How To Upgrade Your Brain Using Technology Transcript

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Introduction to Digital Neural Therapy

So for this segment, we're going to dive into a world called digital neural therapy. And technology is going to take us. We're medicine and killed us over and over again in the world of psychiatry and neuro psychiatry.

So today we have a very fabulous guest, and I'm really proud to introduce Doctor Wexler. And what's great about Doctor Wexler is that he is, one of the people that are pioneers in redefining the link between, emotional and psychiatry based sciences to the actual brain.

So Doctor Wexler graduated from Harvard College, with magna cum laude and with a major in government, and, earned his MD Albert Einstein School of Medicine, where he did his research on neurotransmitters.

And then subsequently, studied psychiatry, and a Freud's clinic in Hampstead in, neurology at the Institute of Neurology at Queen square. He trained in psychiatry at Yale University and stayed as a member of the faculty, and really argued for the importance of neural systems, view of really normal and abnormal brain functions and which led to a paper that was, published in 1986, in the British Journal of Psychiatry, advocating the use of multiple physiologic and cognitive measures to move past, rather than hope to confirm, Psychiatry's 100 year old diagnostic system, which really helped launch the field of digital neuro therapy even back then.

And so this really lets you, from the 1980s to now, a huge amount of technology driven, imaging, as well as cognitive assessment tools such as functional MRI, as well as other tools as well quantitative EEG, etc., etc..

And he developed he helped develop this program, called C8 Sciences program. And it's at C8 sciences.com. And this program is really the goal of it is to put it into, everyone's homes and schools as a digital neural therapy tool.

So basically games and things that the kids can play, to allow their brains to process things in a more optimal way rather than just kind of relying on medications.

And so Professor Wechsler, in 2006 published in Brain and Culture, neurobiology, Ideology and Social Change, a seminal text in cultural neuroscience. And we're really here to discover what his concept is and where psychiatry is going to go, in the near future and where it has landed right now.

And the tools that you can utilize right now. So I'm super proud to introduce Professor Wechsler to the stage. So professor, welcome to the show. Appreciate you having on it's my pleasure to be here.

Yeah. Awesome. So we're going to dive right into this thing called digital neural therapy. And I think it's new for a lot of people listening to this.

So we have moms listening to this. You know, we have husbands listening to this. We have children listening to this. We have geriatric adults listening to the suffering from memory problems and whatnot.

So we have a huge range of audiences that are listening to this right now.

How the Brain Works as a System

And so let's, let's, let's have you kind of define what is digital nerve therapy and how is it different? Okay. That's that's a great question because people hear digital health digital intervention is they tend to mix them all together and not appreciate that there is, fundamentally different types of digital interventions.

And then within one type, of course, they're not all the same. Just like, antidepressant pills aren't the same. So we'll talk about all those things, and I appreciate the opportunity to do that.

Let me start. Was putting my comments in the context of contemporary understanding of how the brain is organized. It works because it's a brain we're trying to address.

It's a brain we're trying to help. And we have to understand, just like if you're if your car is broken people, it stops. Everybody knows the first thing to do, right?

Go out front, got out of your car, open the hood and look under the engine and then there's that moment of truth. If you don't know how the thing works, it's very hard to figure out what's wrong with it.

Right? Fix it. And that's a problem we've had with the brain and treating psychiatric and other neurologic disorders, because we haven't understood enough about the way the brain works.

So we have made progress. And the progress is this, again, for comparison to what we used to think in the 19th century, people thought that specific parts of the brain were dedicated to a specific cognitive function, moral function, personal equality.

There was a little area for greed. Another one for generosity, another one for compassion, another one for mathematics, another one for written language.

And it didn't occur to them to wonder how this happened, you know, how did these brain areas get so specialized for these functions that were like created by human beings afterwards?

And that's not the way the brain works. It's not the way evolution developed our brains. And that was called phrenology. And it's also carried forward.

And what we call localization is thinking about how the brain is organized, that a particular area does a particular function. And part of the appeal for that is it's simpler and we can understand it that way.

Think we understand it, imagine it that way, but it's not true. So the way the brain really works is through distributed functional systems. So let me build that up for you.

Brain consists of neurons. We know that 86 billion of them, each one connected to a thousand other ones, each one receiving hundreds of inputs in the south of a second.

That's how complicated it is. So you have the brain is organized, we say, hierarchically. So the first level is a neuron, one neuron, the next one is two neurons.

Together I make a synapse. The next one are neighboring cells together that form a little local micro circuit we call it. And then the next level up integrates these micro circuits from all over the brain into functional neuro systems.

Now why is that understanding so critical? It's because, cognition that you want to preserve if you're compromising your brain function through sleep problems, you have, mild cognitive impairment.

You have cognitive problems for other reasons. You have. So cognition and emotion don't exist in single neurons that don't exist at the level of two neurons together.

Then when they exist in the level that micro circuits, they only exist in these neural systems that integrate function and neurons, hundreds of millions from all over the brain to do the simplest operation.

So these so these neural circuits systems dynamically reorganize themselves constantly to make prepare the brain to do the next function. We might think of that as getting ready to get in the right mindset, get in the right tasks.

And, you know, you think differently when you're approaching a certain type of problem. That means your neuro systems are getting reorganized. And so what we have is that areas so as a person, we don't care if we have an extra copy of a gene and one of our neurons unless it disrupts the nervous system.

So the basis of our thinking and feeling, we don't care if there are a few extra plaques floating around in the brain, unless it disrupts the neuro systems that are responsible for who we are.

And so disease disease exists at the nervous systems level. So that's the first point to point. So you could say right, the brain is hierarchically organized.

It doesn't add up when you get to the neuro systems and integrate actions, of neurons all over the brain that we first are able to even have emotion and cognition, and it's disruption of that level that constitutes disease because that's what disease is problem thinking, problem stealing and things like that.

So now let's think about what the therapy approaches have been. Well, so you can have disease process processes at any one of these levels. You can have a problem in your neurons.

You could have a problem in your synapses, you could have a problem in your micro circuits, or you could have a problem in your distributed neuron systems.

Drugs target neurons and synapses. That's it. And they can address pathology down there. But many times that's insufficient to restore the nervous system function.

So people probably may have read because it made headlines that Biogen, one of the very big pharma company, spent billions of dollars developing a new medication for.

All right, I do hope. Yeah. All right. That would address pathology at at these lower levels of neuron. Right. And it had no effect on people's behavior and thinking the CEO was fired was they were trying to sell it as a $50,000 a year drug.

But it didn't change people's feelings at all because it only focused at two lower level. So bring into the picture. Now to answer the question, what is digital neuro therapy?

It is the first treatment that focuses on restoring neuro system dysfunction rather than just like single neuron or synapse. Right? Yeah. It's like drugs. Yeah. Right.

And so how do we do that. How do we how do we correct connectivity problems which have been identified in many disorders. Connectivity problems, lack of synchrony, lack of integration of these different areas.

Right. You correct an imbalance in a system where some parts are supposed to be regulating other parts. This is what happens in depression. Frontal areas is supposed to be regulating posterior regions that generate negative affect, and depression gets turned around.

The frontal areas are compromised. The negative emotion escapes regulation, further compromises the cognition, and people go into a downward spiral. That's a accepted model of what depression is.

And it's not my model, but I endorse it as neurosis know. So how can you repair that? So moving now to another key point, is where do these neuro systems come from that are responsible for our thinking, or are they determined by our genes?

No, they're not. The Nobel Prize was given for work done in the 1950s by Hubel and Weisel, showing you that in all mammals, the nervous systems are shaped after birth by stimulation from the environment.

And we call that neuroplasticity environment. This is brain's neuroplasticity after birth. To create these neuro systems. And it's what distinguishes the human brain from every other animal is the extent to which the neuro systems are shaped after birth.

So that's a clue.

Why Digital Therapy Differs from Medication

So listeners, you may want to think, now, I've just said to you, see what you can have, what you might think about if you if you're trying to design a new treatment, given that this is the way the brain is organized, it disorders in the nervous systems level, we know neuro systems are shaped after birth by stimulation from the environment.

Where does that stimulation come in from? Eyes, ears and types. And so how could that have some therapeutic implication? Let people pause for a moment and puzzle over, you know, the first thing that that I think about when you see this, is that our experiences determine our emotions and these sort of neural systems.

And right now I feel like there's a divorce between psychiatry and neurology, but they're really all in one. And we'll get to that point later. Absolutely. Fundamental point. Yeah.

What kind of I think. Right. And I think there's a stigma here in psychiatry. It's a lot of people don't want themselves to be, you know, quote unquote stigmatized, for having a psychiatric disorder.

So you don't know how many times people come to my office and say, hey, is it just me? Or is a stress or is it my body? I'm like, what's the difference?

I mean, you know, in the fact that are these experiences and these stressors, whether they're psychological, emotional, you know, sensory things that really occur has been happening since we were born.

Should really take away this stigma from from psychiatric disorders, don't you agree? Yeah. No, I do agree, definitely. And, because you don't have control over that when you're a little kid about my experiences or coming in.

So it's your misfortune if it shapes you or if you come from poverty and you don't get the type of stimulation to promote these neuro system development, then you have these achievement gaps, related to poverty, because neuro systems are important for learning, didn't develop exposure to trauma, compromises the development of these neuro systems, right.

And stress through cortisol mechanisms. So all of that is certainly true. But let me let me now go back to my question about the therapeutic is how could we could we now restore nerve system function?

We're here. The nerve systems are shaped by stimulation coming in, say, through the eyes and ears into the brain that harnesses neuro plastic processes that we evolved to have.

Our brains evolved to be responsive to this input. Our brains have amazing ability, amazing ability in the whole universe to shape themselves to the nature of the stimuli coming in, reorganize their physical matter, their actual brain structure based on the stimulation coming in through the eyes and ears.

And this is real physical stimulation. Because consider if you go around the corner and you're trying to decide if it's a bear or a small delivery truck coming at you, what do you have to go on?

It's only lightweights that come in your eyes that are reflected off the truck or the bear. That's all you've got to go on. You might say, I'm thinking about that.

You know, what do I remember? I mean, look at it this way, but all that's coming into you is physical. Light wave patterns. Those activate, physical, electronic processes in the eyes and brain.

And if it's a bear that comes, it stimulates different neural systems. Like, let's get out of here fast. If it's an ice cream truck that comes, it's stimulating different neural systems like yum yum.

Let's walk up to that truck. And so so what we do with digital nerve therapy is we have very precise control over the nature of the stimuli we're putting in to the eyes and ears and then very precise, much more subtle control than whether it's a bear or a delivery truck.

It could be in a memory task. Are we putting in words? We're putting in shapes. Maybe you have trouble with shapes, memory. More shapes. Maybe I have trouble remembering more words.

That's a difference in the way our nervous systems are organized and functioning. And we can discover that with digital means, and then we can target that to improve it.

So we know we have control over the nature of the stimuli we're putting in. And then the processing demands, like, are you supposed to remember this? Is that all it is, remembering a list of things?

Or you're supposed to figure out a pattern and what we're showing you that's a different neural system. And what if we show you one problem when you're doing a pattern, and then the next problem you have to do with just a memory and the next one is categories.

That's cognitive flexibility. We're making those neuro systems just like you're, you know, out there doing training for on the soccer field. And you're having to do different types of steps on an agility ladder, moving back and forth different ways we can drive those neuro systems to reconfigure.

We can tell when they've got a problem, when one person has a different problem, and then another person so, so important. Because, you know, in psychiatry, because our diagnostic systems are so weak that we have to be able to individualize treatment.

And that's what neuroscience can do. So just to finish this first question, what is digital neuro therapy? What it is is it's a first treatment that targets neuro system dysfunction.

It uses the eyes and ears to direct specific, highly controlled stimuli and task requirements to activate targeted dysfunctional neuro systems so we can produce activity dependent neuro plastic enhancement just the way the systems were created.

And so one last statement, you know, that you suggest next questions or topics that we might want to transition to you. You talked about the, you know, confusion that people and psychiatry had between mind and brain. And one to think about it, the psychological when you think about it, physical.

Yeah. Our whole research operations funded at the highest levels have that problem. They say we have an NIH brain initiative. It says we want to understand the aspects of brain function that make us human.

We understand that there's systems in its hierarchy. You know, what they find. They find looking at micro circuits deeper and deeper in the brain. They have nothing on neuro system level.

They don't they don't even use cognitive assessments as measures of brain function. Cognitive assess what are they measuring other than brain function.

So we'll get back to that because they want to intervene in the brain. You know what they do. They put electrodes on your skull, hook it up to a battery you can get from RadioShack, send the electricity through the skull to impact your brain.

And I'm saying like, hello, what about the eyes? And ears that were evolved just for this purpose over millions of years to shape our neuro systems? Guys, these are just just as physical, just as much.

Your brain intervention is what you're doing by putting electricity in, but much more controlled. So that's what they do on Earth therapy is and it works.

And we've, we've demonstrated that as have others. So. Well, that's great because, just to summarize, there's no neuro therapy is something it's brisk.

It's a, it's a simple concept. But very complex topic. Right. And the simple concept is, use sensory that developed

your neural systems in the first place when you were born, or maybe in utero, and then do that now, no matter how old you are after that, because neuroplasticity exists.

So yes, it's use those things, sir. But here it is. Simple as that. But thousands of research careers and billions of dollars are being wasted. Wasted. You know this.

Evidence from Schizophrenia and Depression Studies

You know how much it costs the pharma company to develop a new drug in their preclinical, preclinical studies, you know, before they get to test them in humans, over $500 million per drug for CNS.

You know, how many fail, 93%. There was something wrong and they don't understand what they're doing wrong, you know, and it's conceptual. It's because they don't appreciate the importance of the newer systems level.

Well, I think I think, you know, from from a pharmaceutical research standpoint and what they're really trying to determine is maybe at the macro neuronal level, at the cellular level, there's some drug to target that specific process that hopefully when you pull the lever has a big effect.

And that doesn't necessarily happen, you know, especially in the hardly ever happens. Let's but it very clearly and I tell people, it's like a foundation of a house.

Right. You have these you have these neural systems that, were established as a foundation before you were three years old. And then, throughout life, experiences build upon that foundation.

And, you're really what you really want to do is, as you get older, you want to upgrade some systems. Well, I mean, it's like you can't just replace one pipe of the plumbing and expect the whole thing to get better.

It's what they're trying to do, right? Yeah, I know right. That's the problem they run into with rehabbing houses. Right? Yeah. So. So, now home, I'm afraid to tell you, homeowner it's a more systemic problem, right?

Yeah. Yeah, exactly. So let's let's compare, the digital neuro therapies, versus medications, has there been studies that demonstrate, how it works? And is it efficacious or not?

Yeah. Compared to, Pharmacol Therapeutics. Yeah. Yeah. So I'll give you some dramatic examples from our own work. Just, let me just disclosure, you know, to my own work, I can do best.

And we got a short time and I can tell you the details and feel confident. And of course, I've reviewed a lot of the other work, and people welcome to read it.

Directly or in some of the articles. But so I first started doing this with people with schizophrenia, actually the first paper published in 1997. And, we were able to show that we could normalize their we used fMRI to just prove what we were doing.

Then we could normalize task related brain activation. So people with schizophrenia have a problem with verbal memory. It's been well established. So I first did a study and published in the Archives of General Psychiatry showing a group of people with schizophrenia, a group of healthy people who give them a task, a verbal memory task to do while you're looking at their brain.

And there's certain key areas that don't get activated that are part of the system in the people with schizophrenia that are robustly activated and healthy people.

So we did a digital made a really crude digital neuro therapy in my lab. 16 weeks of this, we had normalized task related brain activation in people with schizophrenia for many years now they were receiving medication.

So medication we know in schizophrenia can be helpful for symptom reduction. Unfortunately it doesn't improve

cognition much. So we were showing patients who were on medication already had this problem of not activating the brain appropriately in the nervous systems way for very important tasks, verbal memory.

We showed we could normalize it. Then we showed that we could improve a whole bunch of what we call executive cognitive functions. These are our cognitive flexibility, memory, attention a variety of thinking abilities that are essential for learning and success in life so we could improve those.

Then we did a study on Maurice Bell and I, we did two large and I MH funded randomized controlled trials where we put together a digital neuro therapy.

At that time, we were calling it cognitive remediation therapy that I've renamed it together with work Therapy to help patients with schizophrenia get employment.

We showed and we gave it. These were long term interventions. So one of them, we gave a training for a whole year. We followed people for another year.

The group that got our training plus our cognitive training, plus the work therapy, worked more hours and earned more money in the real world compared to people who only got the work therapy.

So the whole lot of what I've told you, we demonstrated we could restore brain system function. It translated into cognitive function improvements because that's what the neural systems do.

And it was big enough to impact real world function. So that's one example. And I'll give you another example. Even more dramatic, I think Cornell Geriatric Psychiatry Center, funded for many, many years, came to me and said, and she Zucco Sarah, she's at the Morimoto was a postdoc there at the time, and she's the one who came to me and said, we at the center have identified a cognitive deficit that predicts failure to respond to medicine.

And it's, for people who have geriatric depression. And it's a big problem because over half the people don't respond in medicine. So we don't have very good treatments for antidepressant.

For depression with medication. So we've also done an fMRI study, and we've shown a brain failure to activate part of the brain that goes along with that cognitive deficit that predicts failure to respond in medicine.

Can you they said to me, create a digital neuro therapy that targets that system. So if you have a target, it's very important. You have to know what neuron system you're trying to repair.

And then so we I, we put it together in my lab. I designed the whole program. We have a key component I, we made from scratch, you know, based on my ideas of how to engage that system.

Then they said, look, give you 11 patients who completely failed to respond to 2 to 3 months of supervised medicine. So we know their treatment refractory to medicine.

And we know it's not you're not getting a placebo effect on them, you know, because they didn't get better during this time. You can try your games. So I should say these brain exercises we create look like computer games.

But we've got the neuroscience inside of them for four weeks because we want to give them another medicine. In that first study, one of the 11 dropped out, and in four weeks, eight of the ten were recovered.

Remission level not improvement, remission levels, symptom reduction and improved cognition. And then a ninth one after six weeks met those criteria. That paper was published in one of the nature journals with only a historical control group, because it was so robust.

Then we got another grant. She got another grant? I got a grant from the NIH for a small follow up study with a concurrent active digital control condition, and replicated the findings not quite as robust.

About 60% of patients who had failed to respond to medicine at all recovered in four weeks with robust cognitive improvement. So you don't get. So these are two cases where we added it to a medicine.

So it wasn't a head to head comparison with medicine. But you can see it addresses the point you're making that medicine alone was unable to do the trick.

A very and we know how limited it is. It's useful but limited in people with schizophrenia, these people with depression. It was totally ineffective. But when we added the systems level intervention, we got very significant life enhancing, meaningful improvements for the patients.

So we're really looking at disease reversal right now rather than just control. You're absolutely right. That's a great point because I did do get a grant to do an MRI study to look at.

Are we looking are we getting cognitive remediation or are, or are we getting cognitive compensation? You know, that we're activating different neural circuits, or we were repairing the ones that are normally there.

And in the schizophrenia study, it looked like we were repairing the normal ones that were there getting getting remediate. She said, reversing disease process.

We just got a study back done in China for 31 year old depressed patients, where they did fMRI cognitive deficits, measurements, cognitive function and symptoms.

Again, these a one year old, 30 of them. Right. 3030, 31 year old sorry 31 year old I don't. So the Cornell studies, 75 years old, these 51 year old depressed adults who had also had partial or limited response to medicine.

And there they found that compared to the control group, improve functional connectivity. Getting back to what you're talking about, because people said that connectivity problems are part of the systems problem in depression, also improves executive cognitive function compared to control group and also greater improvement in depression.

So all three parts of the argument I tried to lay out at the very beginning of my, of our discussion, you know, been confirmed in the schizophrenia early schizophrenia studies and in these depression studies, you know, this, this challenges my brain a little bit, because if you look at the world of cardiology, for example, right.

So we know for those people with high cholesterol or, metabolic issues, the first thing that's recommended by the American Heart Association is lifestyle modification and dietary training, which they call first line therapy.

Right. Why isn't this first line therapy in psychiatry and neuro psychiatry?

Diagnoses, Personalization, and Adaptive Modules

I should absolutely. So I had an op ed in the Financial Times of London. Okay. Partly because the mental health needs and the public health level far exceed the ability of the medical establishment to deliver, you know, a study was published that of young adults and adolescents with a diagnosis of major depression in the US, 60% had no treatment in the previous year.

You can just read the papers, especially with the pandemic. Waiting lists, waiting lists, waiting lists. You see the same example. We have used early intervention for prevention.

In all, just as you said, just exactly as you said. And yet we're not doing it. So in psychiatry with and, for the pandemic argument, I wrote how governments funded a great deal of research from virology, fortunately for us all.

So when the pandemic hit, we could turn that to society's advantage. We also have the research on mental health. It's time to turn that to our public advantage with the same sort of, you know, dedication, just exactly as you said.

Yeah, that was the reason for the summit. We want to shift that attention. And to there are so many things that can be done for mental, cognitive, health and memory.

And this requires some unveiling of things that aren't necessarily out there, if you will, unveiling and changing thought patterns. See, the reason I think that these major brain initiatives ignore digital neuro therapy, although that first study I told you was published in 2015, there's another neat MH whole lab initiative called Noninvasive Neuromodulation based on systems understanding of the brain.

Digital nerve therapies not there at all. Their outcome assessments. We want to they they say they want to measure systems function. They're thinking how can we get electrodes into the micro circuits.

That's what they're funding to measure systems function. Right. They don't believe that cognitive readouts are measures of neuro system function. That's what they are.

They're scalable, inexpensive, fine grained assessments. Like I told you, we can leave a billion data points now from a because we collect every response, every key tap.

So it's like we have a. So it's like, you know, we can tell whether this person's memory problem is because they can't process the things they're supposed to remember fast enough.

That's not a retention problem, but they can't remember them if they can't encode them fast enough. This other person has a memory problem. It turns into retention.

Oh, we put distraction in sometimes. Oh, this person's really susceptible to distraction. This person isn't. Those are the differences in neuro system function.

They're trying to measure it. You know much more grossly non scalable much more money. It's not mentioned. So why. That's my question. Why. Why do they ignore this when they say we're looking at brain function.

I think it's residual dualism. As soon as it smacks of psychology, as soon as it feels like we're talking now about something that we could do in a test of your knowledge, that's not counting for them anymore as being rigorous enough brain based physical intervention.

Come on, guys, what is it? What are you impacting? If people change their thinking and their cognitive so the stigma exists at the highest levels of research, right.

Wasting their lives. So if we go back to my, my, my building a house analogy. So, if I see that my fossa is, having decreased pressure in my pipes, that should tell me that the my entire plumbing system, there's something wrong with it, right?

Yeah, but they don't really care about that. They want to care about what this pipe is really made of. And velocity across one small cross-section of the pipe, which doesn't translate into the system, just tells us what's going on there.

Right. And they're looking at like little things rather than looking at the big picture. And and it's, it's, it's, it's a bit disturbing, I think. Let me, you know, another thing, another example of the big picture that's going to continue with your water analogy.

Yeah. For me, I mean, it's a key concept here is called emergent property. Now an emergent property is something that exists when pieces are put together but only exist in the individual pieces.

So water is a great example. Water has a number of qualities that support life. You know, freeze. You can make crystals. It can make ice cubes. It can flow all those things.

So you said, oh, I wish I understand this wonderful water. I know it's made of H2O, two hydrogen atoms in an

oxygen atom. I'm going to take it apart and look at those hydrogen and oxygen atoms so I can understand what water is.

And as soon as you take it apart, the phenomena you're interested in is gone, because it only exists in the combination. That's an emergent property. It's just like letters in a word.

Take three letters T and a put them together t e you have t put together e a t. It's a different function. It's way organized. Take t e a. That's a perfectly fine function.

It means something. You put an m on the end and it means something entirely different. And so that's. And then you put words together in sentences and sentences together in paragraphs.

If I told you how many if you did an analysis of our talk today and you told your readers how many times I used each letter of the alphabet, that would be an accurate description of my talk.

They have no idea what it's about, right? Because emergent properties would come from combinations. And that's what letter systems do. That's the way our brain works in this hierarchical organization.

New functions appear that don't exist at these lower levels. Research funding is dedicated to each of the individual letters and not necessarily a system as a whole.

Right, absolutely. And reductionist science has its value. It takes things apart, but it has its limitations, especially when it comes to the brain, which is the most complex organization that we know of in the world, you know.

All right. So so let's let's move to diagnoses for a second. Now, people have a pretty good understanding now of what the DNA or digital neuro therapies are supposed to do.

What does it work on. What diagnostic states does it work on? Okay. So here you get to versatility. And here we get to a question of different types of the DNA that are out there.

Because that was another question you know of consumers are interested you know this DNA or that DNA is are all the same. Well, they aren't just all pills aren't the same.

And you got to look and know what research has been done and how they're developed or how all cars are the same. You know, some guys are faster or slower and safer and all those things, they're not they're different. So what you need to do for a successful DNA team is to know what your target neuro dysfunction is, because you want to activate the system, the part of the system that's weak to produce the activity dependent enhancement.

Now those are going to be different in different diseases by with our current diagnostic system. But they're also going to be different in two people have the same diagnosis.

They can be different because our diagnostic categories are not very, accurate at that level of what's going on underneath the same brain dysfunction can produce different symptoms in different people, and different brain dysfunctions can produce the same symptoms.

So you've got this double dose. So two different you know a double problem there about other linking symptoms. So to the brain. So you have to be able with a additional neuro therapy to be able to shape itself to the individual.

You can use diagnosis as a starting point. We still doing research. So now we've published studies on schizophrenia, on depression and on ADHD. Other people published and some other ones.

But these are probably the three biggest areas that have been studied, I think, some more with bipolar disorder, with digital types of interventions. Now, some of these interventions say I'm focusing on a key problem like one of the early interventions for ADHD.

So the problem with ADHD is spatial memory. So my whole training is going to be spatial memory. That's it. Now we know that's not true. There are a lot of other cognitive deficits.

And there's a lot of variability in cognitive deficits. And if you look at MRI there's a lot of variability in ADHD. We have our treatment has six different modules.

Each of the modules has 25 to 100 different levels where we slightly tweak the task requirement or the stimuli, like I said before, or if it now works, or is it shapes?

Or if you're trying to remember something okay, well, you you do pretty well. We'll determine for you as an individual that you do pretty well remembering four things in a row.

So we're going to just have you remember four shapes. But what we're going to do now is make the time that that shape appears on the screen shorter and shorter and shorter to see whether, where does your performance fall off with that type of challenge.

Next thing we'll do is we'll make the two stimuli closer and closer together, because we know one will overwrite the other one. If you don't get it encoded fast enough or we'll put distractors in.

So we systematic. So the ability to address different diseases depends on first having an understanding of what some target neural system dysfunctions are, which can be determined by cognitive readouts or MRI readouts or both together to know what you want to target.

Then you need to have some versatility and breadth in your training program, and then we have patented algorithms, the ability for your training program to continually monitor the individual, using it to shape itself to the individual.

So if you only have one thing you're doing, if all your training is is spatial memory, you don't have anything to shape. But if you want a program to adapt with the individual right, and you just give it the ability to do that by having it have multiple, multiple modularity that it can draw on.

If your whole program is just spatial memory, you don't have anything to adapt with. This final question, thing to say is that if you have a platform technology like we have with multiple modules and all the schedule and mixing of them, you can create new modules for different disorders.

Programs for Children and Adults

And so as soon as you identify that nature of the, you know, a new target, if you want to look into if you have. So we're looking at parkinsonism for example.

Cognitive deficits are huge there. And and depression is huge there. So we want to be able to add on a new module to go with some of our other modules.

So we're probably running out of time because I talk a lot. But I no, that's that's so to summarize. So what we're doing is we're not just taking a diagnosis like depression or attention deficit or anxiety or so what we're doing is maybe we start with the diagnosis.

Right. But because the but the patient got to the diagnosis because of multiple systems that aren't working. Right. So it's all neuro therapy has to adapt to each of those systems.

Kind of like, you know, choose your own adventure books, you know, except for but the program chooses it because it monitors what you're doing and it can keep adjusting it.

And to do that, you have to have two key components to your digital or a therapy that many don't have either of them. One, you have to have multiple modules.

Otherwise you've got nothing to use to shape. And then you have to have the ability. You know, I type of the ability to be monitoring what's happening with the individual to know when you should move them from one module to the other.

And that was just, you know, because I come at this, you know, from a systems perspective, which I said at the very beginning. Yeah. What I localization is perspective, that there's one cognitive problem that defines the disorder.

It's a systems perspective. So I just designed it from the bottom up that way. And to be honest, you know people look around and you know I don't want to be 100% on this, but I don't know of any other digital neuro therapy programs that have those two features.

The breadth of the training space and the technology to shape it to the individual. So let's talk about the program. So this is AC8 like the number eight science is uh.com.

Right. And the program you developed what's called activate right. Is that the name of the program we have two. One's called activate is for children.

And that was done used in for ADHD with a published trial. And then we have it was also used in schools dramatically reduced achievement gaps related to poverty.

Because that for me was a simple shot. It's not a disease. There. They just didn't get the stimulation they needed. I call the school lunch program when they didn't get the stimulation they needed before they got to school.

Unfortunately, to develop the neuro systems they needed. The other program is rejuvenate, and that's for adults, and that's the one that it's for depression and cognitive decline.

And so those are two that we have available. They have a lot of versatility, both of them. But in the future we'll be in a position because of our platform to make more diverse offerings, more disease specific.

So but anyway, rejuvenate, improves mood and improves cognition in adults. So a lot of people are thinking this right now, is it too late for me and my loved one to enter these programs?

And what age is too old? So we just did a study based again in a retirement community, where a couple of my former professors were in the study. They were living in the retirement community outside of New Haven, average age 85 years old, control group and treatment group.

We improved memory and processing speed significantly in 85 year olds. Now they're we combined our computer program with a special physical exercise program.

We also have where the physical exercises engage the same neuro systems because we build cognition into the physical exercises engage the same. There are systems as in computer programs.

But now in the context of whole body activity and social interaction. So in that program for the older adults we use both for ADHD study. We use both for our depression studies we used only the computer programs.

So we have another mixing and matching opportunity. But yes, those are 85 years old. We did another combined study in Beijing and New Haven, with 65 to 85 year olds living in their homes in the community, and also showed improvement in processing speed and, and memory in that age group.

So all through life, your brain is still neuro plastic. It may take a little harder work, just like going to the gym for your physical muscle building and regaining your muscle competence.

You know where I can tell you? I can tell you I'm a lot older than you are. I can tell you when you get up there, you know, it's like I'm not worried about gaining muscle. I want to maintain muscle. That's what I want to do.

I just don't want to see it going away. So. But all these things can respond. But they just take a little more work when you're older. Now, for our program for older people, to give you an idea, 20 minutes a day of the computer program, five days a week, do it from home.

Gotcha. And what's great about it is I'm on the website right now for those fearless. And, once again, it's cat sciences dot coms. It's letter C, the number eight. And in sciences.com, it looks like I can sign up for, for a free trial.

Which is really nice. Yeah. So if you are wondering, just go to C8 science.com and just sign up for the free trial. There's no risk. And just check it out.

You know, give it to your loved ones, give it to yourself. But 20 or 30 minutes a day, 3 to 5 times a week. It's what it says on the website here. And, and, and the I think the outcome of this, it's very exciting to see.

And I think that as we progress forward, I would love to see digital neuro therapies as the first line treatment in the world of psychiatry and neurology.

But that'd be wonderful to watch. Very nice of you to say.

Aging, Accessibility, and the Future of Treatment

Last comment on that one is that we are working with, Richard Shelton and, his colleague at University of Alabama, Richard, going to term for depression, treat and sort because he says your treatment has such face validity.

No side effects. Everybody should get it when they come in the clinic. Doctors can prescribe any other treatment they want. But we know the treatment, incomplete treatment response is so high in depression that after a two week, two month trial of any treatment, there's half the patients need some readjustment.

At that point, we have 10,000 responses from the individual. So it's a treat and sort, use sorry, sorry. Digital not only can be a universal treatment, it also then can guide additional refinements in treatment not just in real time like I described, but looking back, it's like having a 10,000 item grade or Lsat test, 10,000 items each.

Very different, as I told you, you know that shapes. Or is it words? Is it, with distraction, without distraction to really characterize a person to gain further treatment?

So yeah, I, I hope you're right. I've worked for a long time on this, you know, just because I started it early on and we've really developed it. I agree with you completely.

I think it's a future of what treatment will be like. It has no side effects and much more precision and can guide further research. It's it's, technology and enhanced neuroscience.

It's easily accessible as well to everyone, easily accessible and low cost. I don't want to I like psychotherapy, I think I've done psychotherapy as opposed to patient.

As a therapist, it can be very valuable for people. But one year of digital therapy costs less than one hour. Psychotherapy? Yeah, that. Run that through your mind. Yeah.

In terms of other people. Yeah. That's a lot of value. Yeah. Well, I want to thank, Professor Bruce Wexler for being on. This is such a valuable talk.

And, what, my, I think my biggest takeaway from from our discussion today is that, we don't have to wait. I mean, there's, there's digital neuro therapy out right now, and Jersey's example and sea sciences.com that people can, you know, start like right away probably people are clicking on another tab right now and opening your website right now and going through. Great.

And just try it out in and see. I think that the answer for a lot of what, we're searching for, is really locked away in,

technology. And the only reason it's locked away is because there's not enough people talking about it.

So, you know, spread it to your friends and family, to your loved ones through social media, and start talking about these things and take away the stigma of mental health and have it combined with a very holistic view of what the brain is supposed to do, and also honor the our experiences that we have from where we're young, because it really shaped the way our neural systems are.

And if you want to upgrade, your software and your brain, well, then you have to, look at the things that developed our brains in the first place, which is sight and sound and experiences and everything like that.

So once again, thank you so much for the chat. Thank you. Yeah. My pleasure. And go to, for those of you listening, go to C8 science.com to check out, everything there.

And and I want to once again, thank you not just for the talk, but also taking the time out of your busy schedule. I see that, you're all suited up and working and, to allow us to really hear about your perspective, from someone who's been in neuroscience world for a very long time.

So thank you. Thank you. And thank you for the opportunity and the kind words you said. Yeah. Thanks. Bye.