So what we're trying to do is to understand what actually happens in the brain when you do exercise. And we're understanding there're growth factors that go on, parts of these NR2B receptors are turned up, and the entire plasticity machinery is turned on along with these new baby cells.

We have a very good target now, and we're actually working to develop a drug that will enhance your neurogenesis, your ability to produce new brain cells. And, by the way, this happens most in the hippocampus that I told you about. And we're working very hard to basically develop that drugs, so you won't have to do all that messy exercise, or hopefully, it will be synergistic with exercise. So if you can make three times as many more brain cells with physical exercise, maybe three times as many, again, with the drug and physical exercise.

So, there's been a lot of work on understanding — I'll skip this — There's been a lot of work on looking at what happens in humans who do exercise, and this is a longitudinal study that we're involved with. As you get older, your hippocampus shrinks along with everything else in your brain. But if you look at the red group, what you can see is that in a one-year longitudinal study, the controlled group is doing stretching, the experimental group is doing physical exercise, the volume of the hippocampus doesn't shrink, and in fact, it even gets bigger.

So what's my message? Do exercise. We're trying to understand what kind of exercises you should be doing. Here's a study by Teresa Liu-Ambrose from our center, working with a group of women in Dunbar. What she finds actually is that cardio is important, but actually doing weights is also surprisingly important. So do both cardio and resistance training, because that will actually enhance your cognitive performance.

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So one of the things we've been able to achieve in the last few years in the field of brain imaging, is that not only we can see what parts of the brain are active, but we can now actually see the pathways in the brain. And we can see how they change as a function of usage. And this slide shows you this.

Now, what we're learning then is under certain circumstances, pathways can be too weak or perhaps even too strong. And we're learning how to modulate the strengths of brain pathways. There's a new technology, called Transcranial Magnetic Stimulation that Lara Boyd is using in our Center. We put somebody in this apparatus, and we can stimulate one place in the brain, or several places in the brain. And what we can do again now, is to literally arrange — remember, neurons that wire together fire together — we can arrange the contiguities to be such that we strengthen a pathway from A to B in the brain. And when we do this, over time we strengthen the pathway.

How do we do it? We stimulate one place, the other place. We can stimulate lots of places. We got all these electrodes now, arrays are being developed. We're going to be able to imagine the locus of neural points that represents your grandmother versus your grandfather. We should be able to strengthen the memory of your grandmother by just stimulating the right connection of points inside your head.

So we're pretty excited about what's going on now. I can't tell you everything that we're doing, but I just want to close with a quote from that great Canadian philosopher, Wayne Gretzky: "*Skate where the puck is going to be*." And what Wayne is telling us in this quote is that here's a tremendous challenge and opportunity in association with what is now going on in understanding how the brain works.

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Change: Talk About It by Katharine Hayhoe

I've been doing brain research, I hate to tell you, 50 years now, and it has never been as exciting as it is today. It is moving so fast, it sits right at the confluence of genetics, imaging, cell signaling, electrophysiology. And combining all of these technologies is going to give us unprecedented capability to change the brain for the better. I look forward to the next 50 years.

Thank you again.

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