

# Rewiring The Brain - Michael Merzenich

## Neuroplasticity and rewiring your brain with Michael Merzenich

Today's interview is with Dr. Michael Merzenich - If you have had a similar experience with stroke as I have, Rewiring the brain may be just as important to you as it is to me. After I experience 3 brain bleeds between 2012 and 2014. I have left no stone unturned while on the search to recover the deficits that I gain after brain surgery to save my life and stop a faulty blood vessel from bleeding.

You can listen to some of my stories [here](#).



When I woke after Brain surgery in the Royal Melbourne Hospital, complications meant that I could no longer feel my left leg and arm. I studied everything I could find about what I could do to help me in my recovery. That's when I came across the work of Dr. Michael Merzenich.

Often referred to as the father of Neuroplasticity, in his early career Dr. Michael Merzenich was part of the team that developed the early practical prosthetic device models that later became commercially known as the cochlear implant that helps deaf people hear.

# Rewiring the brain offers hope - Michael Merzenich

In the early 1990s Dr. Merzenich set out to find applications of his team's research findings that the brain was in fact able to change and devised a program to help neurologically struggling children and adults.

Dr. Merzenich is the founder of Brain HQ the brain training application helping people enhance their brain function and his most recent book is called Soft Wired - How the science of brain plasticity can change your life.

In the interview, I will ask Dr. Merzenich about how Neuroplasticity can be used to support people that are recovering from brain injury and specifically after stroke.

We also discuss the matter of how General Anaesthetic can create premature aging of the brain, particularly for people that have not had a brain injury as well as people with a compromised blood-brain barrier.

Transcript:

**Bill:** [00:01:30] I actually didn't realize that you were Lebanese.

**DR Merzenich:** [00:01:33] Well I'm not Lebanese. I don't know where I'm from Lebanon Oregon. And that's a strange way of being Lebanese. Was named Lebanon because there were cedar grove trees down by the river which of course Lebanon is famous for.

**DR Merzenich:** [00:01:49] But my wife did spend two years at the University at American University in Beirut so I'm sort of Lebanese by adoption.

**Bill:** [00:01:58] I found it very interesting when I was reading your bio. I thought it was a really funny thing to start the interview with a pinhole people call that thing. Okay so your early research apprenticeship was at the time with one of the world's strongest auditory groups at the University of Wisconsin Madison. The at hand was to define the fundamental nature of functional organization of the central auditory and since somatto sensory nervous system. Back then what. Why do you feel that this was an important definition to achieve. What were the lead

researchers thinking.

**DR Merzenich:** [00:02:37] Well I was interested in the agents of the higher functions of the brain and at that point the understanding of the basic way that brain systems were organized was so primitive that it was very difficult to understand how to get to the real questions which are the basis of perception the basis of sensation based cognition and so just to understand how the machine was working how the machine how the brain was operating encoding information and translating information into action was so poorly understood that we knew we needed to have a better grounding and so these studies did lead to a better understanding of how the brain was actually taking in information from the ear from hearing or from the skin from Madison sation and translating it level by level and interpreting it and then basically using it to control its action the production of speech of the production of vocalizations and animals for the control of actions fed back from information from the body. In the case of semantic sensations so we did contribute to making that first level developing first level understanding of how the brain is actually organized to do what it does or very important and you know you can say some of the implications as a result of that work.

**Bill:** [00:04:02] You know what that led to it is just amazing. It's really fascinating to me that somebody was thinking about those things and trying to come up with solutions. It seems so obvious there but at the time it would have been groundbreaking right.

**DR Merzenich:** [00:04:18] It was wide open in the sense that science was very primitively developed. We really had to know how the brain was organized. For example, there was a fundamental misunderstanding about the plasticity of the brain. Historically it was imagined that the brain could change when you were a baby and it grew up and matured reached a mature state when you were maybe a year or two or three years of age and from that point forward it is like a computer on your desk it was hardwired every element was fixed in its function and the really only way it had changed from that point forward was to go downhill because it had grown to a mature state and it turns out that that that was an incredible error. So we now know that the brain and we see one thing that we contributed to the appreciation of the discovery of the brain is in fact continuously changing itself. In fact, it's big it is continually remodeling itself as a function of how you live your life you engage it. But at that point, our understanding of it was so limited so primitive that we did not understand that.

**Bill:** [00:05:28] Yeah.

**Bill:** [00:05:28] Fair enough it's such a great thing that the brain changes itself and we'll get to that in a while. It's just that it's my big thing but I'm enjoying knowing about my brain. In the 70s and 80s, you led the research team that developed the early practical prosthetic device models that later evolved into a commercial multiple-channel cochlear implant.

**DR Merzenich:** [00:05:53] Right

**Bill:** [00:05:53] When you helped to feel some knowledge gaps for the surgeon. Robin Mikkelson in his understanding of the coding of sound and speech in the inner ear or auditory brain and as a result hearing was recovered for deaf people. Were you aware that these achievements at the time were challenging the broadly held conclusion that the brain was hard wired or did that come later.

**DR Merzenich:** [00:06:21] Well we really did think of it in those terms what we were trying to do and I must say there were two other efforts in parallel. One was in Australia by scientist associated at the University of Melbourne and one was in Austria and in parallel we each develop different strategies to encode speech and our notion was that we could represent speech well enough so that we could have a primitive level of understanding. Mike might expect that if everything worked well but we were really trying to just deliver information into the brain the way the normal ear does in an accurate enough way so that the individual would understand that information even though we knew that our ability to duplicate what normal intact ear delivers to the brain would be very crude. I liken it to playing Chopin with your fist.

[00:07:19] And in fact people didn't understand it initially and it took plasticity and the brain basically to make the devices work.

[00:07:27] So they are often thought of as a sort of miracle of engineering but actually they're a miracle of engineering in the plastic brain and the plasticity and right is absolute critical contributor to the successful application of cochlear implants because they don't understand usually what that information is at all initially. And the brain changes in a way that confers understanding and so we began to appreciate as we are doing in these experiments the only way we can really account for what was happening in these individuals was if their brain was plastic throughout life on a large scale.

[00:08:08] And we began doing experiments that demonstrated that other than other venues

**Bill:** [00:08:14] Yeah Fabulous or is it neuroplasticity or neuroplasticity.

**DR Merzenich:** [00:08:18] Well you can go either way and sometimes we call it plasticity neuroplasticity and well it's irrelevant

## The godfather of neuroplasticity

**Bill:** [00:08:26] Awesome you've been called the father or the Godfather of neuro neuroplasticity for good reason. I wonder who were some of the scientists and researchers that you learned from and based your research on.

**Michael Merzenich:** [00:08:42] Well actually it's a little unfair because around you know if we look to the early part of the 20th century it in fact even in the late 19th century the predominant belief was that the brain was in fact changing itself as you acquired ability as you learned. And then we sort of lost sight of it in the mainstream of science.

[00:09:02] But there was always scientist from physiological psychology from the psychology side of science that believe that the brain was plastic it's just that in the medical mainstream that notion was abandoned because you know you can say when people are doing the most careful experiments they develop this religious idea that the brain was in fact hardwired. And so certainly we helped. You could say make this correction we did a very specific simple experiment that demonstrated the brain was changing itself if you manipulate its inputs in inputs from the scanner impulse from the ear that when you train an animal in any skill and it improves that ability that you account for this improvement by changes in its brain. So you know that led to the understanding that the brain was continuously plastic and we very early did experiments Bill in which we looked at animals near the end of life. Ok this this animal is expected to pass from this mortal coil within a few months or a year. It just as changeable or is it. And we found to our.

[00:10:16] Delightful surprise that it was just as easy to modify its brain almost as easy as in an animal in the prime of life or an early and you just had to make the conditions appropriate for the brain the machinery of the brain because what

happens when the brain grows up in early childhood is it matures in its ability to control that change and what it's doing is it initially it doesn't have that much control because it still primitive and once it has control you could say it can limit change to the conditions in which the change is going to be good for it but it's still powerfully plastic throughout life.

**Bill:** [00:10:57] I love what you said there is you've got to make the right conditions to allow for the right type of change to occur.

[00:11:03] Right now no the brain only changes when it matters to it is a simple way to think about it and it changes it very much as a function of how you're evaluating it and how engaged you are and how intent you are how how how important it is to you because that's actually controlling the machinery of the brain which is controlling the rate of change and the extent of change.

[00:11:29] So in the case of somebody recovering from deficits after a stroke if it's not important to them to recover it's likely that they're going to have a longer more withdrawn drawn-out rate of recovery.

[00:11:42] And it is one of the biggest problems they have because the brain is damaged and it weakens the information that is fed to areas that are controlling your motivation. So you could say you are commonly demotivated as a function of the injury. And so it's a special struggle for such an individual they have to make a very special effort and you know we have strategies in which we're trying to help them increase their motivation.

[00:12:15] But it's a struggle for them often to just get up for doing what they need to do to get better.

**Bill:** [00:12:21] So I wonder if somebody had was able to be encouraged via things that they enjoyed doing so something that their heart was in so to speak right their heart being in a process of recovery or a version of their recovery if it was something that their heart was in

**Michael Merzenich:** [00:12:39] Right

**Bill:** [00:12:40] That would sort of could that possibly overcome those areas or support those areas of the brain that were damaged on the motivational side.

**DR Merzenich:** [00:12:49] That's a really important question. Well, people have

discovered in rehabilitation in fact that if you go to things that are important to you maybe things that relate to your former life's work may be things that relate to your the things in your family or in your extended relationship or friends that are the most important to you or you go to the hobbies that are the most important you most developed that this is a very favorable avenue for you to begin to restore your ability because and your reinforced by all of those other things that we're contributing all of the richness of that historic experience and bringing power to bear you can say and trying to drive change positively. So yes that is a strategy that can be very helpful and can make a big difference and somebody trying to recover from brain injury.

**Bill:** [00:13:43] Amazing. I wonder early on how was your research received by your peers early on in your career.

**Michael Merzenich:** [00:13:50] How was it?

[00:13:51] I didn't understand your question

**Bill:** [00:13:53] So the research findings that you were publishing how around neuroplasticity how was that received by your peers? Was it a difficult area to gain recognition in?

**Michael Merzenich:** [00:14:06] Well initially there was skepticism because the overwhelming belief in neuroscience was that the brain was just not plastic and as it grew up and it was so deeply embedded in fact a Nobel prize had been awarded in the 1970s around this issue that it was regarded as one of the settled issues in science and it was broadly adopted in medicine. So in fact many neurologists today will tell you that plasticity is powerful in a baby and not powerful in an adult and they still misunderstand its powers.

[00:14:45] I might say in their lack of understanding it in fact is harmful.

[00:14:55] Many people could benefit from it but initially, there was dismay I mean you were a challenge at scientific meetings.

[00:15:02] People are very skeptical that quite quickly the evidence came to be overwhelming and in fact, one of the easy experiments that do Bill in the universe of science is to engage a human or an animal in a learning progression in which they acquire a new ability or they improve that ability.



[00:15:24] And if you do that all the appropriate expression of the brain has to change and it is if you do the exam in an appropriate way you will witness that change and the change will account for or relate clearly relate to the improvement of the ability. So it turned out that over a period of five-six seven years, the evidence became overwhelming and now it is pretty universally agreed that the brain in fact is continually changing itself and we understand the processes by which it changes itself in great detail.

**Bill:** [00:15:57] Yeah, what's really amazing is that I'll talk about my experience with a brain hemorrhage as we continue as well was that when I went to rehab the nurses and the physios and all the people that were involved in my recovery. One of the first things they said to me was I, by the way, do you know about this thing called neuroplasticity. And if people didn't which there were many that didn't that was the first thing that they told you about

**Michael Merzenich:** [00:16:26] Yeah yeah, I found that a fascinating approach because it was four years between my first experience with a hemorrhage and surgery. So I had already read up on it and understood about it but I was really great to hear that that's the approach they were taking when first coming across their new patient.

[00:16:46] Right. No no that's great. And that is, in general, there's a general broad understanding that this is in play and this is a path to restoration and recovery now an increasingly intelligent understanding of how to drive change.

[00:17:02] You could say to the benefit of a patient that an individual needs an individual struggling and that's revolutionizing how we think about rehabilitated medicine.

**Bill:** [00:17:13] In the early 1990s your research findings began to be applied to help neurologically struggling children and adults. What kind of challenges did you seek to apply neuroplasticity to in the early days?

**Michael Merzenich:** [00:17:28] Well we looked for a model we know first love we knew that this had broad practical implications for it that they were you know millions of hundreds of millions of people could benefit by the application of science. So we looked for a target. I met a wonderful psychologist who studied the deficits that children have when they struggle at school and she focused on deafness Paula Talau was her name and she'd focused on deficits and language



and reading skills and she saw that most children that had that struggle to learn to read had deficits in language and that reading because reading is a translation of listening to the sound part of words that are meaning and works to their representation by letter. She appreciated that the majority of the children that struggled in school had inadequate representation in the listening domain and that needed to be clarified for further translation by letter and reading to make sense.

[00:18:30] So being aware of her work there knowing that the kinds of deficits that she described as applied to these children could certainly be impacted by training. We develop the model training program that took a series of these children's laboratories that were in New Jersey and trained them and these children are all you know not reading if they were reading it was way below grade level. They all had language impairments we trained them and after training all of them were normal or above normal. And we realized that this would have a very wide practical application of course. So I went to my university I said look we have something that can potentially up many millions hundreds of millions of children in the world.

[00:19:21] So how do we get it to them in the world?

[00:19:24] And they help me contribute to the foundation of the business and that business which is called scientific learning Corporation has now trained quite a few million children in the world who wouldn't be effective readers in a way that an assured that they were effective readers and basically trained them as listeners and they're listening accuracy. That was the beginning. So it was always imagined by us to be the beginning because we realized that there were many other applications of the science and that there were many people that struggled for all kinds of reasons with psychiatric illness.

[00:20:02] People that had brain wounded, people were losing it as they got older for all kinds of reasons. By engaging your brain to drive changes in your brain to its benefit, how managing your brain health was possible by using these strategies and so that's what I've been up to ever since I've been trying to understand how to translate the science to the benefit of people that struggle and God knows Bill there's plenty of those, that's about half the human race.

[00:20:39] Yeah.

**Bill:** [00:20:40] Look I think it's amazing that specifically, the approach that you took was where you came from understanding that the brain is physically changing, and as a result of that it will adapt and allow for these new structures to occur and therefore anything that we need to enhance or.

[00:21:00] or create for somebody or help somebody create in their own brain is possible.

**Bill:** [00:21:05] So I think that was like a novel way to approach a problem like somebody can't read in the past people like that were just given the pop them on the shelf kind of treatment. They're never going to learn they're always going to be that way. So it's amazing that this approach of neuroplasticity got to that result. How did you track the progress? Obviously they went from not being able to read to being able to read etc. and communicate properly, but in the brain did you guys have access to FMRI at that time in the early 90s that could show the changes.

## Recording the brain and how it operates - Michael Merzenich

**Michael Merzenich:** [00:21:45] Yes did Bill.

[00:21:47] We recorded from brains in a number of ways and FMRI and using evoked response strategies and using positron emission tomography where you're looking with radioactive tracers of activity and we could see the brain physically and functionally changing as we train it.

[00:22:05] So this is, you know, we now know in a rich scientific basis that when you engage a brain and train it first of all you can define a assigned brain of someone struggling for whatever reason you can record their weaknesses their limitations in both behavioral terms and in terms of the physical and functional brain.

[00:22:27] They can document the specific bases of their problems and then that defines a plan of attack for helping them for guiding them to be better and stronger again to move in a normal direction. And unlike medicine that's dependent upon gross for example chemical manipulation or shocking the brain in some way which is a sort of high standard of current neurological medicine we

don't have very crude strategies they're based upon the principle that you're going to do something that distorts the brain in some way that will help you on the path to recovery and that's crude in relation to identifying the faults and using this great natural asset the plasticity of the brain to drive the brain back in a normal direction. You can see if there's ever a true cure for any logic or psychiatric condition. That will come from engaging your brain to naturally drive it in the correct direction.

[00:23:42] So it's not that this is easy to do. You might have to train a lot and maybe you can't get the role to play in practical terms in every person. Certainly not when the brain is damaged but you can make large-scale differences in the corrective direction and almost every individual that's struggling and this is what we're trying to do inpatient cohort after patient cohort

**Bill:** [00:24:09] It's really amazing stuff I was in the hospital recovering from my brain surgery as a result of it when I woke.

[00:24:20] My left side was numb. I had motor neurons on sincere and urine challenges. I had to learn to walk again and reuse and learn how to use my left arm again and in the time that I was waiting for the different rehab exercises to occur and to be called down to rehab I was watching videos of you delivering your speeches and I was watching Paul Bach-y-Rita and I was watching a whole bunch of other people. And it occurred to me that if I meditate and imagine myself

[00:24:58] Walking and using my arm again will begin the process and it will be then not unfamiliar. When I get down to the floor and the walking

**Michael Merzenich:** [00:25:08] Right right.

**Bill:** [00:25:09] How does meditation and imagining oneself walking actually change the brain? Does it actually change the brain?

**Michael Merzenich:** [00:25:16] Well it was a wonderful insight that you had Bill because actually the machinery involved is engaged by mental practice is no different from the machinery that she is involved in physical practice. It's exactly the same machinery. I mean it just doesn't lead in the end stage. In other words, if I practice I'm actually driving changes in my brain just as I practice them and when I'm in action people can imagine playing the piano and imagine playing a piano piece without ever moving their fingers. And then when they get down and

put their hands on the piano keys they're advanced because they have all of the benefits of that mental practice, people can watch somebody juggling balls in front of them and watching them juggling balls in front of them, of course, advances them substantially and actually picking up the balls and juggling. In fact, you get at least as much advantage in managing it as you do and actually playing, actually juggling.

[00:26:26] So so people think that mental practice has the power of physical practice but it does of course I mean you're sitting there you're working on the solution of a problem you're exercising your brain in a very systematic and simple way, of course, your driving changes in the brain and just in the same way you're advancing it as if you're engaged in any physical activity.

**Bill:** [00:26:54] Wow. So it's a great tool because it means it doesn't cost anything. It means you don't have to go anywhere to do it

**Michael Merzenich:** [00:27:01] Exactly.

**Bill:** [00:27:01] All you have to go into your own mind and if you have somebody facilitate that in a guided meditation for example it's even easier you can get one of those off YouTube for free.

**Michael Merzenich:** [00:27:11] You know actually one of the sorts of shocking things about brain training in whatever form is that it's almost free so it's because it's supported by technology and you can sit in front of a computer in front of an iPad or a phone and you can and you can exercise your brain and brain HQ which is one of the programs that we apply widely in clinical populations. It's so inexpensive that people don't take it seriously. They say well you know you're telling me that I can have this intensive training that could fix this for 30 bucks. you know so come on! if we said well this is 5000 dollar treatment we'd probably convince them that it's really worth their time. But the fact is that it cost almost nothing to deliver it and it's inexpensive to make and cheap to deliver.

[00:28:04] You could say so that's another thing that ultimately this will enable the delivery to everyone in the world. You could say there needs help and this is not that this is everything persona has to and this is part often a part of the solution.

**Bill:** [00:28:20] Yeah with brain HQ I played those games early on as well and the

great thing about that is that it's able to calculate where I'm at and it shows me how far I've come and given me some information that you can't get

**Michael Merzenich:** [00:28:37] Yeah

**Bill:** [00:28:38] Which I found was very helpful because I forgot to ask my family my loved ones to pay attention to how far I'd come in my process and I often wasn't noticing that I had regained you know fine motor changes in the ability of how I grabbed the fork etc.. So having somebody be able to remind me even if it wasn't my relatives was great because then I felt good about myself I'd achieved something. I've come a long way.

**Michael Merzenich:** [00:29:07] Well one of the hardest things is the calibrate yourself and it helps you calibrate yourself. I mean you really want to know how you doing when you start and you want to know how things are progressing. And sometimes it's not totally positive. I mean everyone reaches limits in whatever they do. But it's honest. It's an honest calibration and how you doing. And that's a critical part of getting the most out of your brain.

**Michael Merzenich:** [00:29:36] Yeah many people talk about neuroplasticity in a positive light but there's a negative side of neuroplasticity as well. Can we talk about negative neuroplasticity if a little bit about what you're saying?

**Michael Merzenich:** [00:29:47] Well first of all plasticity is bi-directional so it's a little bit of a complex thing to talk about but you commonly do things in life that are self-destructive from a neurological point of view. An example is as many people as they get older develop very stereotypical behaviors and actually plasticity in sustaining the richness in their performance abilities requires that you perform with significant variety and how you do things. So the more stereotyped you are the more you sort of burn in. A simple way to do things that is not healthy for you neurologically an example of this is let's say I'm the person and I fall and I realize that I'm sort of in danger of falling. So I adjust the way I walk I'm going to walk more carefully maybe I'm going to look down at my feet more often.

[00:30:43] And so and so you're adopting a shuffling step that's more stereotyped and you're commonly looking down because you're worried about hazards in front of you. Well, you're stereotyping you're walking when you're older is exactly the wrong thing to do because it's that surprise that bump you know that little bit of

the event that's unexpected that you need to adjust your posture too. Looking down at the ground means that you're going to see things and near vision and if you are bumped things are going to race in front of your eyes and it's going to carry it right to the ground.

[00:31:26] People do all kinds of things and then you know you might, your walking with your knees bent a little bit, walking is more exhausting you're doing all kinds of things that are sure that within a period of a year or two or three, you will not walk anymore. And people do all kinds of things like this that are self-destructive. Another important aspect of this Bill is that we've studied the characteristics of the brain its physical functional chemical characteristics near the end of life and we've contrasted those look at about 35 things that we contrasted with the brain in the prime of life.

[00:32:06] Let's say you're 30 versus 85 and you can ask well how many of those things are different then answers are all different well how many of those things advantage the 85-year-old brain? None of them do, on a statistical average younger is better in everything you measure. And then you ask the question well how many of those same 35 or so things can you reverse like training? And the answer is all of them. Everything is reversible. Or to put it another way, the progression to that 85-year-old state was plasticity, you couldn't call it positive. But I can now say well I'm going to train my brain when I'm 85 and I drive everything in a positive direction. And it's because these processes are designed by the creator of the universe or Mother Nature to be bi-directional. And we struggle with why it would be designed this way.

[00:33:06] Why are all of these things can we move them in a growing positive direction or do they all slide back into a negative direction I think what it's all about is that the brain adjusts its machinery as a function of the noisiness of its operations and when it is really refined and really sharp. It's got very little noise and it's a function of how you live your life.

[00:33:33] In the early part of life coming up to the prime of life you're in a learning phase you are continually advancing your abilities and you reach a sort of high-speed high-performance peak and then you sort of rest on your laurels, like you're spending more time just using the skills and abilities you develop when you're young and you're taking it easy quite a bit you're not engaged very much in learning and learning you're not really sustaining her abilities very well and it's

a noisiness creeps in everything slows down and slowly deteriorates. So you got to live life with a certain level of energy Bill. I mean you got to, use it, or lose it.

**Michael Merzenich:** [00:34:18] Yeah. And, so it's I think what we're trying to understand now is how can we help people manage this.

[00:34:26] So you know from a young age you're basically paying attention to. That's one of the things that I think the calibration on Brain HQ is helpful.

[00:34:35] I tell an older person look, go to Brain HQ and then see how your performance relates to the performance of the average 30 or 40-year-old. If it's substantially deteriorated from their performance get to work and spend a little time and try to get there because 30 or 40-year-olds are very seldom moving directly into the home. They're not so likely to be demented. So there's no promise that you'll be protected from that but you'll in all likelihood you will be safer and you will be functionally more effective.

[00:35:16] And anyway

**Bill:** [00:35:19] It's about moving in the right direction in some way shape or form.

**Michael Merzenich:** [00:35:22] Exactly. Yeah exactly. That's a good way to put it moving in the right way. Would you ever choose not to move in the right direction?

**Bill:** [00:35:29] And then it's also about changing the stereotype of oh well as you approach your 70s these things start to happen as you approach your 80s these things that happen and so on and it's just changing that stereotype being different for somebody who is in the eighties.

[00:35:44] We talk about that a lot though. Dr. Merzenich because you know I often hear people say you know now 50 is the new 40 and 60 the new 45.

[00:35:56] So I feel like we're actually making some progress in changing the stereotype as to what you're supposed to do when you get to 65 which in Australia is the retirement age. People are going I'm not going to stop working because I get to 65. They're looking for other things to occupy their time with and I think that's a really good way to combat you know early-onset dementia or Alzheimer's or those types of things.



**Michael Merzenich:** [00:36:22] I agree. I think it is beyond that. Let's really your brain is really asking you to do is lead a life or continuously new learning. It's asking you to continue to continuously elaborate your skills and abilities not to go into retreat.

[00:36:38] It's asking you to be continuously active and lively and not moving onto the path and just taking it easy. You know it's asking you to remain engaged and interested and with your eyes, wide open and you are you know smiling and enjoying the world in front of you and asking you to basically maintain your connectedness with the world.

**Bill:** [00:37:01] Yeah fantastic as we get to the end of the interview. When I met you earlier this year at I can change my brain in Melbourne in Australia. I pulled you aside for a moment or two and we spoke about general anesthetic. The reason why I'm interested in the topic of John anesthetic is that I experienced a second surgery about 18 months after my brain injury and after the brain surgery and when I woke from surgery the deficits on my left side the numbness the motor-sensory motor neurons and the sensory neurons. The deficits had increased and the numbness was worse and it was a big challenge to sort of understand what was happening to me and I asked a lot of people a lot of questions including my doctors and nobody could really give me any.

[00:37:58] Of course I need a definitive answer but I came to the understanding from some of the stuff that I studied and researched online that potentially anesthetics can influence the aging of the brain, especially after brain surgery. [00:38:12] Can you give us some insight into how it is that anesthetic causes some challenges in those areas and is there some work being done to help combat that?

**Michael Merzenich:** [00:38:22] We've been extremely interested in this because they're a rich variety of conditions in which that and some of them in which the brain is injured in surgical procedures or by natural a whole variety of natural disasters or commonly people just go into surgery for whatever reason maybe it's an operation on their kidney or their heart or their whatever then they go into the ICU after surgery and as a consequence of this their brain takes a big hit they're very substantially impaired cognitively and in fact, if you go into surgery go into the ICU spend a day or two or three in the ICU and when you're out of it when you're hallucinating and when you're that this is a manifestation of damage to

what's called the blood-brain barrier [00:39:14] it's a manifestation of the fact that the brain normally keeps the blood compartment sealed off from the brain tissues themselves. [8.5]

[00:39:24] And when the seal is broken there is an increase in excitability of tissues in the brain and that's what the hallucinations are all about it's basically the brain beings being stimulating itself in this artificial way then to make a long story short you can both recent studies show that you can both increase the resilience of this barrier. Before the surgery. So there's an indication that we could have trained you in a certain way before the surgery to increase the strength of this barrier and its resilience before the surgery and reduce the probability of these things happening to you. And also that we can train an individual after the surgery and substantially reduce the effects of the anesthesia and the surgery the trauma that's occurred that's reflected in your brain.

[00:40:20] So we're working hard on both these issues primarily with the research group at Vanderbilt University and in the United States of Tennessee which is a wonderful medical research university and there have been leaders in this area. But we're trying to sort out how to help people not have this. Well, we think that we can see we're going which might be achievable. We have completed studies in which we train people that have gone through what you've gone through and very rapidly return them to normal not just in their behavioral science but we appear to have restored this barrier separating blood from the brain.

**Bill:** [00:41:03] Is this a physical barrier or is it something that I can look at and touch or not?

**Michael Merzenich:** [00:41:08] Well it is physical in the sense that every little blood vessel in your brain has a seal so that nothing can significantly sized.

[00:41:18] And one of the reasons the brain has this wonderful system of keeping the blood out of the brain is that the brain is very subject to infection. And when the barrier is strong no virus no bacteria can enter its own blood. The brain is especially vulnerable to infection when the various leaky then bad elements from blood that can infect the brain can enter the tissues of the brain. And what the brain does is it has a strategy of walling them off it coats them with a chemical that we call amyloid and it creates what's called an amyloid body which is a

forerunner of Alzheimer's disease.

[00:42:08] So you do not want to go through this process especially when you're a young guy like you have on credit conditions which this barrier is leaky and they have all these bad things leak into your brain and your brain created to go through this process which is really trying to protect itself.

[00:42:23] Right now you're stable now so you're beyond this but a lot of older people are not very stable and or people that are more fragile and you do not want this to happen if it's avoidable.

**Bill:** [00:42:38] It reminds me of the conversations that you hear people talking about the blood-gut barrier.

**Michael Merzenich:** [00:42:44] Yeah right. And how you can get a leaky gut. So are we talking about a leaky brain? It's a very similar set of effects, a very similar set of effects.

**Bill:** [00:42:55] Right.

**Michael Merzenich:** [00:42:55] That's another really not very good thing to have happen to you.

**Bill:** [00:42:59] I think I experienced a little bit of that leaky gut scenario.

[00:43:04] Because as I healed my gut I found that my recovery started to accelerate so my head recovery started to accelerate the sharpness of my mind all those things came on board. Now I know that the gut has neurons in it as well. Quite a lot of you are out now are we talking about neuroplasticity happening in the gut? And I understand my heart has neurons as well

**Michael Merzenich:** [00:43:31] Right.

[00:43:32] The primary, I mean there are changes that can occur in innervation in the gut or the or the brain but they're also very strong are influences from the autonomic nervous system and it it's strongly influenced by other areas in the brain that are monitoring their receiving information from the gut and they are monitoring it and in some ways, they're controlling this sort of end-stage manipulation of the nervous system from the nervous system to the gut. So you don't think of the brain as being involved in the health of the gut but it is

plasticity primarily in the brain.

[00:44:16] It's receiving information it's feeding back information. It's in the other autonomic nervous system receiving information and feeding back information but it's plastic it can be stronger it can be weak and one of the things that we've been actually doing is we've done this a lot in animals experiments we are very limited in what we've been doing in humans.

[00:44:39] We actually trained the brain in ways that increase the integrity and the level of control of the other autonomic nervous system on the Cardiovascular system and the gut.

[00:44:49] So we're doing experiments now which are trying to change the biome in the gut for the benefit of individuals by changing the brain so it's they're all linked together. No one told the brain and the body no one told the brain in the gut that they're not part of the same machine.

**Bill:** [00:45:12] I can there is some anecdotal evidence from me at least that you're on the right track. I love hearing that the research is going down that path because it needs to be a lot more understanding, of the challenge.

[00:45:25] One of the challenges, when I was in the hospital, was the food that we were served food is not normally any good in the hospital anyway but I don't think it was supportive of the brain healing. For example, we were being served you know sugary high sugary desserts and carbohydrates and you know it was just very challenging to sort of be able to understand how am I going to eat this and it's going to make me get out of rehab quicker and free up the spot for somebody else that wasn't doing that so I was getting mum and dad to bring food in for me specifically so that I wouldn't have to eat it.

**Michael Merzenich:** [00:46:05] Well I can tell I can but I know from my conversations with you that you're a man of insight.

**Bill:** [00:46:12] I wouldn't have insights if it wasn't people like you doing the work that give me these insights.

**Michael Merzenich:** [00:46:17] Yeah but you're pretty consistently on the right track. It's good.

**Bill:** [00:46:23] I'm trying hard it's all about moving in the right Dr Merzenich

**DR Merzenich:** [00:46:29] Right it sure is For life, Bill.

[00:46:30] Yeah I agree. When I was researching you for this interview I found a photo of you online with the Dalai Lama.

**DR Merzenich:** [00:46:40] What do you tell the Lama about? Well, I've had the pleasure of being invited to have a conversation with them a couple of times and I find it find it to be astounding. It's a wonderful experience. I tried and I've tried to explain to people that if you imagine that you're in a room in which there were a thousand people everyone would know where he was and it wouldn't be because he's saying anything you just know. So I found it to be a very wonderful and inspirational experience and of course, there's probably nobody that I've met who is more good-hearted than he is. You know he defines good-heartedness he's honed this empathy towards other people and you know it's one of my own ideas of life is that we're here as for to not just live our life to the benefit of ourselves but that we're actually designed to be with others and helping them. And We're designed to be helping everyone in our tribe and beyond that we can. So he embodies that to me so that's a wonderful experience and then you know the thing about him as great as is that he's open he listens. You know he would say that, and he seeks an understanding of science. He would say that if science contradicts his beliefs he's got to reconsider how he's thinking about things. It's a pretty enlightened way to think about your approach to your understanding of the deeper things and most important things in the world and beyond.

**Bill:** [00:48:27] Yeah, That's fascinating are so glad that you shared that part of the story.

[00:48:33] We've touched on the heart a number of times in our conversation. And when I met you earlier this year I bought a copy of your book, soft wired. It's a great name by the way and I asked you to sign it and you signed it for me and you. Your message was quite profound and it said Enjoy and take to heart.

[00:48:59] Now you know for me that was really interesting when we're talking to somebody who talks about the brain all the time. Your message was to enjoy what you've written for me to take to heart.

[00:49:12] You know I think that's a really powerful message

**Michael Merzenich:** [00:49:15] And it seems to me that maybe you have.

[00:49:18] That's good.

**Bill:** [00:49:23] So I hope that the people listening and watching will look more into what it means to take something to heart and if it's a positive thing that you take it to heart it's going to enhance and accelerate you know good feelings and great times on the planet if you're taking negative things to heart you're going to potentially accelerate feeling of pain and other things so you want to make sure we take the right things to heart.

**Michael Merzenich:** [00:49:50] Absolutely. Absolutely. Why would you live your life in misery and why would you leave your life accepting in a sense that a downhill slide when you can continue to grow and be a better and stronger person?

[00:50:05] You know everyone can have a better life next month or next year because they've been endowed with a plastic brain they can actually be stronger and more effective and have a deeper understanding and ultimately greater wisdom or they can continue to slip and slide into increasing insignificance.

[00:50:30] So I strongly recommend a life of personal growth and self-development and with a happy spirit. I strongly recommend it.

**Bill:** [00:50:40] Thank you so much for your time I really appreciate the opportunity to chat with you and learn from you directly. It's just amazing the work they do. I really thank you for doing that work.

[00:50:49] I thank not only you and all the teams that you've worked with and all the people that have done that work because without them I don't think that we would be anywhere near being able to at least kind of explain what it is that we can do to help ourselves and know it as a patient. know know what I can do rather than just be told by Doctor to do this or do that

**Michael Merzenich:** [00:51:14] It's Wonderful wonderful the see you again Bill and see that you're going so well

**Bill:** [00:51:19] Thank you so much and are you in Melbourne or in Australia again anytime soon?

**Michael Merzenich:** [00:51:24] Well not not not in the next months but I'll be back.

[00:51:29] I love Melbourne so you know I'll be back and actually and I have Melbourne visitors staying with me in my house today so it's part of my life.

**Bill:** [00:51:41] Excellent say g'day to them for me.

**Michael Merzenich:** [00:51:44] G'day. I will Well.

**Michael Merzenich:** [00:51:45] Nice to see you, Bill.

**Bill:** [00:51:46] Thanks so much.