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NEUROLEGISLATION: HOW U.S. LEGISLATORS ARE USING BRAIN SCIENCE

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I. INTRODUCTION

The leader of the free world is not a neuroscientist. But he likes what they do.

In 2013, President Obama called on Congress to invest hundreds of millions of dollars in new brain research.[1] The President observed, "As humans, we can identify galaxies light years away, we can study particles smaller than an atom. But we still haven't unlocked the mystery of the three pounds of matter that sits between our ears."[2] Obama

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1. OFFICE OF SCI. AND TECH. POLICY, OBAMA ADMINISTRATION PROPOSES DOUBLING SUPPORT FOR THE BRAIN INITIATIVE (2014).

2. OFFICE OF THE PRESS SEC'Y, REMARKS BY THE PRESIDENT ON THE BRAIN INITIATIVE AND AMERICAN INNOVATION (2013).

went on to boldly proclaim that this brain "knowledge could be — will be — *transformative*."[3]

But will such transformation really materialize, and if so, how and when? 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.[4] Law and neuroscience as a scholarly enterprise has grown rapidly and now numbers over 1200 publications.[5] These fields have emerged along with an increase in the frequency with which neuroscientific evidence is proffered in courts.[6] Scholars have considered questions in the criminal domain such as "Do we have free will?" (and what would it mean for law if we don't),[7] and "Should a particular type of neuroscientific evidence be admitted in a particular court proceeding?"[8] Scholars have also explored the relationship between civil liability and the neuroscience of pain,[9] amongst many other potential applications of neuroscience to law.[10]

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3. *Id.* (emphasis added).

4. On neurolaw, see generally OWEN D. JONES ET AL., LAW AND NEUROSCIENCE (2014); 2 PRESIDENTIAL COMMISSION FOR THE STUDY OF BIOETHICAL ISSUES, GRAY MATTERS: TOPICS AT THE INTERSECTION OF NEUROSCIENCE, ETHICS, AND SOCIETY (2015); Owen D. Jones et al., *Law and Neuroscience*, 33 J. NEUROSCI. 17624 (2013). On neuroethics, see DEFINING RIGHT AND WRONG IN BRAIN SCIENCE: ESSENTIAL READINGS IN NEUROETHICS (Walter Glannon ed., 2007); NEUROETHICS: AN INTRODUCTION WITH READINGS (Martha J. Farah ed., 2010); NEUROETHICS IN PRACTICE (Anjan Chatterjee & Martha J. Farah eds., 2013); THE OXFORD HANDBOOK OF NEUROETHICS (Judy Illes & Barbara J. Sahakian eds., 2011).

5. *Law and Neuroscience Bibliography*, MACARTHUR FOUND. RESEARCH NETWORK ON LAW & NEUROSCI., http://www.lawneuro.org/bibliography.php [https://www.perma.cc/HG4U-RUYN]; Stacey A. Tovino, *Functional Neuroimaging and the Law: Trends and Directions for Future Scholarship*, 7 AM. J. BIOETHICS 44, 44 (2007).

6. Nita A. Farahany, *Neuroscience and Behavioral Genetics in US Criminal Law: An Empirical Analysis*, 2 J.L. & BIOSCIENCES 485, 485 (2016); Deborah W. Denno, *Courts' Increasing Consideration of Behavioral Genetics Evidence in Criminal Cases: Results of a Longitudinal Study*, 2011 MICH. ST. L. REV. 967, 970 (2011); 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, 495 (2015).

7. *See, e.g.*, A PRIMER ON CRIMINAL LAW AND NEUROSCIENCE xx (Stephen J. Morse & Adina L. Roskies eds., 2013); MICHAEL S. PARDO & DENNIS PATTERSON, MINDS, BRAINS, AND LAW: THE CONCEPTUAL FOUNDATIONS OF LAW AND NEUROSCIENCE 35 (2013).

8. *See, e.g.*, Joseph H. Baskin et al., *Is a Picture Worth a Thousand Words? Neuroimaging in the Courtroom*, 33 AM. J.L. & MED. 239, 239 (2007); Neal Feigenson, *Brain Imaging and Courtroom Evidence: On the Admissibility and Persuasiveness of fMRI*, 2 INT'L J.L. CONTEXT 233, 233 (2006); Teneille R. Brown & Emily R. Murphy, *Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States*, 62 STAN. L. REV. 1119, 1155 (2010).

9. *See, e.g.*, Amanda C. Pustilnik, *Pain as Fact and Heuristic: How Pain Neuroimaging Illuminates Moral Dimensions of Law*, 97 CORNELL L. REV. 801, 807–12 (2012); Natalie Salmanowitz, *The Case for Pain Neuroimaging in the Courtroom: Lessons from Deception Detection*, 2 J.L. & BIOSCIENCES 139, 140 (2015).

10. *See generally* JONES ET AL., *supra* note 4 (presenting neurolaw material on topics such as lie detection, emotions, memory, brain death, brain injury, cognitive enhancement, artificial intelligence, and brain-machine interfaces).

Yet despite the growing interest in neuroscience generally, and in neurolaw in particular, scholarship in these areas has too narrowly conceptualized the "law" part of neurolaw as limited to what happens in courtrooms. In doing so, scholarship has overlooked the role that brain science is playing, and might one day play, in *legislatures*. Just as legislation is an important type of law, so too is neurolegislation an important type of neurolaw. Failing to recognize this is problematic because, as legal scholar David Faigman pointed out many years ago, "legislators [as compared to courts] come in contact with the largest number and widest array of matters involving science."[11] Moreover, in this modern "age of legislation," statutory law plays a tremendously important role in shaping public policy.[12] This is especially true in certain policy domains such as education and criminal justice, where — although courts set important constitutional boundaries — states and localities have significant discretion in how they formulate policy.

This Article thus starts from the premise that one of the important routes by which neuroscience may bring about transformative change in citizens' lives is through legislative action. This Article defines "neurolegislation" as legislation that explicitly mentions the brain or brain sciences. The definition thus includes a wide range of legislation, including bills aimed at improving brain health and funding brain research, as well as bills aimed at changing polices in domains such as education and criminal justice partly on the basis of brain science. By focusing on neurolegislation, the Article counters the trend of court-centric scholarship in neurolaw[13] and contributes to ongoing scholarly efforts to understand the influence of science on public policy.[14]

The Article explores two related empirical questions. First, what types of neurolegislation have been proposed in U.S. state legislatures? Second, what can be said about the type of legislators who propose these brain bills?[15] Based on an original database of proposed bills in

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11. DAVID L. FAIGMAN, LEGAL ALCHEMY: THE USE AND MISUSE OF SCIENCE IN THE LAW x (1999).

12. Justice Antonin Scalia, Address at the Tanner Lectures on Human Values, "Common-Law Courts in a Civil-Law System: The Role of United States Federal Courts in Interpreting the Constitution and Laws" (Mar. 8–9, 1995) ("We live in an age of legislation, and most new law is statutory law.").

13. *See* Elizabeth Garrett, *Legal Scholarship in the Age of Legislation*, 34 TULSA L.J. 679, 679 (1999) ("[T]he legal academy focuses very little of its attention on Congress and state legislatures.").

14. As the 2012 National Academies Report observed, "there has not been much success in explaining the use of science in public policy." COMMITTEE ON THE USE OF SOCIAL SCIENCE KNOWLEDGE IN PUBLIC POLICY, NAT'L RESEARCH COUNCIL, USING SCIENCE AS EVIDENCE IN PUBLIC POLICY 2 (Kenneth Prewitt, Thomas A. Schwandt, & Miron L. Straf eds., 2012).

15. The terms "neurolegislation" and "brain bills" are used interchangeably in this article. As used here, both terms refer to bills that mention the brain or neuroscience at least once. The limitations of this definitional strategy are discussed in Part III.

U.S. state legislatures from 1992 through 2009, the analysis finds that brain science has been mentioned in nearly 1000 bills.[16] Brain science is mentioned most frequently in bills related to brain injury, insurance and provision of medical care, mental health, education (especially early childhood interventions), veterans' affairs (with an emphasis on posttraumatic stress disorder ("PTSD") and veterans' courts), and sports concussions. In addition, over 70 other types of bills mentioned the brain or neuroscience.[17]

Statistical analysis at the individual legislator level from one year of data, 2009, begins to reveal the conditions under which a legislator will become a "neuro-entrepreneur" by proposing a brain bill. Results suggest that partisanship plays a central role in shaping proposals of particular types of brain bills, and that district demographics and the legislators' gender may also be significant.

The empirical results provide a first glimpse of the early introduction of brain science in the statehouse. Recognizing the limits of the database, most importantly that the use of neuroscience in legislatures may have already changed significantly since 2009, the data nevertheless suggest an emerging pattern.

Legislators seem increasingly curious about the brain, and the diversity of bill types in the data suggests that brain science has potentially wide-ranging application.[18] Yet even if the reach of neuroscience in legislatures is wide, it is not deep. We do not know if neuroscience is simply window dressing on most policy proposals. Neuroscience does not yet appear to be revolutionary in the sense that it persuades large numbers of legislators to change previously established policy positions. Consistent with the cultural cognition theory advanced by legal scholar Dan Kahan, neuroscience is typically embraced when it affirms, rather than challenges, preexisting normative commitments.[19]

However, the data also provides some signs that neuroscience may influence legislators to consider novel policy issues in the future. One example is legislation concerning traumatic brain injury, of which there are a number of bills in the data reported in this Article. It is still too early, and the data still too limited, to make precise predic-

16. As described later in the article, a "mention" is simply that: a mention of the brain or neuroscience in the text of a proposed piece of legislation. See Part III for a detailed discussion of both the coding methodology and the database itself.

17. Included among these other topics are bills related to marijuana regulation, abortion restrictions, Fetal Alcohol Syndrome, and criminal law.

18. Here and throughout, the terms "brain science" and "neuroscience" synonymously refer to a broad variety of brain-related scientific fields including neurology, neurobiology, neuroanatomy, neurochemistry, neurophysiology, psychology, neuropsychology, psychiatry, neuropsychiatry, radiology, pharmacology, genetics, artificial intelligence, and neuroprosthetics, among many others.

19. *See* Dan M. Kahan, *Ideology, Motivated Reasoning, and Cognitive Reflection*, 8 JUDGMENT & DECISION MAKING 407, 407 (2013).

tions about the future of neurolegislation. But it seems quite likely that, as neuroscience continues to advance in sophistication and cultural prominence, legislators will increasingly take notice. If this proves true, then the path by which lab findings are transported to legislatures deserves continued attention.

This Article proceeds in four parts. Part II introduces the field of neurolaw, arguing that scholars have overlooked the important role of legislators. Part III discusses the construction of the neurolegislation database, and identifies the predominant types of neurolegislation. Part IV then presents a statistical analysis of the types of legislators who propose these brain bills. Part V explores the normative implications of the data by looking to the future of brain science and legislative policymaking.

II. NEUROLAW AND NEUROLEGISLATION

Neuroscience is being integrated into U.S. law and policy in a variety of ways.[20] Neuroscientific evidence is increasingly (if still rarely) seen in courtrooms;[21] scholarship at the intersection of law and neuroscience is increasing;[22] more law students are being exposed to neurolaw;[23] the first *Law and Neuroscience* casebook has been published;[24] numerous judges and lawyers have been exposed to neuroscience through conferences and continuing legal education programs;[25] and multiple websites make neurolaw news available to the interested public.[26]

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20. For lengthier and more comprehensive introductions to neurolaw, see BRENT GARLAND, NEUROSCIENCE AND THE LAW: BRAIN, MIND, AND THE SCALES OF JUSTICE, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE & THE DANA FOUNDATION (2004); 13 LAW AND NEUROSCIENCE: CURRENT LEGAL ISSUES 2010 (Michael Freeman ed., 2011); LAW, MIND AND BRAIN (Michael Freeman & Oliver R. Goodenough, eds., 2009); NEUROIMAGING IN FORENSIC PSYCHIATRY: FROM THE CLINIC TO THE COURTROOM (Joseph R. Simpson ed., 2012); Brown & Murphy, *supra* note 8, at 1119; Oliver R. Goodenough & Micaela Tucker, *Law and Cognitive Neuroscience*, 6 ANN. REV. L. & SOC. SCI. 61 (2010); Henry T. Greely & Anthony D. Wagner, *Reference Guide on Neuroscience*, *in* REFERENCE MANUAL ON SCIENTIFIC EVIDENCE (3d ed. 2011); Owen D. Jones & Francis X. Shen, *Law and Neuroscience in the United States*, *in* INTERNATIONAL NEUROLAW (T.M. Spranger, ed., 2012).

21. Farahany, *supra* note 6, at 486.

22. *See* Francis X. Shen, *The Law and Neuroscience Bibliography: Navigating the Emerging Field of Neurolaw*, 38 INT'L J. LEGAL INFO. 352, 352 (2010).

23. *See generally* JONES ET AL., *supra* note 4.

24. *Id.*

25. *See, e.g.*, *Education and Outreach*, MACARTHUR FOUND. RESEARCH NETWORK ON LAW & NEUROSCI., http://www.lawneuro.org/outreach.php [https://www.perma.cc/V72B-EYHL].

26. *See, e.g.*, LAW & NEUROSCIENCE BLOG, http://www.lawneuro.org/blog/ [https://www.perma.cc/692D-5FS2]; NEUROETHICS & LAW BLOG, http://kolber.typepad.com/ [https://www.perma.cc/6NVZ-CMXN]. For a list of further resources, see Francis X. Shen, *Keeping Up with Neurolaw: What to Know and Where to Look*, 50 CT. REV. 104 (2014).

Moreover, this area of research has seen investments from foundations and government agencies. The John D. and Catherine T. MacArthur Foundation invested $10 million in 2007 to start a Law and Neuroscience Project and then invested an additional $4.85 million in 2011 and $1.4 million in 2015 to sustain the Research Network on Law and Neuroscience.[27] These institutional commitments not only foster dialogue and research, but also send a strong signal that this is a field of great possibility. Scholars in the field have debated the potential impact of neuroscience on criminal responsibility,[28] free will,[29] neuroethics,[30] and many areas beyond criminal law.[31]

In addition, neuroscience has been used in the following ways in courts:

- Brain data has routinely been used to show personality change after head trauma.[32]

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27. *See* Amy Wolf, *Landmark Law and Neuroscience Network Expands at Vanderbilt*, VANDERBILT UNIV. (Aug. 24, 2011), http://news.vanderbilt.edu/2011/08/grant-will-expand-law-neuroscience-network/ [https://www.perma.cc/T6HX-9HQU]; Jim Patterson, *Law and Neuroscience Research Gets $1.4 Million in Additional Grant Money*, VANDERBILT UNIV. (Sept. 14, 2015), http://news.vanderbilt.edu/2015/09/law-and-neuroscience-research-gets-1-4-million-in-additional-grant-money [https://www.perma.cc/228U-J6FQ]. *See generally* MACARTHUR FOUND. RESEARCH NETWORK ON LAW & NEUROSCI., http://www.lawneuro.org [https://www.perma.cc/QL9U-FHWD].

28. *See generally, e.g.*, Eyal Aharoni et al., *Can Neurological Evidence Help Courts Assess Criminal Responsibility? Lessons from Law and Neuroscience*, 1124 ANNALS N.Y. ACAD. SCI. 145 (2008); Shelley Batts, *Brain Lesions and Their Implications in Criminal Responsibility*, 27 BEHAV. SCI. & L. 261 (2009); Theodore Y. Blumoff, *The Neuropsychology of Justifications and Excuses: Some Problematic Cases of Self-Defense, Duress, and Provocation*, 50 JURIMETRICS J. 391 (2010). Some scholars believe that neuroscience may fundamentally change this subject. *See, e.g.*, Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y B: BIOLOGICAL SCIENCES 1775, 1776 (2004); Robert M. Sapolsky, *The Frontal Cortex and the Criminal Justice System*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON B: BIOLOGICAL SCIENCES 1787, 1794 (2004). Others have pushed back on this claim. *See, e.g.*, Adam J. Kolber, *Will There Be a Neurolaw Revolution?*, 89 IND. L.J. 807, 813–17 (2014); Stephen J. Morse, *Criminal Law and Common Sense: An Essay on the Perils and Promise of Neuroscience*, 99 MARQ. L. REV. 39, 42 (forthcoming 2015); Michael S. Pardo & Dennis Patterson, *Philosophical Foundations of Law and Neuroscience*, 2010 U. ILL. L. REV. 1211, 1214 (2010).

29. *See generally* CONSCIOUS WILL AND RESPONSIBILITY: A TRIBUTE TO BENJAMIN LIBET (Walter Sinnott-Armstrong & Lynn Nadel eds., 2010).

30. *See generally* THE OXFORD HANDBOOK OF NEUROETHICS (Judy Illes & Barbara J. Sahakian eds., 2011).

31. *See generally* Henry T. Greely, *Prediction, Litigation, Privacy, and Property: Some Possible Legal and Social Implications of Advances in Neuroscience*, *in* NEUROSCIENCE AND THE LAW, *supra* note 20, at 114; Adam J. Kolber, *The Experiential Future of the Law*, 60 EMORY L.J. 585 (2011).

32. *See* 34 AM. JUR. 3D *Proof of Facts* §§ 1, 7–8 (2016); Jane Campbell Moriarty et al., *Brain Trauma, PET Scans and Forensic Complexity* 31 BEHAV. SCI. & L. 702, 702–03 (2013); Donald J. Nolan & Tressa A. Pankovits, *High-Tech Proof in Brain Injury Cases*, TRIAL 27, 27 (2005).

- The electrical brain measurements recorded with electroencephalography ("EEG") appeared in court cases as early as the 1950s and are still used regularly in a variety of civil proceedings.[33]
- Structural brain imaging is a standard part of a psychiatric or neuropsychiatric assessment of individuals known to have experienced traumatic brain injury ("TBI").[34] One type of imaging, computed tomography ("CT") scans, has been increasingly used in litigation since the 1970s.[35]
- Functional brain scans such as positron emission tomography ("PET") and single-photon emission computed tomography ("SPECT") have also been used in a variety of criminal and civil cases.[36]
- Brain scans have been used to determine competency to stand trial.[37]
- Brain scans have been introduced to mitigate sentencing where there is evidence of brain or mental trauma.[38]
- Brain scans have been used in the criminal defense of cases involving sexual offenses.[39]
- In social security disability law, the proffered medical documentation to support a finding of an organic mental disorder (a "[p]sychological or behavioral abnormalit[y] associated with a dysfunction of the brain"[40]) can include neuro-

33. W.M. Moldoff, Annotation, *Admissibility in Civil Action of Electroencephalogram, Electrocardiogram, or Other Record Made by Instrument Used in Medical Test, or of Report Based upon Such Test*, 66 A.L.R. 2D 536 (2011).

34. Robert P. Granacher, Jr., *Traumatic Brain Injury*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 20, at 43.

35. 8 AM. JUR. 3D *Proof of Facts* 145 § 1 (1990) ("The escalating use and development of CT since the 1970s has made it a well-established technique.").

36. Susan E. Rushing et al., *PET and SPECT*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 20, at 3, 20–21.

37. Nathan J. Kolla & Jonathan D. Brodie, *Application of Neuroimaging in Relationship to Competence to Stand Trial and Insanity*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 20, at 147–48.

38. Judith G. Edersheim et al., *Neuroimaging, Diminished Capacity and Mitigation*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 20, at 163–64, 176.

39. *See, e.g.*, Sexton v. State, 997 So. 2d 1073, 1082–85 (Fla. 2008) (concluding that counsel's reliance on brain scan evidence to mitigate sentence was reasonable where defendant had a "history of bizarre sexual and criminal behavior").

40. 20 C.F.R. § 404, subpt. P app. 1, § 12.02 (2015).

scientific evidence, such as EEG and magnetic resonance imaging ("MRI").[41]

- The results of MRI and EEG tests have been included in claimants' efforts to receive benefits for epilepsy.[42]
- Brain data has been introduced in support of a contractual incapacity argument.[43]
- Neuroimaging evidence has been proffered to support insanity defense claims.[44]

Even though many of these examples apply to criminal defense, there are instances where prosecutors have used brain evidence as well.[45] In addition, neuroscience may well play an increasing role in assessing pain, suffering, and damages in civil litigation.[46] This influx of brain data has had, at least in some instances, a material effect on case outcomes.[47]

The effect of neuroscientific evidence on judicial and juror decision-making remains unknown.[48] One view is that the "seductive allure" of neuroscientific explanations, and in particular the allure of colorful brain images, will be unduly persuasive.[49] And one experimental study using state court judges as subjects concluded that judges significantly reduced their sentences for adult psychopaths when provided with a neuroscientific explanation for the psychopath's be-

41. 3 SOC. SEC. LAW & PRAC. § 42:147 n.1 ("In some cases, the origin of the dysfunction is readily identified with diagnostic tools such as computed tomography (CAT) scanning of the brain, magnetic resonance imaging (MRI) of the brain, or electroencephalography (EEG) which reveals the electrical brain wave patterns.").

42. *See, e.g.*, Kliber v. Soc. Sec. Admin., 794 F. Supp. 2d 1025, 1030, 1034 (D. Minn. 2011).

43. *See, e.g.*, Jones & Shen, *supra* note 20, at 354.

44. *Id.* at 355.

45. Susan M. Wolf et al., *How Is Neuroscience Used in Criminal Court? Analysis of Judicial Decisions 1994–2009* 32, tbl.2 (Dec. 29, 2010) (unpublished manuscript) (on file with author).

46. Amanda C. Pustilnik, *Imaging Brains, Changing Minds: How Pain Neuroimaging Can Inform the Law*, 66 ALA. L.R. 1099 (2015); Adam J. Kolber, *Pain Detection and the Privacy of Subjective Experience*, 33 AM. J.L. & MED. 433, 454–55 (2007).

47. *See* Jones & Shen, *supra* note 20, at 350–51; *see also* Jeffrey Rosen, *The Brain on the Stand*, N.Y. TIMES MAG. (Mar. 11, 2007), https://www.nytimes.com/2007/03/11/magazine/11Neurolaw.t.html?_r=0 [https://www.perma.cc/X4MH-MWMG].

48. *See* So Yeon Choe, *Misdiagnosing the Impact of Neuroimages in the Courtroom*, 61 UCLA L. REV. 1502, 1507 (2014).

49. Deena Skolnick Weisberg et al., *The Seductive Allure of Neuroscience Explanations*, 20 J. COGNITIVE NEUROSCI. 470, 474–76 (2008); Lisa G. Aspinwall et al., *The Double-Edged Sword: Does Biomechanism Increase or Decrease Judges' Sentencing of Psychopaths?*, 337 SCIENCE 846, 846 (2012); Jessica R. Gurley & David K. Marcus, *The Effects of Neuroimaging and Brain Injury on Insanity Defenses*, 26 BEHAV. SCI. & L. 85, 85–86, 93 (2008).

havior.[50] But other experimental studies have found no significant effect.[51] In light of data suggesting the minimal impact of neuroscience in courts, some scholars now warn about the seductive allure of the "seductive allure" explanation.[52] In short, while the use of neuroscientific evidence is clearly on the rise, we cannot yet say with confidence what the actual effects of such evidence are or will be in the future.

While neurolaw scholarship is tracking these courtroom developments, the field has, with few exceptions, failed to examine the advent of neurolegislation.[53] Neurolegislation, as defined in this Article, is legislation that explicitly mentions the brain or brain sciences (for example, neuroscience or neurology) in the bill's text. In adopting this definition, this Article embraces a big tent approach to neurolaw, recognizing all intersections of brain science, law, and policy as neurolaw. One of these intersections is neurolegislation.

Because most neurolaw scholars focus on the courthouse, but not the statehouse, we have limited knowledge about legislative use of brain science.[54] Neurolaw scholarship's failure to examine legislation carefully is a specific instance of a more general failing of law-and-science scholars to consider the legislative domain. Professor Faigman identifies four places in which scientific research intersects with law

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50. Aspinwall et al., *supra* note 49, at 848 fig.2.

51. Adina L. Roskies et al., *Neuroimages in Court: Less Biasing Than Feared*, 17 TRENDS IN COGNITIVE SCI., 99, 99 (2013); Michael J. Saks et al., *The Impact of Neuroimages in the Sentencing Phase of Capital Trials*, 11 J. EMPIRICAL LEGAL STUDIES, Mar. 2014, at 105, 105; N.J. Schweitzer et al., *Fooled by the Brain: Re-examining the Influence of Neuroimages*, 129 COGNITION 501, 508 (2013); N. J. Schweitzer et al., *Neuroimages as Evidence in a Mens Rea Defense: No Impact*, 17 PSYCHOL. PUB. POL'Y & L. 357, 382 (2011); *see also* Robert B. Michael et al., *On the (Non)persuasive Power of a Brain Image*, 20 PSYCHONOMIC BULL. & REV. 720, 720 (2013); Nicholas Scurich & Adam Shniderman, *The Selective Allure of Neuroscientific Explanations*, 9 PLOS ONE e107529, e107529 (2014).

52. Martha J. Farah & Cayce J. Hook, *The Seductive Allure of "Seductive Allure"*, 8 PERSP. ON PSYCHOL. SCI. 88, 89 (2013); Terry A. Maroney, *Adolescent Brain Science and Juvenile Justice*, *in* 13 LAW AND NEUROSCIENCE: CURRENT LEGAL ISSUES 258, 269 (Michael Freeman ed., 2010) ("Though the science has been positively received by a small number of courts and judges, usually in the context of sentencing, in no instance has it been outcome-determinative.").

53. *Cf.* FAIGMAN, *supra* note 11, at 210 & n.29.

54. The Law and Neuroscience Bibliography, *supra* note 5, contains few in-depth studies on the use of brain science in legislatures. Political scientist Robert Blank wrote a book in 1999 foreshadowing the coming brain science/policy interactions, arguing that brain policy "warrants urgent attention by policy makers, policy analysts, and informed citizens," and that "the political debate surrounding this emerging knowledge about the brain and new intervention techniques promises to be intense." ROBERT H. BLANK, BRAIN POLICY: HOW THE NEW NEUROSCIENCE WILL CHANGE OUR LIVES AND OUR POLITICS 168, 172 (1999). He followed up in 2013 with a book on neuro-interventions. ROBERT H. BLANK, INTERVENTION IN THE BRAIN: POLITICS, POLICY, AND ETHICS (2013). Neither book, however, has found its way into the mainstream of neurolaw conversation. Blank's 1999 book is cited only four times in Westlaw's secondary sources (as of May 4, 2016). There is no extended treatment of either his 1999 or his 2013 studies in the legal literature.

and policy: "(1) trial and appellate courts in nonconstitutional cases, (2) constitutional cases . . . (3) legislatures, and (4) administrative agencies."[55] While there has been a good deal written about the use of science in trial courts, constitutional issues, and administrative law,[56] Faigman observed in 1999 that "[t]here have been *no* general studies or assessments of the legislative use of science."[57]

Part of the reason for this lack of scholarship may be the view that — at least at the federal level — Congress is not the main player. David Faigman suggests that "politics as usual drives the legislature, and science is usually swept aside, ignored, or corrupted in the process."[58] Faigman argues that this is problematic and that the solution involves better informing legislators about relevant science, but he also takes comfort in the fact that in his analysis, Congress is only an "interested bystander" in relation to science policy.[59] Faigman further argues that "[t]he real instrument of science policy in the United States is the bureaucracy of the executive branch of government," and thus by contrast, Congress "swings wildly [in science policy] but without causing much harm."[60]

Even if it is true at the federal level that the legislature is less important than the regulatory bodies, the actions of state legislatures may

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55. FAIGMAN, *supra* note 11, at 50.

56. In the administrative law realm, the bulk of scholarship has focused on environmental science. *See, e.g.*, Joel Yellin, *Science, Technology, and Administrative Government: Institutional Designs for Environmental Decisionmaking*, 92 YALE L.J. 1300, 1300–01 (1983); Wendy E. Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613, 1614 (1995).

57. FAIGMAN, *supra* note 11, at 210 & n.29 (emphasis added). Faigman includes a chapter on legislatures, but focuses primarily on funding decisions by the U.S. Congress. Since 1999, scholars in political science have started to fill this gap, with a particular emphasis on the use of environmental science in a range of policy decisions. A notable contribution is political scientist Ann Keller's analysis of science in the context of federal environmental policy. ANN CAMPBELL KELLER, SCIENCE IN ENVIRONMENTAL POLICY: THE POLITICS OF OBJECTIVE ADVICE (2009). For other studies, both before and after Keller's, see SHELDON KRIMSKY, HORMONAL CHAOS: THE SCIENTIFIC AND SOCIAL ORIGINS OF THE ENVIRONMENTAL ENDOCRINE HYPOTHESIS (2000); Dana Lee Baker, *Use of Science in Autism Policy Development*, 3 OPEN J. POL. SCI. 1 (2013); Denise Scheberle, *Radon and Asbestos: A Study of Agenda Setting and Causal Stories*, 22 POL'Y STUD. J. 74 (1994); Stephen Zehr, *Comparative Boundary Work: US Acid Rain and Global Climate Change Policy Deliberations*, 32 SCI. & PUB. POL'Y 445 (2005).

58. FAIGMAN, *supra* note 11, at x. Moreover, "legislators often use a facade of science to legitimate decisions — decisions not always made in reliance on or even consistent with the science being cited." *Id.* at 125. At the congressional level, Faigman observes that while Congress "has an overwhelming influence on the practice and pursuit of science in the United States and constantly relies on it, as an institution it exhibits a shocking lack of curiosity about the subject." *Id.* at 126. Legislators may treat the substance of fields other than science similarly. *See generally* JENNIFER L. HOCHSCHILD & KATHERINE LEVINE EINSTEIN, DO FACTS MATTER? INFORMATION AND MISINFORMATION IN AMERICAN POLITICS (2015).

59. *Id.* at 150–52.

60. *Id.* at 152.

not be similarly benign.[61] This is because in the American federalist system, state legislatures are the primary policy drivers for a wide variety of spheres including criminal justice, elementary and secondary education, and personal injury litigation.[62] Examining neurolegislation in the state house thus presents an opportunity to contribute both to the neurolaw literature and to a broader understanding of science-policy interaction in the legislative domain.

III. SETTING THE NEUROLEGISLATION AGENDA

Like courtroom proceedings, the legislative process has multiple distinct stages in which neuroscience may be used differently. Political scientists who study the policy process often break it up into three stages: (1) the agenda-setting stage, (2) the legislative stage, and (3) the implementation and regulation stage.[63] This Article focuses primarily on the first stage — agenda setting. The agenda-setting stage refers broadly to the full swath of activities that lead up to the formal introduction of a bill (at which point the legislative committees begin their work). Agenda-setting activities can include both formal activity, such as presentations to legislative staff by lobbyists, and informal activity such as a personal conversation with a family member or constituent. What a legislator proposes when in session may well be rooted in something that happened years ago.[64]

While the latter two stages are of course important, it is in this agenda-setting stage that the dominant science narrative is typically set. Research in environmental policy suggests that "the major features of each science narrative persist throughout . . . [the] period of congressional debate."[65] Moreover, as the policy process continues into its latter stages, formal constraints limit scientists' ability to in-

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61. Legislatures, especially Congress, certainly play a role in funding the scientific enterprise. To capture this two-way interaction, scholars distinguish between "science in policy" and "policy for science." Science in policy, the focus of this Article, is the use of scientific expertise in policymaking. Policy for science is the development of policy for funding and encouraging scientific research. *See* SHEILA JASANOFF, THE FIFTH BRANCH: SCIENCE ADVISERS AS POLICYMAKERS 5 (1994).

62. *See* William J. Stuntz, *The Political Constitution of Criminal Justice*, 119 HARV. L. REV. 780, 787 (2006) (criminal justice); MICHAEL J. KAUFMAN & SHERELYN R. KAUFMAN, EDUCATION LAW, POLICY, AND PRACTICE: CASES AND MATERIALS 8 (2d ed. 2009) (education); Carly N. Kelly & Michelle M. Mello, *Are Medical Malpractice Damages Caps Constitutional? An Overview of State Litigation*, 33 J.L. MED. & ETHICS 515, 516 (2005) (medical malpractice litigation).

63. *See* KELLER, *supra* note 57, at 13.

64. Indeed, there is evidence suggesting that legislators' agendas are driven in part by their personal experiences. *See* BARRY C. BURDEN, PERSONAL ROOTS OF REPRESENTATION 11 (2007) (arguing that "[l]egislators acquire expertise, values and interests long before they arrive in [the legislature]").

65. *See* KELLER, *supra* note 57, at 134.

fluence the process.[66] Political scientists have accumulated a significant amount of knowledge on the agenda-setting stage.[67] The agenda-setting process is typically conceived as a political one involving multiple, sometimes competing and sometimes overlapping, interests. This stage is "dominated by actors who advance policy ideas through information gathering, storytelling, argument, and persuasion."[68]

Although the agenda-setting stage involves a variety of political behavior, this Article follows a long tradition of political science scholarship in focusing on bill proposals as a way to understand how the legislative agenda is set.[69] As political scientist Kerry Haynie writes, "[B]ill introductions are important because, unlike roll-call votes, they detail what representatives actually add to the policy agenda."[70] Thus, the data that follow answer the specific question: how, if at all, are legislators referencing brain science in the bills they propose? The question is straightforward, but answering it requires significant time and effort.

To build the neurolegislation database, my research assistants and I searched available online legislative databases on individual state legislature websites to create a database of every bill from the first available year in the database through 2009. No single repository of such bills previously existed, so the database of bill proposals was constructed state by state.[71] The search was conducted for both House and Senate bills in all fifty states. While limited to what is available online (which roughly starts in the late 1990s), the database provides a comprehensive, national perspective that has not previously been offered.[72]

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66. *See id.* at 170.

67. A review of the literature found that "[d]uring the past 30 years, more than 350 studies have been conducted on agenda-setting theory." Matthew D. Matsaganis & J. Gregory Payne, *Agenda Setting in a Culture of Fear: The Lasting Effects of September 11 on American Politics and Journalism*, 49 AM. BEHAV. SCI. 379, 380 (2005). *See generally* FRANK R. BAUMGARTNER & BRYAN D. JONES, AGENDAS AND INSTABILITY IN AMERICAN POLITICS (1993); JOHN W. KINGDON, AGENDAS, ALTERNATIVES, AND PUBLIC POLICIES (1984); DEBORAH STONE, POLICY PARADOX: THE ART OF POLITICAL DECISION MAKING (1997).

68. KELLER, *supra* note 57, at 7.

69. *See, e.g.*, R. DOUGLAS ARNOLD, THE LOGIC OF CONGRESSIONAL ACTION (1990); Kathleen A. Bratton & Kerry L. Haynie, *Agenda Setting and Legislative Success in State Legislatures: The Effects of Gender and Race*, 61 J. POL. 658 (1999).

70. KERRY L. HAYNIE, AFRICAN AMERICAN LEGISLATORS IN THE AMERICAN STATES 25 (2001).

71. Although Westlaw tracks more recent bills from recent legislative sessions, coverage of earlier legislative sessions is not consistent across states and years. Thus, we had to visit individual state online archives to search and collect the data.

72. This is not to say that the database is without significant limitations. State variation in reporting and recording legislative activity may introduce some distortions into the data. Moreover, the starting dates (late 1990s) prevent the database from capturing important, brain-related issues that might have arisen in earlier years. One prominent example is brain death, a topic on which most state legislatures acted before the database begins. *See* ELIZABETH PRICE FOLEY, THE LAW OF LIFE AND DEATH 118–21 (2011); Alexander Morgan

Coding the legislation must start with the question: what constitutes neurolegislation? For present purposes, "neurolegislation" is defined as legislation that explicitly mentions the brain or brain sciences. Neurolegislation as used in this Article thus includes a wide range of legislation, including bills aimed at improving brain health and funding brain research, as well as those bills aimed at changing policies in domains such as education and criminal justice in part on the basis of brain science.

The field of neuroscience is interdisciplinary, including clinicians and scholars trained in biology, physics, math, computer science, artificial intelligence, pharmacology, psychiatry, psychology, and many other fields. Here, the terms "brain science" and "neuroscience" include these and similar fields insofar as they actively engage with the development, structure, and function of the brain.

This approach to identifying neurolegislation may both underestimate and overestimate the number of brain bills. It may underestimate the number of bills because the coding techniques employed in this study fail to capture legislation that doesn't explicitly make mention of brain science but is in fact motivated by it. This is a general challenge in understanding the relationship between science and legislation, as legislators need not place on the record their reasons for proposing (or voting for) a particular bill.[73] For instance, imagine a legislator who learns about the neuroscience of eyewitness memory and is then persuaded that a criminal procedure rule relating to memory in the courtroom should be modified. Unless the legislator explicitly cites the brain research in the bill's text or its incorporated legislative findings (or elsewhere in the bill where a search would pick it up), it does not reach the database.

On the other hand, this approach may overestimate the use of brain science to the extent that the reference to brain science is merely perfunctory. While a detailed case study of a particular bill might allow for inferences about the relative importance of the neuroscience vis-à-vis other motivating factors, searching through hundreds of thousands of bills does not allow for such fine-grained evaluation.

With these two important limitations in mind, the database is nonetheless instructive in providing an accurate estimate of the number of brain bills explicitly referencing brain science. How to interpret that data, of course, may be subject to debate and is addressed in the

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Capron & Leon R. Kass, *A Statutory Definition of the Standards for Determining Human Death: An Appraisal and a Proposal*, 121 U. PA. L. REV. 87, 88 (1972).

73. *See* FAIGMAN, *supra* note 11, at 125 (arguing that legislators, unlike judges, have no tradition of writing down their reasons for their decisions and "[b]ecause they are not held accountable for their knowledge, legislators feel little pressure to truly deal with the complexities of science").

next Part of this Article. I first review the coding procedure in more detail.

Coding proceeded as follows. For each state legislature, separate searches were conducted to identify bills containing any of the following key words: brain; neuro!; psycholog!; cognitive; EEG; positron emission; fMRI /MRI; PTSD; genetic!; and veterans AND mental.[74] This search strategy produced a set of bills in each state legislature, and we then read through the bills to identify bills where brain science was explicitly mentioned in the text of the bill itself.[75]

These search methods produced a database of 981 bills proposed from 1998 through 2009.[76] Over this period, although there is some year-to-year fluctuation, the number of brain bills has evidently increased.[77] In addition to tracking bill proposals, we attempted to track each bill's status as it moved through the legislative process. While we were not able to do this for every bill, we were able to do so for a large majority of the bills. Most proposed legislation does not become law, and does not even reach the floor for a vote.[78] While most bills died in committee, 290 of the 981 bills were enacted into law. This basic trend in some ways mirrors that in the courtroom. Just as neuroscience is increasingly introduced into actual cases in the courtroom, neuroscience is increasingly used in the creation of new policy in legislatures.[79] And just as the added value of neuroscientific evidence in

74. Appending "!" to a phrase will return all variants of that root. Thus, "neuro!" would return results such as neurology and neuroscience.

75. House or senate resolutions, appropriation bills, and memorials were all excluded from the database. Appropriation bills included funding for all programs in the legislature, and were not substantive legislation in the conventional sense. They were also not sponsored by individual legislators, thus not allowing for the type of analysis conducted later in this paper. Bills offering only technical, non-substantive changes were also not included in the database.

76. 287 resolutions are excluded from this analysis. Many of these resolutions were to generate awareness or confer an honor. *See, e.g.*, S.J. Res. 53, 2006 Leg., Reg. Sess. (Ala. 2006) (honoring an Alabama neuroscience professor); S. Con. Res. 40, 1993–1994 Leg., Reg. Sess. (Cal. 1994) (creating Autism Treatment Awareness Week).

77. It's worth noting that 981 bills in total over a decade suggests that, as a percentage of all bills proposed in that time, brain bills are a small percentage. By way of comparison, a previous study on rape and sexual assault state legislation found that in the year 2007 alone, 952 proposed bills related to rape. Francis X. Shen, Essays in Political Science, Psychology, and Law (June 18, 2008) (unpublished Ph.D. dissertation, Harvard University) (on file with author). That the brain bill percentage of overall legislative activity is small, however, does not necessarily mean that neuroscience has not played a major role in particular policy areas. For instance, if those bills were all concentrated on a single issue, they could lead to significant reform.

78. PETER L. STRAUSS, LEGISLATION: UNDERSTANDING AND USING STATUTES 3 (2006) ("Just as most potential litigation dies before it ever reaches court, most potential legislation dies in committee."); *see also* SUNLIGHT FOUNDATION, *The Life and Death of Congressional Bills in the 110th Congress*: *A Window into What Happens to Bills in Congress*, SUNLIGHT LABS, https://assets.sunlightlabs.com/billvisualization/index.html [https://www.perma.cc/786D-H8LW].

79. *See, e.g.*, Nita A. Farahany, *Neuroscience and Behavioral Genetics in US Criminal Law: An Empirical Analysis*, 2 J.L. & BIOSCI. 485, 486 (2016).

courts remains unclear, the relative effect of neuroscience on the passage of bills also remains unclear. This is an area ripe for further investigation, and would especially benefit from a deep-dive case study.

Returning to the database, what can be said about the substance of these brain bills? Each bill was coded for content such that a single bill could address multiple categories. The most prominent categories are presented in Table 1.

Table 1: Most Prevalent Categories of Neurolegislation
(with at Least Eight Bills in Database)

Category	**# of Bills (1992–2009)**	**% of Total** [80]
Brain Injury/Trauma	155	16%
Medical Services/Health Care	114	12%
Education	87	9%
Mental Disability/Mental Health	83	8%
Veterans	69	7%
Autism	59	6%
Early Childhood	44	4%
Blue Ribbon (Council, Commission)	43	4%
Awareness	38	4%
Special Education	30	3%
Toxins (Effects on Brain)	27	3%
Research/Research Funding	26	3%
Sports	25	3%
Neonatal	25	3%
Genetics	24	2%
PTSD	24	2%
Crime Victims	22	2%
Accreditation	21	2%
Alzheimer's and Dementia	18	2%
Criminal Defense	18	2%
Privacy	17	2%
Veterans Courts	16	2%
End of Life/Advance Directives	16	2%
DNA	15	2%
Shaken Baby Syndrome	15	2%
Foster Care/Child Care	15	2%

80. For purposes of generating the percentages in this table, bills were double counted when they were coded in more than one category.

Juvenile Justice	14	1%
Civil Commitment	14	1%
Parole/Prison	14	1%
Brain Death	11	1%
Parkinson's Disease	11	1%
Sex Offenders	9	1%
Genetic Screening	9	1%
Criminal Procedure	9	1%
Criminal Sentencing	9	1%
Fetal Pain/Abortion	8	1%

The five leading categories of bills were:

(1) *Brain injury and brain trauma*. Many bills established funds for individuals with brain injuries. For example, in 2002, Colorado enacted H.B. 1281, which increased motor vehicle fines for the Colorado Traumatic Brain Injury Trust Fund.[81] Other bills recognized the effects of traumatic brain injury, and changed laws to prevent TBI. For instance, in 2005, a law was proposed (though not enacted) in Arizona that would have prohibited minors from riding in the back of pickup trucks.[82] Still other bills addressed research funding on brain injury, as well as insurance coverage for such injuries.[83]

(2) *Health care provision and insurance coverage*. Several bills invoked brain science when calling for expansion of medical services or insurance coverage. These bills often overlapped with other categories such as brain injuries and brain based biological disorders. For instance, in 2009, Oklahoma S.B. 36 proposed to define autistic disorder as a neurological disorder and change relevant requirements for insurance coverage.[84] In 2009, Texas S.B. 1348 called for a change in

81. H.R. 1281, 63d Gen. Assemb., 2d Reg. Sess. (Colo. 2002).

82. H.R. 2532, 47th Leg., 1st Reg. Sess. (Ariz. 2005).

83. *See, e.g.*, S. 1252, 2005 Gen. Assemb., Reg. Sess. (N.C. 2005) (funding Traumatic Brain Injury Advisory Council to study needs of individuals with brain injuries and to make recommendations for statewide service delivery system); H.R. 1088, 2003 Leg., 78th Sess. (S.D. 2003) (establishing fund for research of spinal cord injuries).

84. S. 36, 52d Leg., 1st Sess. (Okla. 2009).

health benefit plans to improve coverage for acquired brain injuries.[85]

(3) *Mental health and mental disabilities.* In the late 1990s and early 2000s, a cluster of bills across different states moved for improved insurance coverage of mental illness. In 2001, Rhode Island H.B. 5807 would have required "insurance policies to provide mental illness and substance abuse coverage the same as they cover medical illness."[86] Other similar bills run in parallel to federal efforts to improve parity in mental health coverage. These bills appear in this dataset even in later years. In 2008, New York A.B. 10078 proposed to redefine "biologically based mental illness" to include posttraumatic stress disorder.[87] There were also a number of other ways in which legislators touched on mental health and mental illness. To give just one example, a 2002 state senate bill proposed that some of Arizona's civil rights statutes be revised to include mental impairment as a recognized disability.[88]

(4) *Education, early childhood education, and special education*. One of the largest and most diverse categories of brain bills concerned education. Many of the bills at the end of the 1990s reflect a movement, which at the time did not prove entirely successful, to improve early childhood interventions on the basis of brain research.[89] In 1998, for instance, California A.B. 2332 noted that "[p]ositive stimulation of the brain during the early years, for example, through interactions with others and language

85. S. 1348, 81st Leg., Reg. Sess. (Tex. 2009).

86. H.R. 5807, 2001 Gen. Assemb., Jan. Sess. (R.I. 2001).

87. Assemb. 10078, 2008 State Assemb., Reg. Sess. (N.Y. 2008).

88. S. 1277, 45th Leg., 2d Reg. Sess. (Ariz. 2002).

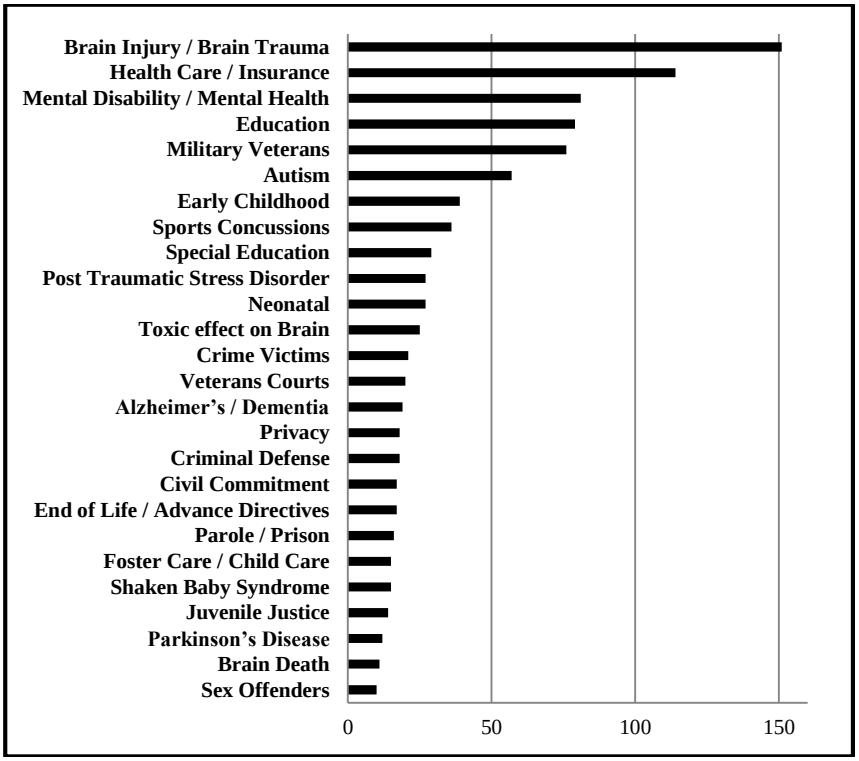
89. *See* JOHN T. BRUER, THE MYTH OF THE FIRST THREE YEARS (1999); John T. Bruer, *Education and the Brain: A Bridge Too Far*, 26 EDUC. RES. 4 (1997). The field of educational neuroscience has since developed, but not without hiccups. *See generally* NEUROSCIENCE IN EDUCATION: THE GOOD, THE BAD, AND THE UGLY (Sergio Della Sala & Mike Anderson eds., 2012); *see also* John T. Bruer, *Research Base for Improved Classroom Learning: Brain or Behavior?*, BROOKINGS (Dec. 17, 2015), http://www.brookings.edu/research/reports/2015/12/17-research-base-improved-learning-bruer [https://perma.cc/2HYZ-NT33]; John T. Bruer, *Windows of Opportunity: Their Seductive Appeal*, BROOKINGS (Oct. 22, 2015), http://www.brookings.edu/research/papers/2015/10/22-childhood-education-neuroscience-window-opportunity-bruer [https://perma.cc/5K5X-T93B].

development, lays the foundation for a child's lifelong thinking, attitudes, and behavior."[90] The bill went on to propose investments in early childhood education. Similarly, in 1999 California S.B. 568 noted that "[s]cientific study of brain development and research on early childhood learning have shown that a child's ability to learn, interact in learning, and attitude toward learning are shaped for life before the age of six."[91] In addition, there have been a variety of bills that link neuroscience to education programs. For instance, in New Mexico in 2008, S.B. 468 called for an "intensive neuroscience-driven language development and reading proficiency intervention pilot research program."[92] Brain science was also cited to support physical education. In 2009, Colorado S.B. 131 noted that "[m]any studies have documented the link between the mind and body and the effect of movement on cognition and stimulated blood flow and oxygen to a child's brain,"[93] in calling for public school students to engage in physical activities.

(5) *Combat veterans and posttraumatic stress disorder.* A number of states in this time period provided for new services and legal alternatives for returning war veterans. In 2008 in Minnesota, H.B. 3670 would have required courts to "inquire as to whether a convicted defendant is a veteran [and consult] with federal and state veterans affairs [departments] regarding mental health treatment options during presentence investigations."[94] Similarly, in Iowa in 2010, H.B. 2123 would have required courts in certain situations to place a combat veteran in a mental health or substance abuse facility as part of a criminal sentence.[95] Many additional bills were proposed across thirty-one states.

90. Assemb. 2332, 1997–1998 Leg., Reg. Sess. (Cal. 1998).
91. S. 568, 1999–2000 Leg., Reg. Sess. (Cal. 1999).
92. S. 468, 48th Leg., 2d Sess. (N.M. 2008).
93. S. 131, 67th Gen. Assemb., Reg. Sess. (Colo. 2009).
94. H.R. 3670, 85th Leg., Reg. Sess. (Minn. 2008).
95. H.R. 2123, 83d Gen. Assemb., 1st Sess. (Iowa 2009).

Table 1 and Figure 1 show that brain science was cited in a wide variety of contexts beyond the five most prominent categories described above. These other contexts included bills relating to: recognition and treatment of autism;[96] regulation of concussion management in high school sports;[97] recognition and studies on the toxic effects of various substances on the brain;[98] the psychological effects of crime on victims;[99] concerns about dementia;[100] issues related to brain death and end of life care;[101] requirements for foster care providers;[102] and civil commitment.[103] Also noteworthy were a variety of bills that concerned the criminal justice system. Juvenile justice, discussed at length in other works,[104] was also a focus for some legislators.[105]



96. *See, e.g.*, S. 348, 2008 Leg., Reg. Sess. (Ala. 2008).
97. *See, e.g.*, S. 2106, 214th Leg., Reg. Sess. (N.J. 2010).
98. *See, e.g.*, H.R. 2466, 81st Gen. Assemb., Reg. Sess. (Iowa 2006).
99. *See, e.g.*, H.R. 489, 110th Leg., Reg. Sess. (Fla. 2008).
100. *See, e.g.*, S. 112, 77th Leg., Reg. Sess. (W. Va. 2006).
101. *See, e.g.*, Assemb. 6287, 2007 State Assemb., Reg. Sess. (N.Y. 2007) (brain death); H.R. 656, 159th Gen. Court, Reg. Sess. (N.H. 2006) (end of life care).
102. *See, e.g.*, S. 79, 67th Gen. Assemb., Reg. Sess. (Colo. 2009).
103. *See, e.g.*, H.R. 2828, 84th Gen. Assemb., Reg. Sess. (Ark. 2003).
104. Francis X. Shen, *Legislating Neuroscience: The Case of Juvenile Justice*, 46 LOY. L.A. L. REV. 985 (2013).
105. H.R. 1142, 66th Gen. Assemb., 2d Reg. Sess. (Colo. 2008).

Figure 1: Number of Brain Bills in Most Prevalent Categories (Across All Years)

Figure 2 presents the total number of proposed bills in U.S. state legislatures that reference neuroscience. Excluded from this data, as explained above, are resolutions. Data is presented in two-year intervals because some state legislatures meet every other year (thus making annual comparisons of bill totals difficult to interpret). Earlier years of data are not graphed, as the quality of data for pre-1997 searches of state legislation is not as high. Data sources are listed in the Appendix.[106] There is an upward trend, with more bills related to neuroscience proposed in recent years. There may simply be more bills proposed per year across all 50 state legislatures overall, in which case this trend would not seem surprising. But the trend seen here is consistent with trends in the number of neuroscientific cases[107] and the rise in neurolaw scholarship.[108] It thus seems quite plausible that the data is indicative of a true increase in legislative attention to brain science.

106. Francis X. Shen, *Neurolegislation: How U.S. Legislators Are Using Brain Science, Appendix*, SHEN NEUROLAW LAB (May 6, 2016), http://www.fxshen.com/Shen_2016_Neurolegislation_Appendix-FINAL.pdf. This Appendix is hosted independently of the *Harvard Journal of Law & Technology*, which reviewed only the Article itself.

107. *See* Farahany, *supra* note 6, at 486.

108. *See* Shen, *supra* note 22, at 352.

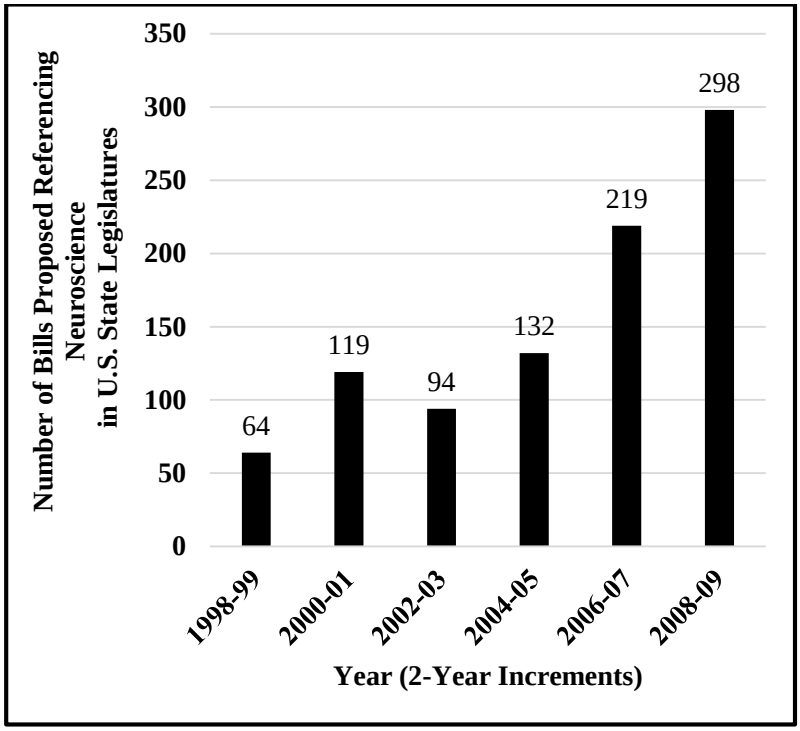


Figure 2: Number of Proposed Bills in U.S. State Legislatures That Reference Neuroscience, 1998–2009
(Summarized in Two-Year Increments)

The laundry list of brain bills could continue for some time, but the pertinent question is: What does this data tell us generally about the use of brain science in state legislatures? The next Part begins to answer this question by examining the politics behind brain bill proposals.

IV. IS NEUROLEGISLATION TRANSFORMATIVE?

The preceding Part gives a sense of the type of bills proposed, but does not provide information on who proposed the bills and what differentiates brain bill proposers from their peers. The statistical analysis reported in this Part begins to address these questions and enable inferences about the politics of neurolaw.[109] Specifically, it examines whether the politics of neurolegislation defies the expectation that neuroscience will be harnessed as other types of science typically

109. This Article focuses on the basic analytic approach and the implications of the study's results. For a more detail discussion of the methodology, see Shen, *supra* note 106.

are — to promote conventional partisan aims. If so, neuroscience might be not only a new but also different type of evidence in the legislative process.

It is again worth emphasizing several limits of the dataset. First, the timespan of the bills analyzed in this paper ends in 2009. Legislative behavior may have changed significantly since then in light of rapidly developing brain science. For instance, the current database does not adequately account for active debate over the use of science in fetal pain bills, much of which emerged after 2009.[110] Second, this database focuses only on state-level legislative activity. Federal support for neuroscience (via research funding and greater attention from the executive branch) is a critical mechanism by which neuroscientific research — and thus policy emerging from that research – will be crafted. Future studies should more explicitly examine federal use of, and support for, brain research.[111] Third, the present analysis focuses exclusively on neuroscience, but neuroscience may not be unique. Its use may be similar to the use of other bodies of scientific knowledge, but without comparative analysis we cannot know for sure. While the foregoing are important limitations on how findings from the current data can be generalized, a closer look at the dataset nonetheless reveals important new information on legislators' use of neuroscience.

Each of the bills in the database described in Part II has at least one (and often more than one) sponsor.[112] No single database exists that includes historical state legislator data year-by-year, but I was able to take advantage of a legislator database that is available for the year 2009. I thus conducted an analysis of 2009 bill proposals.[113] The snapshot, of course, leaves open questions about data from other

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110. *See* John A. Robertson, *Science Disputes in Abortion Law*, 93 TEX. L. REV. 1849 (2015) (discussing the science of and legislation on fetal pain); Teresa S. Collett, *Previability Abortion and the Pain of the Unborn*, 71 WASH. & LEE L. REV. 1211 (2014). The issue of fetal pain had been politicized before at the federal level, as evidenced by a U.S. Congressional hearing on the topic in 2005. *Pain of the Unborn: Hearing before the Subcomm. on the Constitution of the H. Comm. on the Judiciary*, 109th Cong. (2005).

111. Such research will uncover significant federal interest in neuroscience. A federal bipartisan Congressional Brain Injury Task Force formed in 2001 remains active through the present day. *See Brain Injury Task Force*, BILL PASCRELL, https://pascrell.house.gov/issues/brain-injury-task-force [https://www.perma.cc/Q5CL-8UHF]. There is also a Congressional Neuroscience Caucus. *See Neuroscience Caucus*, EARL BLUMENAUER, https://blumenauer.house.gov/index.php?option=com_content&view=article&id=1832:neuroscience-caucus&catid=64 [https://www.perma.cc/YQS2-DFZN]. Under President Obama, the White House has also been interested in neuroscience, most notably through the Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) Initiative. *See BRAIN Initiative*, THE WHITE HOUSE, https://www.whitehouse.gov/share/brain-initiative [https://www.perma.cc/K8V9-AADF].

112. A sponsor is the legislator officially responsible for bringing the bill to the legislative chamber and then seeing the bill through the legislative process.

113. The database on legislators was originally created for analysis in a separate study: Francis X. Shen, *How We Still Fail Rape Victims: Reflecting on Responsibility and Legal Reform*, 22 COLUM. J. GENDER & L. 1 (2011).

years, but one year of analysis is at least suggestive of legislators' likelihood of sponsorship.

Across both chambers (House and Senate) of the fifty states, there were 7542 individual legislators serving in 2009.[114] Only a small fraction of these 7542 legislators sponsored neurolegislation bills. The analysis sought to identify observable characteristics that explain the differences between those legislators who sponsored a brain bill in 2009 and those who did not.

The data collected allowed for observation of both the characteristics of the individual legislator (such as their sex and political affiliation) and the characteristics of the district that the legislator represents (such as its poverty level and demographics). The statistical model utilizing this data is reported in more detail in the Appendix.[115] The statistical analysis (logistic regression) assessed the likelihood of a particular type of legislator proposing a brain bill. That is, it assessed: how much more (or less) likely is it for a Democratic legislator to propose a brain bill?

The results, presented in detail in the Appendix,[116] show that overall there is no statistically significant relationship between party affiliation and the likelihood of proposing a brain bill. This result accords with the observation that the range of brain bills includes bills that likely appeal more to conservatives (for example, bills related to fetal pain) and also bills that appeal to a broader base of the public (such as those raising awareness or creating new care provisions for those with dementia).

But when the regression analysis focused only on the five largest categories of brain bills — Brain Injury, Health Care, Mental Health, Education, and Veterans — a very distinct partisan split emerged in the data. While Democratic legislators were no more likely to propose brain bills generally, they were three times more likely to propose brain bills in these five categories.[117]

This partisanship pattern suggests that, at least in this way, neurolegislation is far from transformative. The five largest categories of brain bills fall into policy areas that are traditionally Democratic, reflecting an interest in social welfare programming. The introduction of neuroscience into the bill text did not change the basic partisan dynamics. The number of bills in the database was too small to allow for meaningful statistical analysis of legislation proposed by Republicans.

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114. This number fluctuates somewhat year-to-year due to vacated seats and redistricting, but there are essentially 7500 state legislators in every year. In the 2009 data, the following states did not have brain bills proposed and thus are not included in the analysis: New Jersey, Rhode Island, Utah, Vermont, West Virginia, Alabama, Idaho, Kansas, Minnesota, and the District of Columbia.

115. *See* Shen, *supra* note 106.

116. *Id.*

117. This relationship still holds even after excluding the "Veterans" category. *See id.*

However, their legislation seemed to address different topics, such as fetal pain.[118] This is not surprising, given current partisan differences on governmental regulation of abortion. In short, it appears that legislators acted as political scientists would expect: they used neuroscience strategically, when it reaffirmed preexisting policy positions.

Legislator use of neuroscience was traditional in another sense as well. Neurolaw scholarship focuses heavily on criminal responsibility and the governance of technology, exploring ways in which both might be dramatically changed by neuroscience.[119] But legislators were, by and large, proposing the types of bills they typically would: bills expanding insurance coverage, regulating public schools, providing health services, and so forth. Even in the domain of criminal justice, the proposals were not radically different from what we might otherwise expect: modifications to sentencing, adjustments in criminal procedure, and improved assessment of prisoner and parolee mental health. One possibility is that many legislators simply had not yet been exposed to neuroscientific arguments and evidence during the time period studied in this Article. Another possibility is that legislators were exposed to neuroscience, but did not find it sufficiently compelling to propose more innovative reforms.

One final empirical finding deserves mention. The statistical analysis also reveals that female legislators were more likely to propose brain bills than male legislators.[120] This is true both in the model that predicted sponsorship of any brain bill, as well as the model that predicted sponsorship of a brain bill in any one of the top five categories. The result is unexpected because the neurolaw literature does not predict that the use of neuroscience in legal contexts should depend upon the sex of the legal actor. But upon reflection, this finding may accord with research on behavioral differences between male and female state legislators. There is much evidence to suggest that having female legislators in the statehouse makes a difference for policy enactment.[121] Political scientist Michele Swers provides a concise sum-

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118. For instance, the Nebraska version of this bill was authored and introduced by Republican Mike Flood. Leg. 1103, 101st Leg., 2d Sess. (Neb. 2010). The bill was generally opposed by Democrats and supported by Republicans. On the final vote for the bill (which passed 44-5), the five voting against were all Democrats. LEG. JOURNAL, 101st Leg., 2d Sess., at 1452 (2010), http://www.nebraskalegislature.gov/FloorDocs/101/PDF/Journal/r2journal.pdf#page=1452 [https://www.perma.cc/D2R2-BL4H].

119. Kolber, *supra* note 28, at 845 (summarizing neurolaw as primarily concerned at present with two types of questions: the "neurolaw of responsibility," which concerns how neuroscience will and should affect laws related to responsible action, and the "neurolaw of technology," which concerns the ways the law will and should respond to new brain-related technologies).

120. *See* Shen, *supra* note 106.

121. *See, e.g.*, SUE THOMAS, HOW WOMEN LEGISLATE (1994); Michael B. Berkman & Robert E. O'Connor, *Do Women Legislators Matter? Female Legislators and State Abortion Policy*, 21 AM. POL. RES. 102 (1993); Kathleen Dolan & Lynn Ford, *Women in the State Legislatures: Feminist Identity and Legislative Behaviors*, 23 AM. POL. Q. 96 (1995);

mary, finding that the "evidence demonstrates that women serving in the state legislatures exhibit unique policy priorities, particularly in the area of women's issues."[122]

As summarized in a study of the Colorado legislature, there are two "hypotheses arising from gendered attitudes and behavior within the context of legislative policymaking[:] . . . 1. Women will formulate policy differently because they will see a problem as affecting many people and groups . . . [and] 2. Women will conceptualize some policy issues in different terms."[123]

Why might these policy interests translate into more brain bill proposals? The available data only allow me to speculate. One plausible answer is that the subject matter of brain bills — for example, policies that promote education, mental health services, and healthcare — align with the "unique policy priorities" that Swers describes. A second, not necessarily mutually exclusive, answer is that female legislators on balance tend to be more receptive to the explanations provided by neuroscience. The results serve as an important reminder that identity politics may well be at play in the arena of neurolegislation.

V. THE FUTURE OF NEUROLEGISLATION

The data reveal that at present, the use of neuroscience in U.S. state legislatures is growing in breadth, but not depth. That is, while brain science is mentioned in an increasing number of policy domains, it seems to reinforce rather than revolutionize legislators' policy commitments. Moreover, it is unclear how persuasive or influential neuroscience is when included in the proposed bills. Section A expands on these thoughts below.

Section B considers a more speculative question: what about the future? Should we expect that — as neuroscience and related disciplines mature — legislators will become bolder in the policies they propose? This Article argues that neuroscience has the potential to be transformative in the legislative domain.

Michelle A. Saint-Germain, *Does Their Difference Make a Difference? The Impact of Women on Public Policy in the Arizona Legislature*, 70 SOC. SCI. Q. 956 (1989); Michele Swers, *Understanding the Policy Impact of Electing Women: Evidence from Research on Congress and State Legislatures*, 34 PS: POL. SCI. AND POL. 217 (2001).

122. Michele Swers, *The Policy Impact of Women in Congress and the State Legislatures*, *in* WOMEN AND CONGRESS: RUNNING, WINNING, AND RULING 173 (2001).

123. Lyn Kathlene, *Alternative Views of Crime: Legislative Policymaking in Gendered Terms*, 57 J. POL. 696, 699 (1995). Kathlene's analysis of proposed bills from the 1989 Colorado legislature finds that women's solutions were "contextual, multifaceted, and long-term," while men "emphasized individual responsibility." *Id.* at 721. Sue Thomas also found that women had distinctive policy interests, focusing more on issues related to women and children. *See* THOMAS, *supra* note 121, at 75.

A. The Current Non-Revolution of Neurolegislation

Scholars of the policy process have long recognized that policy innovation is fueled both by social circumstances and by individual policy entrepreneurs who spark change.[124] Yet the data just analyzed suggests that neuro-entrepreneurs in the statehouse remain rare at this time.

New York has provided an exception that proves the general rule. In 2008, New York Assemblyman Michael Benjamin read about new brain-based lie detection systems in a *New York Times* article reporting a murder conviction based on an MRI scan that implied experiential knowledge of the crime.[125] The article struck a chord.[126] Having seen *Minority Report* and all too aware of cases of wrongful imprisonment (even without the film's mindreading technology), Assemblyman Benjamin saw a need for debate about whether such technology has a place in the U.S. criminal justice system.[127] Thus in 2009, Assemblyman Benjamin worked with statute drafters in the legislature and proposed a bill to "ban the use of magnetic resonance imaging (MRI) brain scans in a criminal proceeding where a defendant's or witness's truthfulness or knowledge of a specific event is at issue."[128]

Benjamin's bill did not leave committee, but it is noteworthy nevertheless. Although there are over a thousand bills in the database so far, almost none of them have the same future-oriented spirit.[129] A question for continued research is why there aren't more bills that directly engage with advancing neuroscience technology and capabilities. This is likely because neuroscience simply has not developed sufficiently to add value to the types of policies typically considered in state legislatures. This could change in the future, though the timing and particular direction of that progress is difficult to predict. In addi-

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124. Policy entrepreneurs are people who are waiting "in and around government with their solutions, waiting for problems to float by to which they can attach their solutions, waiting for a development in the political stream they can use to their advantage." KINGDON, *supra* note 67, at 165.

125. *Assembly Bill A9154*, THE N.Y. ST. SENATE, https://www.nysenate.gov/legislation/bills/2009/a9154 [https://www.perma.cc/R46B-N77T]. For the New York Times article referenced, see Anand Giridharadas, *India's Novel Use of Brain Scans in Courts Is Debated*, N.Y. TIMES (Sept. 14, 2008), https://www.nytimes.com/2008/09/15/world/asia/15brainscan.html?pagewanted=all&_r=0 [https://www.perma.cc/YTY2-ZWY2].

126. Interview with Michael Benjamin, Assemblyman, N.Y. State Assembly (Oct. 27, 2012).

127. *Id.*

128. *Assembly Bill A9154*, *supra* note 125.

129. One exception is a 2003 Connecticut bill sponsored by Lenny Winkler, which would have established a neuropathy program "to be guided by quantitative electroencephalography (QEEG) brain mapping for each adult and juvenile in the custody of the Commissioner of Correction." H.R. 5850, 2003 Gen. Assemb., Jan. Sess. (Ct. 2003).

tion, more recent data from 2010 to the present might reveal new trends.

It also remains unclear whether brain science is meaningfully influencing legislative action or just serving as window dressing. This is an area ripe for further case study investigation, but at present we can at least find anecdotes that speak to the potential power of neuroscience. For instance, in the case of early-childhood-education legislation, Washington State legislator Ruth Kagi credited "the magic of science" for finally enabling her bills on the issue (which she had been proposing for nearly a decade) to pass.[130] Representative Kagi noted in a 2007 speech that after hearing neuroscientific testimony, the "most conservative ranking Republican, who had stopped every piece of early childhood legislation in the past five years, came up to me and said, '*I get it.*'"[131] The result of Representative Kagi's efforts was "overwhelming bipartisan support for the issue and a total of $136 million in private-public funding for Washington state's new Department of Early Learning and a quality-based program called Thrive by Five."[132] Anecdotes such as this one suggest that brain science may in fact be persuasive in legislative contexts in ways that traditional behavioral data is not.

But my own view, informed by the data, is that such anecdotes are at present the exception rather than the rule. For now, the role of neuroscience in the legislature appears to be to affirm, rather than disrupt, prior normative beliefs. The analysis of legislator proposals from 2009, for instance, found a positive relationship between bills cosponsored by Democrats and bills that are traditionally supported by Democrats. When coding and analyzing the data, I saw little evidence that Democrats or Republicans suddenly proposed bills that they would not have without the advent of neuroscience. While I did not systematically analyze roll call votes for each bill, my strong suspicion is that we would continue to see partisan patterns of support. In these ways, the data is likely consistent with the cultural cognition theory advanced by Dan Kahan and colleagues, which posits that "a collection of psychological mechanisms . . . dispose[s] individuals selectively to credit or dismiss evidence of risk in patterns that fit values they share with others."[133] In state legislatures, neuroscience is being filtered by individual legislators who are already disposed to see the world (and thus scientific findings) in particular ways. Neurosci-

130. Elizabeth Gehrman, *From Neuroscience to Childhood Policy*, HARV. GAZETTE (Dec. 7, 2007), http://news.harvard.edu/gazette/story/2007/12/from-neuroscience-to-childhood-policy/ [https://www.perma.cc/84VS-WDH8].

131. *Id.* (emphasis added).

132. *Id.*

133. Dan M. Kahan et al., *Cultural Cognition of Scientific Consensus*, 14 J. RISK RES. 147, 148 (2011).

ence at present does not seem to be revolutionary in the sense of unpinning individual legislators from these preexisting positions.

B. The Possibility of Transformational Neurolegislation

Prominent neurolaw scholar Stephen Morse has repeatedly stressed the need for "neuromodesty": avoiding exaggeration of what neuroscience can do for the law.[134] This Article's findings suggest that this cautious and humble approach is clearly needed in the neurolegislative domain. Yet even Morse has voiced a cautious optimism for the future possibilities that neuroscience may bring to certain domains of law.[135] Because of differences in the nature of legislative work as compared to courtroom proceedings, there is reason for even more optimism for what neuroscience may one day bring to legislative policymaking.

First, introducing neuroscience evidence into the courtroom requires hurdling a host of evidentiary barriers such as *Daubert* (in federal courts and in many state courts) and *Frye* (in some state courts).[136] These barriers simply do not exist in the legislative realm, where legislators are free to cite (or not cite) science as they please.

Second, in the courtroom, lawyers and judges must act within the constraints of existing statutes and procedures. By definition, however, legislatures are tasked with crafting *new* (or revised) statutes. For instance, although courts and legislatures are both important to the formation of the criminal justice system, "legislation — and hence the legislature — occupies the driver's seat."[137]

Being in the driver's seat allows for a type of innovation not available in the courtroom: the use of neuroscience to pursue entirely new programs. Legal scholar Owen Jones has observed that "[t]here are two primary ways that neuroscience can be relevant to law: 1) it can pose new problems; and 2) it can offer aid in solving existing problems."[138] While neuroscience may at present have limited applicability in solving many of the problems faced by state legislators, the data suggest that neuroscience may lead to the identification of new problems.

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134. Morse has made this claim in numerous articles. *See, e.g.*, Stephen J. Morse, *New Therapies, Old Problems, or, a Plea for Neuromodesty*, 3 AM. J. BIOETHICS 60 (2012); *see also* Stephen J. Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO ST. J. CRIM. L. 397 (2006).

135. Morse, *supra* note 28, at 69.

136. This is because expert evidence is treated differently than lay testimony. *See* Frederick Schauer & Barbara A. Spellman, *Is Expert Evidence Really Different?*, 89 NOTRE DAME L. REV. 3 (2014).

137. WILLIAM J. STUNTZ & JOSEPH L. HOFFMAN, DEFINING CRIMES 2 (2011).

138. Owen D. Jones, *Seven Ways Neuroscience Aids Law*, *in* NEUROSCIENCE AND THE HUMAN PERSON: NEW PERSPECTIVES ON HUMAN ACTIVITIES 5 (A. Battro, S. Dehaene & W. Singer eds., 2013).

The bills discussed on traumatic brain injury, for instance, are examples of legislation that almost surely would not be as prevalent but for neuroscience. Similarly, a recent (post-2009) wave of bills related to youth concussions is in large part the result of brain science advances.[139] In these and other ways, neuroscience encourages and enables legislators to confront previously overlooked or unknown health policy challenges.

Third, and probably most importantly, legislatures control the government's purse strings. That is, not only can legislatures develop an idea, they can also pay for the resources and institutional frameworks required for implementation. This sets them apart from courts and makes the possibility of transformational change through legislative action tantalizingly real.

While these reasons suggest that neuroscience might be more transformative in legislatures than in courts, there is also reason to be deeply skeptical. The possibility of legislative action might give way to the all-too-familiar partisan fighting that affects so many areas of policymaking,[140] including funding for neuroscience research and neuroscience-inspired programs.[141] In addition, the flip-side of an open legislative playing field free of evidentiary restraints is that anything goes, including evidence and rhetoric that gives little credence to the scientific method.[142]

Recognizing this challenge, this Article suggests that generating transformational legislative change will require the construction of successful neuroscience narratives.[143] These narratives would enable legislators to see previously overlooked connections between neuroscientific research and their policy work. To start the narrative construction process, one must recognize that in American policymaking, scientific expertise has had an uneasy time finding a seat at the ta-

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139. For a review of recent concussion legislation, see *Traumatic Brain Injury Legislation*, NAT'L CONF. ST. LEGISLATURES (July 28, 2014), https://www.ncsl.org/research/health/traumatic-brain-injury-legislation.aspx [https://www.perma.cc/DVD2-URCE].

140. Studies of the use of science in policymaking have found that partisanship is a major obstacle. *See, e.g.*, BRUCE BIMBER, THE POLITICS OF EXPERTISE IN CONGRESS 4, 9 (1996) (detailing the closure of the Office of Technology Assessment due to a toxic political environment). Lessons such as this one make plain that any framework for understanding neuroscience in legislative decision making must squarely account for politics.

141. Scholarship on the funding of science has grown in recent years. *See, e.g.*, Ana Muñoz et al., *Who Is Willing to Pay for Science? On the Relationship Between Public Perception of Science and the Attitude to Public Funding of Science*, 21 PUB. UNDERSTANDING OF SCI. 242 (2012).

142. A number of scholars have explored the challenge of using scientific evidence in policymaking outside the courtroom. *See, e.g.*, DAVID H. GUSTON, BETWEEN POLITICS AND SCIENCE: ASSURING THE INTEGRITY AND PRODUCTIVITY OF RESEARCH (2000); Wendy E. Wagner, *Importing* Daubert *to Administrative Agencies Through the Information Quality Act*, 12 J.L. & POL'Y 589 (2004); Wendy E. Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613 (1995).

143. I originally introduced the idea of "neuroscience narratives" in the context of juvenile justice. *See generally* Shen, *supra* note 104.

ble.[144] Progressive reformers at the turn of the twentieth century promoted rational policymaking and observed that "'mak[ing] democracy safe for the world' [required] the dissemination of scientific knowledge."[145] But over the course of the twentieth century, critics of a rationalist, expert-led democracy emerged and worried that democracy might morph into technocracy, unresponsive to the input of common citizens.[146] These worries apply with equal force to a potential future of legislation that turns heavily on brain science.

An additional concern is that legislative bodies may lack requisite scientific understanding.[147] The level of technical expertise in federal and state legislatures is low.[148] This can lead to miscommunication about specific data and more generally to cultural conflicts. Such conflicts can lower the possibility for transformational change.

So what should be done? Legal scholar Owen Jones has argued that an overarching principle governing the value of neuroscience to law is law's non-delegable duty to ascribe "legal meaning."[149] Profes-

144. The proper roles in a democracy for the mass citizen and the elite expert (such as a neuroscientist) have been debated since ancient times. *See generally* JOSIAH OBER, MASS AND ELITE IN DEMOCRATIC ATHENS: RHETORIC, IDEOLOGY, AND THE POWER OF THE PEOPLE (1989). As a leading scholar on the role of science in public policy has noted, "[t]he prospect of relinquishing any significant share of political authority to experts . . . goes against the grain in a society where the Jeffersonian ideal of democracy still finds ready public support." JASANOFF, *supra* note 61, at 11.

145. MICHAEL PUPIN, FROM IMMIGRANT TO INVENTOR 373 (1924).

146. *See* Dorothy Nelkin, *Scientific Knowledge, Public Policy, and Democracy: A Review Essay*, 1 SCI. COMM. 106, 111 (1979) (framing the issue with the question "'Who controls crucial policy choices?'"); FAIGMAN, *supra* note 11, at 151 ("Few political scenarios are quite as disturbing as a government run by a scientific oligarchy. . . . [P]opularly elected legislators must provide essential oversight to the implementation of science policy."). In 2007, law professor Suzanna Sherry argued that the pendulum had swung too far to the public, and that the United States is "fleeing expertise at precisely the time that expertise (especially scientific expertise) is the deepest and most specialized that it has ever been." Suzanna Sherry, *Democracy and the Death of Knowledge*, 75 U. CIN. L. REV. 1053, 1054 (2007). Sherry goes on to argue that "the further we proceed with the democratization of knowledge and the flight from expertise, the more credible the anti-evolution claims will be[,]" and that "there can be such a thing as too much democracy, when it starts us down the road to the death of knowledge." *Id.* at 1069.

147. *See* FAIGMAN, *supra* note 11, at 53–55; *see also id.* at 123 ("Although science and technology have become immeasurably more important to modern affairs of state, our leaders' knowledge of these subjects has dwindled to near zero.").

148. In the U.S. Congress as of 2012, for instance, even a generous definition of "scientist" finds that only four percent of congressional members have such a technical background. Mollie Bloudoff-Indelicato, *Physicist Elected to Congress Calls for More Scientists-Statesmen*, NATURE (Nov. 15, 2012), http://www.nature.com/news/physicist-elected-to-congress-calls-for-more-scientists-statesmen-1.11839 [https://www.perma.cc/MZP7-T3U4]. Using a more rigid definition of scientist, the numbers are even lower. *See* Fizziks, *Why There Are So Few Scientists and Engineers in Politics*, DAILY KOS (March 14, 2011), https://www.dailykos.com/stories/2011/3/14/956359/- [https://www.perma.cc/EU46-GHLV]; David H. Guston et al., *The Demand for and Supply of Technical Information and Analysis in State Legislatures*, 25 POL'Y STUD. J. 451, 465 (1997) (reporting on a survey of state legislative actors who expressed a need for "greater sophistication on the part of legislators and staff as consumers of technical information and analysis").

149. Jones, *supra* note 138, at 10.

sor Jones explains that "even assuming that scientific testimony is unanimous as to a particular fact — the legal meaning of that fact is inevitably, unavoidably, and unshirkably a decision that *legal* decision-makers must bear."[150]

Similarly, in the legislative domain the *political* meaning of a particular fact is a decision that only legislators can make. That is, pathbreaking neuroscience research is necessary, but not sufficient, for pathbreaking policy. The task of enacting transformative neurolegislation must ultimately be led by innovative legislators, not brilliant neuroscientists. And whereas legal meaning draws on its traditional sources of authority such as common law, political meaning is to be derived not only from science but also from the many sources of meaning that a legislator and his or her constituency prizes.[151] A legislator may ultimately decide, just as a courtroom fact finder can, to privilege one bit of evidence over another. But unlike a courtroom, where some evidence is not to be considered at all, the legislative context will and should invite broader participation.

In this type of policymaking environment, the persuasiveness of neuroscience will rely not only upon its core scientific value (for example, whether it has been published in scholarly journals), but equally, if not more, on its narrative form. Findings in psychology and neuroscience confirm our intuitions that to be persuasive with fellow humans we must tell effective stories.[152] In the legislative domain, neuroscience narratives must be successfully constructed if the science behind them is to have an impact.

VI. CONCLUSION

Through analysis of an original database of 981 state bills mentioning brain science in the period from 1992–2009, this Article argues that legislative use of neuroscience is growing in breadth but not yet depth. Neuroscience is increasingly mentioned in proposed legislation, but at present neuroscience reaffirms rather than revolutionizes legislators' preexisting policy commitments. Looking to the future, the Article asks: Can neurolegislation be more transformative? It ar-

150. *Id.*

151. Ruling out such participation from the political spectrum by imposing implicit criteria on what evidence a legislator should rely upon in crafting policy is both practically infeasible and at odds with the legislator's duty to serve all of her constituencies.

152. *See* JONATHAN GOTTSCHALL, THE STORYTELLING ANIMAL: HOW STORIES MAKE US HUMAN (2012); Jeremy Hsu, *The Secrets of Storytelling*, 19 SCI. AM. MIND 46 (2008); Nancy Levit, *Reshaping the Narrative Debate*, 34 SEATTLE U. L. REV. 751 (2011). There is a literature devoted to translating scientific research into narrative form. *See, e.g.*, NANCY BARON, ESCAPE FROM THE IVORY TOWER: A GUIDE TO MAKING YOUR SCIENCE MATTER (2010); RAFAEL E. LUNA, THE ART OF SCIENTIFIC STORYTELLING: TRANSFORM YOUR RESEARCH MANUSCRIPT USING A STEP-BY-STEP FORMULA (2013); RANDY OLSON, HOUSTON, WE HAVE A NARRATIVE: WHY SCIENCE NEEDS STORY (2015).

gues that the answer is yes, and that neurolegislation is more likely to produce transformational policy than court-made neurolaw. But such change will require both scientific advances *and* the construction of successful neuroscience narratives. Pathbreaking neuroscience research is necessary, but not sufficient, for pathbreaking public policy. The task of creating transformative neurolegislation must ultimately be led by innovative legislators, not brilliant neuroscientists.