Most of neuroscience, although daunting to those not familiar with it, is one of the more accessible sciences - the brain affects everything! Understanding how things function on a neuroscientific level lets us understand so much about everything from diseases to pain to obesity and more. Dr. Mahlon DeLong, MD from the medical school of Emory University presented at Science 2016 about the impact and revolutionary effect of deep brain stimulation, specifically in patients suffering from Parkinson’s disease. A talk about approaches to treating something like Parkinson's disease appeals to a large audience because so many people are not only aware that it exists but also of how devastating it is.

Dr. DeLong studies neurological movement disorders, such as Parkinson's disease, dystonia, and tremor. Parkinson’s disease, a result of disorder in the basal ganglia similar to Huntington’s and Wilson’s disease, causes major alterations in movement, cognition, and behavior. His work has helped establish the circuitry involved in Parkinson's - when he started, all they knew was that the basal ganglia was somehow involved in movement, and therefore in Parkinson's, but nobody knew how. Working at the NIH, Dr. DeLong used microstimulation to map regions of the brain that correlated to motor response activity relating to the basal ganglia. His work led him to discover a series of circuits that connect the basal ganglia to the cerebral cortex and the thalamus. While studying circuitry in nonhuman primates, Dr. DeLong was able to assess the inhibiting factors causing the characteristics seen in Parkinson’s patients - excessive firing of neurons in the subthalamic nuclei of the basal ganglia. He discovered that ablating, or removing, these neurons improved Parkinsonian symptoms. This method of literally removing parts of the brain is probably familiar to most people in the form of lobotomies that took place in the 1940s and 50s to treat psychiatric disorders. The 1940s and 50s were also a popular time for pallidotomies and thalamotomies, procedures in which part of the basal nuclei and thalamus respectively, are ablated. Dr. Delong and his team first worked in monkeys to assess the efficacy of such procedures and then worked arduously to overcome the stigma of ablation surgery in order to transition to humans. Pallidotomies resulted in an instant, stark reduction of tremor symptoms, a grand breakthrough in treating Parkinson’s disease.

The discovery of Levodopa (L-DOPA) to treat Parkinson's in the early 1960s was hugely important, and it largely
halted ablation surgeries such as pallidotomies and thalamotomies. Patients suffering from Parkinson's do not have enough of the neurotransmitter dopamine, and L-DOPA is often used to treat them because it is a dopamine precursor that can cross the blood brain barrier (dopamine cannot). However, people can develop resistance to L-DOPA treatment, and it becomes less effective over time.

In the 1980s, deep brain stimulation was developed. Deep brain stimulation involves implanting a device known as a neurostimulator, similar to a pacemaker, that sends electrical impulses through implanted electrodes that target specific areas of the brain. Deep brain stimulation uses the same idea as ablation surgeries because it essentially inactivates the part of the brain containing the neurons that are over-firing, but it is both less invasive than ablations surgeries and reversible. The transition from deep brain stimulation surgery has revolutionized the way medical professionals treat severe cases of Parkinson’s where patients who no longer respond to conventional pharmaceutical treatment.

Dr. DeLong not only described the history of treating Parkinson's and studying circuits, but he also presented three extremely heart-felt before and after videos. Patients suffering from Parkinson's so severely that they could not walk or stand up straight received instant relief as soon as the implanted electrodes were turned on. Full benefits of deep brain stimulation come between six and eight months after the start of treatment, and his videos showed patients literally running across fields at full speed with no signs of shakes or tremors. Although the style and technical difficulties of Dr. DeLong’s talk made it difficult understand at times, the videos greatly augmented his presentation, bringing the science down to an easily observable level. Although it is easy to hear about how awful Parkinson's disease is, watching people actually suffer from it makes you realize how truly devastating it is. Showing the before and after videos took the entire audience on a roller coaster of emotion. We left his talk feeling so incredibly happy that these people who were previously unable to truly live their lives due to Parkinson's were given another chance.

Deep brain stimulation is FDA approved to treat Parkinson's disease, tremor, OCD, and dystonia, and it is being tested to treat depression, seizure, Tourette's, and other disorders. Deep brain stimulation is not disease specific but circuit specific, so there are multiple possibilities for diseases that it could treat. Patients must wear a battery powered device that powers the electrodes, but it is a small price to pay to live essentially free of Parkinson's symptoms. The long term effects of deep brain stimulation is now becoming an intense topic of study.

In 2014, Dr. Delong won the Breakthrough Prize in Life Sciences as well as the Lasker-DeBakey Clinical Medical Research Award for his understanding of circuits connecting the basal ganglia to other parts of
the brain and helping so many people suffering from Parkinson's. His work definitely fits into the game changer theme of Science 2016.

We left truly amazed; although the goal of our research is always to translate treatments into humans, it is easy to forget when you are constantly working with mice, monkeys, or other model organisms. It is always so interesting to see the results of research in humans; it is a nice reminder of why we do research and how it can truly change lives.