

Dr. Hill: Yeah. You are. You know, we do two things when we do an assessment. One is a brain map, and one is an attention test, which measures your executive function, your ability to stay focused, to click on stimuli that are boring, to resist clicking on things automatically. And so, that's a very valid, we call it scientifically, test, measures your attention resources pretty immediately. The brain maps are often not quite so valid scientifically speaking, but they're incredibly stable year after year. So, we consider change in the map to be really interesting, even if we can't completely understand each part of it at the very beginning, as we work on your brain, it makes more and more sense. But you're right, there are a few discriminants, we call them, or markers in the EEG that are sort of statistically valid, meaning usually they mean what we think they mean.

The most valid one is the ADHD markers, the ratio of Theta to Beta brainwave. High Theta is a receptive attention state, but it also means the brakes are kind of off. So, if you have a lot of high Theta with your eyes open, then you're, "Squirrel," and I everything pulls your attention. But having a lot of Theta relative to Beta means you tend to sit in that mode of noticing everything being synthetic, getting bored when things aren't stimulating, IE, ADHD. So, when you have high Theta to Beta ratios, I think the statistic from several papers is around 94% accurate in blindly sorting thousands of cases into ADHD and non-ADHD categories by using one single measurement at the vertex of the head, looking at the, essentially, ratio of slow brainwaves to fast brainwaves. So, that's a very valid one.

And then there's others that are, you know, somewhat valid. So, the posterior midline, an area of the brain called the posterior cingulate, that's the part of the brain that watches the environment and kind of evaluates your behavior and makes sure there's not a safety mismatch, so the posterior cingulate gets really annoyed at you if you're driving a car and you start talking to somebody in the back seat and don't look at the road. There's a sense of, "Oh, watch the road." That's the posterior cingulate saying, "Oh, excuse me, what are you doing? This isn't safe." And so, that posterior cingulate is a normal resource that we all have it, but it can get a little tweaked, a little strained if you will, in cases where your brain has learned the world is threat, you know, threats are possible there's some danger out there. And if that's very extreme, either through trauma or through constant threat, then the brain can produce what people know as PTSD, that sort of identifying threat, intrusive thoughts.

And in PTSD, the posterior cingulate markers, the Beta we see in the EEG is quite high, and it's pretty reliable to sort of say, you know, "I think you're a little threat-sensitive, and you're probably having a hard time disengaging from worry." So, ADHD is pretty valid. The PTSD markers are somewhat valid. Sleep markers, I can tell that you have brain fog. I can't tell why necessarily. I can't tell if you have brain fog because you're not sleeping because of stress, or not sleeping because you're staying up all night playing Fortnite, or not sleeping because you had a concussion 10 years ago and it's eroding the quality of your sleep, but I can guess that, oh, look, you have some connectivity changes, some high Delta waves, and this would suggest there's some brain fog that can come from like an aging, anxieties, primary sleep issues, or concussions.

I wouldn't be able to dig in and tell you why your brain looks this way. But, again, the brain maps are really stable. So, your brain map today and in a year would look the same unless you did something pretty significant to your brain, like medication injuries, months of meditation, or neurofeedback. Biofeedback on the brain can make changes often very rapidly. Of course, that's what the utility of the brain mapping is, then what to do with it.

So, the exercise, if you will, or biofeedback on those patterns, to change them, is really where things get exciting. But we try cautiously to inform you about your brain data and then not believe it too much until it starts to make sense. So, again, it's a statistical analysis, how unusual your brain is from average and everyone is unusual. Being weird is normal. I mean, that's kind of the state of being human is being unusual. So, just because you aren't average, we're not saying, "Hey, why aren't you average? Let's make you average." The goal is to say, "Let's figure out the ways in which you're, you know, most unusual, and figure out if any of those ways often come with bottlenecks in performance." And, you know, executive function things like attention, again, are most reliable to see. And then stress markers are often pretty reliable. So, different types of anxiety essentially.

Katie: It's so fascinating. My kids would definitely love the idea that weird is normal. They actually tell each other they are normal as an insult when they're mad at each other, so they would love that.

Dr. Hill: That's great.

Katie: And so, I wanna get into the specifics of the biofeedback and the neurofeedback in a minute. But before we do, I know, like, originally I said my husband was coming in and he had some cognition stuff he wanted to work on, and when I decided to do it too, I was, like, I know I probably have maybe some attention issues because I get bored easily, but also my little bit of neuroticism has served me well in business and it, like, helps me have good recall and pay attention. So, is fixing my brain gonna make that go away, which was...? So, can you address that a little bit of, like, does fixing the brain get rid of that edge?

Dr. Hill: Sure. That's a great question. That's a great question. The short answer is you will not be robbed of anything you already do in your mind that is unique, and you love it, even if it gets in the way sometimes. Two examples are quite common in this space. One, I often see lots of ADHD in people's brains. And typically teen boys ask me this question, they say, "You know, I'm like the best guy ever at playing this video game, and I think that's my ADHD. I don't wanna lose that. So, you know, I'm concerned I'm gonna lose my ability to sort of hyper focus in an intense way that seems to be ADHD." And I tell them, you know, no worries because you'll be able to find that same focus whenever you want. You won't have to rely on the environment to cue that focus.

That's sort of an ADHD is in some ways is relying on the intense environment to tell you if you should be attentive or in an intense mode. So, the ADHD kid can turn on that hyper focus under high stimulus more than the average person. And they can't necessarily turn that on when things are boring, like, they can focus for, you know, 20 hours straight on a video game, but they can't focus for 20 minutes in a classroom because there's no stimulus. So, the answer for this kind of person is you will have that access to that resource, but it will no longer be stuck on. So, you can decide to focus in a boring classroom, and it shows up, or you can decide to disengage from things that feel extra compelling, like when your mom calls you to dinner, you can put down the video game and not feel like you're, you know, withdrawing from a drug.

So, that's one example common for teen boys, and then a lot of CEOs, and this is equivalent to what you said. A lot of people that are high powered, organized, particular individuals, when I look at their brain, I see a front midline. The anterior cingulate is a little overactive compared to the average person, you know, often a couple of standard deviations. And when this anterior cingulate is overactive, the anterior cingulate's job is to switch your attention, decide what's important to pay attention to. So, when it's very, very active and it gets in the way, it can produce obsessions, and compulsion, and ruminations, songs stuck in your head, OCD, that kind of stuff. But if I see it, I'm not gonna say, "Oh, hey, here's a problem for you." I'll say, "Oh, this anterior cingulate is a little overactive compared to average." Usually, that means people are stuck in their head, they, you know, chew on things, they are a little bit perseverative or obsessive.

But it also might be that you're like Steve Jobs, extra high focused, really particular, incredibly organized, you know. So, a lot of my high-level performers, the CEO types and the athletes, will have a little hint of the OCD marker, but it doesn't cause any trouble for them. They use it. And so, my job isn't to say, "Here's what's unusual and it's bad." It's to say, "Here's what's unusual, let's talk about what it could mean for you." So, about half people I find that marker for go, "Yeah. That gets in the way. I sit there and think about what I should have said to my friend all day long. I chew on things, get horrible jingles in my mind, or I'm actually OCD." And the other half say, "Yeah. I notice that I get stuck on things, but actually, I use it. I chew through problems, I strategize, I really like it. I don't wanna work on that resource. I'm gonna leave it alone." And you can. It's kind of, like, walking into a gym and saying, "I want abs," And they work you through the ab program. It might take, you know, different approaches depending on how you started off in physical health, but you can cosmetically almost design the body you want in the gym.

You can kind of do the same thing for your brain resource in terms of your default mode of being calm or focused or flexible, but you still have access to the uniqueness, so to speak, that you are. So, when you want to reach for that resource, it is still there. Just, like, you know, if I sent you to the gym for three months made you to curl, so at the end of that time you weren't walking around flexed, but when you reach for the heavy thing on the ground, your bicep comes online and you use the resource, and that's what happens with executive function. So, train that up, and you're the bored kid in the classroom, you say, "Oh, yeah, I should focus on this stuff." And it just shows up. It's an effortless way of using your resources. So, unlike medication, which imposes state sort of from the outside and you feel different while the medications are active, you can sort of feel it altering you, neurofeedback, the more you do it, the easier things get and the more you feel like yourself.

So, it's a very, you know, almost counterintuitive way of working on your brain because people are used to having stuff done to them instead of feeling more and more, like, you know, strong, and calm, and focused. This is akin to the experience you get when you first start working out at the gym about three or four weeks in. You get up one day, and you go for a walk, and you're like, "Wait a minute, I feel different. My body feels solid. I feel a little bit like I rested better." And things will creep in throughout all aspects of your life when you get fit physically for the first time, and that can happen with your brain. You start noticing that you're a better listener to your partner, your kid takes the trash out being asked once spontaneously like a couple of weeks in. And working on your brain affects everything. So, athletic performance, academic performance, social performance, if you will, intimate performance, it all shifts starting within a few weeks of working on your brain. And the fun thing is, you can go after specific goals we find in the brain maps, and then you get to see them change. And it's sort of a fine-tuning process, again, like a workout where the personal trainer will

structure a workout for you and add new things, and push you harder, and develop sort of compound workouts over time to give you, you know, more access to the goals you're reaching for.

So, it's pretty reliable to work on your brain. The hard part is figuring out what you wanna work on based on the brain maps or based on the clinical lore of what works, and then working through the process because it does take some time to make change. With the biofeedback, we often do about 40 sessions to begin, about three times a week, and we can usually get a couple of standard deviations of change in your brain maps and your executive function, your attention test performance. And that's like going from profoundly ADHD to minimally or having lots of anxiety to, you know, having anxiety that's normal if you will, typical, under your control, only showing up when it should, so to speak. But, again, it's more of a fitness process where I don't decide, you know, Peak Brain doesn't decide for you what you wanna work on. You get the agency to go, "Oh, hey, there's this thing in my brain. I think I wanna go after that." And then as you exercise that resource, you feel it change in your life. So, it feels like you become, again, more yourself and things get easier, which is kind of lovely.

Katie: Well, and just to go a little deeper on that for a second, for anybody who isn't into statistics as I am, so you've mentioned a couple of standard deviations in change, and that is really drastic. So, give us an idea out of, you know, how long would that take if we were just meditating, for instance, or trying some other method?

Dr. Hill: Oh, well, you can't do everything with meditation that you can do with the neurofeedback. Meditation works globally on the brain really nicely, and it works on several frontal features, front midline, the underside of the frontal lobe and the lateral frontal lobe. Those are areas involved with, like, anchoring your attention, being calm and relaxed in the face of stress, and then sort of a detached ego where you're kind of above it all. That's the ventromedial prefrontal cortex that develops over time with meditation, and that's the latest effect, the last effect that shows up in meditation with long term meditators. And that seems to show up in a few months to a couple of years, this sort of, you know, equanimity, the sort of being okay with how things are, not taking things too personally.

Executive function things in meditation seem to start showing up about five or six weeks in. Sue Smalley and Sandy Lux at some papers at UCLA a few years ago looking at meditation with kids or mindfulness with kids in ADHD, and I think it was around six weeks or so you could see measurable changes. But you're mostly gonna work on those frontal features and some broad things, maybe some better sleep and some stress response, but mostly it's executive function training. I really do think meditation broadly is attention training, executive function training, and, you know, people talk about it being something you get relaxation from, or spaciousness, or ease from meditation, and you do. But you get that from meditation as a consequence of meditation, not as the act of meditation. Kind of, like, you get strong from going to the gym. You don't be strong in the gym, you know, when you walk in there. So meditation is fine if you're not feeling especially relaxed or spacious while you're doing it. Continuing to do it every day will produce a mind that has space between your thoughts, is less reactive, you can anchor your attention more, more mental stamina, deeper sleep. And most of those are frontal features, executive function features.

So, again, let's say three months to a year for those kind of broad resources and executive function with the first stuff showing up about six weeks in. But really big change is showing up between one and about 20 years. There's some work by Lazar. She did some wonderful work with elders, looking at long term meditators, showing the amount you meditate lifelong is a dose-dependent effect on sparing you from typical age-related cortical thinning. So, not pathological aging, but normal aging. You'll lose some of the lateral parts of your frontal lobe, and that means you lose some body awareness, some appetite things, maybe some sense of balance. A few other sort of body and attention things get shifted with a lateral frontal lobe. But if you meditate, even, like, 20 minutes a day seems to sidestep that, and you are left, when you're older, with a brain that's fat and happy as opposed to old and lean. And this is a very robust effect, and it doesn't take a lot of meditation, it just takes a lot of practice. You have to do it, you know, for many, many years before these effects will be very robust.

And neurofeedback, in contrast, we reach in and change a brainwave or two or three for you. Now, we have to sometimes be very iterative. We don't know what will work for the goals you have perhaps. Now, the easy things are the things that meditation also works on, so almost everyone responds nearly perfectly to work on their stress response, executive function, attention, things like that. And that's sort of low hanging fruit for neurofeedback, it works, again, for almost everyone. It's the most reliable markers in the brain maps. We can target it to you very, very quickly. And, again, about three months is our first chunk of training typically for people, and we do three times a week, so 40 sessions in about three months. And if you're near the office we map your brain every 20 sessions of neurofeedback, so every seven weeks or so we map you, and if you're not near the office, we might map you every, you know, three to six months whenever you pop in. And we've done a few thousand people over the past few years, and it looks like we're getting about one standard deviation, somewhere around 20 to 25 sessions in. If you're a slightly fast responder, we see more than a standard deviation 20 sessions in, and if you're a slightly slow responder, we see just shy, maybe half a standard deviation, 20 sessions in. And by the time we hit 40 sessions, most people have hit two standard deviations.

And to give people a sense who, again, aren't statisticians what that means, I'm sure people are pretty familiar with the bell curve where most people are kind of average and unusual people are out in the edges of the curve. So, pretty concrete example, if you went to a classroom of kids, you'd have about two-thirds of them be average height, and about a third of them be really, really short, and about a third of them be really, really tall. And so, that two-thirds, that is around the average, it's about one-third above and below the averages, typical variability. That's a standard deviation above and below the mean. So most people, typical variability, being average, being normal is roughly one standard deviation above or below the average. So, you might not be perfect with your executive function, your sleep, your stress, your mood, but if you're roughly within a third of the average, then, you know, you're pretty much typical.

When things exceed that, when you're more than about one and a half standard deviations away from the mean, that's when I start paying attention to the markers, if you will, in the maps, the brain map data and also the attention test data. So, on the attention test data, the average score for about 15 different attention resources is 100. That's the middle of the bell curve, and a standard deviation is around 12 points or so. So, somewhere around 15 points, I'm saying, "Oh, you know, this is a problem for you." So, if your vigilance or noticing new things in the environment is only an 85% compared to your average, that means you're missing some things, and you're not as vigilant as you could be, but 85% of average is right where things start getting in your way. Not great performance, but maybe not a bottleneck, you know. But if your vigilance is at, like,

80% or 75% or 70%, now you're a couple of standard deviations below average at 70%. Now, you're definitely inattentive. You're missing things, and people might call you ADD.

And if I see the problems with vigilance on your attention test, and look at your brain map and look at your eyes open data and your brain is making a lot of Alpha waves, it can't kick into gear, it's staying in neutral with its eyes open, then there's two bits of data. The poor vigilance scores and the high Alpha eyes open would tell me, "Hey, you know, this often shows up when people are inattentive, little ADD. Is that true for you? Oh, it is. Okay, now we know what to go after." And maybe your Alpha is a couple of standard deviations excessive as well. Those become the sort of statistical checks we'll look at, the data points and then hopefully we would assume in about seven weeks that your 15 points are better on the attention tests, and your color shade, you know, standard deviation improved on the eyes open Alpha. And we can almost always go after specific things in the data and change them. The trick, of course, is knowing what things in the data map to your performance goals or bottlenecks or resources you wanna work on.

But yeah, we can typically take ADHD that's profound, like a really hard to manage kid or adult with ADHD or anxiety or sleep issues. Those are pretty classic low hanging fruit, sort of basic regulatory things. One of those big, you know, sleep, stress, attention things comes in, and if it's severe, a couple of standard deviations off of the mean, it's really getting in your way, we can almost always eliminate it in about four months. So, about 50 sessions, we can eliminate ADHD for most people permanently, and take anxiety... And we don't eliminate anxiety because it's a healthy thing, you know, being chased by a tiger, be anxious, run away, it's exactly the right thing to do. You are in tiger country? Keep your feelers up. That's the right thing to do. But human brains are so creative and powerful. We can imagine tigers, on, like, the highway, and, you know, get sort of over keyed up. That posterior cingulate that I mentioned earlier gets a little bit extra active when it learns the world is dangerous, so it tends to stay that way.

But if we find, let's say, some, you know, you're threat sensitive, you're a little bit fear-driven, you worry, and the posterior cingulate is a couple of standard deviations higher than the average activity, then I would assume that's probably why. And then we would drain it down and say, "What do you notice?" A couple of days later. And if you're like, "Yeah, I feel less worried and I feel like I can handle stressful situations better," then we would believe that we might be onto something. But we don't really believe that we understand your brain until we get the really good results we're looking for. And so, seven weeks in, map your brain again. Hopefully, your executive function resources have improved, your brain maps have improved, and you've been reporting all along what you've been noticing, and almost always the three things, the subjective reports, the brain maps and the attention test all sort of cohere. They converge about a month, month and a half in, we're starting to see the same changes and all those types of data points.

And so, we reevaluate what's changed, what hasn't at that seven-week part, come up with a few new goals for you maybe, like, let's work on this too if you want, or refine some approaches we have. Okay, we got half as far as you want to on this goal, but let's really, you know, lean in this more or something. And, again, the client picks this, we don't tell you what to work on. It's not a doctor's office, it's a gym. So, I'm your coach, not your doctor in spite of having a Ph.D. And just like a coach works to execute and implement strategies for the athletes' goals, that's what we do for you. So, it's your goals for attention, stress, sleep, mood, peak performance, creativity, immune function, whatever it is. It's not my goal. And so, while we may work on symptoms, you know, we might not, and it might be about peak performance things, but it's whatever you

want to work on. Again, like a personal trainer might do a fitness assessment and say, "Oh, your left side is weaker than your right side, and you could use some core strength," and you hear that and go, "Oh, abs? Yeah. I want abs." Well, okay, if you want laser-like focus from Peak Brain, or deep creativity, or boost your T-cells, or work on your migraines, or make you, you know, laser-like focused when you have to do a long day, those are all achievable things. I just don't know which of those things would be most useful to you and which ones you might wanna work on.

But yeah, a couple of months of training for specific resources and you see about a standard deviation of change in those resources in objective tests. You can't fake your way through an attention test or a brain map. There's no placebo response in a brain map. It's exactly the same year after year after year unless you do something very significant to your brain. So, when we get changes in, you know, six or seven weeks, we see a standard deviation or more of change, we usually, you know, believe that it's a real change. And once we've hit three or four months and get a couple of standard deviations and your attention resources are typical or above average... I mean, usually with ADHD, most people who come on ADHD will perform on the attention test between two and three standard deviations below average when I first meet them. And most of them when we're done are performing a standard deviation above average about four months later. So, I can often get you from sort of impairments that are really getting in the way to benefits in the exact same resources that are now giving you a competitive advantage or making you able to lean into all the other quirky, wonderful things in your mind. I mean, ADHD, anxiety, those things tend to come along with other things like being gifted or intelligent or extra sensitive, and those are wonderful things. I mean, ADHD people can pattern match like nobody's business. They notice everything, and that's great if you're, you know, in a war zone, or a video game, or you're being an artist, or you're in a forest trying to hunt for the berry, not so good in a boring classroom.

So, if we can get the kid's resources, or the adult, under their control and get that problem out of the way, then people just start thriving. And we will, again, leave all the unique things in place as you asked earlier. So, it's really just deciding which resources are most important for you to ease the bottlenecks in or to build the access to. And then we can usually achieve that in a very short amount of time. Again, you feel it within about two weeks. You know, three to five sessions in, people start feeling neurofeedback, and then usually about seven weeks in, in the office anyways, when we're mapping again it's really, really noticeable subjectively, once you've hit a standard deviation of change or more. I mean, that's basically, like, some ADHD medications don't produce two standard deviations of change while the med is active, and we can almost always produce that or more permanently over a few months. So, big effects.

Katie: Yeah. That's so drastic. I mean, just to reiterate that it's truly amazing that you're taking something, like you said, brain maps, other than extreme things or, like, I'm not sure if you had a concussion or aging or things...other than that, they're not changing over time. It's one thing that's actually pretty stable, and you're able to make a drastic and permanent change, which is really, really amazing. And you have alluded to it with talking about neurofeedback, but walk us through the process now, like, how are we actually creating this change?

Dr. Hill: Yeah. So, neurofeedback is biofeedback on the brain. I mean, all neurofeedback is biofeedback essentially, but not all biofeedback is neurofeedback. So, you can do peripheral-based biofeedback like heart rate variability, or galvanic skin response, or hand warming. And those are, you know, well understood,

biofeedback, where you're training your awareness, if you will, your control of the peripheral nervous system. And peripheral biofeedback takes a lot of repetition. You have to practice feeling it. It's voluntary. And eventually you might develop, it's called skill transfer, where you get access to that state. A lot of what people are doing these days for biofeedback is around HRV, Heart Rate Variability, which is training the reactivity of the vagus nerve which runs from the brain to the heart to the gut and back. So, when your gut clenches from nervousness, your mind starts racing, when you run across town because you're stressed, and then you get to the meeting and you're carrying that stress in the meeting, that's the transfer of excitation between your gut, your heart, and your brain. And that system should be able to ramp up and ramp down really flexibly. If it can't, it stays rigid. That's one of the things that happens in stress and anxiety. So, you can measure that beat to beat variability and train it and learn to sort of drop into that state voluntarily. But it does take some practice, and you have to keep doing it and never becomes permanent in peripheral biofeedback.

Now, central nervous system biofeedback or neurofeedback is training everything inside of the spinal column and skull. So, it's the central nervous system, stuff inside of bone. And mostly we train EEG, although we also train blood flow. We call that HEG, hemoencephalography, which works amazingly well for migraines and for Asperger's, social function, and for freezing up when you're anxious because those things are all driven by a drop in blood flow sometimes.

So, HEG or EEG training will measure what your brain is doing moment to moment. So mostly with EEG, so I'll give you some concrete examples here, I mentioned earlier that distractability is a high Theta state and it's actually a high Theta to Beta ratio. So if we measure your Theta brainwaves moment to moment, and also measure your calm focus Beta, so your poised, alert but not super busy brainwaves, which are a low Beta called SMR, 12 to 15Hz... So, if I measure this Theta and this SMR moment to moment, it'll change. Your brain is changing. It's dynamic, it's chaotic, everything's changing moment to moment. So, I want your Theta to go down, I want your Beta to go up, so I'll just measure them. And whenever they happen to, on their own, trend in the right direction for half a second, I'll applaud your brain and say, "Good job, brain," with audio and visual feedback.

So, operationally that looks like is you come in, sit down, you put three or five wires on your head, we start with three usually, which means two ear clips and one little wire briefly pasted to your head. It doesn't hurt and nothing goes into your brain. We don't zap your brain with electricity. There are forms of neurofeedback that are stimulation, that are microstimulation, that are zapping technologies. We find we get great results with only doing passive tech, meaning your brain is taught to exercise. We don't force it. So, we put two ear clips on and one wire on top of the part of the brain we might wanna exercise, and we'll measure the brainwaves moment to moment, so Theta and Beta. And whenever those trend briefly, you might see, like, a space ship fly faster, or music swell in volume or your Pac-Man eats more dots, or perhaps you're doing it, you know, with an effortful task. So, perhaps you have to do your taxes or write the next business plan, and you're sitting working on something and we play music in the background, and whenever your brain trends towards more focus and less distractability for half a second, we swell the volume of the music or make the game run better essentially. And then the brain likes input, so if we only provide input for some of the things it's doing, it starts to notice that within a few minutes and go, "Hey, wait a minute. Whenever I drop my Theta, stuff happens. I like stuff. So, I'm gonna drop Theta and see what happens. Oh, hey, it happened again." And within about 10 minutes, the brain is responding, it's yoking itself, binding itself to the stimuli that's coming back, and it starts to react to whenever the screen turns off or on the stimuli essentially. And it's trying to figure out how to control it.

Now, the brain is doing this, not the mind. You don't have any conscious experience of control. And after a few seconds, we move the goalposts. So, we ask the brain to make a shift in its brainwave, Theta goes down, and then we move the goalpost and make it have to drop Theta even further to make the spaceship fly. And so, we're always sort of adaptively adjusting these things we call thresholds or comparators to tell your brain which direction to move in, and you train for half an hour, and whenever your brain, on its own, happens to shift in that direction, something happen to the screen. And then over the next 24 hours your brain goes, "You know, whenever I got more Theta or when I dropped my Theta, stuff happened in the world." So, it starts to exercise itself in that direction. It's a very subtle effect. But you get about 24 hours of very gentle movement in the direction you exercise the brain. And as the client, your job is not to do the voluntary thing in the chair because you can't control your brainwaves really voluntarily, it's to spot what happens later. So, you walk out of the office or you, you know, close up your training machine at home and then that afternoon you might notice something, little subtle shift in your focus or calmness, or maybe your sleep is different that night. Your onset is easy, you sleep is super deep, or maybe, you know, you notice a couple of days later you're having an intense conversation with your spouse and you find yourself able to stay with it and be a better listener because you're calmer and less reactive.

So, things start creeping in over time, but the process of training is sitting yourself down in a chair, sticking three to five wires to your head and literally watching things change on a screen off and on. And, again, it's involuntary. This process was discovered 52 years ago, 1967 at UCLA, and it was discovered on cats. And the joke I tell now is that cats are exceptionally bad instruction followers. This is not a voluntary process. Not a placebo response. There is no way to get a placebo, you know, for nonverbal animals, right? So, the experiment that Sterman did in the '60s, NASA came to Sterman and said, "Look, our astronauts are getting sick breathing in rocket fuel vapors, can you please test how dangerous it is?" And Sterman did a dose-dependent study looking at increased time exposed to methylhydrazine vapors, rocket fuel vapors, and he was using cats as his test subject and found that increased minutes' exposure meant increased symptoms, you know, stumbling, drooling, crying, seizures, coma, and death. So, it was pretty brutal, but it was the '60s. They were doing lots more aggressive animal research back then.

And what was interesting is of the 34 cats or so he was using, about 8 of them refused to have seizures, and instead of needing 40 to 60 minutes to show instability, sort of pre-seizure events, they needed 160 minutes to show the same events. And he couldn't figure out why most of the cats, their brains behaved one way under toxic exposure and the other cats behaved a different way essentially, didn't have seizures. Until he remembered he had used these other cats in another experiment, six months prior, where whenever their brainwaves, this SMR brainwave I mentioned earlier, whenever it surged, he squirted chicken broth into their mouth with a milk dropper and did this for, like, a half an hour or two hours. And then months later these cats had seizure-resistant brains. So, Dr. Sterman's lab assistant was also epileptic and was kind of medication uncontrolled, taking meds, lots of heavy duty neuroleptics but not getting suppression of seizures, having, you know, tens of seizures every month. And so they worked on her brain and they found a way to, you know, give her audio-visual reward whenever the SMR changed. And they trained her off and on for a couple of years, and she came off all of her meds and was seizure free for a year. And that was pretty exciting. So, Sterman started to talk about this in regards to epilepsy and seizures. And then, of course, we found that similar frequencies, this SMR pattern is actually rather magical for things like sleep and for ADHD. So, that was really the start of the field in the late '60s.

But, again, an involuntary process, whether or not you want your brain to change, it does. So, your job isn't so much to try in the session, it's to, you know, be the intelligent, you know, creative, driven person before you start and say, "Yes, I wanna work on that, and this, and this, and that," and then later to say what you actually noticed. Because, you know, I won't set your goals for you, I'll also not tell you what you should be experiencing. We wanna know what happens in your sleep, stress, mood, attention. And, again, after three to five sessions, this stuff starts to shift. So, you know, the cats prove it wasn't a placebo, but I've also done a lot of this work on nonverbal children, people with severe impairments, people in coma, also plenty of teenage boys who just don't wanna be here and sit on their phone the whole time. But after about two weeks, their ADHD starts to drop anyways, you know, so it's an involuntary process. Your brain gets moved. Your job is to say, "Oh, let's work on this." And then, "Oh, I think I noticed that. Let's lean into that more, back off from that, try harder, etc." So...

Katie: Yeah. And I will say it was actually, like, for me in the very beginning, it was frustrating because it was, like, wait, I can't actually consciously do better at this, like, I want to be able to win this game. And instead, you're...to put it in perspective, you're hooked up to these monitor or these wires on your head and you literally just, you told us, "Fly the spaceship." And, I'm like, but how? Are there directions? How do I make it go better? And kids love it because to them they're like, "I'm using the Force to fly a spaceship."

Dr. Hill: Yeah. Exactly. Yeah. But for you, you have to let it happen, not make it happen, basically. So, we're just, you know, measuring what your brain is already doing. Your brain is gonna change all by itself. So, it doesn't have to... There's no effort involved, which is nice too.

Katie: Yeah. That's a good life lesson too, let it happen versus make it happen. That's a good lesson to me.

Dr. Hill: Sometimes, some things. Yeah.

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Katie: What about.. Because I get quite a few questions about concussions, which I know there's been more in the news about that recently and I know parents who have children going through that, and I know when we spoke before you explained that you can see sometimes the image from concussion that happens over time. Could it be addressed though?

Dr. Hill: Yes. Yeah. It can be, yes. So, concussions...there's a couple of different things that show up in the brain, in the EEG anyways, with concussion. Impacts to the head or concussive force can often produce a few different types of damage. One of them is crush damage, where part of the brain is pushed on, and you often see a little blob of Delta waves later on. And often like 5 or 10 years later, there's a little hot spot of Delta when you open your eyes. And Delta is a brainwave you make a lot of when you're deeply asleep and not dreaming. So, if it's there in a high amount when your eyes are open, it's kind of a problem, like some scar tissue, some inflammation, some reduced circulation in an area. So, that might show up, or maybe you received some sheer damage, some twisting fall or something and pulled one part of the brain away from another part. This tends to break the wiring a little bit, and most of the long-distance wiring is what we call inhibitory. So, if you reduce the braking on a certain region, it runs fast, and so you see little hot spots and very fast frequencies if you have sheer damage. And concussions won't show up in the EEG immediately unless you have a lot of damage because a lot of the consequence takes days and weeks and even months to show up and the inflammation shows up over time. The changes in connectivity show up over time.

So, if you're one of our existing clients and you get a concussion or think you had a concussion, we want to see you immediately, not to spot the concussion, because it probably won't show up, but to get another baseline and then a month later, and then a month later. And somewhere between two and six months, the concussion will fully bloom in the EEG in my experience, and that'll show up with the, you know, increased Delta waves, fog, slowed Alpha speed, like I mentioned earlier. And all of these things are addressable. Now, again, I don't know why you may have these problems. I might do a statistical analysis, your brain against the concussion population, and go, "Yeah. Okay. It's statistically plausible that this wear and tear are the concussion-type and maybe you know there's some history, maybe you don't, but regardless we can go after those resources." So, yeah, we can fix it is a short answer. It takes a little longer to make permanent the changes that are tissue driven versus tuning the tissue. So in an injury, like a brain injury, a concussion, or a different type of brain, an unusual brain like autism, cerebral palsy, other developmental issues, those are tissue and bigger differences in the brain than average. And it takes longer to make that change stay gone.

So, usually, I tell people with concussion things that it's sort of a minimum of four to six months to make a permanent change where ADHD or anxiety or sleep issues, I say three to four months typically. But people are, you know, variable. So, I have some concussion clients that get great results and permanent results in three to four months. And I've concussion clients that will come back every so often and do six months to a year of training. But it's hard to tell how long it takes to make a change because many of my clients will switch from sort of a fixed perspective on their brain to a fitness somewhere in the process. And the ADHD or the concussion or the anxiety has been gone for a while, but we're still cranking on creativity, deep sleep, alertness, vigilance. And so, it's hard to sort of, you know, for me anyways, to gauge when we flipped from fixing problems to working on the resources. I don't really have a distinction there.

So, yes. Concussions can be fixed, aging, you know, slowing down processing speed with aging. I work a lot with people who have toxic exposure with brain fog, which isn't concussive but produces a lot of the same kind of symptoms. Things like mold and Lyme exposure will produce really similar kind of symptoms, brain fog, irritability, lack of deep sleep, fog and fatigue, short attention spans, short fuse. All of these things show up when your brain has some broad insults, and that can be a concussive or post-concussive as well as Lyme and mold and other sort of toxins like that. So, a lot of the time I'm working on things that I don't know why they're there. I mean, I joke that you go to a doctor to tell you what they do know and what is true, and you go to a scientist to tell you what they don't know and what might be true. And I do a lot of asking questions. I don't do a lot of giving you answers actually. But the questions I ask help you understand your own brain. And so, hopefully, over time, you become the expert and you're telling me what is true about your resource changes, and then I help you validate those changes by looking at data, objective data, attention testing, brain mapping. But really you're the person who understands what's happening, and you're the person picking what direction to go after. I'm just, again, the coach helping you architect that change, and I don't really care if your changes are, "Hey, help me fix my ADHD. Help me fix my brain fog from concussion." Or, "Help me be the most creative and vigilant person that I can be."

Those are really kind of the same statement from my perspective. Just the operational piece of it, you know, what to go after is different. I mean, I treat a high-powered, nine-figure CEO the same way I treat a little kid who's, you know, hand flapping and high pitch wailing and has no language, and is, you know, profoundly autistic. The interventions, the things we're doing to the brain are different for each person, and the criteria for success might be different. I mean, the autistic kid, some eye contact, some drop of, you know, the sensory integration issues, maybe some language coming back, maybe dropping some seizures if he has them. Those are great goals and very achievable. But for the high-powered CEO, it's deepening that sleep, making it so when he gets home, or she gets home at night, they're not burnt out and snapping at their spouse.

You know, handling the things that a CEO or an entrepreneur has to handle all day long, the high stress, high dynamic environment, switching your attention. And, again, those are valid goals, but they're, of course, different than what the autistic person might want. But they're fine. My job is not to say, you know, "Here's what you should do to your brain," or, "Here's what's wrong with you." It's like, "Great. Here's what your brain looks like. What do you wanna do? What do you wanna work on?"

And both those people, the ADHD person and the high-powered CEO, would both have permanent change somewhere between three to six months. And so, you might not get everything you want done in six months, so do some more training and go after more change. So, again, like, the first time you walk into the gym, you might be a little overweight and not flexible and easily winded walking upstairs, and after doing three or four months of working out and now you're incredible shape, maybe your goals change, maybe your goals for your fitness level up and you have different goals after that. Many of my clients come at the process with another level of goals after they fixed their ADHD, their seizures, their anxiety. Now they wanna work on something else. Now, I should clarify something. I've been talking about this as if it's a metaphor similar to the body gym, and it is in some ways. It takes time, it's gradual. But unlike the body gym, the working out is effortless. You don't do anything. And unlike the body gym, once you build enough of the resource, the change is permanent because your brain takes over and has that resource on tap whenever you use it, especially for the things that you use every day. I mean, every day you're attending, being flexible with your stress response, falling asleep, waking up, switching gears.

So, those core human resources if you will, those things, once trained up enough, become permanent because you're practicing them every day. It's kind of, you know, to go back to the body metaphor... If you went to a physical therapist for a knee that wasn't quite right, some strained muscles, some poor gait, and they worked with you for a few months and corrected your gait, got the knee nice and strong, well, now you're walking around every day practicing good knee health and strength and flexibility, and that maintains because you're using it the right way. And that's what happens with their brain, your executive function, your stress, your sleep, your mood, your lack of seizures. You're practicing those things every day with your brain activity, and as long as you keep practicing them, they keep robust and strong. Now, if you stop sleeping, start doing lots of crazy drugs, and sugar, and, you know, take on nine jobs, and stress yourself out, and throw your head through a window, you know, things may come back, you might undo the change. Like I eliminated my ADHD, which is among the most profound you could ever have. I mean, seven standard deviations on attention tests and five standard deviations on brain maps for me when I started. And I did about 18 sessions working as a technician for somebody else in an autism center after hours, and in 18 sessions I eliminated all of my ADHD completely on attention tests. It was still there in my brain maps a little bit, but I could perform perfectly well for impulsivity on attention tests. And then I went back to a grad school and got a Ph.D. studying neurofeedback, and got a neuroscience Ph.D. because I love this stuff.

But about five years into my Ph.D. I was done with the classwork. I was teaching full time, I was working full time, I was doing my dissertation. I was under a little bit of stress, and I wasn't sleeping, eating, doing other, you know, aspects of self-care for my brain all that well. And I started to get anxious and ADHD and it kind of crept back in. Maybe it was about eight or nine years after I had eliminated it, came back because my sort of brain, you know, these were the places in which the weak spots broke through again because I hadn't done quite enough of the shoring up. I only did, like, 18 sessions back then, and I was dealing with lots of things in my life my brain was trying to pattern to and it patterned back into ADHD.

Well, I, at the time, wasn't doing a lot of neurofeedback on myself. I was doing it in the lab. So, I got some stimulants and tried some things and I had no success in any of the non-neurofeedback ways. So I went back and just did more training and that, you know, had a really good effect, again. And that really made me sort of decide to switch gears from the academic tenure track research academic kind of world, and go into the sort of business world and open up neurofeedback centers. Because I went to grad school mostly to figure how this stuff works because I really feel we're sort of in a blind man and elephant situation. We all understand a piece of the picture but no one understands the overall truth, what's going on, and we actually have some conflicting ideas because of our limited perspective. And so that's why I went back to grad school, but in grad school and getting some additional benefit and working with a few people individually, and also seeing what it did in the brain at a really nuanced level in the research lab, made me decide that the mission post-grad school had to be giving people access to this technology.

And this is why Peak Brain is not a doctor's office. You know, we have multiple centers in the world. We're opening more, and the goal is to give you access to neurofeedback like you have access to physical fitness, and it's your decision, your agency about how to engage with it, not doing it when stuff is wrong or when something is broken or when it's a symptom, you know, not receiving it, not having it done to you, the way that a psychologist or a doctor might do stuff to you or do stuff or tell you what's important. We don't wanna do that. And so, for me, it's been a really massive enabler in my personal life. And I, of course, saw amazing things happen in autism centers, and, you know, seizures go away routinely and profound issues in OCD and

PTSD go away routinely. And so I knew it was, you know, worth something, and then deciding what to do as a grad student, finish up my Ph.D. I got called into, you know, doing this sort of business piece, and that's why we're doing it as a series of brain gyms essentially.

Katie: Yeah. And that's such a good analogy because, to go back to the gym and the abs piece, it'd be like almost if you got amazing abs but then you just got to keep them forever without having to do as much work.

Dr. Hill: Yeah. Yeah. Exactly. Exactly. So, it's really nice that you can dial in things and then have them stay stable. And also Peak Brain has this policy, we map your brain and measure your attention and charge you one time for assessments. So, we reassess our clients without charge. As long as we have a company, you're welcome to stop into a center and get a map done. So, brain maps, again, don't change all that often. So, if you aren't doing something aggressive to your brain, then every six months or so should show roughly the same kind of brain activity. But if you are doing lots of things, nootropics, neurofeedback, meditation, exercise, physical therapy, psychological therapy, and you do several months of those things, we'd love to have you pop back in, look at your brain and then I'll go over it with you. And after you do a few of those assessments, you become the expert in what your brain is. And then over years, this is why it becomes valuable. You know, you get a little older, you feel like you're slowing down, you can check, “Am I having an off week or is my Alpha speed actually slowed? Am I aging too fast or am I just not sleeping?” You can answer these questions for yourself over time.

And, again, my job isn't to say, "Here's what's true for you." It's to teach you to become your own sort of scientist. And so we help you learn to read your data. I think a couple of days we're gonna have you go over all your and your kids' data and then I'll teach you to read the reports, to read the raw data and the bitmaps and the statistical analyses. And it'll be interesting, hopefully, to you and we'll record it so you can review it, but that in several months you can do it again, and then you'll start really understanding your brain. When you feel the changes, you know what they feel like subjectively, and then you go back to the data and see how it affects your attention scores and specific brain features you were interested in that may have been related to performance bottlenecks, when it starts to change and you see it in the data, it becomes incredibly empowering.

I mean, sometimes it's empowering the first time you look at your brain. I have clients who've, you know, burst into tears when I look at their brain and I see, like, you know, the evidence of damage they received from abuse and it's real, and they see it and, "Oh, my gosh, it's not just me being lazy. I have some real damage." Or I see their ADHD, and they're like, "Oh my God, yes, it's a real thing." Or I see their, you know, their trauma, the PTSD. Sometimes it's very freeing to go, "Oh, it's my brain. I'm not weak. It's not a problem. I'm not bad for being anxious." I mean, you know, if we have physical injuries, no one blames you for having a broken leg. But the silent sort of limits of our performance, you know, anxiety, ADHD, more significant psychiatric things, do you have stigma. And from the outside, people, you know, blame us for being anxious or distractible or, you know, not sitting still. From the inside we also blame ourselves, and a lifetime of managing your less than tractable attention, stress response, sleep, trauma response, whatever they are, can produce a lot of feelings of disempowerment, but also guilt, shame for being this way, and looking at your brain and going, "Oh, it's my brain. Oh, look at that. My brain is impulsive, and it's real, and now I'm doing something about it." It's incredibly empowering first just to see. And then when you make the change and see all the scores change, and it helps you trust what you're feeling, things actually are different.

So, it's a lovely thing to be able to give people is control over their own brain resources instead of saying, "Here's what's wrong." I've worked in every aspect of mental health you can imagine, inpatient, outpatient crisis, long term residential, profoundly impaired people with no language, highly performing gifted people, and everything in between. And in all those environments, there's not a lot of agency. It's being done to people, especially when it's more severe, you know, more acute psychiatric stuff. And that's always rubbed me the wrong way. I want people to have control and to get access and get agency and showing you your brain and showing you your attention scores gives you a hint, gives you a lens through which you can start to understand yourself. And then you can remap your brain. You want to come in and see what your brain looks like on versus off caffeine? That might be really informative. Or on and off your supplement stack or maybe off and on your, like, three nights of sleep deprivation? You can do those things with us. You can be your own sort of experimenter. I'll be on E! Television doing a brain map on a psychic. We wanted to see what his brain did while he was doing his psychic thing. So, you can do that kind of stuff. If you have quirky brains, Peak Brain is your sort of private science lab to go in and try things. So, yes, we can help you perform well. That's really nice. But I find it almost as useful just to help you understand yourself. So, you know, as you can tell, I'm sort of on a soapbox here, but this is why we do this stuff is to give you this access, this agency.

Katie: No, I love it. And that's why we ended up doing it with all of our kids, even though that wasn't our original plan. And I'm curious also we talked a little bit when in office about the intelligence side, and I can obviously see how, you know, better attention would help with test scores for instance. But I asked you about IQ specifically, and you explained how IQ is an imperfect test to begin with, but that yes, this can help. So, can you walk us through that?

Dr. Hill: Sure. So, yeah, as a cognitive neuroscientist, and I'm also a gerontologist, which is the study of aging, and intelligence is an age-based analysis. Historically, it was developed in California as a difference between, I think it was at Stanford initially, a difference between chronological and developmental age. And it's never been perfect because of that. And it's revised every few years because of cultural biases essentially. And now, I mean, IQ is defined as what IQ tests measure. It's a very circular definition. And so when I'm teaching about IQ or about changes across the life course to my students, I usually point out that there's a couple of resources you can measure that are in the brain, physiological things, that are highly correlated with IQ as well as things like life success, and they're probably more valid than IQ is itself. So, those include two big resources. One is working memory or how many things you can hold in your mind. And one is speed of processing, which from an EEG perspective is indexed by how fast your Alpha waves are at rest. So, if I measure your Alpha waves and I find that they are very slow, I would expect you are aging fast or not sleeping great, so your internal processing speed is slowing down. But on the other end, if your Alpha's very, very fast, that usually means you're highly intelligent and a little bit anxious. Essentially, if you have all these extra resources with which to catastrophize sometimes, your thoughts are having you because they move so fast. You're kind of falling downhill in your mind catching the thoughts, you know, by moving faster.

So, I don't know why it happens completely. There has been several studies looking at intelligence, a few that are very good, and it looks like you get about a standard deviation of intelligence improvement, about 15 points. So, again, like my attention test, the mean of most intelligence tests is 100, the average, and 15 points is a standard deviation. So about a third of the population is 85 to 115, essentially. And unusually not intelligent people are below that, below 85, and unusually intelligent people are above 115. Once you're at two standard deviations, performance differences are unusual. So, below 70 is impaired for intelligence, and

above 130 is quite intelligent. I'm not sure where the genius level is. Some people say 130, some say 150. Once you're another standard deviation, 150, 160, intelligence is so weird that it usually comes along with impairments. Like, you're ridiculously intelligent but also socially awkward or something, once you're, like, 150, 160. And above 160 people are...it fractures, people do not like each other. It's very, very unusual and almost always comes along with a deficit.

Same thing below 70, lot of deficit. So, the individual IQ number isn't all that useful to me. I don't care about it. I care about your speed of processing, working memory, things like that because those are valid. I can measure them in the brain. But across different techniques and neurofeedback, it looks like you get some intelligence improvement on those intelligence tests. So, I know my clients' Alpha speed improves. I know they feel sharper. I know they have better self-control. I know they perform better on the GRE, SAT, MCAT, financial licensing exam, whatever it is they're studying for, they get better. So, that would improve intelligence scores, but I'm not sure it changed the quality of the person in any significant way. It just gave them better control over their resources. And in things like ADHD, I don't think there's so much a lack of the amount of resources. People with ADHD can hyper focus better than average under highly stimulating environments. If you have profound ADHD, you're the guy I want next to me in a war zone, in a jungle, on a sports field, being creative, absolutely you'll perform way better than average. But, of course, in the absence of those highly stimulating environments, you know, you won't. So, that's sort of the overall perspective is that you can take control of these resources.

Sorry, a little sidetracked there. You could bring me back and I'll clarify more.

Katie: Yeah. I think that was a great explanation and really dramatic too because I think people are probably understanding now just how amazing a standard deviation of change is. But when you're talking about that degree of change, like, even just for me or some of my kids, that's truly, actually, a jump between, like, a slightly high IQ to actual genius level, which is amazing.

Dr. Hill: Or taking the genius person and getting their problems out of the way. I mean, I often joke to ADHD people, they're kind of, like, the engine of a Porsche with the brakes and shocks and steering of an old VW bug. So you're always overcompensating, overreacting, can't quite control this amazing amount of power. But neurofeedback gives you better shocks, better steering, better braking, and now you can use that highly, you know, powerful engine to get where you're going instead of to disrupt the classroom or to doodle in the boardroom. You can use it to, like, power through cognitive tasks and to hyper focus even when, you know, you might not be able to from a sort of natural, if you will, ADHD perspective.

Katie: Yeah. I'm really curious to see specifically for one of my children who has, on tested, extremely high IQ, like solved a Rubik's cube at age four unassisted and is bored by normal life. So, I'm really curious to see with that. We'll come out, we'll have to do a round two.

Dr. Hill: Probably really fast processing for that kiddo. You know, really fast Alpha. That's my guess.

Katie: So, I think we'll absolutely have to do at least one if not several more rounds because there's so much more to learn on this topic. But I want to end on a really practical note, and I'm guessing there's a lot of people listening going, "Wait, I have severe anxiety. I can fix this." Or, "My kid has ADHD. I can fix this." So, what is the practical step if someone is struggling through these things and wants to come see you, wants get this work done, what do they do?

Dr. Hill: Sure. So, Peak Brain always starts the process with qEEG or brain mapping, and that's sort of the evidence-based threshold in the neurofeedback field. So, good practitioners always tailor the process to your brain and don't use magic boxes. So we always start with a very intense or very at least rigorous, it's not that hard to do, brain mapping. And that took about 90 minutes your first day. So, everyone has to come to one of the offices for 90 minutes. And we have them in St. Louis, Orange County, Los Angeles, we have some recording stations in Europe as well. And after that, if you're near one of the offices, you can come in three times a week, and if you're not near one of the offices, we can send you home with equipment. We often do, like we did for you Katie, we do a little three-day intensive, little three half day where we train you up on the equipment. So, you end up leaving the office knowing how to do neurofeedback on yourself but not necessarily what to do.

And then once you have your equipment in hand, we'll then give you different protocols. So, like, I'll work with you for yourself and your kids, and we'll have a shared online log of what you're doing, and we'll talk frequently. You'll have a live chat channel to the back end of our company. So about 40% of my clients will work this way where they're working from home, and we do a three-month period of coaching and supervision. We have live chat access, and weekly calls, and daily surveys so we can stay checked in about what effects you're getting. And then we help you iterate and fine-tune the process and develop new protocols and new effects over time. And the home trainers own their own equipment, and so they can keep training forever. There's no charge. We offer free brain mapping in the future so you can keep chipping away at things or, like you, you can share one set of equipment across multiple people and you can get a lot of utility out of it.

But then otherwise people come into the office, you know, three times a week and we can often get a lot of change in a few months. So, to refresh, it starts with a visit to one of the offices and if people are interested, they can check us out on, you know, Peak Brain LA on social or you can call the main number on the Peak Brain Institute website, and we also have a chat box on the website if people have more questions. All my senior staff actually staffs the chat box, so it's not some random call center. And we'd love to answer your brain questions. And if you have specific brain resources, especially regulatory things that are super easy to work on, stress, sleep, attention, we'd love to help you sort out those resources because, you know, there's no reason not to take control of your brain. Shift happens. Your brain is gonna change. So, you know, how it changes is under your control to some extent through lots of, you know, brain health interventions, including neurofeedback. So, we want to give you those tools. We do need to see you for about 90 minutes minimum at least once. Although a lot of my clients will train, you know, in the office three times a week for three to six months. And we'd love to see you there too.

Also, all the offices have free mindfulness classes in the evening. So, if you can't muster the resources to get yourself some equipment or to come to the office for a few months for neurofeedback, which is a little time-consuming, and, you know, it costs some money, we'd still love to have you come in and do mindfulness. We

have free classes several times a week in Culver City as well as St. Louis, and Orange County and those classes are completely, utterly free. We don't need to charge you to come sit and practice with us. We just wanna charge you for the expensive and time-consuming stuff. So, if you're near one of the offices, please come and practice meditation. You'll get some benefit out of it. We do some of that online, about once a year we have an online mindfulness course that is also free. And we'd love to support you in your brain health goals even if it's not neurofeedback or mindfulness. So, if there's quirky brain health questions you have, please reach out. I always am... Brains are really weird, and that's great. So, I'd love to hear your particular weird, quirky brain thing, even if it's just a quick question, or you're curious, we'd love to talk to you. So, please reach out, and if you have more significant things and we wanna make a change, we're absolutely here for you.

Katie: I love it, and I know how busy you are. So, I'm so grateful that you took the time to share all of this today and I'll make sure we link to all of those resources in the show notes at wellnessmama.fm or, of course, your website is peakbraininstitute.com. You guys can find out more there. And like I said, I hope I can talk you into another round someday because this was so fascinating.

Dr. Hill: Absolutely. Yeah. We should do some training and then talk about what you experience subjectively because that's always fun to do too.

Katie: Absolutely. I'm up for it. I love it. Awesome. Thank you, Dr. Hill.

Dr. Hill: Of course. My pleasure. Thanks for having me.

Katie: And thanks to all of you for listening and I hope you join me again for the next episode of the "Wellness Mama" podcast.

If you're enjoying these interviews, would you please take two minutes to leave a rating or review on iTunes for me? Doing this helps more people to find the podcast, which means even more moms and families could benefit from the information. I really appreciate your time, and thanks as always for listening.