Heidi: Thanks Gerald, thanks Phil, thanks Gerry. Pleasure to be here. Not so happy with the Germans at the moment. But anyway, it's probably a good thing that I ended up drinking with the Germans last night, because it might slow me down a little bit, and then it makes it a bit easier to understand.

Is there anyone here that has never heard me speak before? Oh, shit. Oh well, I'll try and behave myself for a few minutes, and then let loose after that. So what I'd like to share with you guys today is a little bit of where we're at when it comes to research, and I want to do a little snapshot of what the last 20 years of basic science research is telling us about what a subluxation is, and about the effects of the adjustment.

But I also want to talk a little bit about where this is going, and this when I get really excited and start speaking really fast, and that's when the swear words start to flow. So I'll try to contain myself though, when it comes to that. And then I also want to talk a little bit about some really exciting studies that we are doing with some amazing collaborators, and I've been able to invite some of these amazing collaborators. They've all sort of managed to seat themselves as far away from me as possible, which is probably a safe thing, at the back of the room there. And several of them, you're going to hear from each of these guys during the weekend, which is pretty cool.

So I'm going to start off to saying again, thank you to Rubicon Group. This is a very interesting group, and I always wonder how Gerry does it. Because if you can imagine these presidents from these different colleges, it takes quite a bit of personality to become a president of a college, are you with me? And then to manage to herd them together in one direction, to me it's a bit like herding cats. So I've had the pleasure of working with the Rubicon Group over several different projects.

One of them in particular was looking at, what does the research tell us about what a subluxation is. And we came up with a really awesome definition, and it wasn't without pain, yeah? I always remember one email I got from Gerry and he was writing to me, and he obviously had written, "Please don't read this email until it's after 8:00, you have drank at least one bottle of wine, and you have no sharp utensils around." That was very interesting, yes. And I still remember that email, too.

Another thing that I get to do with the Rubicon Group is invite speakers to these events that we hold, and last year I had the privilege of inviting some real highly esteemed professors from around the world. So we had Professor Paul Hodges, and he presented on the state of what do we actually know about how the brain controls spinal function. And it's really fascinating, because even as a group of scientists, neuroscientists all around the world, we still don't fully understand how the brain controls normal, healthy spinal function. Think about that, right?

Yet we chiropractors beat ourselves up for not fully understanding what a subluxation is, which is a spinal disfunction, right? We still don't even understand how the brain full controls healthy spinal function, let alone how to understand when there is dysfunction. So he talked us through what we know in a healthy situation, right the way through to

the dysfunctional situation. And I will touch on a few of the, kind of the key highlights that he bought up in his talk again today.

Then we've got Dr. Kelly Holts, he also presented. Any of you heard me speak about Kelly Holt and his PhD with the older adults, and the, no? Okay, not that many. Right, well you've got a real privilege, and a pleasure of hearing him tomorrow with our next colleague, Dr. Imran.

Anyone heard me speak about Dr. Imran and his magic hands? Come one, there's got to be many of you. Yes. So the man is here, so you got to hug him, okay? And I will tell you the story probably tomorrow, about Imran and his magic hands. We know, I mean that's one thing that I always get face with these interesting researchers in our profession, and they tell me that it's all placebo. And I'm sure you practitioners know that it's all placebo, right? Yeah. Anyway, so we know it's not that placebo. We know that, because of Imran and his magic hands, but I'll tell you the story a little bit later on.

So then there's me, and then there was Professor Bernadette Murphy. And Professor Bernadette Murphy, she was my PhD supervisor. So again a chiropractor, a PhD in neuroscience, the most beautiful person I know on the planet, and we still collaborate to this day. And a lot of the work that we've been doing, Bernadette and I together, is looking at the brains of people with dysfunctional spines, and it's quite fascinating.

Again, if something isn't broken, what is it that we're fixing? Are you with me? Because I don't think that we just randomly manipulate the spine, and I know most of you in this room wouldn't necessarily just manipulate someone because they're hurt. Are you with me on that? We're actually checking for that dysfunctional part of the spine that we call a sc, and we're providing our thrust there, right? To allow the body to make the chnages that it needs to make.

So it's been really fascinating. Have you heard the story of why we ended up doing this research? Because we ended up doing this research looking at this dysfunctional spine and their brain function, really because we ended up having so much trouble publishing our early papers, because they're an asymptomatic people. And even though I described what it was that where we were actually directing our thrust, I was describing what subluxation I. I had big paragraphs describing what it is that we were doing, a lot of these reviewers, because we publish all our papers in neuroscience journals.

So of course the reviewers that are neuroscientists, and they couldn't understand why we were applying a clinical intervention to an asymptomatic population. So this became really problematic, it was getting very difficult to publish our papers. So in the end, we came across this category in the literature called sub-clinical pain. And we literally celebrated with champagne, and it was more than one bottle, and yes I was alone. It was one of those days.

But the cool thing about it was that all we needed to do is raced up to someone and go, "Hey, hey, hey. Have you ever had any spinal ache, pain, or tension, ever?" And they go, "Yup. Excellent, tick." "Have you sought any treatment for it?" And they go, "No,

because I don't really have a problem, fabulous, tick." It doesn't really matter if you've any injuries or not, but it only mattered that you've had this reoccurring ache, pain, or tension. And that on the day we're testing you, or that we're studying you, you are not in pain. And this exactly what we wanted.

And the reason we didn't want to study people in pain, is because pain changes every known measure of neuroscience, or brain measure known to man. So if we have people in pain, what usually happens when we adjust people in pain? Their pain reduces, right? So if we changed pain, and we had changes in the brain, there's no reviewer alive that would let me argue it was because of the adjustment. They would say the changes in the brain were because of the changes in pain. Makes senses?

So we had to have people that weren't in pain when we started out looking at, because we wanted to know not what changes in the brain when you change pain, we wanted to know what happens in the brain when you adjust subluxations. So when we had this category, it was just fabulous. So we would race up to our next group, and would go, "Hey, hey, hey, John. Have you ever, ever, ever had any ache, pain, or tension in your spine, ever?" What happened though, was some people turned around and they said, "No." And I'm like, "What?" And I said, "Ache, pain, tension?" And they said, "No." And I'm like, "I don't actually believe you."

And so after a little conversation, I found out that they weren't lying to me. They have never, ever in their entire life had any ache, pain, or tension in their spine. So instead of turning them away, we ring up the ethics committee, or the IRB for you Americans. And we go, "Hey, hey, can we include a healthy comparison group?" So we did, so what we now suddenly had, is we had this group that had this history of ache, pain, and tension, even though they were pain free when we were studying them. And we can compare them with people that have never, ever had any ache, pain, or tension in their spine, ever.

And so it's led to a whole host of studies over the last 15 years, where we found that these groups, even though they're all pain free, these groups, their brains are different. Which we're contributing to their spinal dysfunction, which we're contributing to the subluxations, so it's really fascinating. So people that have got dysfunctional spinal function, their brains are different. And then of course, when we've adjusted these guys, we can improve that function. So it seems very strongly related to that spinal function, and that's where it starts to get so fascinating.

And so we've been doing all this work over the last 20 years now, and there's a very clear picture that is starting to emerge. About just how important that spinal function is for our brain's ability to perceive what's going on in our bodies, and the world around us. And then it gets even more exciting, because of the changes that we're finding in a particular part of the brain and what that particular part of the brain does. But I'll get there.

So Bernie presented on all of that, and then the last guy on your right is Professor Kemal Turker. He's another neuroscientist of 30 years, who's now living in Turkey. And it's

started a phenomenal collaboration that we've had, this is what led to Imran and his magic hands experiments. Because when we were doing our studies in Turkey, chiropractic doesn't really exist. So the closest thing to chiropractic is really massage therapy, and it's not the kind of massage therapy that we know. Are you with me on that one? Yeah. Fabulous.

So it wasn't difficult to get recruits for our studies, are you with me? Anyway, but because no one had a clue what chiropractic was, what we started to do was, and this was Kemal's suggestion. Because I don't think you can share in chiropractic, are you with me on that? You kind of know if you've been adjusted or not, yeah? But when you're in Turkey, and they have no clue whatsoever what chiropractic is. Kemal suggested that we do a sham session. So Dr. Imran who is a doctor of bioengineering, and not chiropractic. Dr. Imran became the chiropractic number one, and I was chiropractor number two, and we just did two different techniques.

And then we could look at the effects, including a proper sham. Now the amazing thing started to happen. Because I had to leave the room when Imran was doing his thing, because I'm just about wetting my pants laughing. Because he's poking on their tummies, and lifting their arms up and, because I'm an [AK 00:10:33] practitioner, he was just kind of mimicking me, muscle testing. So anyways, I'm like... you know? So I leave the room, and I had to listen to him do health histories.

And he was, again I had to leave the room, right? Because he has no idea, so he's making shit up. But the most amazing thing happened. Because we got these ladies to come back in after their first session with Dr. Imran, and they were saying that, "Oh, yes. I slept better, and I feel so much better." I'm going, "What the fuck?" So we started to have a chaperone in the room, because we were wondering what he was doing. You never know. No, I'm joking.

But it was really cool to see because, and again, quite a few of those subjects in that particular study that we did, they preferred Dr. Imran's method over mine. [inaudible 00:11:22] I'm going, "Oh my god." But the coolest thing is, you don't see the changes in the brain from Dr. Imran's sessions, you do from mine. And to me that was a really cool thing to see, and to witness, because these people were absolutely convinced that Imran was a chiropractor, and they preferred his technique over mine. And they felt better, they were sleeping better, and they had all these placebo effects from his chiropractic care.

So to me, what we've been finding over these last, god knows how many years... no honey, I can't talk to you right now. It's not just a placebo effect, it can't be. Or we would be seeing the brain changes when Imran does his thing, does that make sense? So yeah, he's well known all around the world for his magic hands. Anyway, so it was a really interesting session, and I think you can actually watch the thing now on the Rubicon website, so I'd highly recommend doing so. You can actually hear from each of these guys presenting what we did last year, which was really cool.

So this year, I've got another amazing line up of scientists to share with you guys with where we're at. So I'm going to give you a bit of a snapshot today with where we're at. And then with each of these guys, talk about where this research is going, and why it's going in the direction it's going. And why we've ended up working with some really, really cool scientists. We were having breakfast this morning, and I was sitting and asking Ernest when's the first time I actually met Ernest. And we figured out it might be about '12 or '13, 2012 or 2013? And I was in Augsburg, because it's a group that we've worked a lot with in Augsburg. They have really good bioengineers and neuro-physiologists up there that we've been collaborating with for quite a few years.

And I still remember to this day sitting in Ernest's office that first day I met him, I was shy as shit, you know? And here's this superbly bright scientist. He does this robotic arm stuff, so he was telling me about how it's really complicated to try and get a robotic arm to do something as simple as just grasping. So this guy's so bright, it's not even funny. It's really Imran's brain and my brain shoved into one brain, just minus the chiropractic bits.

Because he's a neuroscientist as well as this bioengineering genius. And to be working with him now, it's just, I pinch myself. It's just so wonderful because some of the scientists that I meet around the world that I have the opportunity to possibly work with, as soon as they find out that I'm a chiropractor, there's a big wall up immediately. I remember going into a visit once, again it was in Augsburg, it was with a, he was a neurosurgeon. And I had set up this meeting through connections, and I walk into the room, and he's got my CV in his hands. And he chucks it on the floor, and papers fly everywhere, and he goes, "I didn't know you were a chiropractor." And I'm like, "Fuck."

So luckily I knew a little bit about rehabilitation, my family owned a rehab center. So I decided to talk to him about that, and I managed to talk him around. But the bias, I'm a neuroscientist as well, you know? Can't you just fricking talk to me about science? What does it matter if I'm a chiropractor? But anyway, we got around to it in the end, and he was going, "Well, I don't want to do any chiropractic research." And I said, "Well, I didn't want to do that with you either." He goes, "Oh, what did you want to do?" And I explained the study, and he goes, "Oh, that will be interesting." I said, "I know, and now fuck off." And I left.

But see, someone like Ernest, and Sylvain, that's here as well. I'm getting to you my dear. He's our local Frenchman. But, being able to work with someone like Ernest where there's absolutely no bias, and if anything he probably just laughs at us and thinks we're a little bit crazy. Which is actually true, so it's not too far from the truth. But to be able to work with someone like that that doesn't have that bias, it's the same thing with Kemal. That we got to work with Kemal, he just teased me for about five years, and said, "Oh, you just massage people." And he's talking about that kind of massage therapy. "And you just make people feel good." So I was like... punching him.

But it's so cool because they just don't care. Whatever the results are, the results are. And that to me is a real scientist. And that's where it gets so exciting, and the stuff that we're doing with Ernest and Sylvain at the moment is just, it's unbelievable. Even the

technology is brand new in the neuroscience world. I mean I even remember when Dario were even making those high density EMGs electrodes. Weren't that in some of our first visits there, Imran? I remember, again going into their offices, so this technology that we're using is no more than 10 years old, and again amazing research.

So we've got Dr. Imran and his magic hands, and he's going to share with you some of the most exciting research that we've done to date, is this research that we've been doing in stroke victims, and chronic stroke victims. Anyone heard about those studies? Anyone not heard about those studies? The chronic stroke studies? Anyways, fabulous. Because what our research has been indicating over the last 20 years, is that we're changing and improving brain function. Then Kemal started to tell us, "Well, you need to repeat this study now in sports populations, because improving the efficiency of the brain's ability to produce force would be quite relevant to sports people. Yeah?"

So we did, and we show it to get an improvement. And then he goes, "Wow. So what you're actually able to do", and this is the man that had been teasing me for five years that you just massage them, and you make them feel good. Here he literally comes out with, "Wow. So when you guys do what you do, it's like you enable that person's central nervous system to more efficiently use that [inaudible 00:16:43] information, and will effectively convert it into force. And I'm going, "Can you just repeat that?" And I actually recorded him saying that.

But, and then he goes, "You actually now got to start looking at the other end of the spectrum, Heidi. You've actually got to look at people that have lost their cortical ability to activate their muscles. You should look at stroke populations." And you can imagine my response to that one, right? "We kind of get accused of causing those." And he goes, "Well do you?" And I'm like, "No." Out comes the church study, the [Cassidy 00:17:13] study, the [Koslov 00:17:13] study, and the, we will be hearing all about tomorrow. No doubt? Yes?

And then so after that he goes, "Well you should go and do that then. Let's do this in a chronic stroke population." So again, thanks to this man, I mean honestly I bow down to him. If it wasn't for that man, literally 3/4 of the work that we do, we wouldn't be able to do. But because of Imran's connections again, we end up in Pakistan doing this stroke study. And that's literally what he's going to be talking to you guys about, so I better shut up before I actually tell your talk.

And then we've got the Kelly Holt. Now Kelly Holt, he graduated in the year above me at the New Zealand College of Chiropractic. He was the first year through, I was the second year through. And when I got hired at the New Zealand College in 2006 to be their research director, I didn't even have my PhD, right? I was just about finishing my PhD off. And then there was this guy that I remember from college days to be this weirdo/geek, yeah?

Yeah, that's the Kelly Holt I'm talking about. And he said, "Oh, can I just volunteer and hang out, and work with you?" A couple hours of week, I think you volunteered a couple hours a week, wasn't it?"

Kelly: I think more.

Heidi: Something like that. Well, I mean you were working at the college, but he wasn't supposed to be working with me. So then that turned into a little bit of interest in research, and all of a sudden he's doing his PhD. And he did a phenomenal clinical trial as part of his research studies in the older adults. Anyone not heard about the older adult study? Yeah, a few people. Yeah, that's cool.

So what he did in his PhD, instead of looking at falls risk in older adults, he looked at sensory motor function that's important for falls risk in older adults, and ran a clinical trial. Because what we've been showing is that we seem to be able to improve the brain's ability to perceive what's going on, and therefore to function better. He specifically picked out known measures of brain dysfunction that is found in these older adults, and did this fantastic randomized clinical trial.

Towards the end of it, we were shitting ourselves thinking, "We're not going to get anything out of this." You know? Because you can't, in a clinical trial, it's very, very different from a basic science study. Because in a basic science study, it's, well you're looking at how something works. But if you're doing a clinical trial, you're looking at if it actually improves something for someone, some health measure. So it's a very different type of study, and you can't even look at the data, and there's all these rules that you've got to follow. It's just a completely different thing.

But unbelievable, his PhD supervisor, his Auckland University PhD supervisor, when we got the results back, was so blown away. She was going, "Oh my goodness, this is absolutely fantastic. You've had this major changes in the way the brain perceived what was going on, both in the body and the world around it. We've got to publish this in the British Medical Journal." I laughed. I had spent 10 years at that stage publishing, and knew that there's a little bit of bias out there as well. But anyway, after what, 14 journals later, we got it published? Yeah, yeah.

But really, really amazing, because again, what he showed in that study was the first time we'd seen multi-modal changes. Because up until that stage, I'd shown individual changes in sensory processing... do you guys want to take a seat? Yeah, feel free. Come on in. Welcome, welcome.

We'd seen changes in individual sensory processing, like joint position sense, or a whole lot of measures that don't really mean much to anything other than a neuroscientist. But what Kelly did, is he looked at these older adults ability to perceive what's going on, and from both sound and visual perspectives, and integrate that information.

And this to me is quite remarkable. Because again, it's a study that we've done with Bernadette Murphy, and then we have the other end with Kelly's study, is the way your spine works, even influences how your brain perceives what you see and hear. Doesn't that blow you away? That to me is just so remarkable. So the way your spine works doesn't just change the way the brain controls the spine, it changes the way your brain

perceives what's going on, and changes how you perceive what you see and hear. That just blows me away.

So these kinds of things, when you start putting them altogether, you get this picture that's emerging that what we're really doing, or what spinal dysfunction does, is it makes it harder for your brain to accurately perceive what's going on both in your body and the world around it. And when we adjust you, we make your brain better able to accurately perceive what's going on inside the body and the world around it.

Do we know everything yet? Absolutely not. We're really just starting. So we're really just scratching the surface of what it is that we need know. And that each of these studies that we do, you just keep following the data. And then it takes us down to the next study, and the next study, and the next study. And this is where it just gets more and more exciting.

So what I wanted to spend a little bit of time talking about is exactly where we're at. What exactly do we know about the subluxation, and what are the studies that back this model that we've come up with? And then, what are the effects of when we adjust? But then I also want to spend a little bit of time talking about where is this going, and why is this so incredibly exciting?

Because are any of you chiropractors in the room? Have you ever had patients that have had improvements in their emotional control, or their emotional well-being, and mental health? Yeah. Anyone had improvements in patients under care with their immune system? Yep. Anyone had improvements in endocrine control or hormonal control? Yep. Anyone had improvements in sleep? Yep. Stress? Improvements in stress? Yeah.

Well, we can finally explain all of that. We actually finally now have a biologically plausible mechanism that can explain all of those things. It's quite remarkable. Anyone ever seen, because it can get crazier than that too. Anyone ever had improvements in patients in their practices from any of these chronic inflammatory conditions, like cancers, auto-immune disorder, yeah, weird right? I mean that's when we were really called crazy, yeah?

I was most embarrassed when I was out to dinner with Ernest, and this chiropractor, [Durime 00:23:22]. Because he was sitting there telling Ernest, who doesn't doesn't really know a hell of a lot about chiropractic yet. Telling him how he had cured this guy of cancer. And I was literally like, "Oh, I just wish there was hole that would just swallow me up right now." Because I want to work with this man, I don't want him to think that we're completely mad. Are you with me?

But we could actually explain why you could impact someone's nervous system to the degree that you can change inflammatory levels in the body, which could make differences to some of these chronic inflammatory conditions. Crohn's Disease, Alzheimer's, strokes, cardiovascular problems. Remarkable that we haven't had that before. I mean I know that there's still people that want to hang on to the squashed nerve root, right? Desperately.

I was even presenting at an event just recently, and I presented all the research, and the guy gets up. And I'm like, "I hear what you're saying Heidi, but I still swear if there's a T1 subluxation, there's a heart attack waiting." So I said, "Okay, fine. Fair enough. But can I give you an alternative version to that?" I said, "Because probably, it could be that stress is causing dysfunction in the spine, which puts pressure on, so you end up with postures like this. Which to me, would cause pressure at T1, right? Makes sense, yeah?

And so it's stress that's causing that. It's also stress that's causing the increase in inflammation that is probably causing the heart attack to be happening. And what could be happening is when we're adjusting them, it's not just that we're adjusting T1, but probably subluxated there because of the stress too. But then we're affecting the pre-frontal cortex, which is activating the autonomic, the parasympathetic nervous system that's actually activating our anti-inflammatory system that is probably preventing that heart attack from happening. Are you with me?

So the new model actually explains things far better than the old model ever, ever did. So I literally spend my time now, seven or eight months of the year, traveling around the world trying to stop chiropractors talking about the bone out of place squashing a nerve. How well do you think I'm doing? I'm failing miserably. But yeah, probably because it's quite a complex topic still. And just listening to me once blabber on for about an hour, isn't going to give chiropractors the confidence to be able to talk about this in a different way than they have been for the last 20, 30 years. I'm doing a far better job with the students, because I haven't had 20 years of telling the story in one way.

But before I get to all of this, I just want to spend a couple of minutes just talking about what the latest basic science research is telling us about pain. And why I want to do that, is that there's some incredible parallels between the basic science research in the last 20 years about chronic pain, and about chiropractic. And that's to me, it's really, really fascinating.

If we're not finding stuff in our research evidence that is similar to what's going on elsewhere, and out there in the field, then I would be worried. You know? What we should find in the chiropractic research should be what other people are finding across the board in different areas. And this gets really, really interesting. Something else I wanted to tell you about that, but... oh, I remember now. So when it comes to basic science research, again I just want highlight that gain. When I'm talking basic science, I'm talking about how something works.

When I'm talking clinical research, it's, does it actually improve people's health and well being? So their two very different things. If I wanted to know if chiropractic improves people health, I'd need to do clinical research. You with me? If I want to know how an adjustment works, then I do basic science research. They're two completely different types of research. It's like I normally say, they're in completely different rooms of a house.

So for example, basic science research is bedroom research, because it's where all the sexy stuff takes place. Yes? And clinical research is living room research. So if you are in

a bedroom, you need a bed, yes? If you are in a living room, it would be nice to have a sofa. Are you with me? So they're very different requirements.

And I don't know if, has anyone seen this recent systematic review that came out about brain changes with chiropractic? Anyone read that? Yeah, fascinating. One of the stupidest things you will ever do, and it's kind of interesting, really. I mean, I think that some of the authors on that list made this mistake on purpose, if you know what I mean? Because although they seem to slagging off functional neurology in their title of their actual article, what they've done is, it's a clinical systematic review. So you're meant to review the clinical evidence that exists. Are you with me?

You don't review basic science papers in a systematic clinical review. Basic science papers are completely different, have different requirements. It's like rating an apple with a banana rating scale. No matter how good that apple is, it's never going to be a good banana. Are you with me? Yeah, so it's really interesting that they've included all our basic science research in their systematic review, and then criticize it as being of poor methodological quality. Because they're rating it according to a clinical science study, are you with me?

I mean it's just, it's the dumbest thing. A scientist knows this. And they certainly shouldn't be comparing or swapping them around. Just fascinating. But I suspect, having read the author list, that this mistake might have been done on purpose, which wouldn't surprise me. Anyway, so what's coming out of the basic science research in the last 20 years is where you hurt, does not reflect where there is tissue damage. We're talking chronic pain here.

How much you hurt, does not reflect the degree of tissue damage that you have. [Laurel Mamosa 00:29:05] tells us the most amazing story about this when he worked in the ER department. He's a pain scientist, and he-

And then, there was this dude walking around the ER apartment with an ax stuck in his head. And he was telling jokes, and high fiving the nurses, with an ax stuck in his head. So the degree of tissue damage doesn't equal the amount of pain you feel. And where you hurt when it comes to chronic pain, does not mean that there even is any tissue damage there. What we're finding out in the last 20 years, is that the pain, or the expanse of pain is actually the activation of a whole host of centers in the brain known as the pain matrix.

And this becomes quite interesting. You don't even need to have, if you've had an acute injury, often there is an acute injury. Often do you have actually activated those pain neurons. They are activating that spinothalamic tract that is activating those brain centers and causing the pain. But if you talk about chronic pain, you don't have to have any nociceptors firing. You don't have any of that thalamospinal tract that is activated.

What you have instead, is this learnt process within the brain, within the limbic area of the brain. That's your danger, warning sides, part of the brain, and your cortex. And there's this whole learning process that's taking place, that has activated all these

different areas of the brain. Another old myth we had was that pain was experienced in the sensory cortex. It's not.

It's this matrix that's all around, again in the limbic areas of the brain, and up into the cortex, and in the pre-frontal cortex. So you activated all of these things, and you do not have to have an injury to activate these areas of the brain. And you don't have to activate those nociceptors. And us chiropractors that have been around for a little while, right? We were always looking for, "Where are the nociceptors?" Right? That's what we were taught at school. "Where are those nociceptors that are firing off, causing this pain in our subjects?" Are you with us?

But now what know is, you don't have to have any of this going at all. And there's a whole host of things that can activate those areas in the brain. Anything from neuro-immune responses, you can have these glial cells. Again, one of the funniest sayings I've read recently about the glial cells, is that they're more popular than the Kardashians. You activate a glial cell, and you get millions of responses around in the brain. As opposed to the Kardashian tweets, and it's a few thousand. Are you with me? It's unbelievable.

And these glial cells are finding so much out about them. We used to think that they were just the glue and the scaffolding that held the brain together. They're not. There's so much more to them. They even communicate. I mean that was the very definition of a glial cell. That it was a nerve cell that didn't communicate. So now you've got a glial cell that does communicate, well it actually makes it a nerve cell, but it's not, because it's a glial cell. Are you with me?

Anyway, that's why neuroscience gets quite complicated, because there's always exception to the rules. But you can have a neuro-immune response, it can be central, it can be peripheral. You can have inflammatory levels, it can be systemic, it can be local. You can have a whole host of social problems, things like loneliness and poverty activates the pain centers in the brain. Loneliness and poverty could be the reason someone's in chronic pain. Fascinating. Very different than what we were taught 20 years ago.

And a whole lot of mental health issues, traumatic experiences, and then down to our own behaviors. Like how much we sleep, our microbiome, our diet, how much we exercise, all of these things too, also influence what's going on in the brain.

Well one thing is becoming extremely clear, is that your reality, your perception of reality, comes from the brain. The brain creates its own image of what's going on. And this is exactly what we're seeing when we're doing our research, when we're looking at the subluxation and the effects of the adjustment. Is that we have the changes happening directly up here in the brain as well, and this is to me, very, very exciting stuff.

So one thing that's happening in the pain literature, is that we're moving away from what's known as the old structural pathology model. Meaning that if you've got lower

back pain, it's because you've got a lower back problem. Are you with me? And then moving away to this bio neuroplasticity model instead. That's a learned problem, quite often within the brain. You can have local issues, you can have tissues damage. You can have nociceptors activated as well, and sometimes it's quite complicated, and there's multiple reasons. But they're moving away from that structural pathology model.

So if someone has elbow pain, it doesn't mean that you go and...you know? It's not necessarily something that you have to fix in the elbow. Does that make sense? But see, it would be kind of important if our chiropractic researchers knew this as well, because I stood at chiropractic research conferences, and they've done a study and they say that chiropractic care is no good at fixing elbow pain. So I put my hand up and I said, "What was the chiropractic care?" Have a guess.

Speaker 5: Emergency.

Heidi: Elbow manipulation. And I'm going, "And? What else?" "No, no. No, we keep it nice and defined." And I'm going, "But that's stupid." You try not to say that when you're in the audience, but to me, so I mean I can't change what they do, and how they think, right? But I can suggest that from a scientific point of view, maybe you should change your conclusion to chiropractic care doesn't help with elbow pain. To maybe you should instead say, "Elbow manipulation doesn't help with elbow pain." Are you with me? Huge distinction there.

But this is what this stuff is coming out with. That what we really need to be changing, is the brain itself. And there's pain scientists that are now arguing that we need to find interventions, and look at interventions that have a neuroplastic effect. I get a little bit excited about that, too. And this is exactly what we're finding when it comes to the model of what a subluxation is as well.

What I'm hoping to get away from, is this structural pathology, the bones out of place squashing a nerve bullshit. You with me? Because what's happening instead, is this neuroplasticity, bioplasticity model, that's what's really going on if you look at the last 20 years of research. And you know we still have absolutely eff all evidence for the bone out of place squashing the nerve root theory? Yet we hang onto it like it's, I just don't get it.

I mean there is evidence that you can have squashed nerve roots. Absolutely, you can have herniated disks, you can squash the nerve root. But they've done animal studies where they've looked at increasing the pressure on a squashed nerve root, and to see how much pressure does it take, how much squashing of that nerve root do we need to do before we interfere with any kind of communication across that nerve? Are you with me?

And you know it takes more pressure to interfere with that communication across that nerve root, than it does to cause that radiating symptoms? So what that tells me as a scientist, is unless our patients are walking in our doors with radiating arm or leg pain, and they've got full blown nerve root lesion, basically. Unless they're walking in like that,

you do not have a squashed nerve root to the degree that it's interfering with the communication across that nerve.

But I would argue that every single person that you adjust, every subluxation that you adjust, is having a very different effect. You're not relieving pressure off nerve root, you might be, and it might be to some degree. But I don't know if that's interfering or improving any communication across that nerve root anyway. But what is definitely happening, what is definitely happening when you adjust the spine, is you're changing the communication from the little muscles closest to the spine and skull, and the way that they are communicating to the brain. And this is changing the way that person's brain is perceiving what's going on in their body and the world around them

What we don't know yet, is exactly what adjusting your subluxations are going to do for you. And we don't know exactly what adjusting your subluxations are going to do for you. So getting people into a clinical trial, that say have headaches, and they're looking at the effects of chiropractic care. Well their subluxations may have nothing to do with their headaches. Are you with me?

Their subluxations might have something to do with the strength in their arms and their legs. It might have something to do with the way their brain is digesting their food. And it might have something to do with their pre-frontal cortex activating their parasympathetic nervous system, so that they can calm down and sleep at night.

And this is where the trouble lies, because in a clinical trial, very different rules again. You kind of take people with a condition. And this is to me why it's so amazing what we've been able to find over the last 20 years, because we're finally starting to understand just what a subluxation really is doing in the body, and what the effects of our adjustments are. And that means that we can design better studies.

And that was what was so genius with Kelly Holt's PhD, in the older adults. Where he didn't go for the condition, the falls, he went for what kind of sensory motor dysfunction in the brain can we measure? And let's see if we actually improve that. And this is where we had these dramatic results. I mean some of them, it was three months of chiropractic care? And the changes that he got in some of these measures were better than previous clinical trials with six months of exercise. You know? You got six months of exercise, three months of chiropractic care, and we out much better clinical outcomes. Much better improvements in brain function, which is pretty cool.

Anyway, so this is the Rubicon definition that we came up with. About, not a definition per se, but more of a model. What is the current model of what a subluxation is according to the last 20 years of neuroscience research? And I must admit, that although it was a very painful process to work through, I think we came up with a better definition than I actually had to begin with. So it was useful for me to be working with these interesting people. And thank you for your help, Gerry, on that one.

Gerry: [inaudible 00:39:03]-

Heidi: So what we say is, we currently define a chiropractic subluxation as a self-perpetuating central segment motor control problem that involves the joint, such as avertable motion segment. That is not moving appropriately, thus yielding ongoing mal-adaptive neuroplastic effects. That is interfering with the central nervous system's ability to self-regulate, self-organize, adapt, repair, and heal. To me, that's a fantastic model, and all the work that we've been doing over the last 20 years, backs this up big time.

I just want to sort of break it down for you, just so you're with me on this. We start with we currently define, because it's based on the current research. If the research changes, we will adapt along with it. But currently, according to the latest research, evidence, this is so spot on. We then go into calling it a chiropractic subluxation, just to differentiate between if you work in a hospital, and the medical term of a subluxation might be slightly different from ours, yeah?

And we then go on to say that this is self-perpetuating, and I'm going to come back to that. I'll show you in a slide what I mean about it being self-perpetuating, and just looking from a neuroscience perspective. Then we talk about it as a central segmental motor control problem. Sylvain's going to talk a little bit about motor control in his presentation. When we talk about motor control, we really just mean the brain's ability to create movement. And it's not just a motor thing, it's a sensory thing too, big time.

And sensory motor integration, to then, so the way that the brain creates movements, or creates motion, it uses a lot of sensory information, a lot of integration takes place, and then the actual movement command as well. So it's quite a complex thing. So what we're talking about here when we say a central segmental motor control problem, I wouldn't use those terms with my patients, by the way.

But if you're talking to a neuro scientist, or a medical professional, or anything like that, that's what I call it. So when I have meetings with the neuroscientist, I talk about a central segmental motor control problem. Because what we really mean is, the brain isn't controlling the movement pattern of a segment of the spine appropriately. So what does that mean?

Well, based on the latest science, we know that the two things that the spine are supposed to do is sometimes move, and sometimes stiffen up. But it needs to move to the right degree, or stiffen up to the right degree at the right time, depending on what you're doing. So for example, if you're lifting a heavy object, you want the spine to stiffen up. But if you're out for a run, you want the spine to move in a synchronistic fashion. Makes sense?

So getting the right degree of movement at the right time, or the right stiffening up at the right time, that's what we call ideal motor control. And this is what we neuroscientist still don't fully understand. How a healthy brain and a healthy spine, how a healthy brain controls that healthy spine. But we do know, that it uses the little muscles closest to the spine and skull to sense what's going on. And then it tells the bigger muscles to move or stiffen up at the right times. That's what we know so far. But how it gets that pin point perfection, we don't really know.

But that's what I mean with a central segmental motor control problem. It means that there is a part of the spine that the brain isn't controlling the movement pattern appropriately. And then what ends up happening is that you get the tenderness around the joint, the end feel and the joint play is not quite ideal, it's not moving the way that you can feel other segments move. That's because it's not being controlled in an ideal way.

So then we go on and talk about how this, I mean yeah. We haven't narrowed it down to the spine only. The reason we didn't narrow it down to the spine only is from a neuroscience perspective, you can't. I mean the way that muscles communicate with the brain and then the brain controls movement, happens in all joints, not just the spine, the avertible column. So we didn't just narrow it down to that.

This inappropriate movement, it could be that it's not stiffening up and it should, or it's moving too much, or it's moving too little. Again, we don't really know. And then we talk about that this has an ongoing maladaptive neuroplastic effect, and I'll get to that in a minute as well. Because while it's becoming quite clear as the way we function in our health and our well-being, is a continuum. And the more stress, and the more interference that you have to your system, the further along this continuum you end up.

And one thing we are learning, is just how incredibly important stress really is. And what's quite fascinating is, we're even finding references in the literature that stress actually turns off those little muscles closest to the spine and skull. To me as a scientist, that screams that stress causes subluxations. Because if the brain can't perceive what's going on in the spine, it can't control the spinal function of that segment appropriately, and you have a central segmental motor control problem. Are you with me?

So to me, it's stress turns off those little muscles closest to the spine or skull, stress causes subluxations. So from a physiological perspective, again looking at the neuroscience literature, that's probably the number one reason that people get subluxiated. Fascinating, isn't it? And then of course you can have injury, you can do the same thing.

And then finally, we talk about that why this is a problem, why this maladaptive neuroplastic effect is a problem. Is that it interferes with the brain's ability to self regulate, develop, and heal. And that is what we mean by vitalism. No airy, fairy, godlike figure in that definition at all. Are you with me?

But we recognize that the body has this innate ability to self maintain, self regulate, and heal, repair. And if you look at it physiologically speaking, we're talking about homeostasis, neuroplasticity, and bioplasticity, and our immune functions. So again, no hocus pocus in any of that, which is kind of helpful.

So what is becoming quite clear, is that the brain uses all the different sensory information to create it's own virtual reality. And this is why it's becoming so much more easier to understand how spinal function fits into all of this. We didn't know that spinal function was so important to all of this until we started to do all these studies.

But what's coming out of this research is, the way your spine is functioning is even influencing how you perceive sound and visual information. Or how you control arm movements, or how you mentally rotate objects in your environment mentally. I mean it's quite remarkable, so spinal function is just one part of the sensory information. It's the propriocept of spinal information coming from the spine, seems to be so important for how the brain creates all these maps.

And again, how the brain does that is very, very well known. I mean this is multiple chapters in Kandel, Schwartz, and Jessell, which is one of the bibles for neuroscientists post grad. They have hole volumes on talking about how the brain uses its sensory information to create these maps in the brain of what's going on in the body and the world around it. And it uses these maps for every thing.

So all of a sudden, it's again becoming so clear now why or how spinal information could so easily influence how the brain is processing vision, and how the brain is processing sound. It sort of becomes much easier to understand if you understand how the brain actually operates.

And then it's recognizing or realizing that, oops.

Speaker 4: You're good.

Heidi: We're all good? Recognizing that these adaptations that take place in the nervous system, they can be a positive thing or a negative thing, depending on what's going on for you. If you're under too much pressure and stress, you'll end up developing or adapting in a negative way. It's all the same adaptations, but we call it maladaptive if it's going in a direction that is not good for you, that ends up with signs and symptoms. Then we call it maladaptive.

So this is what we talk about now that you have a healthy state, and you have a pathological state. But between there's 50 shades of gray, and yes I do like that book too. So in a perfectly healthy state, if you are affected by stress, or trauma, or traumatic experiences, or in my opinion subluxations. This is what pushes this maladaptive plastic thing down towards the pathology end of the spectrum.

And it is possible to move backwards, so things that improve or have a positive bioplastic effect, do you know the model that we talk about? What that's called? It's the salutogenic effect. It's that positive salutogenic effect. What things cause positive healthy adaptations in the brain and body?

Speaker 5: Exercise.

Heidi: Exercise.

Speaker 5: Nutrition.

Heidi: Nutrition.

Speaker 5: Rest.

Heidi: Rest.

Speaker 5: Meditation, mind-

Heidi: Meditation, mind, mindfulness.

Speaker 6: Sleep.

Heidi: Sleep. Microbiome. So we know this, and what appears to be the case is now when we adjust subluxations of the spine.

And I would almost argue that adjusting the subluxations of the spine is almost more important than all the others, because it makes the brain more accurately more aware of what's going on so it can do all those other things better. And all of a sudden it starts to make sense what we've seen and practiced for the last 125 years. And this is to me, what gets, it just gets so exciting.

So we know that stress and traumatic events push the body down that negative direction. I add in subluxation, because it fits so perfectly with the last 20 years of research. That's what it indicates, that it pushes us in this direction. Once you've experienced enough of it, you go past that magic line and you end up with symptoms.

Usually the first type of symptoms that we get is... increase in heart rate, breathing rate, anxiety, depression type things. Especially with traumatic experiences. Once you've had a traumatic experience, you go into fight and flight. That's usually what happens with injuries as well. Your body goes into this fight and flight, and you end up with these symptoms.

If you continue to have stress in your life, or if you've had a traumatic experience, all you need is a potential stressful even that reminds your brain of what happened. That's the freaky thing, our brains remember everything that happens to us, and changes based on our experiences. So if you've had a bad experience in your life, your brain has become different from that day onwards.

And now all you need is something that vaguely reminds your brain of that experience, and you go back into full blown fight and flight mode. Really, really interesting. There's a truckload of research on this. And you obviously then get pushed further down that direction, and now you end up with those alertness issues. So you can't sleep properly, you end up with a functional gastrointestinal problems. Because of the time you're spending in fight and flight, you're not into the parasympathetic with the digestion, and the healing, and the reproduction takes place.

And this is why you can't calm down, and that's why you end up with the sleep problems. This is where people start with all the addictive behaviors. The alcohol, the drugs, to numb the trauma, to numb the pain that they're feeling. This is when you start to have problems with memory and attention. This is because stress turns off the prefrontal cortex, and that prefrontal cortex is your rational mind, your ability to think clearly, and remember stuff, and organize yourself. That is the prefrontal cortex.

And this gets switched off by the time we are continuously exposed to stress and trauma. This is when we end up with tight, sore, big muscles. Again, because the body, because of the fight and flight. It's putting your system into getting everything going into the bigger muscles for fighting and flighting, or running away, right? And so if you can't do that and you're not exercising enough, you get the build up of lactic acid, and this is where our muscles get tight, sore, and stiff. Aren't these your typical patients?

And it just now makes so much more sense when we start to realize the physiology behind it. And again, I put frequent subluxations in there, because if you're in fight and flight, you've literally turned off those little muscles close to your spine and skull. How much time do I have left?

Speaker 4: Ten.

Heidi: Sweet.

Speaker 4: Ten minutes.

Heidi: Yep. When you get pushed far enough along, this is when you get into the symptom category. This is when your inflammatory levels have been so high, because your prefrontal cortex is turned off, and your prefrontal cortex is your anti-inflammatory system. They know from blockage studies, if you block the prefrontal cortex it literally stops the vagus nerve from functioning. The right vagus nerve in particular. And that is your anti-inflammatory system, so if you're not ever turning on your anti-inflammatory system, the inflammation levels rise.

And this is what they think is the reason why you get a lot of these chronic inflammatory conditions, like your coronary artery diseases, strokes, obesity, Alzheimer's, diabetes, cancer, and so on, and so on. Fascinating. Purely from stress. Really, really interesting when you start looking at the physiology of it. And of course, a whole host of mental health disorders, and then you can push backwards.

So the bio neuroplasticity of the subluxation, what's coming out of all these studies that we've been doing with Bernadette Murphy over the last 15 years, is either stress or injury to the spine turns off these little muscles closest to the spine and skull. And I don't just mean episodically, but it turns off these little muscles, it can be neurological. But overtime as well, these little muscles can actually atrophy.

And it's so important that they actually send their messages to the brain. But anyways, if you literally turn them off, you're changing the communication from these little muscles

going up to your brain, and this is changing the way the brain perceives what's going on in the body and the world around you. So this obviously makes it harder for the brain to know what's going on, so it's not controlling, it's not as self-aware, it's not able to regulate itself, it's not able to maintain itself, and adapt and heal.

And this, obviously then, you can see how this can me self perpetuating cycle as well. Hmm, having issues here aren't I?

Speaker 5: [inaudible 00:52:51]-

Heidi: Because if the brain doesn't know what's going on from the little muscles closest to the spine and skull, how can it control that segment in an ideal way? So you get this self perpetuating cycle, because the brain doesn't know what's going on, it can't control a spine appropriately. And this is going to continue to negatively impact the brain's awareness of what's going on in the body, and the world around it. And again, we've done many studies over the last 15 years that has shown this quite clearly, and I've got the references there for you as well.

And actually you can get the handout, which is why I'm skipping past it, but you can get all the slides if you want there, the handout from today's talk. But what's becoming quite clear is the messages from these little muscles spindles, the stretch receptors within those little muscles closet to the spine and skull are so important. And this is coming out of so many different groups, this is not just us speaking.

There are scientist that are arguing that the proprioceptive signaling, meaning the stretch receptors from the little muscles closest to the spine and skull, is vitally important for why you get the brain changes that take place with chronic muscularly problems. So they're saying that the communication from these little muscles is what causes the reoccurrence and the chronicity of spinal pain problems.

There's other groups that are talking about, because we know that these little muscles change over time. And again, there's a ton of research on that, I'm skipping past it because of my time delay. And there's also an accompanying massive amount of changes in the way the brain processes information after again you've had spinal injury. So this is well documented stuff, I'm not making this shit up at all. It's well documented in the literature that you get all these changes.

And this is fascinating, we were sent this study by Bernadette Murphy even just a couple of days ago, where they're talking about again, neck muscle spindles. So again, the communication from these little muscles around the neck is causing problems with the way you can integrate multi-sensory information, and causes problems with reaching. So again, study upon study, upon study is showing that this is the case.

And to me, what's happening is when we're subluxated, this communication from these stretch receptors different. It changes. And that's what makes it so hard for the brain to recognize what's going on, to perceive it accurately what's going on, and therefore be able to perceive what's going on and control the body in an ideal way.

So what then are the effects of the adjustment? Well when we adjust, what we know happens is we stretch these little muscles close to the spine and skull. When we set up our specific adjustments, we're stretching those little muscles that go between the vertebrae. And what we're doing in that case, is we are blasting the brain with that mechanopreceptive input.

And when we're doing a fast thrust, the high velocity, low amplitude thrust, or using an activator, or an adjustive device like that, we know we're activating the muscle spindles. And that this is blasting the brain. Not only that, you change the movement pattern of the vertebrae afterwards as well. So not only do you have the blast during the thrust, during the adjustment, but you're also changing the signaling from those little muscles after the adjustment. And it's like an ongoing effect, which is kind of cool.

And what we're seeing in the research again, that this is changing the accuracy with which the brain can perceive what's going on, both in the body and the world around you. So not just changing the way the brain perceives what's going on in the spine, but it's changing the way we see and hear things. It's changing the accuracy of the brain knows of where arms and legs are. It's changing the efficiency with which the brain can produce force. It's making us stronger.

It's fascinating the kinds of research that we're finding. So the brain seems to be more accurately aware of what's going on, and therefore it has improved awareness, improved control, and improved adaptations and healing. So again, many, many studies are showing this, and again we've got two pages of references this time, and you can get the handout, and you... those blue ones by the way, they're all freely downloadable. So you can actually just click on those links and read the whole article, if anyone is so inclined.

But what's really exciting to me, in the last few minutes I've got, is this effect that we now know we have on the prefrontal cortex. Because that prefrontal cortex is incredible, I mean when we found that out, we were in Denmark. We were in this hospital in Augsburg, and we didn't do any of the data analysis. So we found the same thing, this little squiggle changing multiples times, and we published it multiple times. And then we ended up going to Denmark, because we wanted to find out exactly where in the brain are these changes taking place, that we've consistently seen in multiple studies.

And then when we're there, and it's Dina Lelic is the, she was the post grad student that actually did all the data collection, and the analysis for us. And she could calculate exactly where in the brain the changes were taking place. So we had an idea, because we knew what the squiggle was, and we knew that there were multiple generators of that particular squiggle. But we just didn't know, were we affecting all of them, or one of them, or what?

And she comes to us and she goes, "Heidi, you're only actually affecting one part of the brain when you're adjusting the spines, and it's the prefrontal cortex." Well I just about died. That was another one of those moments that I'm celebrating with champagne,

actually it was more than champagne. I think it was so bad, we drank so many bottles of wine that night, didn't we with [Aspiern 00:58:11]? Down in this little restaurant in Augsburg there, that we didn't even dare put it on the college account. So Kelly was splitting some of it, and I was paying for some it, because it was an embarrassing amount of wine.

But it was unbelievable, and at that stage, I didn't even fully understand what it is that we had discovered. I knew that the prefrontal cortex was this rational thinking mind, but I didn't realize how big a finding that was for us as a profession. Because what I've since discovered, is that that prefrontal cortex, it's a major part of the pain matrix. So this is possibly one of the reasons that we're so good at fixing pain, because we're directly affecting the brain where the volume dial is for people feeling pain.

Because we know now that pain isn't necessarily because of tissue damage, chronic pain could just be a brain learning problem. And we're probably turning it down directly in the brain. But it's bigger than that, we also know that the prefrontal cortex is our executive function.

Their ability to reason, their memory, their logic, being able to think clearly. How many of you have not heard that? That it's like my brain is clear after an adjustment.

Speaker 5: Absolutely.

Heidi: Yeah.

Speaker 5: Yeah.

Heidi: I mean that makes so much sense. But it's even better than that, that prefrontal cortex is critically involved in our emotional responses and mental health. Critically involved. We not have a rational, logical, biologically plausible mechanism for how we could help patients with mental health problems if we're actually improving prefrontal cortex function.

And it gets better than that, the prefrontal cortex is vital for balancing that autonomic nervous system. Being able to switch on the parasympathetic nervous system, so being able to sleep, being able to lower blood pressure. I mean how many people have not had patients reduce blood pressure? It's remarkable, isn't it? Well we now can understand why. Because if we're affecting the prefrontal cortex, and it's activating our parasympathetic nervous system, it will calm down the blood pressure, the breathing rate, the heart rate, improve heart rate variability, being able to settle down and sleep.

And it's even better, prefrontal cortex is critically involved in endocrine control. And it gets even better than that, prefrontal cortex is critically involved in our immune functions. So no wonder we have these studies showing that people that are managed by chiropractors have 60% less hospital visits than all the rest of it. Are you with me? It makes so much sense now.

Other studies as well, and then again all chronic inflammation. All chronic inflammation. Prefrontal cortex is vitally involved in activating our anti-inflammatory system, and therefore potentially influencing anything of this. That just blows my mind. So when you look at studies like this where you survey 25,000 Americans, and ask them what do they feel with chiropractic care, and 67% said they feel better, they stress less. They can calm down, 40% sleep better.

I think that's my cut off.

Speaker 4: Take your time.

Heidi: Give me a minute. 13% even reckon they have better relationships with others. I don't know about you, but these kind of statistics scream prefrontal cortex to me. To me this is exactly why we can make those differences, would be because we affect the prefrontal cortex.

So, yeah I've put that in there as being the reason, but before I finish, and I am about to finish, is we have a hell of a lot more work to go. Because so far, all the stuff that we've been doing is basic science research. So what we've got lined up, and what you're going to hear about soon from the boys, is that we're doing a lot more now in the clinical side of things. Because we don't know if we improve all these functions, all we know is we affect prefrontal cortex function.

So if that's a positive thing, I'm assuming it's a positive thing, because I'm a chiropractor. But we actually have to prove that as well, we have to see in studies, are we actually improving these different aspects of prefrontal cortex function? So we've got to do a lot of clinical trials now and see, "Do we actually improve mental health? Do we reduce inflammatory levels? Do we affect all these different sides?"

So we can't go claiming based on the research that we've currently done that we definitely know that we fixed all those things, because we don't know that yet. But that's what this research indicates. And that's what gets me so incredibly excited about the work that we're currently doing, and the collaborations that we've got going. Because it's taking us to the next level, and the next level, and beyond.

So we're having a break now, aren't we? And then we're back on again with Ernest. So yeah, I'll get the handout up on my closed Facebook group, and thank you very much for having me.