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INTRODUCTION

I often describe law and neuroscience as a "new" and "emerging" field.[1] This gives neurolaw a shiny gloss and attracts headlines. The claim also is true, in the sense that we are examining the legal implications of new neuroscientific technology and novel findings.

But there are many ways in which the intersection of neuroscience and law is *not* new.[2] In this Article, I argue that our field should more readily

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1. *See, e.g.*, Francis X. Shen, *Neurolegislation: How U.S. Legislators Are Using Brain Science*, 29 HARV. J.L. & TECH. 495, 496 (2016) ("The questions of whether, when, and how brain science should be, and will be, incorporated into legal proceedings have led to the *emerging* fields of neurolaw and neuroethics." (emphasis added)).

2. This Article is certainly not the first to make this point. *See, e.g.*, Henry T. Greely, *Neuroscience and Criminal Justice: Not Responsibility but Treatment*, 56 U. KAN. L. REV. 1103, 1111 (2008) (discussing the history of psychosurgery); Jed S. Rakoff, *Neuroscience and the Law: Don't Rush In*, N.Y. REV. BOOKS (May 12, 2016), http://www.nybooks.com/articles/2016/05/12/neuroscience-and-the-law-dont-rush-in/ (arguing that "the history of using 'brain science' to alter the law is not a pretty picture") [https://perma.cc/J5ND-XLCS]. Legal scholar Amanda Pustilnik has argued that "[c]riminal law and neuroscience have been engaged in an episodic and ill-fated love affair for over two hundred years." Amanda C. Pustilnik, *Violence on the Brain: A Critique of Neuroscience in Criminal Law*, 44 WAKE FOREST L. REV. 183, 185 (2009). The part in Pustilnik's article entitled "A History of

acknowledge that there is a history to law and neuroscience. A central challenge is whether, and how, we will learn from this history.

On the one hand, the history of law and neuroscience offers encouragement that law and policy can be improved through advances in brain science. On the other hand, however, this history offers caution about the limits of using brain science to address legal problems.

I do not endeavor here to provide a comprehensive history of brain science and law but rather to highlight a series of four important, yet often overlooked, "moments." These moments are (1) foundational medico-legal dialogue in the nineteenth and early twentieth centuries, (2) the introduction of electroencephalography evidence into the legal system in the mid-twentieth century, (3) the use of psychosurgery for violence prevention in the 1960s and 1970s, and, most recently, (4) the development of neurolaw in personal injury litigation in the late 1980s and 1990s. I review each of these moments in Parts I–IV, respectively, and then offer a discussion in Part V of what this history means for future inquiries into neurolaw.

Before moving into the historical analysis, however, I start with a story and a scholarly mea culpa. Before I began my position as a law professor at the University of Minnesota, I completed a postdoctoral fellowship with the MacArthur Foundation Law and Neuroscience Project.[3] One of the projects I was assigned to complete as a fellow was to construct a law and neuroscience bibliography.[4] Today, the bibliography is hosted by the MacArthur Foundation Research Network on Law and Neuroscience, and users can search through thousands of entries.[5] A graph of the number of entries in the bibliography, plotted by year, is presented in figure 1.

Those who look at this graph most likely focus, as I did when I helped to create it, on the growth in the number of publications.[6] Particularly noteworthy is the very rapid increase in publications since 2000.

But focusing so intently on the right hand side of the figure has the unintended consequence of making one think that there is nothing to the left. Indeed, if the graph is to be believed, the earliest publication at the

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Violence" is one of the few extended treatments of this history in a law review article. *See id.* at 90; *see also infra* Part III (providing additional discussion of the history of neurolaw).

3. The Law and Neuroscience Project is now named the Research Network on Law and Neuroscience. *See History: Phase I (2007–2011)*, MACARTHUR FOUND. RES. NETWORK ON L. & NEUROSCIENCE, http://lawneuro.org/history.php (last visited Oct. 16, 2016) [https://perma.cc/925X-UFS6].

4. The first iteration of the bibliography was constructed by Teneille Brown, and details of the bibliography are described in Francis X. Shen, *The Law and Neuroscience Bibliography: Navigating the Emerging Field of Neurolaw*, 38 INT'L J. LEGAL INFO. 352, 354–57 (2010).

5. *Law and Neuroscience Bibliography*, MACARTHUR FOUND. RES. NETWORK ON L. & NEUROSCIENCE, http://lawneuro.org/bibliography.php (last visited Oct. 16, 2016) [https://perma.cc/5HWD-95QJ].

6. For instance, in 2010, I observed that "[l]ooking at historical trend scholarship, it is evident that there has been consistent growth since 2000, strong growth since 2005, and incredibly strong growth in the past two years in the annual number of articles published per year." Shen, *supra* note 4, at 357.

intersection of brain science and law came in 1984.[7] The problem, and hence my mea culpa, is this: upon closer review, it turns out that there are in fact many publications well before the 1980s at the intersection of brain science and law.

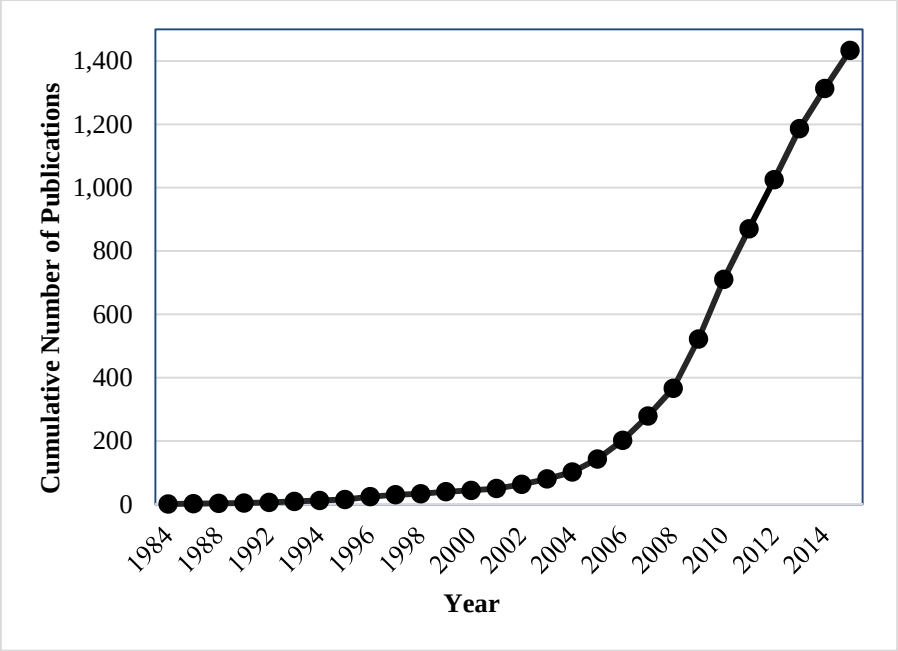
Figure 1, then, is deceptive. Figure 1 suggests that the field of neurolaw need not concern itself with anything older than a few decades.[8] The scholarship on neurolaw typically reflects this as well, focusing on the first use of the term neurolaw in 1991 to mark the birth of the field.[9] I will spend the rest of this Article, however, arguing that this start date for neuroscience and law interaction is misleading. Rather than starting in the 1990s, we should go back to the nineteenth century (and earlier).

7. Quite appropriately for this symposium, hosted at Fordham University School of Law, the first entry in the published bibliography is by a Fordham Law professor: Deborah Denno, *Neuropsychological and Early Environmental Correlates of Sex Differences in Crime*, 23 INT'L J. NEUROSCIENCE 199 (1984).

8. This is a common framing in the literature. For instance, in a 2010 review piece, in a section entitled, "Development of Neurolaw," the authors write: "Although there is a long history of interaction between law and psychology . . . the blending of law and cognitive neuroscience began in earnest in the *late 1990s*." Oliver R. Goodenough & Micaela Tucker, *Law and Cognitive Neuroscience*, 6 ANN. REV. L. & SOC. SCI. 61, 63 (2010) (emphasis added); *see also* CHRIS WILLMOTT, USE OF GENETIC AND NEUROSCIENTIFIC EVIDENCE IN CRIMINAL CASES: A BRIEF HISTORY OF "NEUROLAW" IN BIOLOGICAL DETERMINISM, FREE WILL AND MORAL RESPONSIBILITY 41 (2016) (tracking the history only through the most recent decades).

9. As one scholar writes, "Neurolaw owes its fame to a modest and seemingly innocuous beginning. Lawyer J. Sherrod Taylor coined the term during the early 1990s to describe the 'converging courses' of neuropsychology and the legal system." Steven K. Erickson, *Blaming the Brain*, 11 MINN. J.L. SCI. & TECH. 27, 35 (2010).

Figure 1: Cumulative Number of Articles, Books, and Book Chapters Included in Law and Neuroscience Bibliography, by Publication Year, 1984–2015



Data source is the Law and Neuroscience Bibliography, maintained by the MacArthur Foundation Research Network on Law and Neuroscience.

I. NINETEENTH CENTURY FOUNDATIONS: THE MEDICO-LEGAL DIALOGUE

At Delmonico's restaurant on March 19, 1873, less than a decade after the Civil War, a distinguished group of doctors and lawyers gathered for the first annual dinner of the Medico-Legal Society of the City of New York.[10] The goal was to spark dialogue between their two professions in an effort to improve the use of medicine in the law.[11]

10. *See* MEDICO-LEGAL SOC'Y OF N.Y., FIRST ANNUAL DINNER OF THE MEDICO-LEGAL SOCIETY OF THE CITY OF NEW YORK 5 (1873) [hereinafter FIRST ANNUAL DINNER]. Although this society was first formed in 1873, interest in medical jurisprudence had been rising since the late eighteenth century. *See* JAMES C. MOHR, DOCTORS AND THE LAW: MEDICAL JURISPRUDENCE IN NINETEENTH-CENTURY AMERICA 41 (1993) (noting that a "discipline that did not exist in 1790 had been established in medical schools as a significant subject of inquiry and instruction by 1850").

11. *See* Clark Bell, President, Medico-Legal Soc'y of N.Y., Opening Remarks at the First Annual Dinner of the Medico-Legal Society of New York (Mar. 19, 1873), *in* FIRST ANNUAL DINNER, *supra* note 10, at 5, 5. ("If there be any platform upon which the two professions of Law and Medicine can meet upon equal terms, with a common aim, a common purpose and equal skill, it must be on such an occasion as the present—at a dinner, under the auspices of a Society which claims to unite and combine all the higher and nobler

Over a meal of scallops and steak, those in attendance expressed their eagerness to work together. As one of the speakers exhorted, "there are so many things we might work out in common if we were all of one mind and one heart in the matter."[12] One discussion concerned medical malpractice.[13] But some of the topics for discussion concerned mental states and were strikingly similar to the contemporary neurolaw debate.[14] The issues before the group included "the inviolability of children, the sanity of persons, [and] responsibility for acts."[15]

At about the same time as these efforts in New York, similar medico-legal societies emerged in other states and internationally.[16] The *Medico-Legal Journal* was established, with articles in the first issue concerning insanity and the appropriate weight to attach to medical evidence in legal proceedings.[17] Topics discussed in the *Medico-Legal Journal* in this period included legal aspects of drug use,[18] tort recovery for mental damages,[19] the effects of trauma,[20] and lie detection.[21] These topics will strike the contemporary reader as similar to topics that remain with us today.

Historians have explored the history of dialogue between medicine and the law.[22] For my purposes here, it is simply enough to recognize that there have been many instances in which the historical dialogue foreshadows

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talent of both professions, with an earnest endeavor to exclude all the follies and foibles of each."). This was not the first, or only, effort to bring together the two disciplines. *See generally* Janet A. Tighe, *The New York Medico-Legal Society: Legitimating the Union of Law and Psychiatry (1867–1918)*, 9 INT'L J.L. & PSYCHIATRY 231, 231 (1986).

12. Elsworth Eliot, President, N.Y. Cty. Med. Soc'y, Address at the First Annual Dinner of the Medico-Legal Society of New York, *in* FIRST ANNUAL DINNER, *supra* note 10, at 10, 11.

13. *See* James Moir, President, St. Andrew's Soc'y, Address at the First Annual Dinner of the Medico-Legal Society of New York, *in* FIRST ANNUAL DINNER, *supra* note 10, at 29, 30.

14. *See id.* Lewis A. Sayre, Member, Medico-Legal Soc'y of N.Y., *in* FIRST ANNUAL DINNER, *supra* note 10, at 17, 18.

15. *Id.*

16. *See, e.g.*, George A. Sanderson, *The Co-Operation of the Medical and Legal Professions*, 143 NEW ENG. J. MED. 499, 499 (1900).

17. *See, e.g.*, Earl Russell, *The Weight to Be Attached to Medical Evidence*, 1 MEDICO-LEGAL J. 94 (1903); T. Claye Shaw, *Impulsive Insanity*, 1 MEDICO-LEGAL J. 30 (1903). The *Medico-Legal Journal* was not the first journal to explore such issues, and I do not mean to imply here that the Medico-Legal Society was the genesis of dialogue between the mind sciences and the law. For instance, physician Amariah Brigham founded the *American Journal of Insanity* over fifty years earlier, in 1844. *See Diseases of the Mind: Highlights of American Psychiatry Through 1900*, U.S. NAT'L LIBRARY MED., https://www.nlm.nih.gov/hmd/diseases/professional.html (last updated Feb. 26, 2014) [https://perma.cc/G9RV-3UUP].

18. *See generally* T.D. Crothers, *Legal Responsibilities of Drug Takers*, 33 MEDICO-LEGAL J. 14 (1916).

19. *See generally* Herbert F. Goodrich, *Emotional Disturbance as Legal Damage*, 39 MEDICO-LEGAL J. 129 (1922).

20. *See generally* Alfred Gordon, *Mental and Nervous Conditions Following Traumatism*, 14 J. NAT'L MED. ASS'N 67 (1922).

21. *See generally* R.E. House, *Why Truth Serum Should be Made Legal*, 42 MEDICO-LEGAL J. 138 (1925).

22. *See, e.g.*, MOHR, *supra* note 10.

contemporary neurolaw debates. In 1892, for instance, physician Abraham Jacobi gave a lecture to the National Prison Congress entitled, "Brain, Crime, and Capital Punishment."[23] The questions he posed to the audience are similar to ones that we continue to ask today: "Was the criminal when he committed the act matured both in years and intellect? . . . Were there chronic diseases of brain known to produce psychic disesases?"[24] And in 1910, attorney Henry Frank observed:

> The legal profession has been greatly helped by the medical, especially in criminal jurisprudence, because it has led the jurist to an understanding of the somewhat recondite and complex structure of the physical brain and its bearings on human action, and the still profounder secrets that course in the veins of blood. The judgments of the courts for centuries have evidenced profound ignorance concerning the secret promptings of human action, which were not alleviated till the pursuit of the medical science removed the ignorance of the centuries.[25]

Yet, goodwill between the fields could not be sustained. Even midway through the nineteenth century, rifts were developing, for instance, over the issue of mental states and criminal responsibility. Although some doctors were eager to testify, judges and lawyers were becoming skeptical of medicine's ability to inform legal determinations of insanity. By 1901, attorney and author Gino Speranza found that even the "most casual observation . . . suffices to show that there is . . . an apparently irreconcilable conflict between doctors and lawyers . . . [on] the question of mental responsibility in regard to criminal acts."[26]

The rift continued to grow into the 1930s. Writing in the *Notre Dame Law Review* in 1932, Judge Edward Streit found that

> [t]he perennial conflict between members of the legal and medical professions on the question of the relation of mental abnormality to criminal responsibility is a matter of common knowledge. Every sensational trial, especially for a capital offense, brings it again to the forefront and in almost every book of an exclusively legal or medical character are found spirited attacks against the views held by the opposing group.[27]

At the heart of many of these disputes was the contested concept of "insanity."[28] As legal historian Susanna Blumenthal[29] has shown, the

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23. *See* Z.R. Brockway, *The Physical Basis of Crime (Viewed from the Prison), in* PHYSICAL BASES OF CRIME: A SYMPOSIUM 134, 136 (Am. Acad. Med. ed., 1914).

24. *Id.*

25. Henry Frank, *Psychology ANR Its Relation to Medical Jurisprudence and the Aims and Objects of the Medico Legal Society*, 27 MEDICO-LEGAL J. 213, 214 (1910).

26. Gino C. Speranza, *The Medico-Legal Conflict over Mental Responsibility*, 13 GREEN BAG 123, 123 (1901).

27. Edward F. Streit, *Conflicting Viewpoints of Psychiatry and the Law on the Matter of Criminal Responsibility*, 8 NOTRE DAME L. REV. 146, 146 (1933).

28. *See, e.g.*, WILLIAM GEORGE HENRY COOK, INSANITY AND MENTAL DEFICIENCY IN RELATION TO LEGAL RESPONSIBILITY: A STUDY IN PSYCHOLOGICAL JURISPRUDENCE, at xix (1921); R.H. Ahrenfeldt, *Legal and Medical "Insanity,"* 2 BRIT. MED. J. 710, 710 (1946);

nineteenth-century development of insanity doctrine emerged out of Enlightenment mental science.[30] Owing in part to the influential work of physician Benjamin Rush, some in medicine hoped to move society toward a more biological understanding of mental disorder.[31] Debates over the biological basis of insanity are too extensive to review here.[32] But it can be said that at least some viewed insanity as a "condition due to *disease* of the brain, and expressed by impairment of feeling, thought, and volition."[33] Another suggested, in a similar vein, that "[t]he human being is endowed with certain moral powers, comprising the various sentiments, propensities, and affections, which, like the intellect, being connected with the brain, are necessarily affected by pathological conditions of that organ."[34]

Yet, nineteenth-century hypotheses about the brain basis of mental life mostly remained just that: theories without much legal purchase. Courts

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A. Moresby White, *Legal Insanity in Criminal Cases: Past, Present and Future*, 18 J. AM. INST. CRIM. L. & CRIMINOLOGY 165, 168 (1927).

29. *See* SUSANNA BLUMENTHAL, LAW AND THE MODERN MIND: CONSCIOUSNESS AND RESPONSIBILITY IN AMERICAN LEGAL CULTURE 59–86 (2015); *see also* S. SHELDON GLUECK, MENTAL DISORDER AND THE CRIMINAL LAW 443 (1927); FRANCIS OGSTON, LECTURES ON MEDICAL JURISPRUDENCE 277 (1878); ISAAC RAY, A TREATISE ON THE MEDICAL JURISPRUDENCE OF INSANITY 1 (1853). As attorney James Moir observed in 1873:

> In the United States, law and medicine have become necessary to each other, especially since the new disease of emotional insanity has become so prominent, and it now takes both professions to convict or liberate—to decide as to insanity from drink or inheritance, as may suit the case; thus rendering the study of physiology very essential to the lawyers of the present day.

Moir, *supra* note 13, at 30. Isaac Ray developed an influential classification of insanity, based on work by Europeans such as Jean Étienne Dominique Esquirol. Ray suggested that insanity (or "mental derangement") could develop in one of two ways: either the individual had deficient development of mental faculties or there was a lesion in the brain sometime after childhood. *See* RAY, *supra*, at 70–71.

30. *See* BLUMENTHAL, *supra* note 29, at 4. Debate over insanity doctrine was heavily influenced by "alienists," physicians who studied "mental alienation" in asylums, hospitals, and prisons. *Id.* at 77. The Association of Medical Superintendents of American Institutions for the Insane was founded in 1844, and later became the American Psychiatric Association. *See* MOHR, *supra* note 10, at 141.

31. *See* BLUMENTHAL, *supra* note 29, at 62–64.

32. For an analysis, see NORMAN DAIN, CONCEPTS OF INSANITY IN THE UNITED STATES, 1789–1865 (1964).

33. 2 ALLAN MCLANE HAMILTON & LAWRENCE GODKIN, A SYSTEM OF LEGAL MEDICINE 53 (2d ed. 1900). Additionally,

> disorder of brain, producing disorder of mind; or, to define its nature in greater detail, it is a disorder of the supreme nerve centers of the brain . . . . Mind may be defined physiologically as a general term denoting the sum total of those functions of the brain which are known as thought, feeling, and will. By disorder of the mind is meant disorder of these functions.

Id. The emergence of these views gave rise to what one scholar has labeled the "first biological psychiatry." EDWARD SHORTER, A HISTORY OF PSYCHIATRY: FROM THE ERA OF THE ASYLUM TO THE AGE OF PROZAC 69 (1977).

34. OGSTON, *supra* note 29, at 283. Dr. Francis Ogston was Professor of Medical Jurisprudence and Medical Logic at University of Aberdeen. *See id.* at 317. Ogston also found that in a murder trial in 1865 in Aberdeen, the jury was warned by the attorney that "they must not mistake brain disease, or weakness of mind produced by brain disease, for that kind of insanity which alone exempts from legal responsibility." *Id.*

routinely rejected the science as irrelevant to the legal decision at hand.[35] As Blumenthal has shown, such views on the biological basis of insanity failed to gain legal traction in criminal law for at least two reasons.[36] First, without the necessary tools for examining brain cells, it was difficult to confidently identify the abnormal brain function allegedly contributing to the illegal act. Second, even if mental disease could be established, it was not clear how that should affect determinations of culpability.

In sum, psychological medicine and scientific theories could not resolve the fundamental question: At what point do we draw the line between a criminal defendant who had the capacity to do otherwise versus a defendant who (due to his "insanity") did not really make a "choice" in the way that criminal law requires for culpability? Modern neuroscience—despite its many advances—still cannot answer this question either. The historical perspective reinforces the argument that the difficulty in applying neuroscience to law is more conceptual than technical.

Revisiting historical medico-legal debates also reminds us that scientists equivocated their positions as well. Blumenthal finds that in the nineteenth century, few neurologists "went so far as to say publically that there was no such thing as human responsibility."[37] In sum, Blumenthal's analysis of the

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35. An 1858 decision in a Connecticut contracts case is illustrative. The issue had to do with the alleged insanity of a testatrix as the time of the execution of her will. The court explained why the brain evidence was not needed, stating:

> After having examined, and somewhat thoroughly read, the treatises and reported cases brought to our notice on the trial . . . I am convinced that the question of a man's ability to make a contract or will, or of his legal responsibility for his actions, is best determined by calling the attention of the court and jury to two plain questions of common sense: 1st. What degree of mental capacity is essential in such cases?—which is a question of law; and 2d. Does that capacity exist in the case in hand?—which is a question of fact. Refinements and speculations beyond this can avail very little in my judgment; and to indulge in them will confuse more than enlighten the minds of the jury; and, after all, it will come to these questions, whatever technical rule may be laid down by the court.
>
> . . . [T]he jury, who are not necessarily learned men nor familiar with the refinements of phrenological or physiological science or with the pathology of mental disease.

Appeal of Dunham, 27 Conn. 192, 201–02 (1858). In a similar vein, Edward Streit observed:

> From a strictly medical viewpoint, if it is assumed that the brain is the seat of the mind or that the mind is no more than cerebral activity, and that all normal mental phenomena are regarded as the result of a healthy brain, while abnormal phenomena are the result of a diseased or deranged brain, then the condition of a particular individual may be designated as either sanity or insanity, with no middle ground, for the brain must be either healthy or unhealthy. However, such an omnibus definition is entirely useless for legal purposes.

Streit, *supra* note 27, at 183–84.

36. *See* BLUMENTHAL, *supra* note 29, at 70–71 (suggesting that the legal "audience was not so easily persuaded" and that "the distinction between the responsible moral agent and the person who was diseased and therefore blameless remained sketchy at best"). Blumenthal also observes that "[m]embers of the bench came to doubt that much enlightenment would come from psychological medicine" and that "[j]urists were especially reluctant to credit the theories of the 'materialistic psychologists,' who assumed that all mental life had a biological basis." *Id.* at 141.

37. *Id.* at 284.

issue of insanity and responsibility in nineteenth-century courts leaves us with a telling conclusion about this historical moment: rather than clarify legal doctrine, biological theories of mental disease "obscured as much as they revealed about what distinguished the normal from the pathological."[38]

II. THE ADVENT OF ELECTROENCEPHALOGRAPHY (EEG)

The previous part explored early debates about criminal responsibility. But the intersection of brain science and law is much broader than criminal law.[39] Thus, it is important to look back at historical examples from noncriminal law domains too. In this part, I examine one such instance: the use of electroencephalography (EEG) in the law in the mid-twentieth century. I focus especially on how EEG reshaped American laws concerning epileptics.

One of the reasons that brain scientists in the nineteenth and early twentieth century could offer so little to courts was their long-standing inability to measure brain activity in living humans. A revolutionary breakthrough, however, came in the 1920s thanks to the work of German psychiatrist Hans Berger.[40] In the late nineteenth century, it had been discovered that one could record electrical activity from the mammal brain.[41] Building on this work, Berger began trying to record electrical activity in humans. He was able to record the first human electroencephalogram and publish the first electroencephalography paper in the mid-1920s.[42] Berger's discovery is considered "revolutionary,"[43] and "one of the most remarkable and momentous developments in the history of clinical neurology."[44]

The logistics of EEG are straightforward. Electrodes are placed on the human head, and they are used to measure electrical activity. That activity is recorded and analyzed with the aid of a computer system, and the results allow for inferences about brain function. These results can be used to aid medical diagnoses or for basic research. The value of EEG for research and clinical treatment was immediately obvious, and use of the technique

38. *Id.* at 251.

39. Francis X. Shen, *Law and Neuroscience 2.0*, ARIZ. ST. U. L. REV. 1, 2 (forthcoming 2016).

40. *See* L.F. Haas, *Hans Berger (1873–1941), Richard Caton (1842–1926), and Electroencephalography*, 74 J. NEUROLOGY NEUROSURGERY & PSYCHIATRY 9, 9 (2003); T.J. La Vaque, *The History of EEG: Hans Berger: Psychophysiologist*, 3 J. NEUROTHERAPY 1, 1 (1999).

41. This work was completed in large part by physiologist Richard Caton. *See* David Millet, *Hans Berger: From Psychic Energy to the EEG*, 44 PERSP. BIOLOGY & MED. 522 (2001) (providing a lengthy description of Berger and his work).

42. *See id.* at 523.

43. Renato M.E. Sabbatini, *The History of the Electroencephalogram*, BRAIN & MIND (Aug. 1997), http://www.cerebromente.org.br/n03/tecnologia/historia.htm ("These were revolutionary discoveries, and, in fact, Berger founded an entirely new and very important branch of medical science, named clinical neurophysiology." (emphasis omitted)) [https://perma.cc/CF34-CAEQ].

44. Gregory L. Holmes, *Epilepsy*, *in* LANDMARK PAPERS IN NEUROLOGY 163, 168 (Martin R. Turner & Matthew C. Kiernan eds., 2015).

flourished. So much had been published on EEG by 1937 that the literature was "already too extensive for adequate review."[45]

It was not immediate, but EEG eventually found its way into American courtrooms.[46] Figure 2 charts the number of EEG cases, by decade, starting in 1930. Before 1950, there were just eight reported cases making mention of EEG. The use of EEG, however, has risen every decade since, with nearly 2,000 total reported cases through 2016.

Generally, the field of law and neuroscience has overlooked this large body of cases. Yet these cases are ripe for further analysis, and I offer here a few observations on the cases in the hope of sparking scholarly interest in a more thorough analysis.

A first observation is that EEG was particularly useful in the diagnosis and treatment of epilepsy and related seizure disorders.[47] Epilepsy had "plagued mankind from time immemorial,"[48] and twenty-eight states had sterilization laws that included epileptics.[49] As late as 1956, some states still had laws that restricted marriage of epileptics.[50] But the "discovery [of EEG] . . . released epilepsy from the crypt of the unknown."[51] Before EEG, and "[u]ntil the 1950s, individuals with epilepsy were legally denied the right to marry, the right to drive a car, and the right to obtain employment."[52] But gradually, such laws targeting epileptics came under attack as lawyers and doctors banded together.[53] A landmark book was published in 1956 named *Epilepsy and the Law: A Proposal for Legal Reform in the Light of Medical Progress*.[54] Publications such as this

45. F. Golla et al., *The Electro-Encephalogram in Epilepsy*, 83 J. MENTAL SCI. 1, 10 (1937).

46. *See* Irwin N. Perr, *Epilepsy and the Law*, 7 CLEV.-MARSHALL L. REV. 280, 287 (1958) ("The lawyer interested in this subject must know some principles of electroencephalography—both in understanding and evaluating epilepsy and because of its frequent use as a tool in court cases.").

47. *See* Charles L. Rubenstein, *Medico-Legal Aspects of Traumatic Epilepsy*, 89 CAL. MED. 276, 276 (1958); Hubert Winston Smith, *Medico-Legal Facets of Epilepsy*, 31 TEX. L. REV. 765, 771 (1953); W. Grey Walter, *Electro-Encephalography in the Study of Epilepsy*, 85 BRIT. J. PSYCHOL. 932, 933 (1939).

48. Perr, *supra* note 46, at 280. In some third world countries, "epilepsy is still considered a contagious disease caused by witchcraft and other supernatural powers." Asindi A. Asindi & Komomo I. Eyong, *Stigma on Nigerian Children Living with Epilepsy*, 10 J. PEDIATRIC NEUROLOGY 105, 106 (2012).

49. *See* Perr, *supra* note 46, at 290.

50. *See* William G. Lennox, Guest Editorial, *Epilepsy and the Epileptic*, 162 J. AM. MED. ASS'N 118, 119 (1956).

51. *Id.* at 118–19 (noting that "[e]pilepsy has been the chief beneficiary of electroencephalography").

52. Kathryn Kramer, *Shifting and Seizing: A Call to Reform Ohio's Outdated Restrictions on Drivers with Epilepsy*, 22 J.L. & HEALTH 343, 351–52 (2009) ("Some were even subjected to involuntary sterilization to preclude reproduction. It was not until 1982 that the last state repealed its law precluding individuals with epilepsy from marrying.").

53. This joint work was facilitated by the American Epilepsy Foundation, founded in 1946. Howard P. Goodkin, *The Founding of the American Epilepsy Society: 1936–1971*, 48 EPILEPSIA 15, 15 (2007).

54. *See generally* ROSCOE L. BARROW & HOWARD D. FABING, EPILEPSY AND THE LAW: A PROPOSAL FOR LEGAL REFORM IN THE LIGHT OF MEDICAL PROGRESS (1956).

contributed to a series of legal reforms, including giving epileptics the right to marry and drive cars with fewer restrictions.[55] These changes in the laws owed much to the discovery and application of EEG.

A second observation is that the EEG history can be useful in helping us understand how clinicians and courts make inferences from brain data—especially when the data may be at odds with behavioral observations. In the early 1940s, scientists were trying to figure out what to make of abnormal EEGs (which they were seeing both in those with behavioral abnormalities and those without).[56] EEG also was used in at least one case to identify the neural underpinnings of violent behavior.[57] And as early as 1959, at least one hospital's procedures for psychiatric exams to assess sanity included x-rays and EEGs if needed.[58] It did not take long for some researchers to ask: Can EEG help us to discriminate between criminals and noncriminals?[59] Indeed, one physician in 1953 hoped that

> many mentally abnormal offenders not otherwise recognizable as such might be detected by the EEG, and the day is to be eagerly anticipated when all individuals who commit major offenses, particularly crimes involving rage, aggressive outbursts, and violence will be studied by this method as a routine part of the diagnostic examination.[60]

Such hopes for EEG were never realized, but constructive dialogue emerged. Criminologist and attorney Marcel Frym, for instance, cautioned against the view that new brain sciences would "furnish us with all the answers," yet recognized the need for attorneys to appreciate these emerging knowledge areas since an "understanding of human behavior is the fundamental prerequisite for dealing with offenders under criminal law."[61] Another part of the legal-medical dialogue over EEG concerned the limits of EEG results in diagnosing a patient. Physician Irwin Perr insisted that "[f]irst and of most importance, the EEG does not usually make a diagnosis. It is used as corroborative evidence by physicians, and should be interpreted only by correlation with the clinical data."[62]

The challenge of drawing legally relevant inferences from EEG data also played out in the context of civil litigation and disputes over disability benefits. By 1955, experts already were testifying about EEG evidence in workers' compensation cases involving brain injury.[63] As I have written

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55. *See* Kramer, *supra* note 52, at 351–52.

56. *See, e.g.*, Denis Williams, *The Significance of an Abnormal Electroencephalogram*, 4 J. NEUROLOGY & PSYCHIATRY 257, 257 (1941).

57. *See* J. Wesson Ashford et al., *Violent Automatism in a Partial Complex Seizure*, 37 ARCHIVES NEUROLOGY 120, 121 (1980) (using EEG to measure brain activity in a violent patient with a seizure disorder).

58. *See* Downs v. State, 330 S.W.2d 281, 284 (Ark. 1959).

59. *See* Frederic Gibbs et al., *Electroencephalographic Study of Criminals*, 102 AM. J. PSYCHIATRY 294, 298 (1945).

60. Smith, *supra* note 47, at 771.

61. Marcel Frym, *The Criminal Intent*, 31 TEX. L. REV. 260, 284 (1953).

62. Perr, *supra* note 46, at 287.

63. *See* Betz v. Travelers Ins., 82 So.2d 379, 383–86 (La. Ct. App. 1955).

elsewhere,[64] one of the big legal battles involved the contested use of EEG in the determination of epilepsy for purposes of social security disability benefits.[65] At the core of legal disputes over EEG was what to do when an EEG result was at odds with observed behavior. That is, what if the plaintiff seemed to behave normally but had an abnormal EEG (or vice versa)?

A useful illustration of this dynamic comes from a battle of the experts in a 1955 workers' compensation case brought by Cornelius Betz.[66] Betz worked for the American Bitumuls Asphalt Company for twenty years without incident.[67] But on October 19, 1951, while Betz was standing next to a truck with a tank full of asphalt, the tank exploded and Betz was knocked unconscious.[68] He was hospitalized and told he could resume work in December.[69] But Betz disputed his ability to work, and, in particular, he claimed brain damage from the asphalt explosion.[70] This led to the legal dispute and a battle of expert witnesses over the EEG data.[71]

On one side were two doctors who took an EEG of Betz and concluded that the contusion Betz experienced "as judged from the electroencephalogram, was sustained at least mainly by the left temporal lobe of the brain."[72] On the other side, however, was a doctor who did not agree with the brain damage diagnosis.[73] When questioned about why the EEG evidence did not affect his diagnosis, he answered that it was "because the electroencephalogram is a laboratory instrument of an experimental character, the value of which has been limited as a diagnostic aid primarily

64. *See* Francis X. Shen, *Neuroscience, Mental Privacy, and the Law*, 36 HARV. J.L. & PUB. POL'Y 653, 664–67 (2013).

65. *See, e.g.*, Salerno v. Astrue, No. 10 C 2582, 2011 WL 6318716, at *10 (N.D. Ill. Dec. 16, 2011) ("In sum, given the unknown etiology of Plaintiff's seizure activity, the lack of MRI and CT abnormalities is not unexpected. If some of Plaintiff's seizures were not epileptic in nature, the MRI and CT tests would be normal."); Rebrook v. Astrue, No. 1:09CV50, 2010 WL 2233672, at *18 (N.D. W. Va. May 14, 2010) ("[T]here is absolutely no requirement or even mention of positive EEG's, CT scans or MRI's in the revised listings."), *adopted by* No. 1:09CV50, 2010 WL 2292668 (N.D. W. Va. June 3, 2010). More generally, courts have emphasized that an administrative law judge may not substitute his judgment for that of a trained physician, as would occur in the scenario where such a judge barred a disability claim for epilepsy because of a negative EEG finding, notwithstanding a physician's diagnosis that the claimant had the condition. *See, e.g.*, Rohan v. Chater, 98 F.3d 966, 970 (7th Cir. 1996) ("[A]s this Court has counseled on many occasions, ALJs must not succumb to the temptation to play doctor and make their own independent medical findings."). Epilepsy advocacy groups commonly remind epileptics that a normal EEG does not rule out the condition. *See, e.g.*, *A Closer Look at EEG*, EPILEPSY SOC'Y (Mar. 2007), https://www.epilepsysociety.org.uk/closer-look-eeg#.V7ieuDaxNYY [https://perma.cc/4ADG-2442].

66. *See Betz*, 82 So.2d at 379.

67. *See id.* at 380.

68. *See id.*

69. *See id.*

70. *See id.*

71. *See id.* at 380–82.

72. *Id.* at 389.

73. *See id.* at 381.

in cases of epilepsy and not otherwise."[74] The doctor went on to describe a general problem with EEG diagnoses:

> [T]he question comes up, "*Are you going to believe the electroencephalogram, or are you going to believe what you actually saw with your eyes?*" . . .
>
> As far as its use is concerned for the diagnosis of neurological diseases, there is no neurological disease that we are familiar with today that we were not familiar with prior to the invention of this machine. This machine is primarily and strictly one which is used in the laboratory in connection with animal experimentation. It is not a reliable diagnostic tool in its clinical applications; for example, in the determination of brain tumors, the extent of brain injuries, or a determining factor in the course of treatment to be carried out in a patient with any of those conditions.
>
> . . . [U]p to this point we do not rely upon this machine.[75]

Similar exchanges can be found elsewhere in the case law, and they foreshadow the types of debates the field currently sees with regard to the diagnostic capabilities of technologies such as functional magnetic resonance imaging (fMRI).

While more could (and should) be said about EEG and the law in the twentieth-century cases, even this brief review should be enough to demonstrate that—as seen in the reform of laws governing epilepsy—advances in medical science can lead to positive legal and social outcomes. The elimination of legal restrictions on marriage by epileptics are perhaps the most stunning illustration. I do not suggest that medical discoveries were the sole reason that these restrictions were lifted, but they surely played a role, and perhaps and major one, in reshaping legal and social views of epilepsy. Not addressed here, but worthy of additional attention, is how advances in neuroscience contributed to the reduction of stigma associated with epilepsy.

74. *Id.* at 394–95.
75. *Id.* at 395 (emphasis added).

Figure 2: Cumulative Number of American Cases Involving Electroencephalography Evidence, 1930–2016

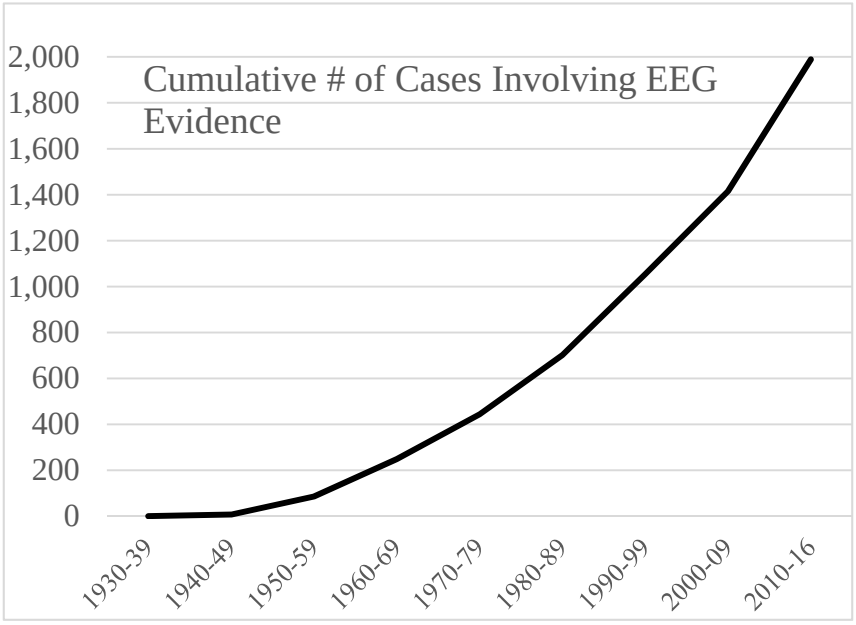

Figure 2 was created based on a search of all state and federal cases on Westlaw Next.[76]

III. THE 1960S AND 1970S: MODERN PSYCHOSURGERY

In this part, I explore an often forgotten era of brain science and law: advocacy for the use of psychosurgery in the 1960s and 1970s. A variety of scholars, both within and beyond law, have discussed eugenics, phrenology, and the frontal lobotomy.[77] But the psychosurgery debates of the 1960s

76. The search term used was "electroenceph!" The search was conducted separately for each decade, through July 20, 2016.

77. Discussing eugenics, the lobotomy, and additional historical examples, Judge Jed Rakoff has argued that "the law has often been too quick to accept, and too slow to abandon, the 'accepted' brain science of the moment." Rakoff, *supra* note 2; *see, e.g.*, ROGER COOTER, THE CULTURAL MEANING OF POPULAR SCIENCE: PHRENOLOGY AND THE ORGANIZATION OF CONSENT IN NINETEENTH-CENTURY BRITAIN 8–9 (1984); NICOLE RAFTER, THE CRIMINAL BRAIN 202 (2008); Jeanne Gaakeer, *"The Art to Find the Mind's Construction in the Face," Lombroso's Criminal Anthropology and Literature: The Example of Zola, Dostoevsky, and Tolstoy*, 26 CARDOZO L. REV. 2345, 2348 (2005); Paul A. Lombardo, *Taking Eugenics Seriously: Three Generations of ??? Are Enough?*, 30 FLA. ST. U. L. REV. 191, 191–92 (2003); Carlin Meyer, *Brain, Gender, Law: A Cautionary Tale*, 53 N.Y.L. SCH. L. REV. 995, 997 (2009) ("The U.S. legal system has a long history of romance with brain science—often junk science."); Nicole Hahn Rafter, *Seeing and Believing: Images of Heredity in Biological Theories of Crime*, 67 BROOK. L. REV. 71, 76 (2001). Phrenology was actually introduced in the 1834 trial of a nine-year-old. *See* Geoffrey S. Holtzman, *When Phrenology Was Used in Court: Lessons in Neuroscience from the 1834 Trial of a 9-Year-Old*, SLATE (Dec. 16, 2015,

have more routinely been overlooked. Before discussing that period, I provide a brief, contextualizing discussion of the law's fascination with the violent brain.

In 1939 *Popular Science* magazine featured the work of New York psychiatrist and criminologist Carleton Simon. Under the headline, "Have You a Wrong Way Brain?" the opening paragraph of the article read: "Can new discoveries about the brain reclaim a million criminals? Can psychological research cut America's crime bill in half? Can scientists, using drugs and surgery, eliminate dishonest impulses from the minds of crooks?"[78] The answer to all of these questions, of course, turned out to be a resounding "no." Brain science in the 1930s (like brain science today) could not fully unpack the criminal mind. But it is not for lack of trying on the part of some in the scientific community.

The law's flirtation with the lobotomy in the 1940s and 1950s rightfully raises concern about prematurely embracing the promises of brain science. Consider this 1948 assessment of psychosurgery as a criminal treatment: "[P]sychosurgery has startling implications for rehabilitation . . . and it is proving successful in an increasing number of cases. Perfection of so relatively simple and inexpensive a rehabilitative technique as the prefrontal lobotomy promises to be a major contribution to the cure of criminals."[79]

This assessment was published in the *Yale Law Journal*, one of the nation's leading outlets for legal scholarship. Looking back, it is easy to critique the commentary as being overly optimistic and not rigorous enough in its evaluation of the research. But at the time, this might have been a reasonable view of the future. After all, Egas Moniz won a Nobel Prize in 1949 for his work on psychosurgery.[80] The *Yale Law Journal* example illustrates the danger of overenthusiasm of underdeveloped science. But an even more recent episode in psychosurgery is also instructive.[81]

7:00 AM), http://www.slate.com/articles/technology/future_tense/2015/12/how_phrenology_was_used_in_the_1834_trial_of_9_year_old_major_mitchell.html [https://perma.cc/9SSP-FDVW]. The devastating consequences of the lobotomy are captured in Howard Dully's aptly titled autobiography. *See* HOWARD DULLY, MY LOBOTOMY 1 (2008) (describing his life after Dr. Walter Freeman performed a prefrontal lobotomy on him).

78. *See* Paul A. Clarkson, *Have You a Wrong Way Brain?*, POPULAR SCI., July 1939, at 46. The magazine also explored the use of brain science to explain family fights. *See* Bruce Bliven, *Brain Waves Explain Family Fights*, POPULAR SCI., Sept. 1955, at 148–51.

79. *Toward Rehabilitation of Criminals: Appraisal of Statutory Treatment of Mentally Disordered Recidivists*, 57 YALE L.J. 1085, 1097–98 (1948).

80. *See* Henry T. Greely, *Neuroscience and Criminal Justice: Not Responsibility but Treatment*, 56 U. KAN. L. REV. 1103, 1103 (2008) ("In 1949 Egas Moniz won the Nobel Prize for inventing the procedure commonly known as the prefrontal lobotomy. Within twenty-five years, the procedure was both generally abandoned and widely reviled."). The lobotomy was quickly abandoned, as its dire side effects became clear. *See* Sheldon Gelman, *Looking Backward: The Twentieth Century Revolutions in Psychiatry, Law, and Public Mental Health*, 29 OHIO N.U. L. REV. 531, 532 (2003) (noting that "within four years of [the Nobel prize] . . . the operation fell into disuse in the United States").

81. Several commentators have also discussed this era. *See* Henry T. Greely, *Law and the Revolution in Neuroscience: An Early Look at the Field*, 42 AKRON L. REV. 687, 702 (2009) ("In the 1960s, various researchers experimented with neurosurgery to stop criminal

Audiences—including judges, lawyers, physicians, and scientists—continue to have a strong interest in whether, and how, brain science might be able to identify (and then treat) those likely to harm others. When presenting to such audiences, I often ask whether anyone has ever heard of the book, published in 1970, called *Violence and the Brain*[82] by Vernon Mark and Frank Ervin. Typically just a few, if any, hands go up in response to my query. In the remainder of this section, I discuss why examining the work of Mark and Ervin (and their contemporaries) serves as an important reminder for why we must be vigilant in examining the dangers of importing neuroscience advances into legal practice.

By the 1960s, the lobotomy was no longer in vogue, but psychosurgery was still a part of a few practitioners' work.[83] Most prominently, *Violence and the Brain* was published in 1970 by Harvard Medical School faculty members Mark (a neurosurgeon) and Ervin (a psychiatrist and neurophysiologist).[84] Mark and Ervin's book was the summation of over a decade of research on brain interventions to reduce violent tendencies.[85] Their work drew national attention,[86] as is made evident from a 1973 *Fortune* magazine story:

> A broad interdisciplinary effort is getting under way to explore the biological nature and origins of violence. Biologists, biochemists, neurophysiologists, geneticists, and other natural scientists are probing with increasingly precise tools and techniques in a field where supposition and speculation have long prevailed. Their work is beginning to provide new clues to the complex ways in which the brain shapes violent behavior. It is also shedding new light on how environmental influences, by affecting the brain, can trigger violence. In time, these insights and discoveries could lead to practical action that may inhibit violent acts—perhaps, for example, a change in the way children are brought up, or treatment with "antiviolence" drugs.[87]

This description could well describe contemporary interdisciplinary work between neuroscience and law. Indeed, we can see many parallels between

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behavior. With the fall of the lobotomy, this kind of 'psychosurgery' went out of fashion."); Pustilnik, *supra* note 2, at 202.

82. VERNON H. MARK & FRANK R. ERVIN, VIOLENCE AND THE BRAIN (1970).

83. *See* ELLIOT S. VALENSTEIN, GREAT AND DESPERATE CURES: THE RISE AND DECLINE OF PSYCHOSURGERY AND OTHER RADICAL TREATMENTS FOR MENTAL ILLNESS 288 (2010).

84. MARK & ERVIN, *supra* note 82, at 1. The book was heralded by the *Los Angeles Times* as "the first publication accessible to lay audiences that deals squarely with the biological basis of violent behavior." Kenneth Klivington, *The Biological Basis of Violent Behavior*, L.A. TIMES, Nov. 22, 1970, at Q6.

85. *See, e.g.*, WILLIAM H. SWEET ET AL., THE RELATIONSHIP OF VIOLENT BEHAVIOR TO FOCAL CEREBRAL DISEASE 1 (1969); *Anatomy of Violence*, 12 ROCHE MED. IMAGE & COMMENT., Jan. 1970, at 22, 22; Jose M.R. Delgado et al., *Intracerebral Radio Stimulation and Recording in Completely Free Patients*, 147 J. NERVOUS & MENTAL DISEASE 329, 330 (1968).

86. The work also led to a large lawsuit and served as the inspiration for Michael Crichton's novel *Terminal Man*. *See* Jean Dietz, *Battling Decrepitude with Brain Power*, BOS. GLOBE, Feb. 4, 1990, at B43.

87. Gene Bylinsky, *New Clues to the Causes of Violence*, FORTUNE, Jan. 1973, at 134–36.

the framework of Mark and Ervin and the approach taken in a 2013 book, *The Anatomy of Violence* by neuroscientist Adriane Raine.[88]

As does Raine, Mark and Ervin start their volume by observing that violence remains a societal problem and by imploring traditional behavioral scientists to consider a biological perspective: "Even those social scientists who disdain a biological approach to what they consider an exclusively social problem will have to agree that a new point of view might be helpful."[89] Similar to Raine, Mark and Ervin write that "violence is a public health problem, and the major thrust of any program dealing with violence must be toward its prevention."[90]

There are of course many important differences, the most important of which is that Raine is not advocating for psychosurgery. Raine emphasizes that we should reject an overly simplistic understanding of the brain-violence relationship, recognizing instead the "multiple distributed brain processes that in turn give rise to broad social and psychological processes that predispose someone to violence."[91] But nevertheless, this 1960s psychosurgery historical moment resonates with contemporary social issues in ways that are unmistakable.

One notable parallel concerns the relationship between neuroscience, violence, and social unrest. On September 7, 2016, Harvard Law School hosted a panel entitled, *Battling Blood in the Streets: How Can Neuroscience Promote Public Health and Support Public Policy to Prevent Community Violence?*[92] Aimed at fostering a "science-informed" advocacy movement, the program and its goals are laudable. But the same could have been said for efforts forty years earlier.

In 1967, as the country was wrestling with how to respond to racial unrest and urban riots, Mark and Ervin wrote to the editor of the *Journal of the American Medical Association*, imploring their colleagues to consider the overlooked role of brain dysfunction in contributing to violence:

> That poverty, unemployment, slum housing, and inadequate education underlie the nation's urban riots is well known, but the obviousness of these causes may have blinded us to the more subtle role of other possible

88. The discussion that follows is based in part on previous observations I made in an online post. *See* Francis X. Shen, Comment to *An Online Symposium on* The Anatomy of Violence, WASH. INDEP. REV. BOOKS (Feb. 6, 2014), http://www.washingtonindependentreviewofbooks.com/features/symposium-on-emthe-anatomy-of-violence-em-by-adrian-raine [https://perma.cc/U3QR-HKZ7].

89. MARK & ERVIN, *supra* note 82, at xi. Mark and Ervin do not connect their work to the nineteenth-century work discussed in Part I.

90. *Id.* at 160.

91. Shen, *supra* note 88.

92. *Battling Blood in the Streets: How Can Neuroscience Promote Public Health and Support Public Policy to Prevent Community Violence?*, PETRIE-FLOM CTR. HEALTH L. POL'Y BIOTECHNOLOGY & BIOETHICS HARV. L. SCH., http://petrieflom.law.harvard.edu/events/details/battling-blood-in-the-streets (last visited Oct. 16, 2016) [https://perma.cc/H2KL-8EBH]. The program was sponsored by the Project on Law and Applied Neuroscience, a collaboration between the Center for Law, Brain & Behavior at Massachusetts General Hospital and the Petrie-Flom Center for Health Law Policy, Biotechnology, and Bioethics at Harvard Law School. *See id.*

> factors, including brain dysfunction in the rioters who engaged in arson, sniping, and physical assault. The urgent needs of underprivileged urban centers for jobs, education and better housing should not be minimized, but to believe that these factors are solely responsible for the present urban riots is to overlook some of the newer medical evidence about the personal aspects of violent behavior.[93]

The political response to psychosurgery was generally critical.[94] Debate ensued, with Mark, Ervin, and their defenders arguing for the value of a biologically based approach to curbing violence.[95] Given the racialized dimensions of the 1970s unrest, one concern with the biologically based reforms was racial discrimination. For example, *Ebony* magazine published an article, called "New Threats to Blacks: Brain Surgery to Control Behavior," which questioned the motivations of those promoting the brain interventions.[96]

Psychosurgery became such a controversial proposal that the state legislatures in Massachusetts and Oregon passed legislation preemptively banning the procedures.[97] But voicing an objection to legislative interference was the *Stanford Law Review*, which argued in an editorial that

> [t]he potential value of lobotomies can never be realized without progress through experimentation. Yet no restrictive statute could effectively avoid the possibility of rare abuses without stifling such experimentation. Here the greater good will be achieved by avoiding legislative fetters and relying for protection on the high standards of the medical profession and the individuals who compose it.[98]

Psychosurgery made national headlines but never made much headway in the actual criminal justice system. The political and social criticism, combined with the lack of demonstrated results and the advent of a much cheaper alternative in psychotropic medication, was too much to overcome. But the contours of the debate ought not to be forgotten.

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93. V.H. Mark et al., *Role of Brain Disease in Riots and Urban Violence*, 201 J. AM. MED. ASS'N 895, 895 (1967).

94. *See* PETER R. BREGGIN, THE RETURN OF LOBOTOMY AND PSYCHOSURGERY 350 (1982); Bernard L. Diamond, *The Psychiatric Prediction of Dangerousness*, 123 U. PA. L. REV. 439, 443–44 (1974) (noting that psychosurgery was "surrounded by intense controversy, both scientific and political"); Steven Jay Greenblatt, *The Ethics and Legality of Psychosurgery*, 22 N.Y.L. SCH. L. REV. 961, 961 (1977).

95. *See* Peter R. Breggin, *Psychosurgery for Political Purposes*, 13 DUQ. L. REV. 841, 845 (1975).

96. *See* B.J. Mason, *Brain Surgery to Control Behavior: Controversial Operations Are Coming Back as Violence Curbs*, EBONY, Feb. 1973, at 63. A contemporary critique of the medical community similarly argued "that sociologically identified inherently defective individuals within the target African-American community be subjected to medical treatment of intrusive, indeed, invasive varieties." Alfreda A. Sellers-Diamond, *Disposable Children in Black Faces: The Violence Initiative as Inner-City Containment Policy*, 62 UMKC L. REV. 423, 465 (1994).

97. *See* Chester G. Akins & Alison Lauriat, *Psychosurgery and the Role of Legislation*, 54 B.U. L. REV. 288, 291 (1974).

98. Note, *Lobotomy: Surgery for the Insane*, 1 STAN. L. REV. 463, 474 (1949).

In closing, we can reflect on a lengthy 1973 *New York Times* article (complete with images of the brain and of patients who underwent psychosurgery), in which one neurosurgeon defended the use of surgery even amid incomplete understanding of brain-behavior relationships.[99] In the surgeon's view, "[w]e must work in partial ignorance to relieve suffering" of those experiencing untreatable mental disorders.[100]

Surely, the surgeon is correct that society cannot wait for medicine to fully decode the mystery of the brain before we allow for direct brain interventions. If this were the case, virtually every drug for mental illness would need to be pulled off the shelf. But the surgeon's question also misses the point. Accepting that we will require only partial knowledge does not tell us when we have *sufficient* knowledge to proceed. At what point can we be sufficiently confident in the neuroscientific findings that we should change legal doctrine or practice? Answering this question remains a central challenge for neurolaw.

IV. THE 1980S AND 1990S: NEUROLAW AND NEUROPSYCHOLOGY

Moving beyond the criminal law, the last historical moment I consider in this Article is the most recent: the emergence in the 1980s and 1990s of forensic neuropsychology in civil litigation. This era has been discussed in other places,[101] but it is worth revisiting here because—similar to the previous eras analyzed—it provides us with an important foundation for current neurolaw developments.[102]

At the center of activity in the 1980s and 1990s was attorney Sherrod Taylor. Taylor, after graduating from the University of Georgia School of Law in 1978, embarked on a career in plaintiff personal injury lawsuits. His caseload in the early 1980s included typical bread-and-butter plaintiff's work, such as workers' compensation and "sprain and strain" cases.[103] But, unbeknownst to Taylor and his legal colleagues, a movement was beginning that would drastically change his career trajectory—as well as the trajectory of personal injury litigation.

At the same time that Taylor was arguing in front of juries about back and neck injuries, a group of patients with brain injuries and doctors were

99. *See* Lee Edson, *For the Mentally Ill, a Court of Last Resort*, N.Y. TIMES (Sept. 30, 1973), http://www.nytimes.com/1973/09/30/archives/the-psyche-and-the-surgeon-for-the-mentally-ill-a-court-of-last.html?_r=0 [https://perma.cc/7MXS-3KEF].

100. *Id.*

101. *See* J. Sherrod Taylor, *Neurolaw and Traumatic Brain Injury: Principles for Trial Lawyers*, 84 UMKC L. REV. 397, 399 (2015).

102. Of course it is not the only foundation. *See* Jennifer L. Mnookin, *The Image of Truth: Photographic Evidence and the Power of Analogy*, 10 YALE J.L. & HUMAN. 1, 73–74 (1998). For instance, not considered here is a related, and earlier, development concerning the introduction of x-ray technology into the litigation of personal injury cases. *See, e.g.*, Ralph S. Bauer, *Fundamental Principles of the Law of Damages in Medico-Legal Cases*, 19 TENN. L. REV. 255, 267 (1946); Mnookin, *supra*, at 52 n.187; George I. Swetlow, *Medico-Legal Aspects of the X-Ray in Head Injury Cases*, 6 U. MIAMI L. REV. 208 (1952).

103. Telephone Interview with J. Sherrod Taylor (July 5, 2016).

beginning to organize. In 1980, in the Massachusetts home of Dr. Martin Spivack and Marilyn Price Spivack, the National Head Injury Foundation (NHIF) was formed.[104] The NHIF would grow and become one of the largest advocacy organizations for brain-injured individuals.[105] Today the NHIF is known as the Brain Injury Association of America (BIAA), and its mission is primarily one of advocacy for brain-injured individuals and their families. But, as the group soon realized after its founding in 1980, advocacy for brain-injured individuals would need to involve the law. The NHIF hosted its first conference for attorneys in 1987,[106] and that is where Taylor and his law partner, Tyron Elliott, saw an opportunity.

In many ways, Taylor was a perfect conduit for these new interfaces. With an unmistakable southern charm, and a deep interest in the underlying science, Taylor was able to deftly navigate both the legal and medical worlds. In the late 1980s and especially the early 1990s, Taylor and his colleagues met regularly at professional conferences in the United States and the United Kingdom.[107] Seeing a need for a written guide (mainly for the plaintiff's bar) on how to successfully litigate brain-injury cases, Taylor and Elliott published *Neuropsychological Evidence on Appeal* in 1989.[108] This volume recognized that neuropsychologists were increasingly testifying in courtroom matters.[109] To galvanize the emerging interest, Taylor also started publishing *The Neurolaw Letter* in 1991, which, at its peak, had over 600 subscribers paying ninety-nine dollars a year for the publication.[110] It was in the pages of *The Neurolaw Letter* where Taylor first coined the phrase "neurolaw."[111]

Taylor's use of the term has been repeatedly recognized in the literature.[112] But much of the work of Taylor and his colleagues has been

104. *See* Gerald W. Bush, *The National Head Injury Foundation: Eight Years of Challenge and Growth*, 3 J. HEAD TRAUMA REHABILITATION 73, 73 (1988); *About Us*, BRAIN INJURY ASS'N AM., http://www.biausa.org/about-us/about-brain-injury-association.htm (last visited Oct. 16, 2016) [https://perma.cc/Q2HT-EFRN].

105. *See* Marilyn Price Spivack, *Pathways to Policy: A Personal Perspective*, 9 J. HEAD TRAUMA REHABILITATION 82, 83 (1994).

106. *See* Taylor, *supra* note 101, at 398. ("In 1987, the National Head Injury Foundation (NHIF) designed and presented its first conference for attorneys and concerned healthcare providers in an effort to heal these broken relationships and to educate both of these professional groups about the nuances of TBI [(traumatic brain injury)] litigation.").

107. *See id.* at 399.

108. *See* J. SHERROD TAYLOR & TYRON ELLIOTT, NEUROPSYCHOLOGICAL EVIDENCE ON APPEAL (1989).

109. *See id.* at 53; *see also* Jerry J. Sweet & Dawn Giuffre Meyer, *Trends in Forensic Practice and Research*, *in* FORENSIC NEUROPSYCHOLOGY: A SCIENTIFIC APPROACH 501, 512 (Glenn J. Larrabee ed., 2d ed. 2012).

110. *See* Telephone Interview with J. Sherrod Taylor, *supra* note 103.

111. *See* J. Sherrod Taylor, *Meeting the Legal Challenge*, NEUROLAW LETTER, Sept. 1991, at 1. Taylor also used the term in J. Sherrod Taylor et al., *Neuropsychologists and Neurolawyers*, 5 NEUROPSYCHOLOGY 293, 294 (1991), and published regularly on the topic. *See, e.g.*, J. Sherrod Taylor, *An Overview of Neurolaw for the Clinician: What Every Potential Witness Should Know*, 16 NEUROREHABILITATION 69, 69 (2001); J. Sherrod Taylor, *Neurolaw: Towards a New Medical Jurisprudence*, 9 BRAIN INJ. 745, 746 (1995).

112. *See, e.g.*, Zurizadai Balmakund, *The Realities of Neurolaw: A Composition of Data & Research*, 9 U. ST. THOMAS J.L. & PUB. POL'Y 189, 190 (2015) ("Attorney J. Sherrod

overlooked. While contemporary discussions surrounding neurolaw typically focus on neuroimaging, in the 1990s "neuroscientific testimony" primarily took the form of neuropsychological testimony.[113] The contours of the field of neuropsychology were not precise,[114] but it was clear that the proffered testimony would concern brain structure, brain function, and how the alleged tortious injury was likely related to abnormal brain function.[115] This type of testimony could transform what might have previously been a "sprain and strain" case (settling for less than $10,000) into a brain injury case (with a settlement in the hundreds of thousands of dollars).

Taylor was swamped with invitations from other attorneys to present on this newly found avenue for legal redress. As Taylor and his colleagues wrote in 1991, "neuropsychology and the legal system are on converging courses."[116] Insurance companies and attorneys representing defendants were concerned that the advent of neuropsychological testimony would be bad for business. Thus, judges soon began to hear evidentiary arguments against the admissibility of neuropsychological testimony.[117] By 1999, it was observed that "the legal environment pertaining to clinical neuropsychology is in a state of flux."[118]

But today, this flux has generally settled. While a minority of states remain skeptical of neuropsychological testimony, "admissibility of a neuropsychologist's testimony as to the existence of a brain injury is generally accepted in most jurisdictions."[119] How did courts arrive at this result? The short answer, overlooking the twists and turns across many state courts, is that admissibility was the result of extensive collaboration between the forensic neuropsychology community and practicing attorneys.[120] It seems a safe bet that the future admissibility of novel neuroscience testimony will also depend on the quality of the interdisciplinary dialogue in the decades to follow.

Taylor introduced the term 'neurolaw' in 1995 when he explored the possible influence neuroscientific evidence could have on civil litigation."); Erickson, *supra* note 9, at 35; William Singer & J. Anderson Harp, *The Paralyzed Patient's Overlooked Mild or Moderate Traumatic Brain Injury*, 1 TOPICS SPINAL CORD INJ. REHABILITATION 71, 73 (1995) ("*Neurolaw* as a term first appeared in the health care literature in Taylor and colleagues' 'Neuropsychologists and Neurolawyers' in *Neuropsychology*.").

113. Recent empirical data show that, even today, neuropsychology testimony is far more frequent than neuroimaging evidence. Francis X. Shen, *Neuroscientific Evidence as Instant Replay*, 3 J.L. & BIOSCIENCES 343, 347 (2016) (arguing that more attention should be focused on "the types of evidence that lawyers are actually using").

114. *See* D.O. Hebb, *Neuropsychology: Retrospect and Prospect*, 37 CANADIAN J. PSYCHOL. 4, 6 (1983).

115. *See* J. Sherrod Taylor, *The Legal Environment Pertaining to Clinical Neuropsychology*, *in* FORENSIC NEUROPSYCHOLOGY: FUNDAMENTALS AND PRACTICE 419, 429 (Jerry J. Sweet ed., 1999).

116. J. Sherrod Taylor et al., *supra* note 111, at 293.

117. *See* Gerald C. Young, *The Nuts and Bolts of Neuropsychological Testimony or How to Survive in Court*, 3 CLINICAL NEUROPSYCHOLOGIST 197, 198 (1989).

118. Taylor, *supra* note 115, at 422.

119. 1 BRUCE H. STERN & JEFFREY A. BROWN, LITIGATING BRAIN INJURIES § 6:1 (2015).

120. *See* Taylor, *supra* note 101, at 399.

V. LEARNING FROM THE PAST

The tour of neurolaw's history presented in this Article was, by design, a short one. An extended treatment could consider many more topics, including situating neurolaw within the much longer history of medicine and law;[121] nineteenth-century investigations into the moral sciences;[122] the development of toxicology in the nineteenth century;[123] early neuroscience research to find the seat of consciousness;[124] brain death;[125] connections with the literature on the ethical, legal, and social implications of genetics;[126] history of expert witnesses;[127] FDA and drug development;[128] administration of antipsychotic drugs;[129] and the use of "facilitated communication" with autistic individuals.[130] This list, and the analysis, could continue for some time. But even limited to just the four historical moments examined in this Article, much emerges for further discussion.

Most fundamentally, it is clear that there is a rich, problematic, and underexplored history of neurolaw. So why does our field sometimes experience academic amnesia in overlooking it? One reason may be due to shifting terminology over time. For instance, the word "neuroscience" does not appear until much later in history, even though early brain scientists were as much "neuroscientists" in substance as those today. Relatedly, disciplinary boundaries, professional societies, and journal names change over time too. More work needs to be done to determine the extent to which differences in wording are substantive or superficial.

Beyond the changing language, another reason for not engaging with the past is that it is often discouraging to look backward and see how one's

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121. *See, e.g.*, Cyril H. Wecht, *The History of Legal Medicine*, 33 J. AM. ACAD. PSYCHIATRY & L. 245 (2005).

122. *See* BLUMENTHAL, *supra* note 29, at 46–48.

123. *See* MOHR, *supra* note 10, at 69 ("Forensic toxicology seemed to epitomize medical jurisprudence at its best.").

124. *See* JAN VERPLAETSE, LOCALISING THE MORAL SENSE: NEUROSCIENCE AND THE SEARCH FOR THE CEREBRAL SEAT OF MORALITY, 1800–1930, at xiv (2009) (discussing the work of German psychiatrists to find the neural underpinnings of morality and consciousness).

125. *See* Michael B. Green & Daniel Wikler, *Brain Death and Personal Identity*, 9 PHIL. & PUB. AFF. 105, 105 (1980).

126. *See* Henry T. Greely, *Neuroethics and ELSI: Similarities and Differences*, 7 MINN. J.L. SCI. & TECH. 599, 599 (2006).

127. By the 1950s, legal scholarship was beginning to consider experts in the courtroom. *See, e.g.*, Jewel Hammond Mack, *Forensic Psychiatry and the Witness—A Survey*, 7 CLEV.-MARSHALL L. REV. 302 (1958); Charles T. McCormick, *Science, Experts and the Courts*, 29 TEX. L. REV. 611 (1950).

128. *See* James T. O'Reilly, *Losing Deference in the FDA's Second Century: Judicial Review, Politics, and a Diminished Legacy of Expertise*, 93 CORNELL L. REV. 939, 940 (2008).

129. *See* Dennis E. Cichon, *The Right to "Just Say No": A History and Analysis of the Right to Refuse Antipsychotic Drugs*, 53 LA. L. REV. 283, 285–86 (1992).

130. *See* Scott O. Lilienfeld et al., *The Persistence of Fad Interventions in the Face of Negative Scientific Evidence: Facilitated Communication for Autism as a Case Example*, 8 EVIDENCE-BASED COMM. ASSESSMENT & INTERVENTION 62 (2014).

professional field failed at previous endeavors.[131] Certainly a look back (at least in the realm of the criminal domain) would reveal many failures. As ethicist Paul Root Wolpe has suggested, "History has shown us the repeated policy failures of a biologically based approach to criminal justice."[132] This simple explanation may account for much of our field's reluctance to carefully examine previous historical moments. If so, neurolaw would join other law and technology fields that share "a problematic tendency to exaggerate the *newness* of those issues."[133] The problem here is potentially much deeper than my review suggests. Interrelated issues of power, finances, politics, and identity are present in each of the historical episodes I have reviewed. Further attention is surely warranted.

For instance, I have not explored the question of who profits financially from the law's embrace of various types of brain science. To what extent must we problematize the stated justifications of medical professionals and probe deeper to see if benevolent motivations are paired with a financial interest?

If one theme of this Article is that we have asked many of the same questions before, a corollary theme is that the answers to those questions have often been unsatisfactory. This suggests that we ought to embrace a cautious view of how to change law on the basis of neuroscientific findings.[134] As legal scholar Stephen Morse has argued, the current

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131. As law professor Sheldon Gelman has observed in the context of the history of psychiatry:

> When psychiatrists present the face of their profession to the world—or when they look at their profession as if in a mirror—the image certainly does not include neurologically damaged patients, out of control clinical practices, or researchers inventing imaginary treatment benefits. Thus, a detailed history of the field can mar psychiatry's picture of itself. For that reason, such histories often strike psychiatrists as calculated insults.

Sheldon Gelman, *Looking Backward: The Twentieth Century Revolutions in Psychiatry, Law, and Public Mental Health*, 29 OHIO N.U. L. REV. 531, 546 (2003).

132. Paul Root Wolpe, *Rethinking the Implications of Discovering Biomarkers for Biologically Based Criminality*, *in* BIOPREDICTION, BIOMARKERS, AND BAD BEHAVIOR: SCIENTIFIC, LEGAL, AND ETHICAL CHALLENGERS 118, 121 (Ilina Singh et al. eds., 2014).

133. Lyria Bennett Moses & Nicola Gollan, *The Illusion of Newness: The Importance of History in Understanding the Law-Technology Interface* 2 (Univ. N.S.W., Law Research Paper No. 2015-71, 2015), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2697311 [https://perma.cc/G37G-VRKR]. I agree with Lyria Moses and Nicola Gollan's more general point that it "would be beneficial for legal and policy commentators to pay more attention to history when considering how law ought to relate to new technologies." *Id.* at 30.

134. *See, e.g.*, Greely, *supra* note 81, at 707 ("People studying the ethical, legal, and social implications of neuroscience have to walk a tightrope. We have to worry about the implications if the technology does work, but we also always have to remember that there cannot be any good implications of using an ineffective technology. So we need to watch, and to talk about, both sides—the hypothetical future and the known present."); Owen D. Jones et al., *Brain Imaging for Legal Thinkers: A Guide for the Perplexed*, 2009 STAN. TECH. L. REV. 5, 6 ("While there is no denying that brain imaging is a powerful tool, whether used for medical or legal purposes, it is also clear that, like any tool, brain imaging can be used for good or for ill, skillfully or sloppily, and in ways useful or irrelevant."); Stephen J. Morse, *Avoiding Irrational NeuroLaw Exuberance: A Plea for Neuromodesty*, 62 MERCER L. REV. 837, 838 (2011) (arguing that "there has been irrational exuberance about the potential contribution of neuroscience" to law).

"challenge to free will from neurophysical determinism is familiar to similar challenges in the past,"[135] and current challenges fail as past ones similarly did.[136]

Questions of determinism are central to current neuorolaw debates.[137] In the nineteenth century, we saw similar debates regularly arise over free will and the causes of violence. Writing in a law review in 1900, Judge Henry White reflected on scientific debates about the extent to which the mind was one and the same as the brain.[138] Judge White, after reviewing the available literature, found that from his view on the bench, the science simply was not sufficiently developed, stating:

> [W]hat becomes more and more apparent the deeper one explores the literature of psychology, [is] that the line between the material cortical, and nerve function, and thought, feeling, and will, is an uncertain and debatable line; and that no sufficient data has yet been found from which, by any true inductive process, any safe hypothesis can be reached.[139]

Judge White suggested that the problem was medicine's encroachment on legal issues and vice versa.[140] Those promoting a drastic change in

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135. Stephen J. Morse, *Determinism and the Death of Folk Psychology: Two Challenges to Responsibility from Neuroscience*, 9 MINN. J.L. SCI. & TECH. 1, 2 (2008); Rakoff, *supra* note 2 ("Neuroscience is mind-boggling. It is developing at a rapid pace, and may have more to offer the legal system in the future. For now, however, the lessons of the past suggest that, while neuroscientific advances may be a useful aid in evaluating broad policy initiatives, a too-quick acceptance by the legal system of the latest neuroscientific 'discoveries' may be fraught with danger.").

136. Morse argues that this failure is for three reasons:

> First, free will is not a criterion for the application of any legal rule. Second, free will is not foundational for criminal responsibility. Third, there is a philosophically plausible response to those who claim that determinism—whether based on the theories and findings of neuroscience or any other discipline—and responsibility are incompatible.

Morse, *supra* note 135, at 2.

137. *See* Stephen J. Morse, *Criminal Law and Common Sense: An Essay on the Perils and Promise of Neuroscience*, 99 MARQ. L. REV. 39, 40 (2015) ("The law's concept of the person and responsibility has been under assault throughout the modern scientific era, but in the last few decades dazzling technological innovations and discoveries in some sciences, especially the new neuroscience and to a lesser extent genetics, have put unprecedented pressure on the standard picture."); *see also* Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON B 1775, 1785 (2004) (discussing the determinism debate); Stephen J. Morse, *Brain Overclaim Redux*, 31 LAW & INEQ. 509, 530–31 (2013) (same); Stephen J. Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO ST. J. CRIM. L. 397, 402 (2006) [hereinafter Morse, *Brain Overclaim Syndrome*] (same); Stephen J. Morse, *Lost in Translation?: An Essay on Law and Neuroscience*, 13 FAC. SCHOLARSHIP 529, 530 (2010) (same).

138. *See* Henry C. White, *Mental Diseases and Legal Relations*, 6 W. RES. L.J. 21, 26 (1900).

139. *Id.* at 24. White also observed that it "can readily be seen that these divergent postulates of authority have naturally led to grave conflict between the rules of responsibility as practically applied by the physician and lawyer." *Id.* at 23.

140. *See id.* at 25 ("The real cause of this whole controversy between medicine and law, as to rational tests of responsibility, after all, rests largely in a misconception of the distinct province of each profession, in contributing to the joint result. Each has sought to usurp the office of the other.").

criminal culpability on the basis of brain insights could not convince courts to follow. Lawyer and physician John Ordronaux (who ran asylums in New York State) in 1874 articulated the slippery slope that worried many within both professional fields:

> Every vice, every crime is disease, nothing short. And if the crime be so great that human endurance is provoked into an attempt to punish it, the criminal is at once surrounded by an army of sentimental protectors, whose prayers are not so much for his reform, as for scientific light whereby they may explain and extenuate his offense to the world. . . . [I]t is . . . always disease, or that can't-help-it justification which is supposed to admit of no answer.[141]

For a variety of reasons, including both lawyers' and physicians' hesitation to accept a deterministic universe, brain-based reforms to criminal law were not widely adopted in the nineteenth century. And legal scholars such as Stephen J. Morse and Michael Moore have eloquently shown why neuroscience in the twenty-first century also seems to have little implication for criminal responsibility doctrine.[142]

Yet, we still see prominent examples of what Morse has dubbed "brain overclaim" syndrome.[143] For instance, in April 2016, the Society for Neuroscience sponsored website, BrainFacts.org, published a post by neuroscientist Douglas Fields called "The Neuroscience of Violence."[144] The first line of the blog post reads, "We are on the brink of a new understanding of the neuroscience of violence."[145] Later, readers are told that "social implications of this new line of research are profound" and that "neuroscience research offers a new perspective on violence."[146] Moreover, the post goes on to claim that the "most important factor in violence is not pathology, psychology, or politics—it is *biology*."[147]

The blog post seems to channel the spirit of the Mark and Ervin psychosurgery era, as it sends a clear message to the reader that neuroscience is providing a heretofore untold perspective on why humans become violent. Missing are the caveats and cautions that should accompany such claims.

Moreover, what is missing from this and from so many other instances of contemporary discussion of neuroscience and law is an appreciation that

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141. BLUMENTHAL, *supra* note 29, at 97 (quoting John Ordronaux, *Is Habitual Drunkenness a Disease?*, 30 AM. J. INSANITY 430, 432 (1874)).

142. *See generally* Michael S. Moore, *Responsible Choices, Desert-Based Legal Institutions, and the Challenges of Contemporary Neuroscience*, 29 SOC. PHIL. & POL'Y 23 (2012); Morse, *Brain Overclaim Syndrome*, *supra* note 137, at 411.

143. Morse, *Brain Overclaim Syndrome*, *supra* note 137, at 397.

144. *See* Douglas Fields, *The Neuroscience of Violence*, BRAINFACTS.ORG (Apr. 29, 2016), http://blog.brainfacts.org/2016/04/the-neuroscience-of-violence/#.V5VorbgrLRY [https://perma.cc/NP7R-5K7W]. Fields is a neuroscientist. His book, DOUGLAS FIELDS, WHY WE SNAP: UNDERSTANDING THE RAGE CIRCUIT IN YOUR BRAIN (2016), does not cite the work of Mark and Ervin.

145. Fields, *supra* note 144.

146. *Id.*

147. *Id.* (emphasis added).

similar debates have happened in earlier eras. A pattern emerges in which the novelty of neuroscience is overemphasized, and the history of neurolaw is overlooked. Additional work is needed to understand why this pattern is repeated and how the pattern might be broken.

Although I am critical of such academic amnesia, I am not pessimistic about the future of law and neuroscience. Indeed, I think the future of neurolaw is quite bright.[148] Even though the historical moments reviewed in this Article give us reason to pause, they also give us reason to be enthusiastic about what can be accomplished if the correct issues are targeted. That epileptics can marry, for instance, is in part the result of the discovery of EEG, advances in neuroscientific understanding, and a productive social and political dialogue. The future may well give us more of these positive collaborations.[149]

The most important factor that distinguishes the current iteration of neurolaw from its predecessors is the rate of discovery in neuroscience. I agree with legal scholar Hank Greely who writes that "we are in the middle of a revolution in neuroscience."[150] This revolution has been a long time in the making. In the early twentieth century, there was speculation that we would one day be able to unpack mental disorders with brain data. In 1918, neurologist George Jacoby speculated that "[i]t is quite probable that the increasing improvement in our technical methods and means of [neurological] examination ultimately will enable us to . . . recognize . . . more minute structural changes of the brain tissue which have until now escaped our notice."[151] A century later, neuroscience has made tremendous advances in mapping out brain structure and function. For instance, in 2016, the Human Connectome Project published a landmark paper identifying new ways to understand brain structure.[152]

I began this Article with a look at publication counts, and I will close with another peek at publication data. Here, however, I plot in figure 3 the number of published books in the Library of Congress (LOC) catalog that concern the brain, plotted against the total number of books in the LOC catalog in that same time span.[153] The results, plotted in figure 3, show that

148. *See* Shen, *supra* note 39, at 2.

149. Legal scholar Owen Jones has usefully laid out some of the ways in which this future might take shape. *See* Owen D. Jones, *Seven Ways Neuroscience Aids Law* 5 (Vanderbilt Univ. Law Sch. Pub. Law & Legal Theory Research Paper Series, Working Paper No. 13-28, 2013). Adam Kolber, too, provides an important perspective on the future of the field. *See generally* Adam J. Kolber, *Will There Be a Neurolaw Revolution?*, 89 IND. L.J. 807 (2014).

150. Greely, *supra* note 81, at 688.

151. GEORGE JACOBY, THE UNSOUND MIND AND THE LAW: A PRESENTATION OF FORENSIC PSYCHIATRY 8 (1918).

152. *See* Matthew F. Glasser et al., *A Multi-Modal Parcellation of Human Cerebral Cortex*, 536 NATURE 171 (2016).

153. To estimate the number of books relating to the brain published in each year, we defined "brain books" as the number of hits returned from the LOC catalog that included the keywords "neuroscience" or "brain." To determine the total number of books in the LOC catalog, we used each year's *Annual Report of the Librarian of Congress*. The reports prior to 1866 have not been digitized, thus we do not know the total number of books in the LOC

publications with brain in the title have been around for over a century, but that a steep rise in publications began in the 1960s. Moreover, we see that the rate of increase in publishing books involving the brain has outpaced the general increase in published volumes since 2000. This suggests increasing growth and interest in research on the brain.

Ultimately, it is the trend in figure 3 that will distinguish the future of neurolaw from its past. For not only will neuroscience technology provide novel answers to age-old questions, but neuroscience will also challenge us to ask new questions altogether. For instance, what is the legal relevance of brain biomarkers for Alzheimer's disease? What are the ethics of growing human neuron cells in nonhuman animals? How should the law govern brain-machine interfaces? And so on.

How the law responds to these new discoveries will be determined by how it reconciles the problematic relationships seen in years past. Can scientists and lawyers work productively together? Can we avoid snake oil salespeople hawking their neuro-wares? Can we as a citizenry be open to new knowledge, even when it challenges our preconceptions about who we are? I am optimistic that we can. But to do so, we must not forget that we have seen so much of this before. To enjoy a successful future for neurolaw, we must learn from our past.

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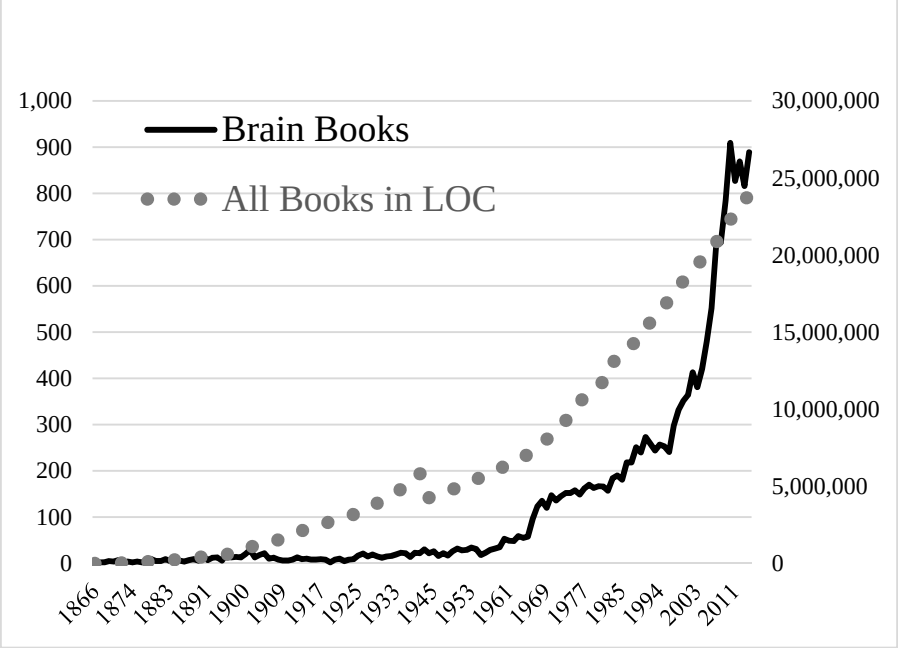
catalog for those years (1851–1865). Also, we were unable to determine the total number of books published in 1880, 1897, 1904, 1940–1943, 1991, and 1998. For the year 1898, we focused on the "Enumeration of the Library," which listed the total collection. For the years 1899 and 1900, under the header "Increase of the Library" in the 1900 report, we noted the total number of printed books and pamphlets (volumes) listed in the table on page 10. For 1901 and 1902, listed in the 1902 report under the header "Increase of the Library" were the total accessions of printed books and pamphlets for 1900–1901 and 1901–1902. For the years 2000–2014, we used the following website to locate the pertinent information for those years: *Annual Reports*, LIBRARY OF CONG., https://www.loc.gov/about/reports-and-budgets/annual-reports/ (last visited Oct. 16, 2016) [https://perma.cc/R5LN-P3HM]. We tuned our focus to the appendix of statistical tables, table 5 of the *Annual Report of the Librarian of Congress* and noted the number of total classified book collections for each year. The report for 2015 has not been digitized.

Figure 3: Number of Books in Library of Congress Catalog with "Brain" in the Title, Plotted Against Total Number of Library of Congress Volumes, by Year, 1866–2014



The x-axis plots year of book publication. There are two vertical y-axes. The left-hand y-axis plots the number of brain books, and the right-hand y-axis plots the overall number of books in the Library of Congress catalog. As discussed in the text, the primary things to notice are (a) that brain books are published in large numbers beginning in the mid-twentieth century and (b) that recent decades have seen an explosion of brain book publications (relative to the overall increase in publications).[154]

CONCLUSION

This Article presented a series of four historical moments in the centuries-long conversation between brain science and law: the medico-legal dialogue of the nineteenth century, the introduction of electroencephalography into the law starting in the 1950s, the controversy over psychosurgery in the 1960s and 1970s, and the introduction of

154. *See* ENCYCLOPEDIA OF THE LIBRARY OF CONGRESS: FOR CONGRESS, THE NATION & THE WORLD 195 (2004) ("When Archibald MacLeish became Librarian in 1939, he ordered a comprehensive review of processing operations by a Librarian's Committee . . . . Finding that of the Library's 5.8 million volumes about 1.5 million were not fully processed and that the arrears were growing at a rate of 300,000 volumes annually, the committee recommended reorganization, [and] the use of simplified cataloging . . . .").

neuropsychological testimony in the 1980s and 1990s. Although the terminology and technology were different, these four moments make clear that there is a rich and complicated history of neurolaw. My hope is that we learn from our past mistakes, build on our past successes, and forge a future of increasingly productive interdisciplinary conversation.