Caspar (00:00):

We talk a lot about brain health at innovative medicine, but what's the single best way to actually test one's brain health? As it turns out, there are at least eight metrics of brain health that we can test using the latest technology in neuroscience. Our guest today is a neuroscientist, a science guy and co-founder of Cortical Metrics, a company creating non-invasive, biologically based systems for measuring brain health. This is the story of Brain Gauge with Mark. Mark Tommerdahl. Mark. Sorry about that. I, I, I know you're not, Mike. I've seen you before, give a talk and, but I, I had heard about Brain Gauge at an event recently but I want you to describe to the audience what exactly is Brain Gauge.

Mark (00:46):

Yeah. Well, brain Brain Gauge is a product of about 30 or 40 years of research that started with basically looking at patterns of activ, patterns of brain activity. And for 20 years we were looking at patterns of brain activity in the laboratory, and we realized that the best way to test brain activity and brain function would be if we could deliver sensory stimuli through the skin, and more specifically, very precise and very accurate skins stimuli to the skin. And deliver two points and basically two points to the skin, where, which project to two places in the brain that talk to each other, and we can look at we basically look at how those places interact. And that gives us a lot of insight into brain function. And, and really the way to think about it is that we probe brain function, but we don't do it.

Mark (01:44):

And we, we don't do it with language. It's a non-language based method and a lot, there's a lot of online cognitive tools that simply don't work all that well. But you can, you can really probe brain function a lot better by using sensory input, which bypasses language and just delivers very simple stimuli or very complex stimuli, which have very, and we, we ask very simple questions. And the Brain Gauge itself has lost about a hundred pounds in 15 years because the very first time we came up with this idea we were trying, we're struggling with how to build the device. And a, a scientist engineer moved in across the hall from me. I'm in the Department of Biomedical Engineering at the University of North Carolina. And Bob Dennis moved in across the hall and he said, what can I do to, to help you, you know, with your research?

Mark (02:41):

And I said, well, you can we can figure out a way to deliver two stimuli very accurately to the skin, cuz right now all we've got is this a hundred pound beast to deliver one stimulus to the skin and it costs about $30,000. So, you know, we spent a lot of time talking about that. And he, and he came up with some ideas. And one of the ideas was to pitch it to a group of students in a class who were doing, you know, basically their design project in the, in the spring semester. And, you know, so they spent their whole spring semester trying to build this device. And like most senior undergraduates like what you would expect from most senior undergraduates they tried very, very hard and they failed and because they were spending a lot of time being seniors in the spring semester.

Mark (03:31):

And and then Bob took a weekend and took some duct tape and some paperclips and built something that basically worked. And that was the first prototype. And from there, but that device was very, very heavy. And we've reduced this to something that's the size of computer mouse. It looks, it gets called a computer mouse by mistake quite often, but it's it's basically, you know, this, this device that looks, I'm holding it up to you, but it looks like a computer mouse has two probe tips that vibrate. They vibrate

your, your first two, your digit two and digit three, your index finger and the finger next to it. So it's it, it's very simple. It delivers stimuli to the, to the probe, to the fingertips. And it basically activates places in the brain that make you feel certain things. And when you feel those things, we ask you questions like, which one is bigger? Which one lasts longer? Which one came first? So none of the questions are very difficult, but the stimuli that we deliver, which are based on 30 years of animal studies, can be quite complex. But it gives us a lot of information about what's going on in your brain. So that's the short version.

Caspar (04:43):

Yeah, no, listen, when you talk about brain, I'm sure there's always long versions of everything. We could probably spend hours upon that on the most complicated object in the known universe, the human brain. But, you know, you mentioned something before that there are a lot of tests out there you could do for brain. Most of them don't really make the cut according to you

Mark (05:01):

Right.

Caspar (05:03):

Now we, we see a lot of this cuz there's apps for it. And a lot of them are based in language, cognitive function, things like that where Sure. Yours is quite different in that it, it's, it's basically sensory first and foremost. What is that great advantage over that from others that claim to, you know, improve your cognitive function by doing the app-based and more language-based things?

Mark (05:26):

Yeah. Okay. There's several different ways I can go on this answer. But there's, that's a great question. Language-Based tests basically they're not just, it's not just that they're language based, they're also inaccurate to be quite frank. We published a paper a couple years ago that made us very unpopular because what we did was we sh we found that, you know, just, they're not accurate for things like reaction time, reaction time's a great, great measure to talk about because everybody understands what reaction time is. They say, oh, that's how fast you respond and how fast you react. And so what we do is we deliver a stimulus to the finger and you respond with another finger. It's that simple. And basically this test has been done for over 150 years. It's been published. These results have been published over 150 years. And from 1850 until 1970, the results were the same because people were using laboratory high-grade laboratory equipment, even back in the 1850s.

Mark (06:30):

Very, very precise equipment to measure what your reaction time was around 1970, with the advent of personal computers, everybody started collecting reaction time with personal computers, which have layers of problems. For example, every time you probably never experience, I'm sure all your viewers have experienced like a software update on their operating system, on whatever computer they're using. Every time you get an update, it's slowing your computer down. And what we showed, what we did was we did a little test comparing the brain gauge for reaction time, and we compared it with other systems. And the way we did the, we didn't use humans, we didn't use thousands of humans to do this. We used, we built some robotics to do the testing. And the brain gauge is actually extremely accurate down to a third of a millisecond. And some of these other measures are between 40 and 500 milliseconds off.

Mark (07:32):

Your reaction time is typically 200 milliseconds. So if you add three or 400 milliseconds to that, that's not good. You can't just subtract that offset because that offset is different every time. And so it might, even if you were exactly right, every time you took that test and you say you tested at 200 and you added 200 and you were 401 day, the next test might be 600, or the next test might be 500, even though you are exactly the same. So it's very inaccurate. And so that's one, one big advantage is that we actually have developed laboratory equipment grade hardware that we put inside the brain gauge and it bypasses the computer and just sends the answer to the computer. That's a big, one of the big advantages. One of the problems with language has to do that. I, I run into a lot, I didn't really think about this much, but a lot of clinicians work with a lot of different sociodemographic groups and they say, yeah, language barrier is huge, especially if you have people that, you know, English is not their first language.

Mark (08:40):

You know, that that's, that adds a whole nother layer of, of complexity on it. But also different you know, different, different groups, different demographics, interpret things differently and answer and respond differently. What the Brain Gauge does, the different tests that we do, target specific mechanisms of information processing. And so that's, that's what's very different. And so a lot of these language-based tests, what they do is they, they'll do things like, let's look at, come up with ways or, or, or protocols to come up and, and look at l learning and memory, for example. We do things like where we target the basic fundamental mechanisms that contribute to learning and memory. So like one of them's lateral inhibition. Lateral inhibition is very, very important mechanism. And the way to think about this is to think about if we deliver stimuli to two fingers, those two places in the brain that are getting active are side by side and they're fighting.

Mark (09:47):

So in the brain, what you have all the time is a fight or, or fight to maintain balance between excitation and inhibition. Everything in your brain is either excited or inhibited. It's either being turned on or it's being turned off. And that that fight that's going on is really really important and really important to maintain. It's your healthy connectivity that maintains that balance. But the way to measure lateral inhibition is to activate a couple of places in the brain and activate one that's larger than another. And you activate, when you deliver one stimulus that's larger than another it it will, the larger activity will try to suppress the smaller activity. And so if, if got two places that are side by side fighting and your lateral inhibition is healthy, then you can tell the difference between two points in the brain.

Mark (10:43):

If it's not healthy, then you have a lot of trouble with that. But anyway, that's a basic mechanistic thing and that's, that plays a huge role and in learning and memory as does some of our other measures like plasticity and information processing speed. So all those things play a big role in learning and memory. And so, but we are testing the fundamental building blocks versus these language based tests, which are really kind of l looking at high level things, which can you know, you can kind of rewire and run around and, and trick things. You know, it's a lot easier to cheat on the language based test.

Caspar (11:22):

Yeah, I mean, it, it's, it's definitely a interesting aspect because so much of what we think is brain function is based in that cognitive type of memory things and not so much in the reaction. Listen, we sit

around all day, you know, and we don't use our reactionary time that much at all anymore. We're not escaping some sabertooth tiger, you know, having to be on edge or anything like that. We're on edge now because of technology and information, getting ourselves stressed that way. But have you witnessed this in people, people that are using, let's say athletes, are you using Brain Gauge to, to, you know, monitor athletes and try and help them improve reaction time.

Mark (12:03):

Actually reaction. You know, one thing that we've done that we've added lately is we have our own brain gauge training platform or brain own bring age exercise platform. And so when we built this the original testing platform, we were very careful to do it very, you know, take the scientific route and say, okay, let's, let's make this so that if somebody tests two or three times a week, that the testing won't influence their, their, their ability. In other words, the best way to think about this is if you want to, if you wanna test somebody's ability to run around the track, run a quarter mile you and you say, okay, come in and walk a quarter mile or run a quarter mile and we'll do that once a month and just to see what your general health is. That's, that once a month time is not gonna have any effect on your, on your quarter mile time or how fast you are.

Mark (13:01):

Or if you were to come in at a weight room and do the same thing and lift weights just to see how strong you are. But if you were to start doing this two or three times a week, it would actually, a and you did a diff slightly different regimen. You came in and you say, okay, are you gonna run like a quarter mile once a day for, you know, two or three days a week? That's great. That still really won't improve it. And you know, you're, but it might start to get, have a little bit of impact on your performance. But what we've done is we've flipped it, the testing on its head and come up with a brain gauge exercise platform that will actually help you improve your speed. And we've seen people speed improve incredibly I, I'm, I was, I'm actually kind of surprised at how much better people are getting.

Mark (13:51):

And keep in mind, you know, some people will immediately, some people in these training platforms or the brain training world will immediately say, oh, well you're just, they're just learning how to game the system. And I was like, actually, you can't improve reaction time. You can't cheat on any of these tests. The only thing you only way to get better is to train and that actually exercise and perform a little bit better. It's like saying, you know, lifting weights, you know, two times a week for 30 minutes, that's not cheating. You're getting stronger. If you could use the brain gauge and we've got a brain gauge tra on the training platform, if you use that, you know, 10, 20 minutes a day or you know, let's say 20 minutes a day for three days a week, and you focus on reaction time, you will get better.

Mark (14:42):

We actually, we have multiple tests, but you know, we even have a multitasking test where you can work on your ability to multitask. So, and again, we're going after the basic mechanisms and we're the basic, it's the basic building blocks of of brain function. So it's a little bit different, but yes, and we we're seeing people get much, much better at reaction time. I'm actually at all the scores so much so that we've had to change the platform and add different levels. For example, I mentioned, you know, the, the average reaction time for most people is around 200 milliseconds, and we're seeing people get well below 150 milliseconds, which is really fast. Theoretically the best you can do is probably a hundred, 110. I, but I haven't seen anybody do that. That's all theory as well.

Caspar (15:39):

It, it would be interesting to test some of these people that have to have these F1 or, you know, boxers, something like that, that have to have those sort of really quick and see which ones are the best out of those as well.

Mark (15:48):

Yeah. So we've tested a lot of athletes, a lot of student athletes, and yeah, they are quite good. I mean, they're, and I mean, I was a competitive athlete myself, and I spent a lot of time doing speed drills, which had absolutely nothing to do with swimming, which is, I was a competitive swimmer, but it really did help me get off the starting block faster. So I was, and that was one thing, my background in competitive sports actually had a lot to do with the development of Brain Gauge because when we first started, I was kind of blown away that nobody really tried to track brain function at all in terms of when people were getting better or, you know, when they were you know, going through some kind of treatment they really didn't track, you know, they didn't really have an easy way to track it. So that was one reason we, we were, and, and that's sort of been the approach of the way we do things and we've tried to make it very user friendly so that anybody can use it.

Caspar (16:46):

Have you been tracking anything about what would hinder brain function or anything you've seen there, whether it's like sleep deprivation or substances like alcohol? Is there something you've seen that's, wow, this really incredibly, you know, slowed down the brain or impacted it negatively?

Mark (17:00):

Sure. We've seen, we've seen a lot of things that impact the brain negatively. We've done a lot of studies we've, we've worked with people like addicts getting cleaned up. Meth does not help your brain. You know, we've seen we've seen impact of ADHD drugs, we've seen the impacts of alcohol. Obviously, you know, alcohol does have an impact on brain function. We've seen you know, impacts of nicotine, impacts of marijuana or cannabis.

Caspar (17:35):

So talk about those talk, talk about A D H D, marijuana and nicotine, because I'm interested to hear what, what was, what happened with those.

Mark (17:42):

Yeah, okay. Well, I, I'll do the easy one first. Ni nicotine was in, was interesting. And that's sort of of it's harder, it is getting harder and harder to find a lot of smokers, but if you can talk them into not smoking for a prolonged period of time, they test very poorly until they get their, they, they can get smoke again, and then they test normally. So they say sort of adapted nic, you know, you do have nic receptors. And so it's kinda we haven't test, we didn't test a large enough population to show if there was a large scale decrement between with people who smoke versus people who don't smoke. Cannabis was interesting. That was you know, the interesting part of that is, you know, if you look at three different groups, you look at people who don't or control healthy controls that don't ever use cannabis, recreational users of cannabis, and then very heavy users of cannabis.

Mark (18:42):

And the interesting thing is, if you do a questionnaire and ask people how they did, the people who you know, how they did before and after cannabis people who never use it, and the recreational users after they used cannabis say, oh, I tested horribly. And they usually tested about 40% worse. And the, but the heavy users said, nah, man, I tested great. And they, but they tested worse too. They actually didn't test that much worse because there was, there before and after. There was hardly any difference. People who used cannabis heavily tested poorly before and after, didn't really, there was not a big difference, but they thought that they tested very well. Alcohol's interesting. Probably not supposed to say this, but you know, the first on some tests, it seems like the very, like one or two drinks sometimes helps some people perform better. Whether they're, it loosens them up a little bit or they have a little bit of anxiety. I don't want to go there, I don't want to pro I'm not promoting alcohol. I don't think/

Caspar (19:52):

We're not saying that, but.

Mark (19:54):

But I'm just telling you the an, the response. But then after several several drinks, then performance goes way down just across the board. So anyway, I used to do that test myself. When we first developed the first first device that was portable, I brought it home, sat it on my kitchen and said, let's see if how this, how these different tests respond. And found out, you know, after about six to nine beers, you start doing really, really poorly,

Caspar (20:25):

Really poorly, right? Yeah. You, you, you kind of confirm what you sort in you, but yeah, let's, let's, let's put that into the science and the data of it. So

Caspar (20:34):

Let's flip the script. We know there are harmful substances out there that absolutely show what about things that impact it in a beneficial way, positively.

Mark (20:44):

Yeah. Like, sure Nootropics and of course everything has a tuning curve. That's one thing to remember. And, you know, just give you anecdotal evidence for this, is that I, all my students in the fall, I got, I had about 50 students, 50 or 60 students every fall. And they all got a brain gauge to do projects with, to do their labs with, but you know, they could use it any way they wanted. And typically you know, a lot of 'em found out, oh, I don't test very well in the morning until I've had a couple, you know, my caffeine. And, you know, they find out they do a lot better after one or two espressos, and then they find out, well, what about after eight espressos? And this is all, you know, people just doing their own thing. And it was like, yeah, after 6, 7, 8, espresso, no, too much caffeine makes you a nervous wreck and you can't test well.

Mark (21:37):

Yep. So yeah, there is a tuning curve for all these nootropics and and supplements as well. Now supplements are a little different in that if you're, what we find is, you know, if you're deficient in something and you take the supplement, then it will help you. But if, you know, if you've got two, if you're doing fine, if every, if you're everything's balanced in terms and you've got plenty of the supplement on board or whatever the supplement is trying to enable, then, then it's not gonna help

you. So you know, that's, that's true for just about anything, you know, if you've got right amount of ex citation inhibition and you take a GABA agonist, that's probably not gonna help you too much, you know, it's not because you've got plenty on board. So yeah, it's a, you know, and exercise in general, we found exercise does improve Brain Gauge scores quite a, quite a bit especially.

Mark (22:37):

And, but we, you know, in our exercise studies, the interesting things that we see are that you know, people that are that, that are normally exercise, they exercise a lot, you know, so let's say somebody runs four or five miles a day and they usually test a little bit better after they go out for their four or five mile an hour, four or five mile run. But if you have, if you compare them to sedentary people who do a four or five mile run and then test, you find that they perform, they've very fatigued and they don't do well. So you have to be in, you know, but exercise in general, doing a cross-sectional study will show you that people that exercise and are in good shape perform very well compared to people that don't. That's actually in the literature back to the 1970s, you know, in terms of just any kind of cognitive health and.

Caspar (23:36):

Consistency is key. Right?

Mark (23:38):

Yeah.

Caspar (23:40):

Tell, tell us about the different models you have now because you, you started it with this gigantic, just one singular model that, that now you have these, these the mouse. What, what are the different models you have now?

Mark (23:51):

Sure. Right now we like, as far as your listeners go, I would think the, the Brain Gauge home, the BrainGauge Pro, and the BrainGauge MD of the three that they would be most interested in, we have some research models as well, but that's sort of a, those are usually custom made, all three look alike. The BrainGauge home is for the home user. That's, you know, it allows like a family all, everyone in the family to test up to five users, but we usually modify that if you got a big family Brain Gauge Pro is mo most clinicians use that. Most professionals use the Brain Gauge Pro, and that's that allows for an unlimited number of users to test. And then the Brain Gauge MD is our F D A listed model, and that's typically used where whoever's using it is in an institution that requires an F FDA listing. And really the difference in costs has really got to do with bureaucracy. We'll, we'll leave it at that in terms.

Caspar (24:57):

Of, yeah, I understand. I get it. I, I'm in medicine, I know what bureaucracy is.

Mark (25:03):

Yeah. But it's really, it's really the paperwork that is the price difference between the Brain Gauge MD and the Brain Gauge Pro Brain Gauge Pro is better suited for research as well. Cuz you can modify the different programs. We can change the protocols on the md, everything's set. I mean, we, we don't change anything. So those are the, that's, those are the main differences. We also, with the, with the

md, we can give you normative levels. And so we can say, here's, we can use the normative values and tell you what, you know, what's, what we would consider would be within the norm.

Caspar (25:41):

Do you see this technology being used now or in the future for, you know, neurological diseases? That's something that's, of course, expanding more and more and more people are dealing with neurological issues. Do you see the brain gauge as a, a metric, something being used in doctor's offices, hospitals in the future?

Mark (25:59):

It is right now. I mean, it's been used worldwide and different doctors' offices, different researchers. As far as which demographics it's been used on. We've got, we've both in the clinic and in research studies, it's been used with developmental disorders such as autism, A D H D, O C D, ADHD, with degenerative disorders such as Parkinson's, aging, dementias, Alzheimer's, you know, and, and basically with that we see people who are trying to slow the progression of it, of degenerative disorders and saying what works and what helps. Sometimes just brain training, brain exercises will help. We also, you know, with pain and chronic pain, you can look at, there are different things that the Brain Gauge can be used for evaluating. It's, it's got a pretty big footprint in terms of TBI.

Mark (26:57):

I especially in some of the studies that we've done, we've done quite a few studies with T B I, but a lot of clinicians are using it to track recovery depending on, and it really doesn't matter what kind of what kind of trauma or what kind of treatment that they're being used for that, for any particular trauma. Whether it's T B or P T S D, whatever kind of trauma, whether it's emotional or, or severe or or physical or both. But it's been used quite a bit and a lot for a lot of different treatments and, and especially it's helpful to clinicians when they do multiple treatments and they wanna see which treatment is more effective. And sometimes one treatment will work at first, but then it starts losing efficacy and it's time to change, or maybe it's time to roll off.

Mark (27:52):

And that's how they, they basically track people very well. So it's been set up so that they can actually, you can glance at their scores and see if they're improving fairly rapidly. Yeah, can graphically, you can look at somebody's history very, very easily. I'm hope, I think I hit all the, all the different groups, but basically it's agnostic. We like to, basically, the brain gauge is agnostic, doesn't care what kind of neurological disorder or neurological insult there is. If the, if you have an insult, it will, it will show up. Now, like I said, you know, even sleep de deprivation, you know, clearly shows significant changes. And we do have multiple measures and so that gets a little more complicated when you look at, what we do is we give one comprehensive score that's, that's generated from all those measures, but, which are different mechanisms, but you need all those mechanisms in intact to give you a full hundred percent score. But you know, different, different problems or different insults will create, will create deficits in different places or in diff in different areas for mechanisms. So.

Caspar (29:03):

Makes sense. Now, what, what's next for your company? Any new developments? Anything exciting on, on the horizon for you?

Mark (29:10):

I mean we, we've involved in a lot of research. Really what's next right now is, this is the first time I publicly announced the Brain Gauge exercise platform. I hadn't gotten around to making videos of it. And that's because I was waiting for our platform to get to the, you know, phase two. The first part was beta tested, it's ready to go. Phase two of it is with multiple, multiple pages of tests. So right now we've got a brain gauge plat training platform that's really looks very, very effective. And that's one thing that's really exciting to me. It's, is just being able to see how much it helps, how, how much it helps people improve their scores, improve their reaction time reaction time. You know, if it's, one thing I'm really interested in is you know, we, we know that with say, degenerative disorders, reaction time does degenerate. That's one thing that gets worse and worse and worse. If you just had someone train with reaction time, how, how much will that help slow down that, that degradation and, you know, or how much will brain training help that? And so that's a really exciting area for us. We're really, we really like trying to help people this way.

Caspar (30:27):

Super exciting. I mean, I, I, I see it all the time. We have a clinic here and I speak with so many other doctors elsewhere and it's, you know, when when you start to lose the, the function of your brain capacity, when you start to lose, everything else goes. It's so important. It's what keeps us human in a sense. it's, it's, you know, that that thing that, that, if you want to optimize any area, I say the brain is always a great one to look at. Yeah.

Mark (30:48):

Yeah.

Caspar (30:49):

So really important work you're doing thank you for that. Where can people learn more about Brain Gauge? Pick it up do the research?

Mark (30:57):

Well, you know, the, basically the Brain Gauge YouTube channel has a lot of stuff. You know, I, I used to, we also, our main website is cortical metrics.com. But you know, people go there and they get a little overwhelmed cuz there's so much information. Easiest thing to do is go to the Brain Gauge YouTube channel, just type in Brain Gauge and it'll pop up somewhere and you know, take a look at the table of contents and there's quite a few videos and take a look at the introductory videos to start and take it from there. That's probably the best way to get started. And I was, I don't know if this is appropriate, but for any of your viewers I'll give a 10% off any of the products with I N V M E D discount code and you know, if they're interested, you know, that'll drop the price a little bit.

Caspar (31:49):

Yeah. Amazing. Thank you for that. We'll link that up in the show notes and send that out as well. But mark, thank you so much for all of this and your work. Where are you headed to next to present? Cause I saw you in Scottsdale there are you going?

Mark (32:04):

I'm going to, I believe Los Angeles in a couple of weeks for the Human Brain Mapping conference. And

Caspar (32:12):

That's, that sounds like that

Mark (32:14):

I'll be at the isis I micro feedback conference giving a talk there.

Caspar (32:20):

I I'm sure you're, you're always on the road. There's a lot of events and conferences to go to and spread. Yeah,

Mark (32:26):

I'm on the road a lot. It's it's kind of tough, it's kinda tough.

Caspar (32:30):

No, it, it, it, it's not an easy life. Right. I used to do that a lot when I was younger and just go one to the other conference. And especially when you're an exhibitor and just have to stand all day and talk to people who know nothing about you,

Mark (32:41):

Exactly. That it is a, it's a tough gig, but

Caspar (32:46):

Yeah. But, but it's a, it's a worthwhile clause and, and you're doing a great job with this. So again, mark, thank you so much.

Mark (32:52):

Thank you. I, I enjoyed it.

Caspar (32:54):

And as you heard here today, there's so many ways we can improve our brain health and work to protect one of our most important organs and brain. Great. Brain Gauge is doing a great job at it. Look into it, see how you can apply brain gauge in your life. Until next time, keep writing your own healing story.