NEUROLAW: THE PROSPECTS AND LIMITATIONS OF NEUROSCIENCE IN CRIMINAL JURISPRUDENCE

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Abstract

Neuroscience research sheds light on the mechanisms underlying behavior, illuminating how the complex nervous system gives rise to conscious thoughts and actions, as well as disease and dysfunction. Neuroscientists have made remarkable progress over the recent decades, resulting in an infinitely clearer understanding of the human brain's functions. This is partly driven by technical innovations and current technologies, which provide new means for studying and visualizing these systems. Such growth can have far-reaching repercussions and should be considered in the context of the law.

Since its introduction in the 1980s, the use of neuroimaging evidence in the courtroom has exponentially risen. This growing trend has prompted questions from legal and scientific experts alike. This article addresses some of these queries and explores how neuroscience evidence may be valuable throughout criminal proceedings.

Besides serving an evidentiary role in the courtroom, neuroscience can have meaningful implications for criminal justice reform. The United States has incredibly high incarceration and recidivism rates. There is a strong tendency towards punishment and retribution–despite the recurring failure of this approach. Neuroscience provides a lens through which we should view and evaluate current systems that fail to address mental health and other issues effectively. It offers a perspective grounded in a scientific understanding of human behavior and can help

address many of the brain-based concerns within criminal law. Given the significant refinements in knowledge and technology, more interdisciplinary collaboration must exist. This paper illuminates the ways in which neuroscience and law intersect to impact criminal justice. Modern neuroscience provides novel insights and tools for shaping a more equitable and effective judicial system.

Introduction

Remarkable progress has been made over the past decades in neuroscience, affording a clearer understanding of how the intricate human brain–comprised of billions of neurons and synaptic connections–produces behavior. Evidence from the cellular level to the circuit level sheds light on how illusive neural networks and mental processes underlie cognition, motivation, and action. Cutting-edge neuroimaging technologies offer unique windows into the structure and functioning of individuals' brains. Presently, the effects of this research are moving beyond the laboratory and clinical settings and into numerous areas of society–one of which is the courtroom.[1] Neuroscience research seeks insights into the neural mechanisms underlying human behavior, so its growing presence in the legal system is unsurprising–given the field's overarching concern with behavioral regulation.

Greater emphasis is being placed on the degree of influence that neuroscience research might have on legal proceedings and policy. An increasing number of cases are bringing neuroscience into the courtroom, leading to a myriad of questions. Given the advancements and possibilities of neuroscience, a recent field has emerged–neurolaw. At the intersection of law and science, neurolaw seeks to incorporate neuroscientific perspectives and technologies within various areas of law and policy and construct new frameworks surrounding the

[1] Cara M. Altimus et al., *The next 50 years of Neuroscience*, 40 The Journal of Neuroscience 101 (2020), https://www.jneurosci.org/ content/40/1/101, (last visited March 12, 2023).

legal system, from strengthening our predictions of juror responses to certain types of evidence,[2] to improving our understanding of the reliability of eyewitness memory,[3] and substantiating brain injury and abnormality claims.[4] This article will focus on the particularly notable implications for criminal law.

Criminal justice policymakers face many questions centered around human behavior issues, which parallel some of the research and inquiry occurring in neuroscience laboratories and academic settings. Although there is significant overlap between these fields, a considerable gap still exists between them.[5] Neuroscience has the potential to address many of the brain-based concerns within criminal law, and given the incredible refinements in understanding and technology, more collaboration must exist. Despite uncertainty from skeptics and various limitations, modern neuroscience offers vital tools for supporting criminal justice reform and helping shape a more equitable and rehabilitative approach. The purpose of this article is to present the possibilities and limitations of neuroscience in criminal jurisprudence. The first part will address these topics in the context of criminal proceedings by examining the historical and modern uses of neuroscientific evidence in various phases, from trial to sentencing. Shortcomings, limitations, and risks will also be addressed. The focus will shift to discussing the broader implications of

[2] Jessica M. Salerno & Bette L. Bottoms, *Emotional evidence and jurors' judgments: The promise of neuroscience for informing psychology and law*, 27 Behavioral Sciences & the Law 273 (2009).
[3] John T. Wixted et al., *Rethinking the reliability of eyewitness memory*, 13 Perspectives on Psychological Science 324 (2018), https://pubmed.ncbi.nlm.nih.gov/29716454/. (last visited March 12, 2023).
[4] Purvak Patel et al., *The role of imaging in United States courtrooms*, 17 Neuroimaging Clinics of North America 557 (2007), https://www.sciencedirect.com/science/article/abs/pii/S1052514907000585?via%3Dihub, (last visited March 12, 2023).
[5] Cara M. Altimus, *Neuroscience has the power to change the criminal justice system*, 4 eNeuro (2017), https://www.eneuro.org/content/4/1/ENEURO.0362-16.2016, (last visited March 12, 2023).

neuroscience in fostering a more effective and fair criminal justice system.

Historical Use of Neuroscientific Evidence in Criminal Trials

The use of neuroimaging evidence emerged in the twentieth century. One of the first and most well-known cases involving neuroimaging in the criminal courtroom is the 1982 trial of John Hinckley–who attempted to assassinate President Ronald Reagan.[6] Hinckley's attorneys presented evidence supporting an insanity defense. Alongside testimony from a consulting psychiatrist who spoke on his diagnosis of schizophrenia, Hinckley's lawyers also sought to admit CAT (Computer Axial Tomography) scans to visually depict abnormalities in his brain to the jury. The prosecution opposed the introduction of neuroimaging evidence, arguing that there was no "accepted scientific basis for relating these results to Mr. Hinckley's behavior."[7] In a special hearing, experts spoke about how the scans may provide the jury with a fuller picture of the factors influencing Hinckley's mental state, and ultimately, the court allowed the admission of CAT scans as evidence.[8] The jury found Hinckley not guilty by reason of insanity (NGRI).[9]

After Hinkley's successful defense, excitement about the possibilities of neuroimaging grew. In the early 1990s, the presentation of brain scans in another pivotal case lent credence to using neuroimaging evidence in the criminal courtroom. In *People v. Weinstein*, defendant Herbert Weinstein

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[6] *People v. Weinstein*, 156 Misc. 2d 34, 35, 591 N.Y.S.2d 715, 717 (Sup. Ct. 1992), https://casetext.com/case/people-v-weinstein-13, (last visited March 12, 2023).
[7] Stuart Taylor, *Judge Rebukes Hinckley Witness Over Cat Scan* The New York Times (1982), https://www.nytimes.com/1982/05/20/us/judge-rebukes-hinckley-witness-over-cat-scan.html, (last visited Jan 17, 2023).
[8] Stuart Taylor, *CAT Scans Said to Show Shrunken Hinckley Brain*, The New York Times (1982), https://www.nytimes.com/1982/06/02/us/cat-scans-said-to-show-shrunken-hinckley-brain.html, (last visited Jan 17, 2023).
[9] Eryn Brown, *Is "Neurolaw" Coming Soon to a Courtroom Near You?* Scientific American (2019), https://www.scientificamerican.com/article/is-neurolaw-coming-soon-to-a-courtroom-near-you/, (last visited Jan 17, 2023).

(who had no history of mental illness) suddenly and violently murdered his wife. Brain scans uncovered a large arachnoid cyst compressing his prefrontal cortex–[10] a brain region responsible for reasoning, decision-making, behavior inhibition, impulse control, and executive functions.[11] Weinstein's attorneys argued that he lacked culpability for his actions and provided evidence, including PET (Positron Emission Tomography) scans that demonstrated the cyst and metabolic imbalances in the surrounding region. His psychiatrist concluded that at the time of the murder, Weinstein had severely impaired cognitive ability, which rendered him unable to either recognize the consequences of his actions or understand that his conduct was unethical. The court ruled that the PET scans were admissible, though ultimately, Weinstein settled for a favorable plea deal for a lesser charge of manslaughter.[12] Following these pivotal cases, the introduction of neuroscience evidence in criminal trials grew tremendously and was shaped by two major standards for admissibility.

Frye And *Daubert* Standards of Admissibility

The use of neuroimaging and neuroscientific evidence in the courtroom highly depends on the relevant evidentiary standards in a given jurisdiction. The primary standards governing the admissibility of scientific evidence emerged from two influential cases–*Frye v. United States*[13] and *Daubert v. Merrell Dow Pharmaceuticals, Inc*.[14] In 1923, the Court of Appeals for the District of Columbia established the *Frye*

[10] *Supra* note 6.
[11] Robert M. Sapolsky, *The frontal cortex and the criminal justice system*, 359 Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences 1787 (2004).
[12] *Supra* note 6.
[13] Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923), https://casetext.com/case/frye-v-united-states-7, (last visited March 12, 2023).
[14] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993), https://supreme.justia.com/cases/federal/us/509/579/, (last visited March 12, 2023).

standard–now commonly referred to as the 'general acceptance' test. In *Frye v. United States*, the defendant–accused of murder in the second degree–unsuccessfully attempted to introduce results of a (lie-detector-like) systolic blood pressure deception test.[15] In upholding the lower court's decision, the D.C. Court of Appeals concluded that because the systolic blood pressure test had not achieved 'general acceptance' within its field, the evidence presented was rightly inadmissible. The *Frye* standard was applied to nearly all scientific technologies and methods. It stood as the principle test for determining the admissibility of scientific evidence at trial until the *Daubert* standard was established in 1993.

In *Daubert v. Merrell Dow Pharmaceuticals, Inc*., the Supreme Court held that the Federal Rules of Evidence 702 superseded the 'general acceptance' test for admissibility of scientific evidence set by *Frye*.[16] The Court felt the rigid definition outlined in *Frye* conflicted with the more liberal standard of the Federal Rules. Nothing in the text of Rule 702, nor the legislation as a whole, indicated that 'general acceptance' was a requisite for evidentiary admissibility. Thus, the Court set forth a new standard focusing on factors of relevance and reliability. Under this *Daubert* standard, 'general acceptance' is not required; instead, the trial judge is tasked with ensuring that an expert's testimony rests on a reliable foundation and applies to the given issue. Appropriate evidence founded on scientifically valid principles is, therefore, acceptable. The Court set forth general guidelines to assist in the determination of whether particular testimony or evidence in question is scientifically valid and supports the jury's evaluation of the facts at issue.[17] The federal court system follows the *Daubert* standard, while state courts are split between *Frye* and *Daubert*. Understanding the bounds and guidelines established by these standards is critical to the discussion of the role neuroscience

[15] *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923), https://casetext.com/case/frye-v-united-states-7, (last visited March 12, 2023).
[16] Federal Rules of Evidence, 28 U.S.C. § 702, https://www.law.cornell.edu/rules/fre/rule_702, (last visited March 12, 2023).
[17] *Daubert v. Merrell Dow Pharms., Inc*., 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993), https://supreme.justia.com/cases/federal/us/509/579/, (last visited March 12, 2023).

evidence may or may not play in any given case. These two standards have numerous similarities, though the establishment of the more liberal *Daubert* standard unlocked the potential for broader use of neuroscience evidence in modern courtrooms.

Modern Neuroscience in The Criminal Courtroom

Generally, criminal offenses involve three elements: the behavior (*actus reus*), the mental element (*mens rea*), and the causation between the action and result.[18] For someone to be held liable for a crime, typically, their mental state must have had a direct relationship to the event, such that, had the individual been in a different mental state, the consequence would not have materialized. Therefore, in a criminal trial, the prosecution strives to demonstrate criminal intent–proving 'beyond a reasonable doubt' that the detrimental occurrence directly resulted from the individual's conscious decisions and subsequent actions. This cognitive aspect of criminal liability opens the door to various neuroscientific considerations. Evidence of this nature can aid in assessing whether the appropriate causal link existed between the defendant's mental state and the consequences of their actions.

Decades of research have revealed the numerous ways in which brain abnormalities can cause atypical behavior. It has been demonstrated repeatedly in the neuroscientific literature that when the brain is physically altered, cognition and mental processes fundamentally change. Neurological pathologies can result in impairments of various functions, including reasoning, impulse control, and ethical decision-making.[19] Additionally, over the past decades, neuroscience technologies, and particularly neuroimaging, saw tremendous advancements.[20] In the 1970s and 1980s, there was the development of

[18] *Criminal law*, Legal Information Institute, https://www.law.cornell.edu/wex/criminal_law, (last visited Jan 20, 2022).
[19] *Supra* note 11.
[20] *History of PET and MRI*, U.S. Department of Energy Molecular Nuclear Medicine Legacy, https://www.doemedicalsciences.org/historypetmri.shtml, (last visited Jan 25, 2023).

PET–offering visualization of blood flow and oxygen consumption throughout the brain–[21] and MRI technology (Magnetic Resonance Imaging)–providing detailed images of the brain and revealing disease and abnormality.[22] By the 1990s, fMRI (Functional Magnetic Resonance Imaging) emerged, offering a window into the brain's tissue and structure as well as the brain's functions.[23] These innovative tools helped researchers to more clearly see the relationship between the brain and behavior, which has become increasingly pertinent to legal proceedings. For some defendants, imaging can depict neural dysfunction that may have obstructed cognitive processes such that the necessary mental state, or sense of agency, was lacking. Neuroimaging evidence could be presented to mitigate culpability or support an NGRI defense.

As evidenced by empirical studies, the interdisciplinary connections between neuroscience and the law continue to grow, both in understanding and application. It is important, however, to note that a large portion of the criminal law system remains a black box, as the majority of criminal cases in the United States (estimated at over 90%) resolve through plea bargaining–a largely undocumented process.[24] Of the cases that go to trial, it is clear that each year neuroscientific evidence is becoming another tool for defendants. A detailed review of criminal cases between 1992 and 2012 revealed 553 cases in which some

[21] A. Berger, *Positron emission tomography*, 326 BMJ 1449 (2003), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1126321/, (last visited March 12, 2023).
[22] *Id.*
[23] Gary H. Glover, *Overview of functional magnetic resonance imaging*, 22 Neurosurgery Clinics of North America 133 (2012), https://www.samfunnet.org/wp-content/uploads/2021/06/Overview-of-Functional-Magnetic-Resonance-Imaging.pdf, (last visited March 12, 2023).
[24] Ram Subramanian et al., *In the Shadows: A Review of the Research on Plea Bargaining* (2020), https://safetyandjusticechallenge.org/wp-content/uploads/2021/06/In-the-Shadows-A-Review-of-the-Research-on-Plea Bargaining.pdf, (last visited March 12, 2023).

neuroscientific evidence was presented.[25] Of those, over 63% of the reviewed cases involved neuroimaging evidence, such as CT scans, MRI imaging, or PET. Such empirical reviews indicate the modern trends of neuroscience in the criminal courtroom.

Neuroscientific evidence can potentially play a role in all phases of a criminal trial, from deciding competency to guilt and sentencing. Neuroscience evidence may aid in mitigating or obliterating criminal responsibility during the liability phase. There are four primary arguments for which neuroscience evidence may be relevant during that stage, including "a claim that the defendant's act was 'involuntary,' a claim that the defendant lacked the *mens rea* (or mental state) for the offense, and a claim that the defendant was insane, due either to cognitive or volitional impairment."[26] However, each approach has limitations, and in some cases, neuroscientific evidence might not be helpful, relevant, or supportive of one's trial defense. Instead, it may serve a role in a later stage.

Research suggests that attempts to use neuroscientific evidence at the sentencing phase might be far more impactful than at the liability phase. [27] In some cases, proof of brain damage or abnormality may not be enough to nullify criminal liability, though it may be valuable in the following stage. Various factors are considered during sentencing, and information such as neuroscientific evidence can aid in shaping the appropriate penalty.[28] During sentencing, the standards for evidentiary

[25] Deborah W. Denno, *The Myth of the Double- Edged Sword: An Empirical Study of Neuroscience Evidence in Criminal Cases*, 56 B.C. L. Rev. 493 (2015), https://bclawreview.bc.edu/articles/557, (last visited March 12, 2023).
[26] Christopher Slobogin, *Neuroscience nuance: Dissecting the relevance of neuroscience in adjudicating criminal culpability*, Journal of Law and the Biosciences 577 (2017), https://academic.oup.com/jlb/article/4/3/577/4617740?login=false, (last visited March 12, 2023).
[27] *Supra* note 23.
[28] Yu Du, *The Application of Neuroscience Evidence on Court Sentencing Decisions: Suggesting a Guideline for Neuro-Evidence*, 18 Seattle Journal for Social Justice 493

admissibility are lower.[29] The judge can consider a larger pool of evidence and background information about the defendant to sentence accordingly.[30] Hence, a wider net can be cast as more factors become relevant. As the capabilities of science and technology continue to advance, lawyers, researchers, and scholars should explore new ways in which neuroscience may provide deeper insights into defendants to improve sentencing.

Neuroscience Evidence and Capital Punishment

Despite attempts for reform, capital punishment remains prone to error and bias, with high costs and grave consequences.[31] Supporters of the death penalty claim that it protects society, deters crime, and is a necessary punishment for certain transgressions, but this argument fails to acknowledge its inhumanness, irreversibility, and the inherent racial and economic biases which pervade the system.[32] What may be most concerning is the frequency at which innocent individuals are erroneously sentenced to death. One study, analyzing over three decades of death sentence and death row exonerations, revealed that one in 25 individuals on death row, or 4.1% of criminal defendants, were likely convicted mistakenly.[33]

(2020), https://digitalcommons.law.seattleu.edu/cgi/viewcontent.cgi?article=1989&context=sjsj, (last visited March 12, 2023).

[29] *Supra* note 24.

[30] Bernice B. Donald & Erica Bakies, *A Glimpse Inside the Brain's Black Box: Understanding the Role of Neuroscience in Criminal Sentencing*, 85 Fordham L. Rev. 481 (2016), https://ir.lawnet.fordham.edu/flr/vol85/iss2/5/, (last visited March 12, 2023).

[31] *Death penalty*, Equal Justice Initiative (2022), https://eji.org/issues/death-penalty/ (last visited Feb 11, 2023).

[32] *The case against the death penalty*, American Civil Liberties Union (2012), https://www.aclu.org/other/case-against-death-penalty (last visited Feb 11, 2023).

[33] Greg Miller, *More than 4% of death row inmates may be innocent*, Science (2014), https://www.science.org/content /article/more-4-death-row-inmates-may-be-innocent, (last visited Feb 11, 2023).

Research suggests that it's in capital punishment where neuroscience evidence is having the most profound effect.[34] Various Supreme Court opinions highlight the relevance of brain-based considerations in capital cases. For example, in evaluating cases involving the death penalty, the Supreme Court has noted the importance of considering particular factors which may support diminished culpability–such as neurological problems. A pivotal case reflecting this rationale is the 2002 case *Atkins v. Virginia*. The Court held that the execution of individuals with severe intellectual disabilities is considered cruel and unusual punishment, thus barred by the Eighth Amendment.[35] This underscores the relevance of examining and, when necessary, presenting neuroscience-based arguments when a defendant faces the death penalty.

Research highlights the growing use of neuroscience evidence in death penalty cases. In a 2015 review of 553 criminal cases involving some presentation of neuroscientific evidence, a majority of cases, 366 or 66.18%, began as capital cases.[36] This study also showed that neuroscience evidence was employed at all stages of capital cases, most frequently during the penalty phase.[37] In capital cases, neuroscientific evidence, such as imaging, can be introduced to pinpoint and support reduced culpability due to physical abnormalities. Such mitigating evidence may also be introduced in the penalty phase of capital trials to obtain a lesser punishment. The effectiveness of these strategies appears largely successful thus far. In one exploratory study, researchers presented mock jurors with case facts and varied diagnostic evidence (such as either (a) a psychosis diagnosis alone; (b) diagnosis and neuropsychological test results; or (c) diagnosis, test results, and neuroimages) to assess the impact of neuroscience evidence on

[34] Darby Aono et al., *Neuroscientific evidence in the courtroom: A Review*, Cognitive Research: Principles and Implications (2019), https://cognitiveresearchjournal.springeropen.com/articles/10.1186/s41235-019-0179-y, (last visited March 12, 2023).
[35] Atkins v. Virginia, 536 U.S. 304 (2002), https://supreme.justia.com/cases/federal/us/536/304/, (last visited March 12, 2023).
[36] *Supra* note 23.
[37] *Id.*

sentencing recommendations. The results showed a mitigating effect, particularly for defendants at high risk for future dangerous conduct, such that when either neuropsychological test results or test results alongside neuroimages were presented, the mock jurors were dramatically less likely to sentence the defendant to death.[38] Further support of neuroscience evidence in capital cases comes from literature reviews. An extensive review article by Aono et al. studied the impact of neuroscience evidence and neuroimaging on legal judgments in various conditions. For all studies which involved the death penalty, the presence of neuroscientific evidence consistently decreased death sentences–for at least a subset of defendants.[39]

Beyond mock juries and laboratory experiments, insights from real jurors provide a unique perspective. One case in which the evidence and testimony of a defendant's brain likely saved him from the death penalty was *Florida v. Nelson*. Grady Nelson was found guilty of brutally stabbing and killing his wife, among other heinous crimes.[40] During the trial, neuroscience evidence in the form of quantitative electroencephalography (QEEG) was admitted, as it met the legal prerequisites

for admissibility under the *Frye* and *Daubert* standards.[41] QEEG occurs through a method similar to a standard EEG; electrodes are placed on the skull to record the brain's electrical activity; however, in QEEG, a computer program analyzes the data in search of abnormalities. In *State*

[38] Edith Greene & Brian S. Cahill, *Effects of neuroimaging evidence on mock juror decision making*, 30 Behavioral Sciences and the Law 280 (2011).
[39] *Supra* note 32.
[40] Florida v. Nelson, No. F05-0846 (11 Fla. Cir. Ct., 2010), https://caselaw.findlaw.com/fl-supreme-court/1497419.html, (last visited March 12, 2023).
[41] Terry Lenamon, *Qeeg Brain Mapping Evidence and mitigation in South Florida's Grady Nelson trial,* Death Penalty (2010), https://www.deathpenaltyblog.com/qeeg-brain-mapping-evidence-and-mitigation-in-south-floridas-grady-nelson-trial/, (last visited Feb 13, 2023).

v. Nelson, neuroscientist Robert Thatcher testified before the court regarding the frontal lobe abnormalities that Nelson's QEEG revealed and described the significant behavior implications of such damage.[42] Ultimately, the jury rejected the death penalty, instead recommending life in prison. Post-trial interviews with jury members shed light on the crucial role that neuroscience evidence played in their decision. Multiple jurors who voted against the death penalty cited the QEEG as the evidence which motivated their decision.[43] One juror noted that she was initially inclined toward recommending the death penalty, "but then when it came in [the QEEG evidence], some of us changed our mind."[44] Another juror echoed this sentiment stating, "the technology really swayed me . . . After seeing the brain scans, I was convinced this guy had some sort of brain problem."[45] This case illustrates how introducing neuroscientific evidence can aid in an argument of diminished punishment due to neural abnormality and reduce the likelihood of those with mental illness or brain irregularities being sentenced to death.

An indirect yet significant indication of systemic change relating to neuroscience evidence comes from data on *Strickland* claims. In *Strickland v. Washington*, the Supreme Court established the framework for evaluating 'ineffective assistance of counsel–' or *Strickland* claims.[46] The Court has emphasized that for capital cases, a comprehensive examination into any mitigating evidence must occur, which includes probing for potential cognitive or intellectual deficits or abnormalities.[47] A high bar exists, making 'ineffective assistance of counsel' extremely difficult to prove; thus, *Strickland* claims have low success rates.[48] Data

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[42] Greg Miller, *Brain Exam may have swayed jury in sentencing convicted murderer*, Science (2010), https://www.science.org/content/article/brain-exam-may-have-swayed-jury-sentencing-convicted-murderer, (last visited Feb 13, 2023).
[43] *Id.*
[44] *Id.*
[45] *Id.*
[46] Strickland v. Washington, 466 U.S. 668, (1984), https://supreme.justia.com/cases/federal/us/466/668/, (last visited March 12, 2023).
[47] *Supra* note 23.
[48] *Supra* note 32.

from a 2015 review suggests an interesting trend when neuroscience evidence is called into question. More defendants are arguing and succeeding in *Strickland* claims based on their attorney's failure to introduce neuroscience evidence as a defense.[49] The study illustrated how the absence of an investigation into relevant neuroscience evidence increased the chance that defense counsel would be found ineffective.[50] Overall, these neuroscience-based arguments had far higher success rates than the average success rate for all *Strickland* claims.[51] This finding is remarkable and indicative of a fundamental shift in the expectations surrounding neuroscience inquiry during capital cases. Courts are beginning to expect attorneys to investigate and present neuroscience evidence when appropriate. Those disregarding this obligation are more frequently rendered ineffective during appeals.

Shortcomings & Risks

The growing presence of neuroscience in the courtroom
has prompted critiques, discourse, and questions surrounding its use. The impact of neuroscience evidence should not be broadly overstated. It is important to recognize the limitations and risks of neuroscience in legal settings while highlighting its value and function in the judicial system.

One argument against neuroimaging evidence is the fear of bias, distraction, and being misleading. Some cite an inherent allure of visual neuroscience that may impede juror's abilities to properly assess the validity of the

underlying psychological explanation.[52] Others claim that presenting neuroimaging evidence may bias both the moral and legal intuitions of

[49] *Supra* note 23.
[50] *Id.*
[51] *Id.*
[52] Deena Skolnick Weisberg et al., *The seductive allure of neuroscience explanations,* 20 Journal of Cognitive Neuroscience, pp. 470–477 (2008),

judges and jurors, as "pretty pictures" might obscure their conclusions and interpretation of the data.[53] These concerns center heavily around the visual impact of neuroimages which is asserted to fuel their unfair persuasiveness. While some early research examining this issue showed mixed results, the aggregate of empirical studies largely fails to uphold the argument. In a study by Baker et al., eye-tracking technology was used to assess participants' attention to various types of neuroscientific data. Subjects received a brief description of a court case where a neurological defect was used to support the defendant's argument. Participants then saw either an MRI image of the defendant's brain or a depiction of their brain activity via a bar graph. In comparing the mock juror's responses to the two types of evidence, the researchers found no significant differences in judgments, such that the neuroimage bias argument was not supported.[54] A growing body of research examining the independent impact of neuroimages on decision-making fails to demonstrate an inordinately biasing allure effect.

Another force of resistance comes from a small group of neuroscientists who disparage the use of neuroscience in criminal law, with some calling for a complete ban. This argument stems largely from those who fear its premature use in the courtroom. While acknowledging a risk of misuse– as could occur with many types of evidence–research largely disproves this fear, highlighting instead how neuroscience can actually be used to improve decision-making in law.[55] Safeguards exist and effectively

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https://www.ncbi.nlm.nih.gov/pmc/articles/ PMC2778755/, (last visited March 12, 2023).

[53] Thomas Nadelhoffer, *Jurors, brain imaging, and the allure of pretty pictures* , The Situationist (2009), https://thesituationist.wordpress.com/2009/03/10/jurors-brain-imaging-and-the-allure-of-pretty-pictures/, (last visited Feb 13, 2023).

[54] D. A. Baker et al., *Visual attention and the neuroimage bias*, 8 PLoS ONE (2013), https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0074449, (last visited March 12, 2023).

[55] Henry T. Greely & Nita A. Farahany, *Neuroscience and the Criminal Justice System*, 2 Annual Review of Criminology 451 (2019), https://www.annualreviews.org/doi/pdf/10.1146/annurev-criminol-011518-024433, (last visited March 12, 2023).

protect the fairness and integrity of criminal proceedings. For example, judges serve an active role in upholding standards of evidentiary admissibility during trial, which further prevents inappropriate applications of neuroscience tools. Various cases illustrate how the courts have prevented premature or improper techniques from being admitted as evidence. For example, in *United States v. Semrau*, the court ruled that the lower court did not abuse its discretion in excluding fMRI evidence as a form of lie detection.[56] At present, researchers largely agree that fMRI technology is not yet well established as a reliable lie-detection tool and thus does not pass the established *Daubert* or *Frye* standards.[57]

Neuroscience is now a well-established form of evidence in the courtroom, and its use has increased in recent years. The focus should not be on resisting it; instead, experts across fields should embrace this intersection and seek practical approaches and supporting frameworks. Additionally, more education and awareness of the prospects and limitations of neuroscience in legal settings can ease concerns and combat potentially inappropriate applications.

Further Implications for Neuroscience in Fostering a More Effective and Fair Criminal Justice System

The United States has around 2 million Americans incarcerated, which has increased by about 500% across the last four decades.[58] America

[56] United States v. Semrau - 693 F.3d 510 (6th Cir. 2012), https://casetext.com/case/united-states-v-semrau, (last visited March 12, 2023).
[57] Anthony D. Wagner et al., *fMRI and Lie Detection*, Macarthur Foundation Research Network on Law & Neuroscience, Vanderbilt Law (2016), file:///C:/Users/user/Downloads/SSRN-id2881586.pdf, (last visited March 12, 2023).
[58] *Research - get the facts*, The Sentencing Project (2022), https://www.sentencingproject.org/research/, (last visited Feb 13, 2023).

incarcerates more individuals than any other nation.[59] This is not a reflection of rising crime rates but is primarily due to failures in policy, procedures, and sentencing. The shift towards mass incarceration can be traced back to policy and attitudes of the 1970s and 1980s. The prevailing narrative centered around being 'tough on crime,'[60] and initiatives such as the 'war on drugs' shaped ineffective and discriminatory policies. These shifts led to overly severe penalties for drug-related crimes and a tremendous increase in incarcerations of nonviolent offenders.[61] Over time, the primary view of criminal justice shifted further away from one of rehabilitation and towards the largely retributivist approach which prevails today. This more punitive system carries great societal costs, and many Americans agree that it is largely failing.[62]

Though some disagree with this perspective, the evidence is clear–mass incarceration is ineffective. While the need for accountability should not be dismissed, it must not be the only pillar of criminal justice. In addressing drug crimes, a distinction should be made between serious offenders and lower-level offenders who are more frequently prosecuted and often face overly severe, counterproductive punishments. An extensive body of evidence discredits the belief that harsher sentences deter most drug-law offenses. For example, a 2001 report demonstrated that significant increases in imprisonment did not result in a reduction in illegal drug use.[63] Another report found that mandatory minimum

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[59] James Cullen, *The history of mass incarceration*, Brennan Center for Justice (2018), https://www.brennancenter.org/our-work/analysis-opinion/history-mass-incarceration, (last visited Feb 13, 2023).

[60] Nkechi Taifa, *Race, mass incarceration, and the disastrous war on drugs*, Brennan Center for Justice (2021), https://www.brennancenter.org/our-work/analysis-opinion/race-mass-incarceration-and-disastrous-war-drugs, (last visited Feb 13, 2023).

[61] *War on drugs*, History (2017), https://www.history.com/topics/crime/the-war-on-drugs, (last visited Feb 14, 2023).

[62] Daryl V. Atkinson, *A revolution of values in the U.S. criminal justice system*, Center for American Progress (2018), https://www.americanprogress.org/article/revolution-values-u-s-criminal-justice-system/, (last visited Feb 13, 2023).

[63] *The growth of incarceration in the United States: Exploring causes and consequences*, National Academies Press (2014), https://nap.nationalacademies.org/read/18613/chapter/1, (last visited Feb 25, 2023).

sentences for certain drug offenders have nominal to no deterrent effects, and lengthy sentences do not facilitate crime reduction. Research also demonstrated that when prison terms for specific federal drug offenders were reduced, recidivism rates did not subsequently rise.[64] The research strongly suggests that alternative approaches are necessary. We must aim to strike an appropriate balance between public safety, punishment, accountability, and effective deterrence. Innovative policies can reduce costs and improve public health by reducing the number of incarcerated low-level,
non-violent drug offenders.[65] Addressing high incarceration rates in the U.S. requires reassessing decades-old policies that have been proven ineffective and costly. Illegal drug abuse must be recognized as both a health policy and a justice policy issue.[66]

Neuroscience may play a crucial role in shaping criminal justice reform grounded in a scientific understanding of human behavior. Neuroscience sheds light on the biological underpinnings of behavior and dysfunction, offering a unique channel for confronting the complex factors causing criminal conduct. The overarching goals of the criminal justice system are multifaceted: it functions to prevent crime, safeguard the public, hold offenders responsible through punishment, and help rehabilitate those who breach societal expectations.[67] Presently, there is a disregard for most goals and a tendency towards punishment and retribution–despite the recurring failure of this approach. Anderson and Kiehl pose an interesting perspective, suggesting neuroscience as a platform upon which to evaluate the limitations of our current system–which does little to address the mental illness and social issues that contribute to high

[64] *Id.*
[65] Adam Gelb et al., *More imprisonment does not reduce state drug problems*, The Pew Charitable Trusts (2018), https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2018/03/more-imprisonment-does-not-reduce-state-drug-problems, (last visited Feb 25, 2023).
[66] *Supra* note 61 at 348.
[67] *A guide to the criminal justice system*, CriminalJustice.com, https://www.criminaljustice.com/resources/guide-to-us-criminal-justice-system/, (last visited Feb 13, 2023).

incarceration rates. "Rather than eroding jurisprudence, [neuroscience] has the potential to inform more effective policies that serve our society in progressive ways."[68] These might include evidence-based strategies targeting mental health and rehabilitation, more substantive reintegration programs, better-informed approaches to personalized sentencing, and reduced long-term incarceration rates for certain low-risk and non-violent offenders.[69] For cases in which rehabilitation is not realistic, neuroscience tools can also be implemented to improve assessments for future risk.[70]

Another contributor to mass incarceration in the United States is high levels of recidivism. Data from the Bureau of Justice Statistics reveals staggering patterns. In one study, about 82% of prisoners released across 24 states in 2008 were re-arrested within 10 years,[71] and in a separate study, about 71% of prisoners released across

34 states in 2012 were re-arrested within 5 years.[72] With so many re-entering the criminal justice system, it is clear that new approaches are needed.

Another data-driven tool with great promise is formal risk assessment. Risk assessment has grown in use over the past few years, and interview-style processes have become more prominent. There are several limitations to this method, including the risk of bias, absence of

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[68] Nathaniel E. Anderson & Kent A. Kiehl, *Re-wiring guilt: How advancing neuroscience encourages strategic interventions over retributive justice*, 11 Frontiers in Psychology (2020).
[69] *Id.*
[70] *Id.*
[71] Leonardo Antenangeli & Matthew R. Durose, *Recidivism of prisoners released in 24 states in 2008: A 10-year follow-up period (2008–2018),* Bureau of Justice Statistics (2021), https://bjs.ojp.gov/library/publications/recidivism-prisoners-released-24-states-2008-10-year-follow-period-2008-2018, (last visited Feb 13, 2023).
[72] Matthew R. Durose & Leonardo Antenangeli, *Recidivism of prisoners released in 34 states in 2012: A 5-year follow-up period (2012–2017),* Bureau of Justice Statistics (2021), https://bjs.ojp.gov/library/publications/recidivism-prisoners-released-34-states-2012-5-year-follow-period-2012-2017, (last visited Feb 13, 2023).

objectivity, and lack of accuracy in assessing certain psychological aspects associated with reoffence.[73] Neuroscience and cognitive psychology could significantly contribute to the development of more accurate recidivism risk assessments. There are still limitations to certain technologies, and more research is needed. Tremendous progress has been made toward this goal. One promising development is in the first mobile, self-scoring, risk assessment software that relies on neurocognitive testing to predict reoffence.[74] As neuroimaging and diagnostic tools become more sophisticated, offering scientists a clearer understanding of the underlying mechanisms of cognition and behavior, greater attention should be paid to their potential applications to criminal justice. More objective measures can help improve the accuracy of predictions and eliminate implicit biases and irrelevant factors which can improperly influence decisions.

Conclusion

As law and neuroscience continue to intersect, questions emerge about the possibilities and inherent risks. There are numerous ways in which neuroscience can influence the criminal justice system, from offering insights into a defendant's brain abnormalities to reframing how sentencing and punishment are approached. As technology progresses, legal professionals must stay informed and educated about the possibilities and applications of neuroscience tools. Outside of the courtroom, neuroscience has implications for punishment and recidivism.

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[73] Pablo A. Ormachea et al., *Enabling individualized criminal sentencing while reducing subjectivity: A tablet-based assessment of recidivism risk*, 18 AMA Journal of Ethics 243–251 (2016), https://journalofethics.ama-assn.org/article/enabling-individualized-criminal-sentencing-while-reducing-subjectivity-tablet-based-assessment/2016-03, (last visited March 12, 2023).

[74] Gabe Haarsma et al., *Assessing risk among correctional community probation populations: Predicting Reoffense with mobile neurocognitive assessment software*, 10 Frontiers in Psychology (2020), https://www.frontiersin.org/articles/10.3389/fpsyg.2019.02926/full, (last visited March 12, 2023).

While certain limitations exist, and neuroscience alone does not hold all the answers, it provides a crucial perspective grounded in empirical research and biological understanding. It offers a lens through which we should consider sentencing and can aid in developing evidence-based tools to foster a more effective and equitable criminal justice.