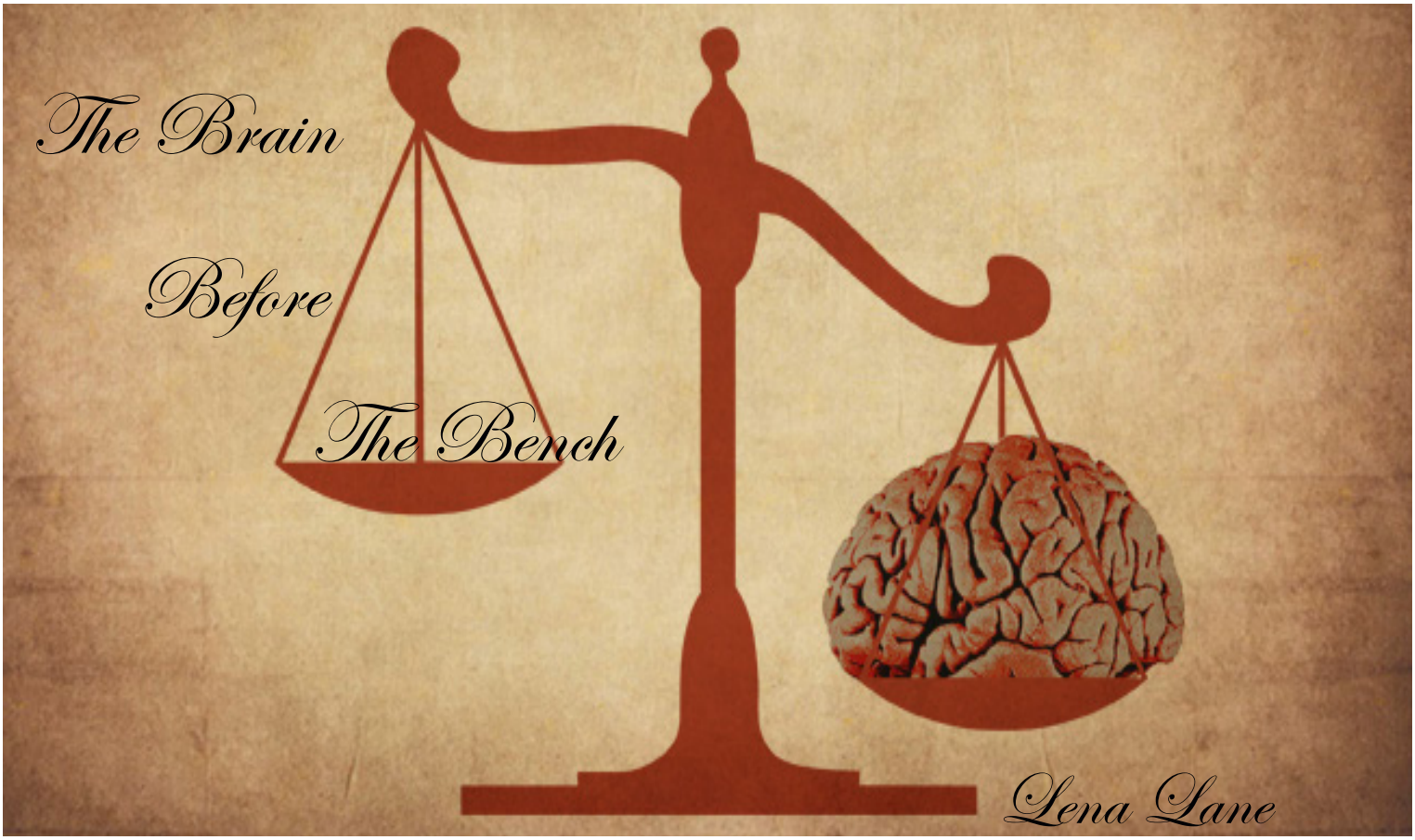

You are your brain. At least, over a century of cases demonstrate that when your brain changes, so do you — your personality, your proclivities, your capacity for rational decision-making, etc. Such was the case for Charles Whitman who, on the first of August 1966, climbed to the top of the clock tower on the University of Texas campus at Austin and began to shoot passerby indiscriminately; he killed 13 people and wounded 32 more before police were able to shoot him down. That morning, he killed both his mother and his wife. In his suicide note he expressed confusion about his condition, claiming that he had become a victim of irrational thoughts.

> "It was after much thought that I decided to kill my wife, Kathy, tonight… I love her dearly, and she has been as fine a wife to me as any man could ever hope to have. I cannot rationally pinpoint any specific reason for doing this..."

Whitman instructed that his brain be examined to determine the cause of his perplexing behavior. When the doctors extracted his brain, they discovered a nickel-sized tumor pressing on his amygdala, the center of the brain controlling fear and aggression. It was this tumor that most likely caused his violent shooting spree.

If Charles Whitman had lived and his tumor been removed, would we still convict him of murder? In law, defendants can invoke the "automaton defense," which posits: if you have, for example, some condition that causes your arm to fling uncontrollably and you happen to knock someone off of a cliff, you are not fully culpable for their death. In essence, it was your body, not you, that committed murder. Now this poses a tricky dilemma— should we consider a brain tumor to be an automaton? Does a person on drugs really know what he is doing? Can we ever separate someone's biology from who they are? Culpability, intent, and rationality are only a few of many subjects in the rapidly expanding field of Neurolaw.

Neurolaw is a multidisciplinary field that seeks to reconcile the law, which deals with human behavior, and neuroscience, which attempts to explain that behavior. Neurolaw reexamines the major question in our criminal court cases from that of intent, essentially distinguishing an individual's actions from their biology, which is often impossible, as we saw in Whitman's case. Neurolaw does not neglect intent or attempt to blindly exculpate criminals. Rather, it aims to locate a more rational method of sentencing, one that considers biology and uses that knowledge productively.

Sherrod Taylor coined the term Neurolaw in a paper published in 1991. This paper explained how advancing medical technology has led to survival of traumatic brain injuries and the need for neuroscientists and neuropsychologists in the courtrooms. In fact, Taylor writes, "more than two-thirds of all appellate court cases discussing neuropsychological evidence have appeared within the past 10 years!" Since the birth

of Neurolaw, the Gruter Institute of Law and Behavioral Research, the Dana Foundation, and the MacArthur Foundation have contributed millions of dollars to the interdisciplinary field. Colleges have also started to create spaces to explore this field, such as the Initiative on Neuroscience and Law at Baylor College of Medicine and the creation of the world's first joint JD/PhD program in law and neuroscience at Vanderbilt University, the home of the MacArthur Foundation.

Neurolaw enables lawyers to reconsider basic assumptions in the law and make more informed decisions in the sentencing and rehabilitation of criminals. Neuroscience forces the law to reevaluate the assumption that everyone is equal before the law— no two brains are alike. This approach has implications for convicted individuals that share certain characteristics. For example, there is an assumption in law that all persons over the age of 18 should be tried as adults when these individuals may have much greater or less brain development than other people their age.

Not only are the assumptions underlying sentencing changing, but also the evidence used in the sentencing of criminals. One of the biggest technologies in cognitive neuroscience is fMRI. In 2010, fMRI or functional magnetic resonance imaging was used as a method of lie detection for the first time in court (United States v. Semrau 2010). It is a technology that permits us to look at blood flow to different brain areas as a proxy for brain activity while the individual is still alive and conscious. But there are many limitations to fMRI, such as the assumption that blood flow and oxygen usage means brain activity, especially when the defendant is asked questions retroactively. With new neuroscience technology, guilt will be put on a spectrum that gives the law a tool to recognize the uniqueness of each brain.

Neurolaw invites the legal system to re-imagine rehabilitation and the conception of jail as a one-size-fits all solution, or a de facto mental health facility. Neurolaw ponders whether criminals can be helped towards more pro-social behavior and how to restructure incentives to decrease likelihood of recidivism. One such form of rehabilitation is impulse-control. Long-term considerations versus short-term considerations are constantly at odds in our minds. This competition between different parts of your brain can be swayed towards long-term decision-making. The neuroscientists David Eagleman, Pearl Chiu, and Stephen LaConte have created a training routine that gives real-time visual feedback about brain activity through a bar representing craving, short-term decision making, etc. that it is the criminal's job to lower thereby giving them a physical object that they can work with as an avenue to training their mind. Making drug testing for drug addicts more frequent and the consequences for failure harsher and swifter is another means of restructuring incentives.

"Neuroscience forces the law to reevaluate the assumption that everyone is equal before the law—no two brains are alike."

In the case of Jackson v. Hobbs (2012) and Miller v. Alabama (2012) the Supreme Court determined that juveniles convicted of murder couldn't be sentenced to life imprisonment without the possibility of parole. Rather, the child's character and life circumstances must also be taken into account when determining the sentence for a juvenile that has committed murder. The opinion cited scientific research about the development of the adolescent brain and their underdeveloped ability for long-term decision making that lessen a child's moral culpability. This marks a shift in judicial thinking about the differences between brains as well as taking into consideration that brains are not constant over time and that there is a chance for rehabilitation as a more viable option than life sentences in prison.

With the growing influence of neuroscience on the law, some believe that a great change will occur in law, others that question the extent of how much the law can change, and still others that worry about the possibility for misunderstandings of neuroscientists about law and of lawyers about neuroscience. Justice Ian Donald, the chairman of the British Columbia Court of Appeal's education committee, thinks that a profound change will happen in our conception of criminal responsibility. Peter McKnight, a writer for the Vancouver Sun argues our view of criminal responsibility will be slightly changed but that the real influence of neuroscience will be in sentencing and rehabilitation. People like Steven Erickson, a visiting professor at Widener Law, warn that neuroscientists must be careful to work within current legal framework rather than upending some of its basic foundations such as the assumption of responsibility. With growing use of neuroscience in courtrooms there is always danger in communicating across the divide between law and neuroscience disciplines. For Owen Jones of Vanderbilt Law School, avoiding misrepresentations of neuroscientific evidence depends on engagement of neuroscientists with many areas of law and support for more research in the area of Neurolaw.

Despite doubts, it cannot be denied that the rapid progression of neuroscience as a field has led to much enthusiasm for Neurolaw. Subjects in the field of Neurolaw cover more than just culpability and rehabilitation but also lie detection, memories, brain injuries, pain and distress, addiction, adolescence, judgment, brain death, and artificial intelligence. In years to come these subjects will give us new understandings of how our biology and decision-making coincide with the law.