Module 1 Transcript

Looking At The Brain

"The human brain has 100 billion neurons, each neuron connected to 10 thousand other neurons. Sitting on your shoulders is the most complicated object in the known universe."

-Michio Kaku

The feeling of warm sunlight on skin. The quick blink of an eye. The color of fall leaves, and the sound of them rustling. The words of a poem, carefully memorized. The movement of your lips as you recite it. The feelings of exuberance in a joyful moment, of sullen despair, of anger, fear, joy, or stress.

Everything you and your body experience--and every action you take--is a product of the complex, three-pound construct of nerves, fat, minerals, hormones, and electricity that is your brain.

For the vast majority of history, any real semblance of understanding of the human brain eluded those who tried to study it. The ancient Egyptians didn't even have a singular word for it, referring to its individual components with terms like, "folded cloth" and "reed field." It wasn't until some three millennia later, during the enlightenment, that scientists began to make the first real connections between brain processes, electricity, and the signals that dictate our every waking--and non-waking--moment. In the twentieth century, Nobel Prize-winning researcher Charles Scott Sherrington published works centered around the base unit of communication between a neuron and other cells within the body. In doing so, he was the first to coin the term "synapse."

"You are your synapses," writes Justin Ledoux in his book Synaptic Self. "They are who you are." And that's all very poetic, but what truly is a synapse, and how does a miniscule reaction between two neurons result in, well, anything?

Imagine you--or rather, your brain--wants the body to do something small, like a movement of the finger--just a twitch, like this. Like all movements, reactions, and experiences, this starts in the brain, which sends a signal to specialized motor neurons,

located in the spinal cord. This signal occurs in the infinitesimally small space between two nerve cells, a junction that we call the synapse. The space of a synapse is almost too small to conceptualize 50 nanometers...that's 1/100 millionth of a meter, and here, cells can exchange both chemical and electrical signals between one another, at an incredibly rapid pace. These signals, which act as a precisely tuned messaging system, in turn form the basis of all human experience.

This single signal which begins in the brain sends a chain reaction down the nervous system, a game of synapse telephone that, when it reaches its destination---causes your finger to twitch.

Every action, sensation, and thought you experience is the result of these synaptic signals, and the economy of scale is enormous. In the brain alone, at least five hundred billion of these messages are sent every single second. But not all brain activity is the same, and the flow of these messages is ever-changing, a dynamic symphony of electricity, information, and life. Just take a look at brain scans of someone sleeping, someone exercising, playing violin, engaged in conversation. In these images, which highlight the synaptic activity of various regions of the brain, we begin to uncover the complexities within ourselves.

The true value of modern imaging technology is that we don't have to just rely entirely on personal description or the physical anatomy of the brain. When someone feels good, when they feel mentally healthy, when they're experiencing a positive mood, we can see that, we can trace it to an extent using modern imaging and the new tools of neuroscience. And at the same time, when someone is reporting feeling anxious, we can see that too and understand the biology of these conditions like never before.

And, for the first time, we can see that the brain is growing and changing. For essentially the entire history of neuroscience, we never thought that we could grow new brain cells. After child development, we thought, the brain was what it was--fully formed. When I was in medical school, most clinicians agreed that, once you grew into adulthood, your brain was done growing. While the rest of the cells in the body would continue to reproduce throughout your life, you only got one set of brain cells—about a hundred billion or so—

and with luck, you'd manage not to kill too many off as you aged. Now, scientists have shown us that the brain, like the rest of the body, continues to change and grow well into our golden years. Its ability to continue to make new connections between cells is referred to as neuroplasticity. And the ability to produce fresh, new brain cells is called neurogenesis and is known to occur in a specialized area of the brain called the hippocampus, which is the center of your brain's emotional, learning and memory functions.

Dr. Celeste Campbell writes, "From the time the brain begins to develop in utero until the day we die, the connections among the cells in our brains reorganize in response to our changing needs. This dynamic process allows us to learn from and adapt to different experiences."

Even more so, researchers are learning that each of us has a degree of agency over neuroplasticity and neurogenesis. Consider the hippocampus. This small, seahorse-shaped region is often described as the brain's memory center. It also happens to be a part of the limbic, or emotional, system—and, as such, is also affected by mood and anxiety disorders. In fact, studies have found that this key region can shrink as much as 20 percent in patients who are struggling with depression.

Felice Jacka, a leading nutritional psychiatry researcher, and her colleagues decided to directly examine the relationship between the way people eat and hippocampal size. They asked 255 individuals, aged sixty to sixty-four, to fill out a questionnaire to assess their dietary practices. They then took brain scans of each person, once at the beginning of the study and then again after four years, to look at diet's effect on the hippocampus. They found individuals who ate a healthier diet were more likely to have a larger memory center. Those who consumed an unhealthier "Western" dietary pattern showed the opposite effect. Simply put, more whole foods like vegetables, fish, nuts, beans, and olive oil meant a bigger brain and pizza, fries, and soda meant a smaller brain...and remember, this is in the brain's center of memory, learning, and emotional regulation...I think we can all agree...more of those brain cells sounds like a good thing.

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HEALING THE MODERN BRAIN

As we've seen more and more work from animal studies, observational studies, and neuroimaging studies and randomized clinical trials—and triangulated that with what we know about biology—it becomes clear that habits, lifestyle, and decisions allow us to intervene in our brains' growth and development. Each and every one of us has the power to make more educated decisions about what we eat, how we move, how we sleep and how we manage stress in order to modify the way our genes are expressed and help optimize the mental fitness of our modern brains.