NEUROSCIENCE, MENTAL PRIVACY, AND THE LAW

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INTRODUCTION

> "If there is a quintessential zone of human privacy it is the mind."
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> —Justice Allen E. Broussard, Supreme Court of California[1]

> "If George Orwell had written *Nineteen Eighty-four* during our times, would he have put an MRI scanner in the Ministry of Truth?"
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> —Neuroscientist Jamie Ward, in *The Student's Guide to Cognitive Neuroscience*[2]

> "fMRI is not and will never be a mind reader . . . ."
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> —Neuroscientist Nikos Logothetis[3]

The first and second quotations in the epigraph capture a fear that many share about rapidly improving neuroscientific techniques: Will brain science be used by the government to access the most private of spaces—our minds—against our wills?[4] Such scientific tools would have tremendous privacy implications if the government suddenly used brain science to more effectively read minds during police interrogations, criminal trials, and even routine traffic stops. Pundits and scholars alike have thus explored the constitutional protections that citizens, defendants, and witnesses would require to be safe from such mind searching.[5]

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1. Long Beach City Emps. Ass'n. v. City of Long Beach, 719 P.2d 660, 663 (Cal. 1986).
2. JAMIE WARD, THE STUDENT'S GUIDE TO COGNITIVE NEUROSCIENCE 49 (2d ed. 2010).
3. Nikos K. Logothetis, *What we can do and what we cannot do with fMRI*, 453 NATURE 869, 869 (2008).
4. *See infra* Part I.A.
5. *See infra* Part II.A.

Mind reading has also caught the public's imagination. Machine-aided neuroimaging[6] lie detection has shown up in popular television shows and films, including the show "*Numb3rs*,"[7] and the action thriller *Salt*.[8] Most notably, the plot of the 2002 Tom Cruise movie *Minority Report*,[9] based on a short story of the same name by Philip K. Dick,[10] involved the government reading citizens' thoughts. In the movie, when criminal thoughts were detected, the government would react before the criminal act occurred. This "precrime" monitoring and enforcement, carried out by "PreCogs," was made possible in the movie by the fictional assumption that technology would develop to a point where the government could reliably determine a person's criminal intentions.[11]

Future-oriented thinking about where brain science may lead us can make for great entertainment and can also be useful for forward-thinking policy development. But only to a point. Too much talk of *1984*, *Minority Report*, *Inception*,[12] and the like can generate a legal and policy debate that becomes too untethered from scientific reality. Consider this opening line from a law review note published in 2012: "In George Orwell's novel *Nineteen Eighty-Four*, the Thought Police monitor the thoughts of citizens, trolling for any hint of forbidden viewpoints. In 2012, functional Magnetic Resonance Imaging ('fMRI') of the brain may accomplish similar ends."[13] As the third quotation in the epigraph suggests, such claims about the current mind reading powers of fMRI are mistaken, and similar claims about the fu-

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6. I use the term "machine aided neuroimaging" throughout to distinguish this technology from other forms of mind reading, including mind reading that may use technology other than neuroimaging. *See infra* Part II.B. The Article focuses primarily on fMRI and EEG methods, but employs a broad conceptualization of "neuroimaging" to include fMRI, EEG, QEEG, MEG, PET, SPECT, and other related techniques. To improve readability, the Article at times shortens the phrase "machine-aided neuroimaging" to simply "neuroimaging."

7. *Numb3rs* (CBS television series Jan. 23, 2005 to Mar. 12, 2010).

8. SALT (Columbia Pictures 2010).

9. MINORITY REPORT (20th Century Fox 2002).

10. *Minority Report*, IMDB, http://www.imdb.com/title/tt0181689/ (last visited Feb. 6, 2013).

11. *See* MINORITY REPORT, *supra* note 9. The failure of this technology gives rise to the plot tensions in the movie.

12. INCEPTION (Warner Bros. Pictures 2010).

13. Mara Boundy, Note, *The Government Can Read Your Mind: Can the Constitution Stop It?*, 63 HASTINGS L.J. 1627, 1628 (2012).

ture of fMRI (and related) techniques should be carefully scrutinized.[14]

Such claims are the seeds of a mental privacy panic.[15] The panic script typically unfolds in the following way. First, it is observed that we are now on the verge of powerful mind reading technologies. Second, it is suggested that the state will use these technologies in devious ways. Third, it is argued that citizens (especially those suspected of criminal acts) will be powerless to stop these practices because necessary legal protections are not in place. Thus, so the script concludes, quick and drastic action is required to prevent the government from reading our minds.

In this Article, I reconsider these concerns about the use of brain science to infer mental functioning. The primary message of this Article is straightforward: "*Don't panic!*"[16] Current constitutional protections are sufficiently nimble to allow for protection against involuntary government machine-aided neuroimaging mind reading. The chief challenge emerging from advances in brain science is not the insidious collection of brain data, but how brain data is (mis)used and (mis)interpreted in legal and policy settings by the government and private actors alike.

Reconsideration of neuroscience and mental privacy should start by acknowledging a basic fact about the social nature of the human race: We are all natural mind readers.[17] As recognized in the introduction to a comprehensive volume on brain imaging and mental privacy, our brains "are well equipped by

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14. *See infra* Part I.

15. It should be emphasized that excellent scholars have carefully examined the topic free from any such panic elements. *See, e.g.*, I KNOW WHAT YOU'RE THINKING: BRAIN IMAGING AND MENTAL PRIVACY (Sarah D. Richmond et al. eds., 2012); *see also* Nita A. Farahany, *Incriminating Thoughts*, 64 STAN. L. REV. 351, 406 (2012) [hereinafter Farahany, *Incriminating Thoughts*]; Nita A. Farahany, *Searching Secrets*, 160 U. PA. L. REV. 1239 (2012) [hereinafter Farahany, *Searching Secrets*].

16. Borrowed from DOUGLAS ADAMS, THE HITCHHIKER'S GUIDE TO THE GALAXY 50 (Random House 1997) (1979).

17. *See* Emily R. Murphy & Henry T Greely, *What Will Be the Limits of Neuroscience-Based Mind Reading in the Law?*, *in* OXFORD HANDBOOK OF NEUROETHICS 642 (Judy Illes & Barbara J. Sahakian eds., 2011) ("The law reads minds all the time, though not through technical means."). More precisely, we all become mind readers as we develop cognitively, unless we suffer a developmental challenge such as autism. MICHAEL S. GAZZANIGA & TODD HEATHERTON, PSYCHOLOGICAL SCIENCE 452–53 (2d ed. 2006). Whether this is a unique human trait is the topic of much debate. *See* MICHAEL S. GAZZANIGA, HUMAN: THE SCIENCE BEHIND WHAT MAKES US UNIQUE 49–54 (2008).

natural selection to read other people's minds."[18] One of the influential theories in psychology to describe this natural mind reading capacity is called "Theory of Mind" (ToM). ToM can be defined as "the ability to observe behavior and then infer the unobservable mental state that is causing it."[19] To "infer the unobservable mental state" is mind reading, and unless we are living in isolation, we do this type of mind reading every day. In law, we even sometimes codify such mind reading, such as when jurors are assigned the task of determining the mens rea of a criminal defendant.[20]

If mind reading is a skill that every normally developing human acquires, and if humans do it all the time in the course of life, why would we ever see—as we did in 2009—a headline in *Newsweek* announcing with great fanfare that "Mind Reading Is Now Possible"?[21] The reason that *Newsweek* ran this headline is that mind reading techniques using fMRI are new and thought to be inherently better than everything else that has come before. In particular, such media coverage suggests that machine-aided neuroimaging mind reading will unearth the contents of our minds without our permission (and perhaps even without our knowledge). We ought to be cautious in making this presumption. Just as legal scholar Stephen Morse has called for "neuromodesty" in the context of brain science and criminal responsibility,[22] so too should we be modest in making claims about the power of brain science tools to read minds against our will.

The question, "can the government (or anyone else) read your mind against your will?" is not a useful way to phrase the problem, because the answer to this question is an obvious "yes." As just discussed, humans—including those working for the government—are natural mind readers. Many remember

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18. Sarah Richmond, *Introduction* to I KNOW WHAT YOU'RE THINKING, *supra* note 15, at 1, 3.

19. GAZZANIGA, *supra* note 17, at 49.

20. *See generally* Francis X. Shen et al., *Sorting Guilty Minds*, 86 N.Y.U. L. REV. 1306 (2011).

21. Sharon Begley, *Mind Reading Is Now Possible: A Computer Can Tell with 78 Percent Accuracy When Someone Is Thinking About a Hammer and Not Pliers*, NEWSWEEK, Jan. 12, 2008, at 22, *available at* http://www.thedailybeast.com/newsweek/2008/01/12/mind-reading-is-now-possible.print.html.

22. Stephen J. Morse, *Avoiding Irrational NeuroLaw Exuberance: A Plea for Neuromodesty*, 62 MERCER L. REV. 837 (2011).

moments when our parents only had to look at us (and the chocolate on our hands) to know that we were lying about grabbing an extra chocolate chip cookie. These traditional methods of mind reading have been with us since our earliest history.[23]

It is useful at this point to clarify terminology. I use the term mind reading throughout the Article to capture the myriad of strategies humans use to attribute mental states to others.[24] I distinguish between non-machine-aided, machine-aided (but not neuroimaging), and machine-aided neuroimaging methods of mind reading. Examples of non-machine-aided mind reading are using facial expressions and body language to gauge intent. Government officials routinely use such techniques to make inferences about the mental states of individual citizens. An example of machine-aided (but not neuroimaging) mind reading is the use of a computer to administer a psychological evaluation to determine cognitive ability. Neuroimaging methods include the use of a neuroscience technology such as fMRI, EEG, or PET, among others.

Having clarified terminology, the question to ask is: "How, if at all, should the law differentially treat, in particular contexts, certain types of government-compelled and government-

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23. "[W]e are aware of the mental states of our fellow human beings on the basis of what they do and say" and the origins of these "traditional forms of mindreading . . . predate the beginnings of recorded history." Tim Baynes, *How to Read Minds*, *in* I KNOW WHAT YOU'RE THINKING, *supra* note 15, at 41, 41.

24. *See generally* OTHER MINDS: HOW HUMANS BRIDGE THE DIVIDE BETWEEN SELF AND OTHERS (Bertram F. Malle & Sara D. Hodges eds., 2005) (providing a number of different disciplinary perspectives on how we do mind reading). As scholars have pointed out, and as everyday experience confirms, "Whether we are sizing someone up or seducing him or her, assigning blame or extending our trust, we are very nearly always performing the ordinary magic of mindreading." Daniel R. Ames, *Everyday Solutions to the Problem of Other Minds: Which Tools are Useful When?*, *in id*., at 158, 158. Defined in this way, we can see that airline employees are mind reading when they assess your answer to the question, "Did you pack your own bags?"; that public school officials are mind reading when they assess a tardy student's answer to the question, "Why were you late to school?"; and that a highway patrolman is mind reading when he asks a driver, "Have you been drinking tonight?" In the latter two examples, the government may require additional information to further assess the mental state. For instance, a doctor's note will help the principal assess whether or not the student is lying about the reason for being late, and the odor of alcohol (or lack thereof) will help a patrolman assess whether the driver is being honest. In all of these instances, a government official is trying to assess the mental state of a citizen, and thus is engaging in "mind reading" in the sense the term is used in this Article.

coerced machine-aided neuroimaging evidence?" Admittedly, this formulation of the question does not roll off the tongue. But that is to be expected, because the legal and policy questions related to involuntary machine-aided neuroimaging mind reading are not readily packaged into a catchy headline. The questions are multiple, murky, and often misunderstood. In this Article, I articulate a framework by which we might better navigate this complexity. The framework emphasizes the importance of placing new neuroscience techniques into proper historical and legal perspectives, and of recognizing the difficulties in making inferences about the mind from brain data.

The Article proceeds in five parts. Part I reviews the use of neuroscientific information in legal settings generally, discussing both the recent rise of neurolaw as well as an often overlooked history of brain science and law that stretches back decades. Part II evaluates concerns about mental privacy and argues for a two-by-three typology that distinguishes between the inferences to be drawn from the data and the methods by which the data is collected. Part III assesses current neuroscience techniques for lie detection and mind reading. Part IV then evaluates the relevant legal protections available in the criminal justice system. I argue that the weight of scholarly opinion is correct: The Fourth Amendment and Fifth Amendment likely both provide protections against involuntary use of machine-aided neuroimaging mind reading evidence. Part V explores other possible machine-aided neuroimaging mind reading contexts where these protections might not apply in the same way. The Article then briefly concludes.

I. GOVERNMENT USE OF NEUROSCIENCE IN LAW

Before turning to the specific question of machine-aided neuroimaging mind reading, it is useful to consider how the government is already using neuroscience in law.[25] After a brief

25. For a lengthier and more comprehensive introduction to neurolaw, see, for example, A PRIMER ON CRIMINAL LAW AND NEUROSCIENCE (Stephen J. Morse & Adina L. Roskies eds., forthcoming May 2013); 13 CURRENT LEGAL ISSUES, LAW AND NEUROSCIENCE (Michael Freeman et al. eds., 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); Henry T. Greely & Anthony D. Wagner, *Reference Guide on Neuroscience*, *in* FED. JUDICIAL CTR. ET AL., REFERENCE MANUAL ON SCIENTIFIC EVIDENCE (3d ed.

review of the emerging field of neurolaw, this Part discusses two illustrative instances in which the government might require a citizen to undergo a neuroimaging test or might carry out such a test as part of its legal machinery: (1) the use of electroencephalography (EEG) in diagnosing epilepsy for purposes of social security disability benefits; and (2) the use of neuroimaging methods in competency exams initiated by the judge or prosecution. I argue that both cases can help us understand the likely path forward for neuroimaging mind reading evidence. Such mind reading evidence will not be dispositive, but may be relevant as an additional piece of information from which to arrive at a legal conclusion.

A. The Use of Neuroscientific Evidence in Law

Neuroscience is being integrated into U.S. law and policy in a variety of ways. Neuroscientific evidence is increasingly (if still rarely) seen in courtrooms;[26] legislatures are using neuroscience to craft public policy;[27] scholarship at the intersection of law and neuroscience is increasing;[28] more law students are being exposed to neurolaw;[29] the first "Law and Neuroscience" coursebook is being published;[30] thousands of judges and lawyers have been exposed to neuroscience through conferences

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2011); Owen D. Jones & Francis X. Shen, *Law and Neuroscience in the United States*, *in* INTERNATIONAL NEUROLAW: A COMPARATIVE ANALYSIS 349 (Tade Spranger ed., 2012); Teneille Brown & Emily Murphy, *Through A Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States*, 62 STAN. L. REV. 1119 (2010); Stacey A. Tovino, *Functional Neuroimaging and the Law: Trends and Directions for Future Scholarship*, 7 AM. J. BIOETHICS 44 (2007).

26. *See* Jones & Shen, *supra* note 25, at 374 (citing Nita A. Farahany, An Empirical Study of Brains and Genes in U.S. Criminal Law (2011) (unpublished manuscript) (on file with Vanderbilt University Law School)).

27. *See, e.g.*, Francis X. Shen, *Neurolegislation & Juvenile Justice*, 46 LOY. L.A. L. REV. (forthcoming 2013).

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

29. OWEN D. JONES, JEFFREY D. SCHALL, & FRANCIS X. SHEN, LAW AND NEUROSCIENCE (forthcoming 2013).

30. *Id.*

and continuing legal education programs;[31] and multiple websites make neurolaw news available to the interested public.[32]

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 in 2011 the Foundation renewed its commitment with a $4.85 million grant to sustain the Research Network on Law and Neuroscience.[33] These institutional commitments not only foster dialogue and research, but also send a strong signal that this is a field of great possibility.

Though some have predicted that neuroscience will fundamentally change the law,[34] there has been push back to this claim.[35] The field has debated criminal responsibility;[36] free will;[37] neuroethics;[38] and many areas beyond criminal law.[39]

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31. *See, e.g.*, *Education and Outreach*, MACARTHUR FOUND. RESEARCH NETWORK ON LAW & NEUROSCIENCE, http://www.lawneuro.org/outreach.php (last visited Jan. 27, 2013).

32. *See, e.g.*, LAW AND NEUROSCIENCE BLOG, http://lawneuro.org/blog/ (last visited Jan. 27, 2013).

33. *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/. *See generally* MACARTHUR FOUND. RESEARCH NETWORK ON LAW & NEUROSCIENCE, www.lawneuro.org (last visited Jan. 27, 2013).

34. *See, e.g.*, Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y: BIOLOGICAL SCI. 1775 (2004).

35. *See, e.g.*, Michael S. Pardo & Dennis Patterson, *Philosophical Foundations of Law and Neuroscience*, 2010 U. ILL. L. REV. 1211 (2010); Adam J. Kolber, Paper Presented at Rutgers School of Law–Camden Law and Neuroscience Conference: Will There Be a Neurolaw Revolution? (Sept. 7–8, 2012), available at http://lawandphil.rutgers.edu/sites/lawandphil.rutgers.edu/files/kolber.pdf.

36. *See, 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); Nita A. Farahany & James E. Coleman, Jr., *Genetics, Neuroscience, and Criminal Responsibility*, *in* THE IMPACT OF BEHAVIORAL SCIENCES ON CRIMINAL LAW 183 (Nita A. Farahany ed., 2009); David Eagleman, *The Brain on Trial*, ATLANTIC, July–Aug. 2011, at 112; DEBORAH W. DENNO, CHANGING LAW'S MIND: HOW NEUROSCIENCE CAN HELP US PUNISH CRIMINALS MORE FAIRLY AND EFFECTIVELY (forthcoming n.d.).

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

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

Structural brain imaging is a standard part of a psychiatric or neuropsychiatric assessment of an individual known to have experienced a traumatic brain injury (TBI).[40] Positron emission tomography (PET) and single-photon emission computed tomography (SPECT) technology have been used in a variety of criminal and civil cases.[41]

In a paper assessing the state of neurolaw, legal scholar Adam Kolber (noting the routine use of structural brain scans in brain injury cases) asks: "Has a revolution already occurred?"[42] The answer is both yes and no. On one hand, much of the law remains untouched by neuroscience, and certainly no body of legal doctrine has been upended by neuroscience research. But on the other hand, the "technological neurolaw revolution" Kolber writes of[43] has already touched law in a number of ways. Consider the following ways in which neuroscience and law now intersect:

- Brain data routinely is used to show personality change after head trauma.[44]

- The electrical brain measurements recorded with EEG appeared in court cases as early as the 1950s and are used regularly in a variety of civil proceedings.[45]

- Structural brain scans such as computed tomography (CT) scans were first used in the 1970s and are now used in many types of litigation.[46]

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39. *See* Henry T. Greely, *Prediction, Litigation, Privacy, and Property: Some Possible Legal and Social Implications of Advances in Neuroscience*, *in* NEUROSCIENCE AND THE LAW: BRAIN, MIND, AND THE SCALES OF JUSTICE 114 (Brent Garland ed., 2004); Adam J. Kolber, *The Experiential Future of the Law*, 60 EMORY L.J. 585 (2011).

40. Robert P. Granacher, Jr., *Traumatic Brain Injury*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at 44.

41. Susan E. Rushing, Daniel A. Pryma, & Daniel D. Langleben, *PET and SPECT*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at 3, 20–21.

42. Kolber, *supra* note 35, at 16.

43. *Id.* at 16–28.

44. *See* 34 AM. JUR. 3D *Proof of Facts* § 1 (2012); *id.* § 363; Donald J. Nolan & Tressa A. Pankovits, *High-Tech Proof in Brain Injury Cases*, TRIAL, June 2005, at 26 (2005).

45. 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 (1959).

46. 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.").

- Brain scans have been used in the determination of competency to stand trial.[47]

- Brain scans have been introduced to mitigate sentencing where there is evidence of brain trauma or mental trauma.[48]

- Brain scans have been used in the criminal defense of cases involving sexual offense.[49]

- 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"[50]) can include neuroscientific evidence such as EEG and MRI.[51]

- The results of MRI and EEG tests are sometimes included in a claimant's efforts to receive benefits for epilepsy.[52]

- Brain data has been introduced in support of a contractual incapacity argument.[53]

- Brain evidence has been proffered to support insanity defense claims.[54]

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47. 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 25, at 147, 147–48.

48. Judith G. Edersheim, Rebecca Weintraub Brendel, & Bruce H. Price, *Neuroimaging, Diminished Capacity and Mitigation*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25 at 163–64 (Joseph R. Simpson ed., 2012).

49. *See, e.g.*, Sexton v. State, 997 So. 2d 1073, 1082–85 (Fla. 2008) (counsel's decision to rely on brain scan evidence to prove statutory mitigation was reasonable in case involving defendant with "history of bizarre sexual and criminal behavior").

50. 20 C.F.R. ch. III, pt. 404, subpt. P, app. 1 § 12.02 (2012).

51. 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.").

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

53. *See, e.g.*, Jones & Shen, *supra* note 25, at 354.

54. *Id.* at 305.

Even though many of these uses are criminal defenses, there are instances where brain evidence is used by the prosecution as well.[55] In addition, neuroscience may well play an increased role in assessing pain, suffering, and damages in civil litigation.[56] This influx of brain data has had, at least in some instances, a material effect on case outcomes.[57]

B. The Overlooked History of Neurolaw: The Case of EEG and Epilepsy

Although there are many ways in which "law and neuroscience" is indeed a new legal phenomenon, there is a longer history to neurolaw than most contemporary commentators typically recognize. This history can be instructive.[58] Here I review one part of this history: the government's requirement (now abandoned) that in order to receive federal social security disability benefits, a claimant submit at least one abnormal EEG test. This case is particularly helpful for illustrating the limitations of brain data as evidence for mental phenomena.

The method of EEG was discovered in 1929.[59] EEG is a method in which electrodes are placed on the subject's scalp and electrical activity is recorded.[60] In the 1930s, researchers were beginning to use EEG in their diagnosis of epilepsy,[61] "a brain disorder in which a person has repeated seizures (convulsions) over time," where these "[s]eizures are episodes of disturbed brain

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55. Susan M. Wolf, Eva B. Stensvad, & Grace Deason, 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).

56. Adam J. Kolber, *Pain Detection and the Privacy of Subjective Experience*, 33 AM. J.L. & MED. 433, 454–55 (2007).

57. *See* Jones & Shen, *supra* note 25, at 350–51; *see also* JONES ET AL., *supra* note 29.

58. An examination of this overlooked history is useful for at least two reasons. First, it shows us the several ways by which law may reconcile its need for immediate decisionmaking with the uncertainty inherent in probabilistic neuroscience data. Second, this history allows us to trace how instances of new brain discoveries became codified law just a few decades later.

59. S.J.M. Smith, *EEG in the Diagnosis, Classification, and Management of Patients with Epilepsy*, 76 J. NEUROLOGY NEUROSURGERY & PSYCHIATRY ii2, ii2 (2005).

60. *See id.*

61. *See, e.g.*, W. Grey Walter, *Electro-Encephalography in the Study of Epilepsy*, 85 BRIT. J. PSYCHOL. 932, 933 (1939).

activity that cause changes in attention or behavior."[62] By mid-century, EEG was appearing regularly in court proceedings involving epilepsy.[63] Not surprisingly, commentators at the time were already expressing concerns about overreliance on the test.[64] Moreover, some courts were already (and incorrectly) using EEG to supposedly determine "criminal tendencies."[65]

Some medical professionals exhorted lawyers to become familiar with EEG. "The lawyer interested in [epilepsy] must know some principles of [EEG]—both in understanding and evaluating epilepsy and because of its frequent use as a tool in court cases."[66] At the same time, these professionals also recommended caution because "[t]he EEG has been vastly misused, and is likely to be more misused in the future. It is not a magical tool, and does not give magical answers (medicine does not yet have an IBM machine to answer its problems)."[67] This tension, voiced in the 1950s, should sound familiar. It is the same basic tension reemerging today when we ask of mind reading (and other) neuroimaging technology: What can it reliably tell us? Do we learn anything from these new methods that we cannot already discover without them? These questions foreshadow present debates.

As EEG diagnoses of epilepsy developed, they were eventually subsumed into statute by the Social Security Disability

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62. *Epilepsy*, PUBMED HEALTH, http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001714/ (last visited Jan. 31, 2013).

63. *See* Irwin N. Perr, *Epilepsy and the Law*, 128 J. NERVOUS & MENTAL DISEASE 262, 265 (1959) ("The electroencephalogram has become an increasingly important tool in evaluating and understanding epilepsy. It has also become quite useful in court cases for the same reasons [sic].").

64. *See, e.g.*, *id.* (further noting that a factor in EEG's popularity "is that electroencephalography is supposedly an objective procedure, something which will be proof of something, and the lawyer—often with a penchant for oversimplification—is prone to look upon the EEG as a definitive authority. This has led to situations where the EEG has been grossly misused and subsequently maligned.").

65. *Id.* (internal quotation marks omitted). The law used to treat epileptics much differently than it does today. *See* Kathryn Kramer, *Shifting and Seizing: A Call to Reform Ohio's Outdated Restrictions on Drivers with Epilepsy*, 22 J.L. & HEALTH 343, 351–52 (2008) ("Until the 1950s, individuals with epilepsy were legally denied the right to marry, the right to drive a car, and the right to obtain employment. 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.") (footnotes omitted).

66. Irwin N. Perr, *Epilepsy and the Law*, 7 CLEV.-MARSHALL L. REV. 280, 287 (1958).

67. *Id.*

Amendments of 1980,[68] one of the purposes of which was to allow the Secretary of Health and Human Services broader authority in creating regulations, especially in the area of performance standards for disability.[69] Regulations released the same year required EEG evidence for a claim of disability as a result of epilepsy.[70] The epilepsy requirement read, in relevant part: "Epilepsy—major motor seizures, (grand mal or psychomotor), *documented by EEG and by detailed description of a typical seizure pattern*, including all associated phenomena; occurring more frequently than once a month, in spite of at least 3 months of prescribed treatment."[71] In the early 1980s, the first court decisions appear discussing EEGs, epilepsy, and social security disability.[72] Over time, questions began to emerge about the relationship between the EEG brain measure and the inferences made about the existence of epilepsy. What result if the EEG is normal, but other types of evidence suggest an abnormality? One administrative law judge was reprimanded for putting too much emphasis on EEG as a diagnostic measure, while "disregarding the overwhelming weight of evidence of an actual disabling condition."[73] The court found that under the epilepsy regulation, "[a] claimant can be deemed disabled either by meeting the standard or by proving a disability which is equivalent to one described in the standard."[74] Thus, direct observations of *behavior* trumped the inferential chain set in motion by the EEG measures.

By 2000, concerns about the reliability of EEG for diagnosing epilepsy led to a change in the law.[75] The final rules were published in 2002 after notice and comment.[76] The relevant portion states:

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68. Pub. L. No. 96–265, 94 Stat. 441 (1980).

69. *See id.* pmbl. & tits. II–III, §§ 201–311; *Chronology*, SOC. SEC. ADMIN., http://www.ssa.gov/history/1980.html (last visited Jan. 31, 2013).

70. Federal Old Age, Survivors, and Disability Insurance Benefits; Supplemental Security Income for the Aged, Blind, and Disabled, 45 Fed. Reg. 55,566, 55,608 (Aug. 20, 1980) (codified at 20 C.F.R. pts. 404, 416 (2012)).

71. *Id.* (emphasis added).

72. *See, e.g.*, Deuter v. Schweiker, 568 F. Supp. 1414, 1417 (N.D. Ill. 1983).

73. Bradley v. Bowen, 660 F. Supp. 276, 280 (W.D. Ark. 1987).

74. *Id.* at 281.

75. *See* Technical Revisions to Medical Criteria for Determinations of Disability, 65 Fed. Reg. 6,929 (Feb. 11, 2000) (to be codified at 20 C.F.R. pts. 404, 416 (2012)) ("We . . . propose to remove the requirement for electroencephalogram (EEG) evidence to support the existence of epilepsy throughout the neurological listings with the exception of cases involving nonconvulsive epilepsy in children. This is

> In the neurological body system listings for adults and children, 11.00 and 111.00, we made a number of changes to reflect current medical terminology (convulsive and nonconvulsive epilepsy), and to modify the documentation requirement for an electroencephalogram (EEG). *With the exception of nonconvulsive epilepsy in children, we will no longer require that an EEG be part of the documentation needed to support the presence of epilepsy. An EEG is a definitive diagnostic tool in cases of nonconvulsive epilepsy in children, but it is rare for an EEG to confirm epilepsy in its other forms for either adults or children.*[77]

Case law now reflects this new rule. Just because the EEG evidence is negative, it does not follow that an administrative law judge can dismiss a disability claim for epilepsy.[78]

The history of EEG and epilepsy is an example of the government using regulations to require a citizen to provide neuroimaging evidence for the purpose of allowing the government to make an inference about that citizen's mind. This history teaches us that neuroscience may at times prove to be a useful addition to the court's collection of evidence. But if over time neuroscience proves not to be useful, law may adjust by declining to re-

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the only category of epilepsy in which an EEG is the definitive diagnostic tool; in all other situations of epilepsy, it is rare for an EEG to confirm the presence of a seizure disorder.").

76. *See* Technical Revisions to Medical Criteria for Determinations of Disability, 67 Fed. Reg. 20,018 (Apr. 24, 2002) (codified at 20 C.F.R. pt. 404 (2012)).

77. *Id.* at 20,019 (emphasis added).

78. *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.*, *What if It's Normal?*, EPILEPSY THERAPY PROJECT, http://www.epilepsy.com/EPILEPSY/EEG_NORMAL (last visited Jan. 31, 2013).

quire such evidence. The bottom line for law is the added value (or lack thereof) of brain data to the legal enterprise.

II. THE MENTAL PRIVACY PANIC

> "So far, the government is not able to enter and rummage through a person's mind for 'guilty knowledge'—although that possibility may be on the horizon."
>
> —Judge W. William Leaphart, Supreme Court of Montana[79]

Part I established that brain science now appears in a variety of legal contexts, with some version of brain evidence in courts for over a half century. With this foundation in place, Part II now examines the emergence of neuroimaging mind reading. This Part critically examines the "mental privacy panic," and proposes a two-by-three typology that distinguishes between the inferences to be made from brain data and the methods by which that data is collected.

A. Seeds of a Mental Privacy Panic

> "[O]ne might humbly venture a preliminary diagnosis of the pop brain hacks' chronic intellectual error. It is that they misleadingly assume we always know how to interpret . . . 'hidden' information, and that it is always more reliably meaningful than what lies in plain view. The hucksters of neuroscientism are the conspiracy theorists of the human animal, the 9/11 Truthers of the life of the mind."
>
> —Steven Poole[80]

Steven Poole's quotation correctly suggests that "neuro" is a label being placed on just about everything, from neuromarketing to neurolaw, and often without sufficient critical thought.[81]

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79. State v. Allen, 241 P.3d 1045, 1064 (Mont. 2010) (footnote omitted).

80. Steven Poole, *Your Brain on Pseudoscience: The Rise of Popular Neurobollocks*, NEW STATESMAN, Sept. 6, 2012, http://www.newstatesman.com/print/188850.

81. Others have noted this overreaction as well. *See, e.g.*, Daniel D. Langleben, Dan F.X. Willard, & Jane C. Moriarty, *Brain Imaging of Deception*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at 217, 227 ("Overreactions about the potential moral concerns over fMRI lie detection stem in part from misrepresentations in the lay and popular press, which have described the technology more as a 'mind-reading' technique than a method of discrimination between two rather simple behaviors . . . . Though mind-reading with fMRI is no

In published pieces in law reviews, authors have suggested that "[t]he government can read our minds";[82] that "[t]he awesome power an irresponsible government might wield with an unhindered ability to use brain-imaging technology must be addressed, whether the technology is ready or not";[83] and that "Orwell may have missed the mark by a few decades, but the technology that he feared would lead to unbreakable totalitarian society is now visible on the horizon."[84]

Activists are voicing concern not just in law review articles, but in the public sphere. Jay Stanley, a Senior Policy Analyst at the American Civil Liberties Union, warns:

> Nonconsensual mind reading is not something we should ever engage in . . . . We view techniques for peering inside the human mind as a violation of the 4th and 5th Amendments, as well as a fundamental affront to human dignity . . . . [W]e must not let our civilization's privacy principles degrade so far that attempting to peer inside a person's own head against their will ever becomes regarded as acceptable.[85]

There are even groups such as Christians Against Mental Slavery to protest mind reading.[86]

What are the origins of such concern? Although there are likely many factors, a contributor certainly must be the depiction of this technology in the media. For instance, the following headline ran in July 2012: "The Mind-Reading Machine: Veritas Scientific is developing an EEG helmet that may invade the privacy of the mind."[87] In the article, the CEO of the company is quoted as saying that"[t]he last realm of privacy is your

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longer completely in the realm of science-fiction, it is significantly more complex and less developed than fMRI-based lie detection . . . .") (citations omitted).

82. Boundy, *supra* note 13, at 1643.

83. Matthew B. Holloway, *One Image, One Thousand Incriminating Words: Images of Brain Activity and the Privilege against Self-Incrimination*, 27 TEMP. J. SCI. TECH. & ENVTL. L. 141, 143 (2008).

84. William Federspiel, 1984 *Arrives: Thought(Crime), Technology, and the Constitution*, 16 WM. & MARY BILL RTS. J. 865, 900 (2008).

85. Jay Stanley, *High-Tech "Mind Readers" Are Latest Effort to Detect Lies*, ACLU (Aug. 29, 2012, 11:41 AM), http://www.aclu.org/blog/technology-and-liberty/high-tech-mind-readers-are-latest-effort-detect-lies.

86. CHRISTIANS AGAINST MENTAL SLAVERY, http://www.slavery.org.uk/ (last visited Jan. 31, 2013).

87. Celia Gorman, *The Mind-Reading Machine: Veritas Scientific is developing an EEG helmet that may invade the privacy of the mind*, IEEE SPECTRUM, July 2012, http://spectrum.ieee.org/biomedical/diagnostics/the-mind reading-machine.

mind. This [tool] will invade that."[88] He goes on to observe that "it's a potential tool for evil. . . . If only the government has this device, it would be extremely dangerous."[89] Similarly, a professor of biomedical engineering says in the article that "[o]nce you test brain signals, you've moved a little closer to Big Brother in your head."[90] Citizens who read such articles are likely to be concerned about government mind reading.

Citizens also see these types of stories on prime-time television. In a *60 Minutes* segment on fMRI-based mind reading that aired in 2009, the crew went to several neuroscience labs, including those of Marcel Just and John Dylan-Haynes.[91] In the segment, a *60 Minutes* associate producer completed Just's fMRI tasks, in which she looked at ten different images while in the scanner.[92] Using the producer's brain data, and comparing it to brain data previously collected from other subjects, the computer algorithm was 100% successful in determining the category of image at which the producer was looking.[93] The segment also showed that Dylan-Haynes has a program that can accurately predict, based on brain-activation patterns, whether a subject had decided, in his or her head, to add or subtract numbers shown to them in the scanner.[94] Viewers of the program also learn that the bioethicist Dr. Paul Root Wolpe tells his students that "there is no science fiction anymore. All the science fiction I read in high school, we're doing."[95] Toward the end of the segment, two very telling exchanges occur. The first is between CBS correspondent Lesley Stahl and the ethicist Dr. Wolpe:

> [Stahl:] Can you[,] through our legal system[,] be forced to take one of these tests? . . .
>
> [Wolpe:] It's a great question. And the legal system hasn't decided on this yet . . . .

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88. *Id.* (internal quotation marks omitted).

89. *Id.* (internal quotation marks omitted).

90. *Id.* (internal quotation marks omitted).

91. *See How Technology May Soon "Read" Your Mind,* CBS NEWS, http://www.cbsnews.com/stories/1998/07/08/60minutes/main4694713.shtml?tag=cbsnewsSidebarArea.0 (last visited Jan. 31, 2013).

92. *Id.*

93. *Id.*

94. *Id.*

95. *Id.* (internal quotation marks omitted).

> [Stahl:] But we do have a Fifth Amendment. We don't have to incriminate ourselves . . . .
>
> [Wolpe:] Well here's where it gets very interesting, because the Fifth Amendment only prevents the courts from forcing us to testify against ourselves. But you can force me to give DNA or a hair sample or blood . . . . So here's the million dollar question: if you can brain image me and get information directly from my brain, is that testimony? Or is that like DNA, blood, semen, and other things you could take from me? . . . There will be a Supreme Court case about this . . . .[96]

This is followed later in the program by an exchange between Stahl and Dr. Just:

> [Stahl:] Do you think one day, who knows how far in the future, there'll be a machine that'll be able to read very complex thought like 'I hate so-and-so' or . . . 'I love the ballet because…' . . . .
>
> [Just:] Definitely. Definitely. . . . And not in 20 years. I think in three, five years.[97]

With predictions such as this—that a Supreme Court case is inevitable, and that in five years we will be able to reveal thoughts about who one hates—it is no wonder the public is getting concerned.[98] The remainder of this Part suggests that these concerns should be tempered.

B. Mind, Brain, and Behavior

To speak constructively about mind reading via neuroimaging, a working definition of the mind is required, as is a working assumption about the mind's relationship to the brain. To start: Is brain reading the same as mind reading?

For some, the mind reduces to the brain.[99] And, as legal scholars and philosophers Michael Pardo and Dennis Patterson

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96. *Id.* (internal quotation marks omitted).

97. *Id.* (internal quotation marks omitted).

98. User comments on the CBS website included: "Very invasive technology that destroys what is left of the 4th amendment" and "the legal system is behind the times when it comes to advancements in technology." Comments to *Mind Reading*, CBS NEWS, http://www.cbsnews.com/8601-500251_162-5119805.html?assetTypeId=58 (last visited Feb. 6, 2013).

99. But as Stoller and Wolpe suggest:

have pointed out, "Once this reduction takes place, there is nothing about the mind left to explain or understand."[100] If the mind equals the brain, then brain reading is mind reading. But the answer is not so simple.[101]

The relationship between mind and brain, which is known in philosophical circles as the "mind-body" problem,[102] can be understood in many ways. Two common positions are "dualism" and "materialism." Dualism, which finds its roots in the writing of René Descartes, holds that the mind is non-material (while the brain is material).[103] Materialism, in contrast, holds that there is nothing beyond the physical material of our brains.[104] Our minds are our brains, and nothing more.

This is, of course, a vast oversimplification of the mind-brain debate, and there are a multitude of middle and tangential positions that one can reasonably take.[105] However, this dualism-materialism dichotomy is sufficient to illustrate that how one

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> [O]ur everyday conception of humanity still reflects dualistic notions of body and non-physical mind or soul. When we say things like "my brain," we implicate a metaphysical being exerting influence over the workings of the brain, which we consider to be the organ of the mind and consciousness, but not synonymous with them. Even neuroscientists and their studies often "seem to leave room for the homunculus, the little ghost in the machine, which does all the directing of brain traffic."

Sarah E. Stoller & Paul Root Wolpe, *Emerging Neurotechnologies For Lie Detection and the Fifth Amendment*, 33 AM. J.L. & MED. 359, 369 (2007) (footnote omitted) (quoting BRENT GARLAND, NEUROSCIENCE AND THE LAW: BRAIN, MIND, AND THE SCALES OF JUSTICE 66 (2004)).

100. Pardo & Patterson, *supra* note 35, at 1218.

101. The question of the mind-brain (and behavior) relationship is so complex, and has been discussed in such great quantity, that I can only begin to scratch the surface in this Article. For more detailed discussion, see generally TORIN ALTER & ROBERT J. HOWELL, CONSCIOUSNESS AND THE MIND-BODY PROBLEM: A READER (2011); WILLIAM G. LYCAN, MIND AND COGNITION: AN ANTHOLOGY (2d ed. 1999); MATERIALISM AND THE MIND-BODY PROBLEM (David M. Rosenthal ed., 2d ed. 2000); Howard Robinson, *Dualism*, *in* THE BLACKWELL GUIDE TO PHILOSOPHY OF MIND 85 (Stephen P. Stich and Ted A. Warfield eds., 2003).

102. Although the common label is "mind-body" problem, in fact it boils down to a "mind-brain" problem. WARD, *supra* note 2, at 4.

103. *See* D.M. ARMSTRONG, A MATERIALIST THEORY OF THE MIND 6 (Taylor & Francis rev. ed. 2001) (1968).

104. *See id.* at 10.

105. There are many types of reductionist approaches. *See* NANCEY MURPHY & WARREN S. BROWN, DID MY NEURONS MAKE ME DO IT?: PHILOSOPHICAL AND NEUROBIOLOGICAL PERSPECTIVES ON MORAL RESPONSIBILITY AND FREE WILL 47–48 (2007) (distinguishing five different types of reductionism).

defines the mind vis-à-vis the brain has implications for assessing neuroimaging mind reading.

Here, I adopt as my working definition of "mind" the computational theory of mind (CToM). CToM is not universally accepted, but it does have widespread support. The theory, as described by psychologist Steven Pinker, is that "the mind is not the brain but what the brain does, and not even everything it does, such as metabolizing fat and giving off heat."[106] CToM "says that beliefs and desires are *information*, incarnated as configurations of symbols. The symbols are the physical states of bits of matter, like chips in a computer or neurons in the brain."[107] Neuroscientist Read Montague similarly describes CToM this way: "Your mind *is not* equal to your brain and the interaction of its parts, but your mind *is* equivalent to the information processing, the computations, supported by your brain."[108]

C. Mind Reading Typology

In addition to adopting a working definition of the mind-brain relationship, a distinction needs to be made between (1) the inferences to be drawn from brain data, and (2) the method of collecting the brain data. This distinction generates the two-by-three typology presented in Table 1.

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106. STEVEN PINKER, HOW THE MIND WORKS 24 (1997).

107. *Id.* at 25. Just because thinking is computation (or "information processing") "does not mean that the computer is a good metaphor for the mind." *Id.* at 23.

108. READ MONTAGUE, YOUR BRAIN IS (ALMOST) PERFECT: HOW WE MAKE DECISIONS 8 (2007). One need not adopt CTOM to see a distinction between mind and brain. For instance, the "general position accepted by most if not all neuropsychologists" is one of "emergent materialism." J. GRAHAM BEAUMONT, INTRODUCTION TO NEUROPSYCHOLOGY 7–8 (2d ed. 2008). This view accepts the materialist account of the mind (that is, *that* the mind is physically instantiated in the brain), but rejects the claim that the mind can be reduced to a set of physical states. *See id.* Rather, adherents to this view prefer the notion of "emergent properties." *Id.* Whether it is emergent materialism, computational theory of mind, or some other flavor of mind-brain interaction, the basic point holds: The brain enables the mind (and for this reason altering the brain, as with drugs, can alter the mind), but the brain is not equal to the mind. Beaumont likens this to the sweetness of an apple: "There is nothing in the chemistry or physical structure of the apple that possesses sweetness. It is the whole object, in interaction with the eater, that produces the quality of sweetness." *Id.* at 7–8.

Table 1. Distinguishing Mind Reading and Brain Reading

		What type of conclusion is to be made?	
		Conclusion about mental functioning (that is, "mind reading").	*Conclusion about brain tissue itself (that is, "brain reading").*
How is the brain data collected?	*Non-machine-aided (for example, direct observation by a human).*	(1) Traditional mind reading (for example, assessing honesty by looking into an individual's eyes).	(2) Traditional brain reading (for example, autopsy by visual observation alone to determine bullet trajectory).
	Machine-aided but not neuroimaging (for example, computer-assisted assessment of cognitive functioning)	(3) Machine-aided mind reading (for example, using a computer to administer neuropsychogical battery of questions)	(4) Machine-aided brain reading (for example, microscopic tissue examination to determine if cause of death was lead poisoning)
	Machine-aided neuroimaging methods (for example, human assisted by fMRI, EEG, and so on).	5) Machine-aided neuroimaging mind reading (for example, fMRI lie detection or EEG memory detection).	(6) Machine-aided neuroimaging brain reading (for example, an MRI scan to identify the location of a tumor).

The six categories generated by the typology are: (1) non-machine-aided mind reading; (2) non-machine-aided brain reading; (3) machine-aided mind reading; (4) machine-aided brain reading; (5) machine-aided mind reading with neuroimaging; and (6) machine-aided brain reading with neuroimaging.

The first category, non-machine-aided mind reading, consists of observing an individual's behavior and then inferring from that behavior the individual's mental state. This is the mind reading strategy most commonly used in everyday life.

The second category, non-machine-aided brain reading, consists of looking at an individual's brain to see what it looks like, but not drawing an inference about the individual's mental functioning. Since modern brain investigation almost always involves some machinery, this is a relatively less important category.

The third category, machine-aided mind reading, includes the use of non-neuroimaging technology to improve mind reading. This category is now extensive, as non-neuroimaging technology is so much a part of modern life. For instance, this category includes a neuropsychologist administering a computer-based battery of questions to assess cognitive function, a polygrapher administering a polygraph during a police investigation, and an investigator who uses digital technology to study deception through eye movements.[109]

The fourth category, machine-aided brain reading, describes the use of machine technologies, such as the microscope, that allow for improved assessment of brain tissue. For instance, autopsies of some former NFL football players have used new techniques to uncover the presence of the degenerative brain disease Chronic Traumatic Encephalopathy (CTE).[110] Many autopsies fit into this category, for instance when the goal of the coroner is to draw an inference about how a bullet entered the brain, and how a bullet might have disrupted critical functions. The coroner is not aiming to make an inference about what the individual was feeling when shot, whether the individual still holds grudges, or how the individual's memory is functioning in the morgue.

The fifth category, machine-aided neuroimaging mind reading, is the use of fMRI, EEG, and related technologies to probe mental functioning. Part III discusses the use of these technologies for lie and memory detection, and in assessing mental capacity, mental health, and the like.

The sixth category, machine-aided neuroimaging brain reading, is the use of machine-generated data (for example, an MRI scan) to assess the brain for some purpose other than assessing the mind. An example of this category is using a CT or MRI scan to determine the presence of a tumor.

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109. This use of specialized diagnostic tools is not new in neuropsychology. In 1953, it was already observed in the Texas Law Review that "[t]he clinical psychologist is often called upon to infer brain damage from behavior and performances on tests which evaluate cognitive function." David B. Vinson, *The Use and Limitations of Clinical Psychology in Studying Alleged Mental Effects of Head Injury*, 31 TEX. L. REV. 820, 820 (1953).

110. Bennet I. Omalu et al., *Chronic Traumatic Encephalopathy (CTE) in a National Football League Player: Case Report and Emerging Medicolegal Practice Questions*, 6 J. FORENSIC NURSING 40 (2010).

This typology helps us to see that the mental privacy panic is about only a subset of neuroimaging investigations (that is, those investigations aimed at drawing an inference about mental function), and the panic concerns only a subset of mind reading (namely, mind reading that utilizes new neuroimaging technologies). To emphasize this point, Category Five, which will be the focus of the rest of the chapter, is shaded in gray.

The techniques in Category Five all require *inference* of mental functioning from neuroimaging data. At least one commentator has therefore argued that lie detection with neuroimaging "is best conceived of as a sense-enhancement of the observer, not as a 'mind reader' because it does not read thoughts, but merely manifestations of thoughts, which are recorded as electrical waves or oxygenated blood patterns."[111] To be sure, there are many inferential steps between the mental event of lying and the measurement of blood flow,[112] but just because mind reading is inferential does not mean it is not mind reading. Rather, it means that mind reading will only be as good as the inferential connections.

An emphasis on inference allows us to reevaluate the argument that "[i]f we view our minds as our 'selves' and our brains as enabling our minds, then technologies capable of uncovering cognitive information from the brain threaten to violate our sense of privacy in a new and profound way."[113] This argument may be true, but only if we know something very specific about the precise way our minds are enabled by our brains.

If we do not, then the inferential chain between brain activity and mental activity may be broken and our mind's privacy might be left intact (even if our brain's privacy is not). Perhaps fMRI is less akin to mind reading and akin instead "to trying to understand how an engine works by measuring the tempera-

111. Benjamin Holley, *It's All in Your Head: Neurotechnological Lie Detection and the Fourth and Fifth Amendments*, 28 DEV. MENTAL HEALTH L. 1, 20 (2009).

112. *See, e.g.*, Owen D. Jones et al., *Brain Imaging for Legal Thinkers: A Guide for the Perplexed*, 2009 STAN. TECH. L. REV. 5, ¶¶ 40–41 (2009) ("fMRI brain imaging enables inferences about the mind, built on inferences about neural activity, built on the detection of physiological functions believed to be reliably associated with brain activity.").

113. Stoller & Wolpe, *supra* note 99, at 372.

ture of the exhaust manifold."[114] Maybe EEG is "like blind men trying to understand the workings of a factory by listening outside its walls."[115] Reasonable people, including reasonable experts, can—and do—disagree about how much a particular test tells us about a particular mental faculty and its relationship to a behavioral outcome.[116] Brain reading can tell us something meaningful about the mind, just as other non-brain data can. But brain data produced by advanced machinery is not inherently better or worse (for legal purposes) than data gathered by more traditional means.

The current limitations are reflected in neuropsychology and forensic psychiatry practices, where the mind and the brain are typically assessed *without* the use of neuroimaging tools. Neuropsychology, for example, "attempts to explain the way in which the activity of the brain is expressed in observable behavior."[117] Yet, it is introductory textbook material in neuropsychology to recognize that these attempts at explanation typically rely on chains of inference and *not* on actual brain monitoring.[118]

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114. Russell A. Poldrack, *The Future of fMRI in Cognitive Neuroscience*, 62 NEUROIMAGE 1216, 1216 (2012).

115. HANDBOOK OF CRIME CORRELATES 216 (Lee Ellis et al. eds., 2009) (quoting J.H. Margerison et al., *Electroencephalography*, *in* PETER H. VENABLES & IRENE MARTIN, A MANUAL OF PSYCHOPHYSIOLOGICAL METHODS 353 (1967)) (internal quotation marks omitted).

116. *See also* Francis X. Shen, *Law and Neuroscience: Possibilities for Prosecutors*, 33 CDAA PROSECUTOR'S BRIEF 17, 20–21 (2011), *available at* http://ssrn.com/abstract=2078639 (noting that "[t]here is much room for speculation" regarding the proper conclusions to be drawn from PET scan results, and arguing that "[t]here has never been, and never will be, a neuroscientific test that has immediate legal implications free from interpretation.").

117. BEAUMONT, *supra* note 108, at 4.

118. As Beaumont argues:

> Descriptions of brain organization can only be relatively distant inferences from the human performance that is actually observed. The real states of the brain are not observed. Behavioral measures are taken, and by a line of reasoning that is based on background information about either the general arrangement of the brain (in the case of experimental neuropsychology) or about the gross changes in the brain of a particular type of patient (in the case of clinical neuropsychology), conclusions are drawn about what the correlation must be between brain states and behavior.

Id. at 6–7. Beaumont does note that "[t]he one exception to this general rule is in electrophysiological studies and studies of cerebral blood flow and metabolism through advanced scanning techniques, where actual brain states can be observed, albeit rather crudely, in 'real time' alongside the human performance be-

Similarly, defining and detecting mental disorders continues to be based on behavioral, not brain, observation.[119] As neuroscientist Steven Hyman observes:

> The term "mental disorders" is an unfortunate anachronism, one retained from a time when these disorders were not universally understood to reflect abnormalities of brain structure, connectivity or function. Although the central role of the brain in these disorders is no longer in doubt, the identification of the precise neural abnormalities that underlie the different mental disorders has stubbornly defied investigative efforts.[120]

To be sure, there are indications that this may change. In 2012, *Neuroimaging in Forensic Psychiatry* was published, and the editor of the volume, psychiatrist Joseph Simpson, observed that although there are many cautions and concerns to be addressed, "neuroimaging holds great potential for the mental health field . . . [and] also holds significant potential value in the legal domain."[121] Moreover, neuroimaging is sometimes used in assessing dementia,[122] psychopathy,[123] schizo-

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ing measured." *Id.* at 7. Although Beaumont states that "[t]his makes these studies of special importance in neuropsychology," he maintains that, "in general, neuropsychological study proceeds only by inference." *Id.*

119. As the National Institute of Mental Health makes clear in its brochure to educate medical consumers:

> No scientific studies to date have shown that a brain scan by itself can be used for diagnosing a mental illness or to learn about a person's risk for disease . . . . Brain scans are not usually the first test a doctor would do to diagnose changes in mood and behavior. Other medical tests a doctor may use include behavioral and cognitive tests or a medical interview.

NAT'L INST. OF MENTAL HEALTH, U.S. DEP'T OF HEALTH & HUMAN SERVS., NEUROIMAGING AND MENTAL ILLNESS: A WINDOW INTO THE BRAIN 3 (2010), *available at* http://www.nimh.nih.gov/health/publications/neuroimaging-and-mental-illness-a-window-into-the-brain/neuroimaging-faq.pdf.

120. Steven E. Hyman, *Can neuroscience be integrated into the DSM-V?*, 8 NATURE REVIEWS NEUROSCIENCE 725, 725 (2007). To be sure, "[P]rogress in neurogenetics, neuroimaging and other areas of neuroscience is beginning to yield significant insights into mental disorders." *Id.* at 727.

121. Joseph R. Simpson, *Introduction* to NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at xv, xvii.

122. Melissa Lamar et al., *Dementia*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at 67, 69.

123. Nathaniel E. Anderson & Kent A. Kiehl, *The psychopath magnetized: insights from brain imaging*, 16 TRENDS COGNITIVE SCI. 52, 54–56 (2012); Andrea L. Glenn & Adrian Raine, *Psychopathy and instrumental aggression: Evolutionary, neurobiological, and legal perspectives*, 32 INT'L J.L. & PSYCHIATRY 253, 255–57 (2009); Kent Kiehl, *Can neuroscience identify psychopaths?*, in A JUDGE'S GUIDE TO NEUROSCIENCE: A

phrenia,[124] and depression,[125] among others. At present, however, there remains "[a] gaping disconnect . . . between the brilliant discoveries informing genetics and neuroscience and their almost complete failure to elucidate the causes (and guide the treatment) of mental illness."[126]

These illustrations are instructive. They show that even in the fields of neuropsychology and psychiatry—which are both dedicated to studying the "mind"—one does not necessarily need assessment with neuroimaging. They also remind us that the substantive value added of mind reading with neuroimaging is what it can tell us beyond what we can already learn from existing methods.

III. MIND READING WITH NEUROIMAGING: WHAT WE CAN (AND CANNOT) DO

Having established in Part II a working definition of neuroimaging mind reading, the Article now briefly discusses several recent legal applications of such technology. Part III reviews: (A) fMRI-based lie detection; (B) fMRI-based memory detection; (C) EEG-based memory detection; and (D) fMRI-based decoding and reconstruction of visual stimuli.

A. Lie Detection with fMRI[127]

Neurons, the cells of greatest interest in the brain and nervous system, need oxygen to live. This oxygen is supplied to them via blood flow. fMRI is premised on the logic that track-

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CONCISE INTRODUCTION 47, 49 (Andrew S. Mansfield ed., 2010), *available at* http://www.sagecenter.ucsb.edu/sites/staging.sagecenter.ucsb.edu/files/file-and-multimedia/A_Judges_Guide_to_Neuroscience%5Bsample%5D.pdf.

124. Jazmin Camchong & Angus W. MacDonald III, *Imaging Psychoses: Diagnosis and Prediction of Violence*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at 113, 115.

125. Ronald S. Duman & George K. Aghajanian, *Synaptic Dysfunction in Depression: Potential Therapeutic Targets*, 338 SCI. 68, 68–69 (2012); L. Wang et al., *A systematic review of resting-state functional-MRI studies in major depression*, 142 J. AFFECTIVE DISORDERS 6, 7 (2012).

126. Allen J. Frances & Thomas Widiger, *Psychiatric Diagnosis: Lessons from the DSM-IV Past and Cautions for the DSM-V Future*, 8 ANNU. REV. CLIN. PSYCH. 109, 112 (2012); *see also* Hyman, *supra* note 120, at 725.

127. This discussion draws, in part, on Francis X. Shen & Owen D. Jones, *Brain Scans as Evidence: Truths, Proofs, Lies, and Lessons*, 62 MERCER L. REV. 861, 862, 865 (2011).

ing relative blood flow to different parts of the brain will reveal relative oxygen uptake, and thus show which neurons are more active (at a given moment in time).[128] Changes in blood oxygen levels in the brain at different moments during a given experimental task allow for inferences about brain-activation patterns.

Different protocols have been used in fMRI lie detection, most of which rely on a paradigm known as the "Concealed Information Test" (CIT) (also known as the "Guilty Knowledge Test" (GKT)).[129] This paradigm is different than the Control Question Test typically used by professional polygraphers.[130]

fMRI lie detection evidence has been proffered in several U.S. cases, has been the topic of much neuroscience research, and has drawn the attention of many commentators.[131] There are a large number of conceptual and technical problems with this approach. Conceptually, one major challenge with neuroimaging lie detection is defining a "lie."[132] In practice, neuroscience lie detection has utilized an "instructed lie" experimental paradigm,[133] in which subjects are told to lie under certain con-

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128. *See id.* at 865.

129. *Id. See generally* William G. Iacono, *The Forensic Application of "Brain Fingerprinting:" Why Scientists Should Encourage the Use of P300 Memory Detection Methods*, 8 AM. J. BIOETHICS 30, 30–32 (2008); Jones & Shen, *supra* note 127, at 865; Anthony Wagner, *Can neuroscience identify lies?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE, *supra* note 123, at 13, 16–18.

130. *See* William G. Iacono, *Detection of Deception*, *in* HANDBOOK OF PSYCHOPHYSIOLOGY 688, 688–90 (John T. Cacioppo et al. eds., 3d ed. 2007).

131. For lengthier treatment, see, for example, Charles Adelsheim, *Functional Magnetic Resonance Detection of Deception: Great as Fundamental Research, Inadequate as Substantive Evidence*, 62 MERCER L. REV. 885 (2011); Archie Alexander, *Functional Magnetic Resonance Imaging Lie Detection: Is a "Brainstorm" Heading Toward the "Gatekeeper"?*, 7 HOUS. J. HEALTH L. & POL'Y 1 (2007); Giorgio Ganis & Julian Paul Keenan, *The cognitive neuroscience of deception*, 4 SOC. NEUROSCIENCE 465 (2009); Henry T. Greely & Judy Illes, *Neuroscience-Based Lie Detection: The Urgent Need for Regulation*, 33 AM. J.L. & MED. 377 (2007); Jones & Shen, *supra* note 25; John B. Meixner, *Liar, Liar, Jury's the Trier? The Future of Neuroscience-based Credibility Assessment in the Court*, 106 NW. U. L. REV. 1451 (2012); Jane Campbell Moriarty, *Visions of Deception: Neuroimages and the Search for Truth*, 42 AKRON L. REV. 739 (2009); Frederick Schauer, *Can Bad Science Be Good Evidence? Neuroscience, Lie Detection, and Beyond*, 95 CORNELL L. REV. 1191 (2010).

132. "[W]hat constitutes 'deception' or a 'lie' is a conceptual not an empirical question, and . . . the criteria are behavioral not neurological. Certain brain states may be causally *necessary* for deception, but they are not a sufficient condition for deception." Pardo & Patterson, *supra* note 35, at 1230.

133. *See, e.g.*, Schauer, *supra* note 131, at 1201. *But see* Joshua D. Greene & Joseph M. Paxton, *Patterns of neural activity associated with honest and dishonest moral deci-*

ditions in the experiment. Critics point out that this may limit the inferences we can make about "lying," because an instructed lie in the lab may not involve the same brain activity as a high-stakes lie in real life outside the lab.[134] Additionally, technical issues include general concerns about using fMRI techniques to study higher-order cognitive functions.[135]

Of particular note here is the "reverse inference" fallacy. The reverse inference fallacy is the idea that just because a particular part of the brain is more active during a certain cognitive state, it does not necessarily follow that whenever that brain area is more active, a person is in that cognitive state.[136] The reverse inference fallacy is acute in the lie detection case, as "it is not lying per se that is being decoded from these brain areas but rather the cognitive and emotional processes that are associated with lying."[137]

Despite these limitations, two for-profit fMRI-based lie detection companies are now in operation,[138] and both have proffered evidence in criminal trials on behalf of defendants.[139] So far, the evidence has been ruled inadmissible under both the *Daubert* standard in federal court[140] and the *Frye* standard in

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sions, 106 PROC. NAT'L ACAD. SCI. 12506, 12506 (2009) (describing study involving genuine dishonesty).

134. Nancy Kanwisher, *The Use of fMRI in Lie Detection: What Has Been Shown and What Has Not*, *in* USING IMAGING TO IDENTIFY DECEIT: SCIENTIFIC AND ETHICAL QUESTIONS 7, 12 (2009), *available at* http://www.amacad.org/pdfs/deceit.pdf.

135. *See generally* Logothetis, *supra* note 3.

136. *See* Frank Tong & Michael S. Pratte, *Decoding Patterns of Human Brain Activity*, 63 ANN. REV. PSYCHOL. 483, 497 (2012) ("As an example, it is well established that the human amygdala responds more strongly to fear-related stimuli than to neutral stimuli, but it does not logically follow that if the amygdala is more active in a given situation that the person is necessarily experiencing fear. If the amygdala's response varies along other dimensions as well, such as the emotional intensity, ambiguity, or predictive value of a stimulus, then it will be difficult to make strong inferences from the level of amygdala activity alone.") (citations omitted).

137. *Id.* at 502 (citation omitted).

138. Those companies are Cephos Corporation and No Lie MRI, Inc. *See* Greely & Illes, *supra* note 131, at 390–95.

139. *See* United States v. Semrau, No. 07-10074 Ml/P., 2010 WL 6845092, at *3 (W.D. Tenn. 2010) (describing expert testimony of Dr. Steven Laken, president and CEO of Cephos Corporation); Wilson v. Corestaff Servs., L.P., 900 N.Y.S.2d 639, 640 (Sup. Ct. 2010) (same).

140. *Semrau*, 2010 WL 6845092, at *14.

state court.[141] However, the judge overseeing the evidentiary hearing in the federal case suggested that such evidence may one day become admissible:

> [I]n the future, should fMRI-based lie detection undergo further testing, development, and peer review, improve upon standards controlling the technique's operation, and gain acceptance by the scientific community for use in the real world, this methodology may be found to be admissible even if the error rate is not able to be quantified in a real world setting.[142]

For purposes of the Fourth Amendment and Fifth Amendment analysis in Part IV, it is important to note that all of these experimental paradigms involve researcher-subject interaction such as requesting a response to a visual stimulus or question.[143] Although fMRI may be used in what is known as "resting state" analyses (in which the subject just lies in the scanner), such resting-state approaches have not been employed in the lie detection context.[144]

B. Memory Detection with fMRI

Scientists have also made intriguing progress in detecting memories. Neuroscientists Jesse Rissman and Anthony Wagner were able to use fMRI, combined with an advanced data analy-

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141. fMRI lie detection evidence from Cephos was not admitted under the *Daubert* standard in *Semrau*. fMRI lie detection evidence from No Lie MRI was not admitted under the *Frye* standard in *Smith v. State*, 32 A.3d 59 (Md. 2011) (discussion of fMRI and *Frye* standard found in trial court opinion, on file with author).

142. *Semrau*, 2010 WL 6845092, at *12 n.18.

143. *See* Marcus Raichle, *What is an fMRI?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE, *supra* note 123, at 5, 8 (describing procedures used in fMRI experiments).

144. And likely never will, at least for purposes of detecting deception or honesty on a particular question. Resting-state studies are becoming more common, and offer us "many interesting observations of the way in which spontaneous connectivity patterns alter under different conditions." David M. Cole et al., *Advances and pitfalls in the analysis and interpretation of resting-state FMRI data*, 4 FRONTIERS SYS. NEUROSCIENCE, no. 8, 2010, at 12. But without corresponding *non*-resting state studies to complement the resting-state analysis, "the concrete meaning of these inherent processes . . . remains elusive." *Id.* Resting-state activity on its own is "something of an interpretative minefield." *Id.* Given all of the challenges of using task-based fMRI to assess lying on particular questions, and the reliance of resting-state analysis on such task-based studies, it seems very unlikely that resting-state analysis provides an answer to the brain-based lie detection challenge.

sis methodology,[145] to identify with great accuracy the subjective memory states of subjects, such as whether the subject thought he had seen a particular face before.[146] Subjects were initially shown a battery of faces, and then, while in the scanner, were shown both previously seen and new faces.[147] The researchers could tell with great accuracy whether a subject remembered seeing a particular face.[148] Further, "neural signatures associated with subjective memory states were sufficiently consistent across individuals to allow one participant's mnemonic experiences to be decoded using a classifier trained exclusively on brain data from other participants."[149]

At the same time, the researchers were much more limited in their ability to determine from brain signals alone whether a subject had *actually* seen the face before—the subject's objective memory state. The distinction between subjective and objective memory states, as the authors noted, has very important legal implications.[150] The law generally is interested in objective memory states, such as whether a witness actually saw the alleged criminal.

As with fMRI-based lie detection, current memory-detection techniques with fMRI require both subject-researcher interaction (such as pressing a button to indicate when a face is remembered).

C. Memory Recognition with EEG

Distinct from the fMRI-based approaches just described are memory-recognition approaches using electroencephalography (EEG). These techniques are not lie detection *per se*, though they are typically used to improve assessment of an individual's veracity. For instance, if a defendant's alibi is that he was never at the scene of the crime, an EEG memory-recognition

145. The methodology they used is termed multi-voxel pattern analysis (MVPA). *See* Rissman et al., *infra* note 146, at 9849.

146. Jesse Rissman et al., *Detecting individual memories through the neural decoding of memory states and past experience*, 107 PROC. NAT'L ACAD. SCI. 9849, 9849 (2010).

147. *Id.*

148. *Id.* at 9849, 9852.

149. *Id.* at 9852.

150. *Id.* at 9853.

test could theoretically help the fact finder or investigator's assessment of the defendant's credibility.[151]

As discussed earlier, EEG is a method of measuring the electrical activity produced by the brain.[152] Electrodes are placed on the subject's scalp, and electrical activity is recorded.[153] As with fMRI lie detection studies, EEG memory-recognition paradigms use a version of the Concealed Information Test.[154] The logic is that the brain will react differently to a stimulus (such as a photo of a particular aspect of a crime scene) if that person recognizes the stimulus.[155]

A measurement of electrical activity called the P300 wave specifically is of note.[156] "The P300 is a special ERP [event-related potential] component that results whenever a meaningful piece of information is rarely presented among a random series of more frequently presented, non-meaningful stimuli often of the same category as the meaningful stimulus."[157] The theory is that if a series of objects are shown to a subject, the brain will *automatically* respond in a different way to items that have been seen before and are thus recognizable. Starting in the 1980s, research confirmed this to be the case. "The P300 would not represent a lie per se but only a recognition of a familiar item of information, the verbal denial of which would then imply deception."[158]

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151. *See* Lawrence A. Farwell, *Brain fingerprinting: a comprehensive tutorial review of detection of concealed information with event-related brain potentials*, 6 COGNITIVE NEURODYNAMICS 115, 115 (2012).

152. *See* JAMIE WARD, THE STUDENT'S GUIDE TO COGNITIVE NEUROSCIENCE 37–39 (2d ed. 2010).

153. *Id.*

154. *See* Farwell, *supra* note 151, at 127.

155. *See id.*

156. The P300 wave is so named because it is a peak wave appearing 300 milliseconds after the stimulus. The P300 approach has also been used, with off-the-shelf EEG-based gaming equipment, in attempts to "hack" subjects' brains by identifying subjects' regional home location, month of birth, and first digit of bank PIN number. Sara Grossman, *UC Berkeley researchers investigate 'Brain Hacking': Gaming interface that records brain waves could present future security threat*, THE DAILY CALIFORNIAN, Oct. 14, 2012, http://www.dailycal.org/2012/10/14/brain-hacking-possible-security-threat-of-the-future-say-uc-berkeley-researchers/.

157. J. Peter Rosenfeld, *P300 in detecting concealed information*, *in* MEMORY DETECTION: THEORY AND APPLICATION OF THE CONCEALED INFORMATION TEST 63, 64 (Bruno Verschuere et al. eds., 2011) (emphasis omitted).

158. *Id*. at 65. There are good reasons for using the P300 technique in certain circumstances. *See* Iacono, *supra* note 130, at 688 ("Lie detection techniques have been developed to detect two types of liars: criminals and untrustworthy employees.").

In a recognition task with EEG, subjects are exposed to three types of stimuli: probes (the stimuli that only the guilty party would know); irrelevant stimuli (the stimuli that have nothing to do with the crime scene); and target stimuli (the stimuli that are related to the crime scene but that everyone knows).[159] The legal system has seen a particular version of this approach—the "brain fingerprinting" approach developed by scientist Lawrence Farwell.[160] Farwell presented his evidence in two cases,[161] but his approach has not been admitted into evidence since, and has been heavily criticized.[162]

There are many scientific challenges to the brain fingerprinting approach. As some critics have pointed out:

> [T]here is no simple one-to-one relationship between the P300 and memory. Even though information stored in

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159. *See, e.g.*, J. Peter Rosenfeld et al., *Deception awareness improves P300-based deception detection in concealed information tests*, 86 INT'L J. PSYCHOPHYSIOLOGY 114, 115 (2012).

160. *See generally* Farwell, *supra* note 151.

161. Slaughter v. State, 108 P.3d 1052, 1054 (Okla. Crim. App. 2005); Harrington v. State, 659 N.W.2d 509, 516 (Iowa 2003). In the *Slaughter* case, Farwell testified in an affidavit that the defendant did not possess the knowledge that he would expect the perpetrator to have. John G. New, *If You Could Read My Mind: Implications of Neurological Evidence for Twenty-First Century Criminal Jurisprudence*, 29 J. LEGAL MED. 179, 190 (2008). But "although Farwell indicated in his affidavit that a 'comprehensive report' of his analysis would be presented to the court detailing the method of analysis and the results obtained, no such report was submitted in the course of that hearing or a subsequent hearing." *Id.*

162. *See, e.g.*, J. Peter Rosenfeld, *'Brain Fingerprinting': A Critical Analysis*, 4 SCI. REV. MENTAL HEALTH PRAC. 20, 34 (2005); J. Peter Rosenfeld et al., *Simple, effective countermeasures to P300-based tests of detection of concealed information*, 41 PSYCHOPHYSIOLOGY 205, 205 (2004). In 2012, Farwell published a lengthy summary of the brain fingerprinting technique. Farwell, *supra* note 151. But this publication was also heavily criticized by fellow scholars in the field, including a former Farwell coauthor. *See, e.g.*, Ewout H. Meijer et al., *A comment on Farwell (2012): brain fingerprinting: a comprehensive tutorial review of detection of concealed information with event-related brain potentials*, COGNITIVE NEURODYNAMICS, Aug. 14, 2012, at 4 (2012) ("[I]f Dr. Farwell is, as he claims to be, a 'brain fingerprinting scientist' he should feel obligated to retract the article."). There are other types of ERP methods that are well received in the scholarly community and could be legally useful in ways that brain fingerprinting might not. *Id.* at 3 (noting that "many researchers . . . share a positive view towards the use of ERPs for the detection of concealed information." (citation omitted)). For instance, John Meixner and Peter Rosenfeld have shown in the lab that a P300-based Concealed Information Test can help detect, with no false positives, guilty subjects in a mock terrorism paradigm. John B. Meixner & J. Peter Rosenfeld, *A mock terrorism application of the P300-based concealed information test*, 48 PSYCHOPHYSIOLOGY 149, 153 (2010). Such research might one day have applications in counterterrorism efforts. *See id.*

> memory may very well cause some events to be identified as distinct and therefore elicit a P300, reducing the P300 to a simple "Aha!" response driven by 'recognition of the relevant information contained in the probes as significant in the context of the crime' is quite at variance with what is known about the P300.[163]

Moreover, "laboratory research on brain fingerprinting published in peer-reviewed journals amounts to a single study containing 20 participants."[164]

Setting aside the scientific shortcomings, and thus its admissibility on the merits, two features of the brain fingerprinting approach are particularly relevant to subsequent legal analysis discussed in the next Part. Like the fMRI studies just reviewed, every brain fingerprinting study conducted to date requires substantial subject-researcher interaction. Here, the researcher instructs the subject to press a button to indicate that an image is recognized. As Farwell writes, "A subject neither lies nor tells the truth during a brain fingerprinting test. He simply observes the stimuli and pushes the buttons as instructed."[165]

Farwell's claim is that "[b]rain [f]ingerprinting testing has nothing to do with lie detection. Rather, it detects information stored in the brain by measuring brain responses."[166] The critical word is *responses*, as the testing relies on the researcher's questions and the subject's response. Even if the subject's response was not required via pushing a button, it is difficult to see how the protocol could work without requiring the subject to look at the screen in front of him or her. Farwell is clear that the protocol must "[r]equire an overt behavioral task that requires the subject to recognize and process every stimulus, specifically including the probe stimuli."[167]

In addition to response during the testing itself, the brain fingerprinting procedure requires subject cooperation *before* the test. Before the EEG is run, "the subject is interviewed to find out what he knows about the crime from any non-

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163. Meijer et al., *supra* note 162, at 2 (citation omitted).

164. *Id.*

165. Farwell, *supra* note 151, at 127.

166. GOVERNMENT WORKS, BRAINWAVE SCIENCE: EXECUTIVE SUMMARY 4 (n.d.), *available at* http://www.governmentworks.com/bws/brochure/BrainFingerprintingExecutiveSummary.pdf.

167. Farwell, *supra* note 151, at 130.

incriminating source such as news reports or prior interrogations."[168] In short, then, brain fingerprinting is machine-assisted neuroimaging mind reading that requires *as a precondition* the subject's mental cooperation.

D. Decoding of Visual Stimuli with fMRI

Perhaps the most dazzling developments in mind reading with neuroimaging have come from research labs decoding and reconstructing visual stimuli. Over a decade ago, researchers knew enough about the way the brain functions to determine, on the basis of brain activity alone, whether subjects were thinking about a famous face or a place.[169] Researchers can also tell, solely on the basis of brain activity, which of two researcher-selected verbs subjects are viewing.[170] These findings may at first seem to be precisely the type of method that should properly invoke great concerns about mental privacy. This interpretation is, however, unwarranted.

fMRI, as discussed earlier, "detects changes in hemodynamic (literally 'blood movement') properties of the brain as a subject engages in specific mental tasks."[171] Oxygen binds to a protein called hemoglobin in the blood, becoming oxyhemoglobin, and when that oxygen is used by neurons in the brain it releases from the hemoglobin.[172] Without the oxygen attached, the oxyhemoglobin becomes deoxyhemoglobin. fMRI takes advantage

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168. *Id.* at 124. Farwell writes specifically that this pre-test investigative phase is not a science.

> The investigative phase of preparing the brain fingerprinting test discovers the salient features of the crime that are used as probe stimuli. It depends on the skill and judgment of the criminal investigator. This is not a scientific process.
>
> The scientific phase of brain fingerprinting testing begins after the investigation has identified appropriate probes.

Id. at 133.

169. *See* K.M. O'Craven & N. Kanwisher, *Mental Imagery of Faces and Places Activates Corresponding Stimulus-Specific Brain Regions*, 12 J. COGNITIVE NEUROSCIENCE 1013, 1017 (2000).

170. Tom M. Mitchell et al., *Predicting Human Brain Activity Associated with the Meanings of Nouns*, 320 SCI. 1191, 1194 (2008).

171. Francis X. Shen & Owen D. Jones, *Brain Scans as Evidence: Truths, Proofs, Lies, and Lessons*, 62 MERCER L. REV. 861, 865 (2011). For more detail, see Owen D. Jones, Joshua W. Buckholtz, Jeffrey D. Schall & Rene Marois, *Brain Imaging for Legal Thinkers: A Guide for the Perplexed*, 2009 STAN. TECH. L. REV. 5 (2009).

172. JONES, SCHALL & SHEN, *supra* note 29, at 10.

of the "fact that oxyhemoglobin is not magnetic but deoxyhemoglobin is magnetic. This difference is the basis of fMRI because the scanner can detect regions with relatively more oxyhemoglobin (as a consequence of demands from neural activity). This signal is called the blood-oxygenation level-dependent (BOLD) signal."[173]

The BOLD response is divided into small three-dimensional areas roughly the size of a pea, about three cubic centimeters. These small cubes are called voxels (which stands for volumetric pixels) and contain between five hundred thousand and one million neurons.[174]

When researchers investigate the neural correlates of some activity carried out in the scanner, they use an "encoding" approach. They are looking to see how the brain encodes the presented stimuli.[175] By contrast, in a "decoding" approach, researchers start with the measured brain activity and then attempt to predict some information external to the brain, such as the visual stimulus that might have generated the observed brain activation pattern.[176]

Theoretically all cognitive states—from "seeing red" to "feeling love for your mom"—are encoded by neurons, whose activity can be mapped using voxel encoding.[177] Decoding, in contrast, is "a model that uses voxel activity to predict sensory, cognitive, or motor information."[178] One type of decoding is reconstruction, in which "patterns of activity are used to produce a replica of the stimulus or task."[179] A study using this type of decoding, from the lab of Berkeley neuroscientist Jack Gallant, made headlines in 2011 when the researchers reconstructed images of film clips that subjects viewed while in an fMRI scanner.[180]

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173. *Id.*

174. *See id.*

175. Thomas Naselaris et al., *Encoding and Decoding in fMRI*, 56 NEUROIMAGE 400, 401 (2011) ("Voxel-based encoding models predict activity in single voxels that is evoked by different sensory, cognitive or task conditions.").

176. *See id.*

177. *See* Daisy Yuhas, *What's a Voxel and What Can It Tell Us? A Primer on fMRI*, SCI. AM., June 21, 2012, http://blogs.scientificamerican.com/observations/2012/06/21/whats-a-voxel-and-what-can-it-tell-us-a-primer-on-fmri/.

178. Naselaris, *supra* note 175.

179. *Id.*

180. *See, e.g.*, *Getting a glimpse into the "movies in our minds,"* CBS NEWS, Sept. 23, 2011, http://www.cbsnews.com/2100-205_162-20110768.html. For the original

It is not hard to imagine potential legal applications of such technology. However, Gallant's lab cautions that "[t]he potential use of this technology in the legal system is questionable," because "[a]ny brain-reading device that aims to decode stored memories will inevitably be limited not only by the technology itself, but *also by the quality of the stored information*. After all, an accurate read-out of a faulty memory only provides misleading information."[181] Thus, "any future application of this technology in the legal system will have to be approached with extreme caution."[182]

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study, see Shinji Nishimoto et al., *Reconstructing Visual Experiences from Brain Activity Evoked by Natural Movies*, 21 CURRENT BIOLOGY 1641 (2011).

181. *Reconstructing visual experiences from brain activity evoked by natural movies*, GALLANT LAB AT UC BERKELEY, https://sites.google.com/site/gallantlabucb/publications/nishimoto-et-al-2011 (last visited Jan. 31, 2013) (emphasis added).

182. *Id.* One additional note of caution is that even if researchers become sufficiently accurate in decoding activity in the visual cortex of the brain, the decoding strategy will be unique to the visual cortex and not akin to an all-purpose decoder ring to be used for decoding all of our thoughts. This is partly because of the unique structure of the visual cortex, *see* Se-Bum Paik & Dario L. Ringach, *Link between orientation and retinotopic maps in primary visual cortex*, 109 PROC. NAT'L ACAD. SCI. 7091, 7091 (2012) (describing structure of visual cortex), and partly because we have relatively exceptional knowledge of how vision translates to cortical activity, *see, e.g.*, Peter R. Huttenlocher, *Morphometric Study of Human Cerebral Cortex Development*, 28 NEUROPSCYHOLOGIA 517, 517 (1990) (already noting in 1990 that "[e]xtensive data are now available for specific cortical areas, especially for primary visual cortex"). The primary visual cortex, known as "Area V1," is a particularly well-studied structure. *See, e.g.*, Tianyi Yan et al., *Correlated Size Variations Measured in Human Visual Cortex V1/V2/V3 with Functional MRI*, *in* BRAIN INFORMATICS 36, 37 (N. Zhong et al. eds., 2009) ("Area V1 is the human visual cortical area with the most well-defined anatomical boundaries, agreed on by virtually all previous studies, both historical and more recent.") (citations omitted). Studies have shown that Area V1 has a fairly simple structure: "To a good approximation, each two-dimensional . . . location in the visual field is represented at a single physical location within V1." *Id.* In contrast, neural representation of legally relevant mental states such as intention, memory, and emotion is not nearly as well understood. Other areas of the cortex, such as the prefrontal cortex and the ventromedial prefrontal cortex, are structured very differently and encode information more abstractly. *See* Adam P. Steiner & A. David Redish, *The road not taken: neural correlates of decision making in orbitofrontal cortex*, 6 FRONTIERS NEUROSCIENCE, no. 13, 2012, at 12. In sum, then, the progress made in decoding signals in the visual cortex is important and informative, but this does not put us on the verge of highly effective, legally relevant neuroimaging mind reading, because decoding the visual cortex does not readily (or speedily) lead to decoding the multitude of other brain structures that enable the mind.

How should this type of research be categorized in the mind reading and brain reading typology? Neuroscientists Frank Tong and Michael Pratte provide us with two useful illustrations:

> [(1)] A participant is brought into a neuroimaging lab and asked to lie back comfortably on a padded bed table, which is slowly glided into a brain scanner. The participant watches a brightly colored display as it provides a virtual tour of every painting in the Musée d'Orsay. All the while, noninvasive measures of that person's brain activity are discretely taken, and the arrays of numbers are quickly transferred to the memory banks of a high-speed digital computer. After hours of brain scanning and computer analysis, the real scientific test begins. A randomly drawn painting is shown again to the observer. The computer analyzes the incoming patterns of brain activity from the participant's visual cortex and makes the following prediction with 99% confidence: She is looking at painting #1023, Cézanne's *Still Life with Apples and Oranges*. The experimenter turns to look at the computer screen, and indeed, the participant is looking at a plateful of pastel-colored red and yellow apples, and ripe oranges stacked in a porcelain bowl, all carefully arranged in the thick folds of a tousled white tablecloth. Another randomly drawn picture is shown, and the computer correctly predicts *Landscape with Green Trees* by Maurice Denis.
>
> [(2)] [In a separate experiment, the lab volunteer] is shown two paintings in quick succession (*Bedroom in Arles*, *The White Horse*) and then is asked to pick one and hold that image in mind for several seconds. She imagines a horse standing in a shallow river, head bent low as if looking at its own reflection in the slowly flowing stream. The computer quickly scans the matrix of numbers streaming in. Although brain activity levels are substantially weaker as she gazes steadily at the blank screen, compared to moments ago, a pattern begins to emerge from her visual cortex. The computer announces, with 85% confidence, that the participant is imagining the second painting, *The White Horse*.[183]

Both of these scenarios, as the researchers go on to describe at length, are "more fact than fiction,"[184] because neuroscience research has been able to accomplish both, and will only get

183. Tong & Pratte, *supra* note 136, at 484.
184. *Id.* at 485.

better over time.[185] Consequently, they argue, "mental privacy could face enormous new challenges, in both legal settings and beyond, as there has been no precedent for being able to look into the mind of another human being."[186]

Both of the above examples should be categorized as machine-assisted mind reading with neuroimaging. But Tong and Pratte apply a different standard, labeling the first scenario as brain reading and not mind reading because "the experimenter does not need a mind reading device to achieve this performance. The same result could be achieved by simply looking over the participant's shoulder . . . ."[187] Tong and Pratte view the second scenario, however, as mind reading because "information that is fundamentally private and subjective is being decoded from the person's brain; the only alternative would be to ask the participant directly about what she is thinking and to hope for an honest reply."[188]

Their categorization is thus based on the relative value-added of the machine-produced brain information. It is true that the brain data from the second example is more valuable than that from the first example. But whether of high-value or low-value, this is (a) brain data (b) generated by neuroimaging methods and (c) being used to infer a mental state. Thus, as discussed in Part IV, they should be considered the same for purposes of Fourth and Fifth Amendment analyses.

The "mind reading" label is appropriate here because the reconstruction is an inference about the mental state of "what the individual is perceiving visually." But this view is not shared by neuroscientist Jack Gallant, who, when interviewed about his own experiments, argued that "[w]e're not doing mind-reading here. We're not really peering into your brain and reconstructing pictures in your head. We're reading your brain

185. Researchers are working around the world on these types of questions. *See, e.g.*, *Training Computers to Understand the Human Brain*, SCIENCEDAILY, Oct. 5, 2012, http://www.sciencedaily.com/releases/2012/10/121005134328.htm.

186. Tong & Pratte, *supra* note 136, at 502.

187. *Id.* at 485.

188. *Id.*

activity and using that brain activity to reconstruct what you saw. And those are two very, very different things."[189]

Gallant is correct that collecting the brain data (and then using it to reconstruct an image) is not the same as truly reconstructing pictures in one's head. But it seems plausible, and probably very likely, that the reconstruction is being generated to provide meaningful information about the subject's mental experience—that is, what the picture in the subject's head was. Put another way, there is an inferential chain that connects the (observable) reconstruction with the (unobservable) actual mental experience of the visual stimuli. So long as what is being observed is intended to tell us something about the unobserved, it ought to be categorized as mind reading.

IV. PROTECTING MENTAL PRIVACY: THE FOURTH AND FIFTH AMENDMENTS

The preceding Parts of this Article defined mind reading and brain reading, and reviewed some of the emerging technologies. Part IV now considers the Fourth Amendment and Fifth Amendment constitutional protections available as a privilege against admissibility of involuntary government use of such techniques. This Part argues that, at least with the technology that presently exists and is likely to develop in the near future, both privileges should be readily available.

A. "Scholars Scorecard" on Mental Privacy

Although the mind reading techniques just reviewed are relatively new to the scientific scene, a number of law professors, law students, and other scholars are already on record with their predictions about Fourth and Fifth Amendment protections.

Debates about the rationales underlying these two privileges are vigorous in legal scholarship.[190] This Article does not weigh the relative merits of the theoretical approaches, but rather ex-

189. *It's Not Mind-Reading, but Scientists Exploring How Brains Perceive the World* (PBS NewsHour television broadcast Jan. 2, 2012) (transcript and video available at http://www.pbs.org/newshour/bb/science/jan-june12/neuroscience_01-02.html).

190. *See, e.g.*, Michael S. Pardo, *Neuroscience Evidence, Legal Culture, and Criminal Procedure*, 33 AM. J. CRIM. L. 301, 333 (2005–2006) ("[T]he hypothetical neuroscience examples serve an important analytical purpose in testing theoretical accounts of the privilege.").

amines whether, as a practical matter, commentators come to similar conclusions about this evidence. Table 2 summarizes these results in a "Scholars Scorecard."[191] Although there are many doctrinal paths taken, and some notable exceptions, scholars typically find that the Fourth Amendment and the Fifth Amendment both provide protections against mind reading techniques with neuroimaging.

Some scholars see the potential for protection under these Amendments only if the jurisprudence is reconceptualized. Law professor Nita Farahany has most recently and most persuasively put forth such an argument. Professor Farahany suggests that, at present, "[m]ental privacy is not sacrosanct under either the Fourth or Fifth Amendment, which provide procedural safeguards but not substantive ones to adequately protect mental privacy."[192] Professor Farahany suggests innovative ways to shore up these safeguards.[193]

But such innovations may not be required. If the analysis is restricted to technology that is either presently available or likely available in the near future, and if mind reading is defined as in previous Parts, then both the Fourth and the Fifth Amendment constitutional questions are easily resolved even using the conventional approach.[194]

In an early and influential article on the right to privacy, Samuel Warren and Louis Brandeis observed that "the common law secures to each individual the right of determining,

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191. I have not fully reported on the nuances of each author's position. Rather, I have attempted to gauge, based on a reading of the complete piece, how a particular scholar would come out (in general) on the protections against involuntary, government-initiated neuroimaging mind reading or lie detection. I include lie detection in the Table, even though I do not deem it mind reading, because so many of the authors have so labeled it.

192. Farahany, *Incriminating Thoughts*, *supra* note 15.

193. *Id*. at 408.

194. Although doctrinally distinct, the two Amendments' protections may be interrelated. For example, Michael Pardo argues that "the self-incrimination privilege applies to a subset of events *within* the universe of potential Fourth Amendment events." Michael S. Pardo, *Disentangling the Fourth Amendment and the Self-Incrimination Clause*, 90 Iowa L. Rev. 1857, 1860 (2005). In contrast, John New suggests that "if evidence of mental activity is considered testimonial, the strictures of the Fourth Amendment are inapplicable because searches, even of bodily evidence such as hair or blood, are searches for physical evidence," and thus the Fifth Amendment protections against self-incrimination are the "appropriate frame of analytical reference." New, *supra* note 161, at 197–98.

ordinarily, to what extent his thoughts, sentiments, and emotions shall be communicated to others."[195] Animated by this spirit, both Amendments can serve as adequate protection in their defined spheres against government-compelled mind reading with neuroimaging.

Table 2: Scholars Scorecard for Fourth and Fifth Amendment Protection Against Involuntary Mind Reading with Neuroimaging by the Government

Scholars are presented alphabetically by last name of first author.

Scholar	***Fourth Amendment Result***	***Fifth Amendment Result***
Jody Barillare (Comment)[196]	—	Brain fingerprinting protected because it elicits "testimonial psychological responses."[197]
Mara Boundy (Note)[198]	—	Protected because fMRI reveals contents of the mind.[199]
Nita Farahany[200]	Should be protected because of a privacy interest in secrecy of one's own thoughts.[201]	Uncertain: not protected if static, structural scanning or functional scanning of automatic functioning; protected if compelled utterance.[202]

195. Samuel D. Warren & Louis D. Brandeis, *The Right to Privacy*, 4 Harv. L. Rev. 193, 198 (1890); *see also* Long Beach City Employees Ass'n v. City of Long Beach, 719 P.2d 660, 663 (1986) ("If there is a quintessential zone of human privacy it is the mind.").

196. Jody C. Barillare, Comment, *As Its Next Witness, the State Calls . . . the Defendant: Brain Fingerprinting as "Testimonial" Under the Fifth Amendment*, 79 TEMP. L. REV. 971 (2006).

197. *Id.* at 974.

198. Boundy, *supra* note 13.

199. *Id.* at 1643.

200. Farahany, *Incriminating Thoughts*, *supra* note 15 (Fifth Amendment); Farahany, *Searching Secrets*, *supra* note 15 (Fourth and Fifth Amendments).

201. Farahany, *Searching Secrets*, *supra* note 15, at 1306. *But see id.* at 1982 n.225 (suggesting that when biometric data would provide no information other than suspect's identity, data might not be protected).

Scholar	***Fourth Amendment Result***	***Fifth Amendment Result***
William Federspiel (Note)[203]	Unresolved because of shifting conceptions of what is considered a reasonable search.[204]	Uncertain because it is not clear if the evidence is physical or testimonial.[205]
Dov Fox[206]	—	Protected because defendant has a right to silence—to control his thoughts.[207]
Benjamin Holley[208]	Generally protected because there is a reasonable expectation of privacy and the devices are not in general public use, but allowed in places where warrant requirements are relaxed, such as borders and airports.[209]	Not protected if the technology poses no undue risk of harm, because neuroscience lie detection evidence is physical, not testimonial.[210]
Matthew Baptiste Holloway[211]	—	Protected because it is a physical invasion of individual autonomy and is testimonial.[212]

202. Farahany, *Incriminating Thoughts*, *supra* note 15, at 372, 374, 404.
203. Federspiel, *supra* note 84.
204. *Id.* at 874 n.56.
205. *Id.* at 892–94.
206. Dov Fox, *The Right to Silence Protects Mental Control*, *in* 13 CURRENT LEGAL ISSUES, *supra* note 25, at 335.
207. *Id.* at 335.
208. Holley, *supra* note 111.
209. *Id.* at 12–13.
210. *Id.* at 22.
211. Holloway, *supra* note 83.
212. *Id.* at 174–75.

Scholar	*Fourth Amendment Result*	*Fifth Amendment Result*
Aaron Hurd (Note)[213]	—	Not protected because the procedure does not require a deliberate, controlled response and the resulting evidence is therefore non-testimonial.[214]
Emily Murphy and Hank Greely[215]	—	Likely protected because it will be considered testimonial.[216]
John New[217]	Uncertain because the balancing of an individual's privacy versus the government's interest will be fact-specific.[218]	Protected because it is testimonial evidence.[219]
Kristen Nugent[220]	Protected because neuroimaging would be too great an interference with the accused's bodily autonomy.[221]	Protected because the purpose of the exam is to draw inferences about the mind's contents.[222]

213. Aaron J. Hurd, Note, *Reaching Past Fingertips with Forensic Neuroimaging—Non-"Testimonial" Evidence Exceeding the Fifth Amendment's Grasp*, 58 LOY. L. REV. 213 (2012).

214. *Id.* at 217.

215. Murphy & Greely, *supra* note 17.

216. *Id.* at 650. Murphy and Greely also note a broader due process claim that might be brought on the grounds that the neuroscience techniques shock the conscience. *See id. (*citing Rochin v. California, 342 U.S. 165, 172–73 (1952)).

217. New, *supra* note 161.

218. *Id.* at 197–98. That said, "[i]t is questionable, [if] by no means resolved, whether a test so intrusive as to mine human thought or memory could ever be outweighed by a governmental interest in obtaining evidence." *Id.* at 197.

219. *See id.* at 194 ("It seems contradictory to both the history and spirit of the Fifth Amendment, therefore, to permit the state to execute an end run around an individual's refusal to communicate simply by extracting that information held within the brain that the individual refuses to divulge.").

220. Kristen M. Nugent, *Neuroimaging and the Constitution*, *in* NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 25, at 275.

221. *See id.* at 295.

222. *Id.* at 292.

Scholar	*Fourth Amendment Result*	*Fifth Amendment Result*
Michael Pardo[223]	Generally protected because the neuroscience tests are searches and one has a reasonable expectation of privacy regarding one's brain states.[224]	Protected when "the government compels the tests in order to obtain evidence of the incriminating informational content of subjects' propositional attitudes."[225]
Amanda Pustilnik[226]	Protected, because there is a reasonable expectation of privacy for brain activity.[227]	Brain evidence protected when it reveals mental content or knowledge.[228]
Sarah Stoller and Paul Root Wolpe[229]	—	Uncertain, as it depends on how the Supreme Court carries out its Fifth Amendment analysis.[230]
Erich Taylor (Note)[231]	—	Protected because it closely resembles police interrogation and is therefore testimonial evidence.[232]

223. Pardo, *supra* note 190.

224. *Id.* at 325–26.

225. *Id.* at 331–32.

226. Amanda C. Pustilnik, *Neurotechnologies At The Intersection of Criminal Procedure and Constitutional Law*, *in* The Constitution and the Future of the Criminal Law (Song Richardson & John Parry eds., forthcoming 2013) (manuscript available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2143187).

227. *Id.* (manuscript at 2, 19–20).

228. *Id.* (manuscript at 10).

229. Stoller & Wolpe, *supra* note 99, at 359.

230. *Id.* at 371, 374.

231. Erich Taylor, Note, *A New Wave of Police Interrogation? "Brain Fingerprinting," the Constitutional Privilege Against Self-Incrimination, and Hearsay Jurisprudence*, 2006 U. ILL. J.L. TECH. & POL'Y 287 (2006).

232. *Id.* at 307–08.

B. Fourth Amendment

The Fourth Amendment states, in relevant part, "The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause . . . ."[233] To decide whether Fourth Amendment protection should be afforded to evidence from a warrantless search, the Supreme Court applies the two-step "reasonable expectation of privacy" test articulated by Justice Harlan in his concurrence in *Katz v. United States*[234] and first adopted by the Court majority in *Smith v. Maryland*.[235] This test seeks to determine whether the party invoking the Fourth Amendment's protection can claim to have had a "'reasonable . . . expectation of privacy' that [was] invaded by government action."[236] Under the first step of the test, the Court asks "whether the individual, by his conduct, has 'exhibited an actual (subjective) expectation of privacy.'"[237] Given that the party had such a subjective expectation, the Court then asks "whether . . . the individual's expectation, viewed objectively, is 'justifiable' under the circumstances."[238] In applying the second prong of this test, the Court typically balances the importance of the individual privacy interests affected against the government's interest in effective investigation and prosecution.[239]

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233. U.S. CONST. amend. IV.

234. 389 U.S. 347, 360–61 (1967) (Harlan, J., concurring) ("[A] person has a constitutionally protected reasonable expectation of privacy . . . . [T]here is a twofold requirement, first that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as 'reasonable.'"). *Katz* remains the "lodestar" of Fourth Amendment privacy jurisprudence. Smith v. Maryland, 442 U.S. 735, 739 (1979).

235. *See* 442 U.S. at 739–40.

236. *Id.* at 740.

237. *Id.* (quoting *Katz*, 389 U.S. at 361).

238. *Id.* (citing *Katz*, 389 U.S. at 353 (majority opinion)).

239. *See* Orin S. Kerr, *Four Models of Fourth Amendment Protection*, 60 Stan. L. Rev. 503, 519 (2007) ("[T]he reasonable expectation of privacy inquiry poses a policy question: should a particular set of police practices be regulated by the warrant requirement or should those practices remain unregulated by the Fourth Amendment? If the consequences of leaving conduct unregulated are particularly troublesome to civil liberties, then that conduct violates a reasonable expectation of privacy. On the other hand, if the practical consequences of regulating such conduct unnecessarily restrict government investigations given the gain to civil liberties protection, then any expectation of privacy is constitutionally unreasonable. . . . [I]t is widely agreed that something akin to the policy model helps frame

Legal scholar Michael Pardo is correct when he argues that "[a]nalysis under the Fourth Amendment of compelled neuroscience tests is fairly straightforward."[240] If one has a reasonable expectation of privacy in one's blood and urine, surely one has a reasonable expectation of privacy in one's brain cells.[241]

It is true that some of the methods, such as EEG, are noninvasive. But as legal scholar Amanda Pustilink suggests:

> *Kyllo*'s thermal imaging of heat from the home makes an excellent analogy with EEG-detection of brain waves that emanate from the mind. Electrical brain waves, like thermal signatures from an occupied home, are automatically and continuously produced as long as a person is alive and a home is not abandoned . . . . [T]he need for decoding does not make the raw information itself unprotected by the Fourth Amendment.[242]

The Fourth Amendment may allow such a search if undertaken pursuant to a valid warrant.[243] Thus, a neuroimaging mind reading test "could be compelled if the government has probable cause and a warrant, or a recognized exception to these requirements."[244] One exception is a grand jury investiga-

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the basic goals of Fourth Amendment law and the reasonable expectation of privacy test."). In the context of brain-based mind reading, legal scholar John New has posed the problem this way: "To what extent might evidence obtained as a result of the measure of mental activity be protected from search or seizure? On the other hand, to what extent might the extraction of knowledge or memories be considered reasonable?" New, *supra* note 161, at 195.

240. Pardo, *supra* note 190, at 325.

241. *Id.* at 325 n.160 (citing Skinner v. Ry. Labor Executives' Ass'n, 489 U.S. 602, 615–18 (1989) (urine test); Schmerber v. California, 384 U.S. 757, 766–72 (1966) (blood test)).

242. Pustilnik, *supra* note 226, at 15–16.

243. *See* U.S. CONST. amend. IV. If a warrant is issued:

> The use of such a warrant might (or might not) be limited by the privilege against self-incrimination or by some constitutional privacy right, but, if such rights did not apply, would such warrants allow our brains to be searched? This is, in a way, the ultimate result of the revolution in neuroscience, which identifies our incorporeal 'mind' with our physical 'brain' and allows us to begin to draw inferences from the brain to the mind. If the brain is a physical thing or a place, it could be searchable, even if the goal in searching it is to find out something about the mind, something that, as a practical matter, had never itself been directly searchable.

Greely & Wagner, *supra* note 25, at 796.

244. Pardo, *supra* note 190, at 325–26.

tion,[245] where the court will decide whether to allow the search through a balancing test.[246] In cases involving mind reading evidence, the court will need to weigh "the state's need for the information" against "the witness's—and society's—interest in the mental and neurological privacy of the common citizen."[247] Because the court will consider the value of the information to the state, it should assess the value added by the neuroscience data to the state's investigation. This requires a close examination of the methods being used and the inferential chain that will connect the brain data to the mental state conclusions. Compared to the blood test at issue in *Schmerber*,[248] which clearly provided relevant data about blood alcohol level in the individual, neuroimaging data may not provide sufficiently relevant information about the mental state in question.[249] This would be a fact-specific inquiry, but surely would be informed by the likely unsettled nature of the neuroscience.[250]

One alternative, proposed by legal scholar Nita Farahany, draws on intellectual property law to inform Fourth Amendment analysis.[251] Arguing that "[s]ecrecy is a far more important privacy interest than seclusion in the information age,"[252] Farahany suggests that "in the not-too-distant future, the government might have the ability to imperceptibly and noninvasively obtain information directly from a suspect's brain."[253] If

245. Pardo, *supra* note 190, at 327–28. Pustilnik also considers whether the state could obtain memory data from a non-suspect (since the friend's information would help the investigation). Pustilnik, *supra* note 226, at 17–19.

246. *See* United States v. R. Enterprises, Inc., 498 U.S. 292, 297, 302 (1991) (rejecting probable cause requirement for issuance of grand jury subpoena and directing trial court to instead balance interests of subpoena recipient against government interests). *But see In re* Grand Jury Proceedings (T.S.), 816 F. Supp. 1196, 1205–06 (W.D. Ky. 1993) (rejecting government request for grand jury subpoena to obtain blood sample from defendant, and requiring that government instead establish probable cause in order to obtain a warrant).

247. Pustilnik, *supra* note 226 (manuscript at 19).

248. Schmerber v. California, 384 U.S. 757, 758 (1966); *see infra* Part III.C.

249. *See, e.g.*, Tong & Pratte, *supra* note 136, at 497 (discussing problems in "reverse inference" from fMRI data).

250. *Cf.* United States v. Semrau, No. 07-10074 Ml/P., 2010 WL 6845092, at *13–*14 (W.D. Tenn. 2010) (excluding fMRI-based expert testimony under the *Daubert* test because of widespread scientific doubt about the probity of fMRI data).

251. *See* Farahany, *Searching Secrets*, *supra* note 15, at 1240. Professor Farahany has also explored the Fifth Amendment in a companion piece. *See* Farahany, *Incriminating Thoughts*, *supra* note 15, at 351.

252. Farahany, *Searching Secrets*, *supra* note 15, at 1270.

253. *Id.* at 1271.

such a future comes to pass, this Article's Fourth Amendment analysis will need revision. But such a future is not inevitable, short of the advent of a new, currently unforeseen technology. Current fMRI and EEG techniques are nowhere near as imperceptible as intercepting radio signals or tapping into electrical wires. With fMRI, the subject must lie very still in a noisy environment, with his head inside a small enclosure. An MRI machine can reach noise levels of 130 decibels (by comparison, a jackhammer is 95 decibels and sandblasting is estimated to be 125 decibels).[254] EEG protocols require the careful placement of electrodes on one's scalp to record electrical activity.[255] Both EEG and fMRI thus remain very different experiences than the far more unobtrusive experience of government hacking into your wireless Internet network while you surf the Web.

C. Fifth Amendment

The Fifth Amendment states, in relevant part: "No person . . . shall be compelled in any criminal case to be a witness against himself."[256] Fifth Amendment jurisprudence is complex.[257] In analyzing questions that have been raised under the Fifth Amendment, the Supreme Court has considered issues such as:

> (1) who is protected by the privilege; (2) what constitutes "compulsion"; (3) what type of compelled evidence is subject to the protection of the privilege; (4) what uses of that evidence are barred in a criminal case; (5) when and how may a protected person exercise the privilege; and (6) what

254. John Chambers et al., *Developments in active noise control sound systems for magnetic resonance imaging*, 68 APPLIED ACOUSTICS 281, 281 (2007). *See also Decibel (Loudness) Comparison Chart*, GALEN CAROL AUDIO, http://www.gcaudio.com/resources/howtos/loudness.html (last visited Feb. 7, 2013).

255. *See* Sarah E. Stoller & Paul Wolpe, *Emerging Neurotechnologies for Lie Detection and the Fifth Amendment*, 33 AM. J.L. & MED. 359, 362 (2007) ("The subject is seated in front of a computer screen and wears a headband with sensors that measure EEG responses at several locations on the scalp.").

256. U.S. CONST. amend. V.

257. One commentator, for example, has called the privilege against self-incrimination an "unsolved riddle of vast proportions, a Gordian knot in the middle of our Bill of Rights." *See* Fox, *supra* note 206, at 768 (quoting Akhil Reed Amar & Renee B. Lettow, *Fifth Amendment First Principles: The Self-Incrimination Clause*, 93 MICH. L. REV. 857, 857 (1995)) (internal quotation marks omitted). Even the Supreme Court has noted that it is unclear "just what [the privilege] is supposed to do or just whom it is intended to protect." *Id.* (quoting Murphy v. Waterfront Comm'n of N.Y. Harbor, 378 U.S. 52, 56 n.5 (1964)) (internal quotation marks omitted).

> governmentally imposed burdens to impair the exercise of the privilege as [sic] to be unconstitutional.[258]

Slicing through this complexity, analysis of neuroimaging mind reading has returned, in virtually every instance, to a question of characterization: Is the neuroimaging evidence to be considered physical, like blood or breath, or testimonial, like speech or a written diary entry?[259] If it is physical, so the logic goes, then it is not privileged. If it is testimonial, it is.[260]

Many scholars, most recently Professors Farahany and Pustilnik, have rightly criticized this dichotomy.[261] Dov Fox has also laid out an alternative path forward, arguing that:

> The physical/testimonial distinction underlying self-incrimination doctrine is unlikely to protect a criminal suspect from the compelled use of fMRI or EEG. Yet this key

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258. 1 WAYNE R. LAFAVE ET AL., CRIMINAL PROCEDURE § 2.10(a) (3d ed. 2000) (Westlaw database update 2011).

259. *See, e.g.*, Fox, *supra* note 206, at 779 ("Whether brain fingerprinting is privileged by right-to-silence jurisprudence turns on whether it counts as 'testimonial' evidence, which is protected by the Fifth Amendment, or 'physical' evidence, which is not."); Holley, *supra* note 110, at 19 ("Ultimately, determining whether NTLD evidence is admissible 'physical' evidence or inadmissible 'testimonial' evidence boils down to which analogy is more apt: is NTLD more like speech or more like a blood sample?"); New, *supra* note 161, at 193 ("An initial question is whether results of brain activity measurement should be considered by the legal system to be physical evidence or actual testimony by the individual. The consequences and application of legal tests of admissibility will depend upon which of the categories (if either) 'mind activity' is deemed to be."); Pardo, *supra* note 190, at 321–22 ("On the one hand, the fMRI lie detector and the 'brain fingerprinting' technique share similarities with other physical examinations such as blood tests, breathalyzer tests, and fingerprint tests, which may be compelled under certain circumstances. On the other hand, the neuroscience tests arguably are qualitatively different in that they compel inductive evidence of mental events, beliefs, thoughts, and propositional knowledge. How this tension is resolved will depend on how both the evidence and the constitutional protections are conceptualized."); Pustilnik, *supra* note 226 (manuscript at 6) ("Whether and under what circumstances the state could compel individuals to submit to neuroassays under existing Fourth and Fifth Amendment jurisprudence depends on how neuroassays and the brain products they detect are characterized. . . . Whether courts construe their physical sample-like properties or their information product-like properties to predominate would lead to different degrees of protection under each regime.").

260. I restrict my analysis here to whether the government could compel this type of evidence, in the absence of a knowing and voluntary agreement.

261. Farahany, *Incriminating Thoughts*, *supra* note 15, at 351; Pustilnik, *supra* note 226 (manuscript at 1) (arguing that such a distinction "stumbles on a conceptually limited distinction between body and mind, physical and informational" and that "[s]uch a distinction can no longer stand, as brain processes and emanations sit at the juncture of these categories").

> distinction presupposes a flawed conception of mind/body dualism. Brain imaging techniques that deprive individuals of control over their thoughts violate the "spirit and history of the Fifth Amendment."[262]

There is good reason to review and revise this doctrine, but even without scholars' suggested innovations, the distinction between the physical and the testimonial, though not perfect, can be readily applied to new neuroimaging technologies. In the typology developed here, physical evidence can be thought of as *brain* reading with neuroimaging, and testimonial evidence as *mind* reading with neuroimaging.

The touchstone in previous scholarly analyses is often *Schmerber v. California*,[263] and with good reason. In *Schmerber*, the defendant was driving while intoxicated, and after crashing his car, was admitted to the hospital.[264] In the hospital, and at the instruction of a police officer, a doctor took a sample of the defendant's blood.[265] The blood was analyzed and found to contain a sufficient level of alcohol to suggest intoxication, and the analytic report was introduced at trial.[266] The defendant argued that this was a violation of his Fifth Amendment privilege, but the Court disagreed and laid out its influential distinction between "'communications' or 'testimony'" and "'real or physical'" evidence.[267] The Court noted that the Fifth Amendment "offers no protection against compulsion to submit to fingerprinting, photographing, or measurements, to write or speak for identification, to appear in court, to stand, to assume a stance, to walk, or to make a particular gesture."[268] As one state court observed, "No volition—that is, no act of willing—on the part of the mind of the defendant is required" for these types of evidence.[269] Rather "[t]he physical facts speak for themselves; no fears, no hopes, no will of the prisoner to falsify or to exaggerate could produce or create a resemblance of her

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262. Fox, *supra* note 206, at 801 (quoting Schmerber v. California, 384 U.S. 757, 764 (1966)).

263. 384 U.S. at 757.

264. *Id.* at 758.

265. *Id.*

266. *Id.* at 759.

267. *Id.* at 764.

268. *Id.*

269. People v. Sallow, 165 N.Y. Supp. 915, 924 (1917).

finger prints or change them in one line, and therefore there is no danger of error being committed or untruth told."[270]

One way to apply this rule is to argue that all brain data is physical (and not at all testimonial). As Hank Greely and Anthony Wagner remind us, "An fMRI scan is nothing more than a computer record of radio waves emitted by molecules in the brain. It does not seem like 'testimony.'"[271] An EEG might also be described as just a computer record of electrical waves.

But recall that the methods by which the neuroimaging data is collected require *subject response to questions*. This places such techniques squarely in the testimonial category.[272] Moreover, even if the subject is not required to answer questions as part of the research task, if the recorded brain data is subsequently used to make an inference about a mental state, then this *use* of the data should be seen as making it testimonial, because it is eliciting from the (fMRI or EEG measures of) physical brain tissue information about a mental state. If the brain data remain silent (that is, they are not analyzed), they communicate nothing about the subject's mental state (and are similarly irrelevant for introduction as evidence in later criminal proceedings). But when the intent is to analyze the data, and to make an inference about the subject's mind, it crosses the line into mind reading (and thus testimonial evidence).

Professor Pustilnik suggests an additional way in which the case law might be understood by pointing to the comparatively recent case of *Pennsylvania v. Muniz*,[273] in which the Supreme Court seemed to recognize an interest in mental privacy itself.[274] In *Muniz*, a defendant was asked a series of questions in custody without receiving a Miranda warning.[275] The purpose of these questions was to gauge the defendant's sobriety.[276] The Commonwealth argued in its brief that there was no Fifth Amendment

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270. *Id.*

271. Greely & Wagner, *supra* note 25, at 791.

272. Nugent makes this point as well: "Of course, the distinction between physical and testimonial evidence may be moot with respect to those neuroimaging techniques that require the subject to verbally respond to an investigator's questions." Nugent, *supra* note 220, at 293.

273. 496 U.S. 582 (1990).

274. *See* Pustilnik, *supra* note 226 (manuscript at 6–10).

275. *Muniz*, 496 U.S. at 585–86.

276. *See id.* at 586 (officers questioned drunk driving suspect as to whether he recalled the date of his sixth birthday).

privilege because "the inference concerns 'the physiological functioning of [Muniz's] brain'" and the brain is real, physical evidence.[277] The Court responded that "the question is not whether a suspect's 'impaired mental faculties' can fairly be characterized as an aspect of his physiology, but rather whether Muniz's response to the sixth birthday question that gave rise to the inference of such an impairment was testimonial in nature."[278] The Court found that "the privilege is [properly] asserted to spare the accused . . . from having to share his thoughts and beliefs with the Government."[279] Professor Pustilnik argues that *Muniz* suggests "a distinction between two sets of physical signs: (1) the nonprivileged set of physical signs that does not reveal evoked mental contents and (2) the privileged set of physical signs that does."[280] This distinction maps nicely on to the distinction this Article makes between *brain* reading (which should not be privileged) and *mind* reading (which should be privileged).

When courts have contemplated mind reading devices, it seems that they too would find a way to offer these constitutional protections to defendants. For instance, consider this court's musing in dicta:

> [S]hould lie detector and computer technology advance to permit an analysis of brainwave function and physiological effects to reflect thought, a machine might be developed to read the mind . . . . [B]ecause the existence of one's thoughts, one's cognitive process, is a "foregone conclusion," the contents of any thoughts one voluntarily creates could be used against one in a criminal proceeding under [a strict interpretation of the] the *Fisher–Doe* analysis.[281]

This, the court suggested, would be a problematic interpretation, as it would make Fifth Amendment protections redundant with those already provided by the Fifth and Fourteenth Amendments' Due Process Clauses.[282] "If the Fifth Amendment is to stand for our constitutional preference for an accusatorial

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277. *Id.* at 593 (quoting Brief for Petitioner at 21) (alteration in original).

278. *Id.* at 593–94.

279. *Id.* at 595 (quoting Doe v. United States, 487 U.S. 201, 213 (1988)) (internal quotation marks omitted).

280. Pustilnik, *supra* note 226 (manuscript at 9–10).

281. *In re* Grand Jury Subpoena Duces Tecum Dated May 9, 1990, 741 F. Supp. 1059, 1069 n.19 (S.D.N.Y. 1990).

282. *Id.* at 1069.

system," the court argued, "it must protect the divulgence of the contents of one's mind, one's thought processes, when those testimonial divulgences—be they oral or written communications—would self-incriminate."[283]

Not all agree that existing doctrine is sufficient. Professor Farahany, for example, argues that "[n]either 'physical' nor 'testimonial' accurately describes neurological evidence. Neuroscience involves noninvasive testing of the physical brain to gain evidence that has physical form. Just as nodding the head can communicate a response, so too can neurological changes in the brain."[284] Because "[m]ental privacy is not sacrosanct under either the Fourth or Fifth Amendment, which provide procedural safeguards but not substantive ones to adequately protect mental privacy,"[285] Farahany suggests that mental privacy may be at risk in the future:

> A society interested in robust cognitive freedom would likely wish to protect its citizens from unwarranted detection of automatic, memorialized, and uttered evidence in the brain. That current self-incrimination doctrine is unlikely to do so should give us pause. Private thoughts, private memories, and undisclosed ideas in the mind help to define our sense of autonomy and inviolate personality. A sphere of private rumination is essential to our fundamental concepts of freedom of thought, freedom of expression, freedom of will and individual autonomy. Whether or not we preserve that sphere may come to define us as a society as emerging neuroscience begins to take hold. And yet none of our con-

283. *Id.*

284. Farahany, *Incriminating Thoughts*, *supra* note 15, at 366. Professor Farahany correctly suggests that static information such as a structural scan (like a CT scan) would be allowed because, in comparable situations, "the Court has held that the privilege against self-incrimination does not protect an accused from compelled submission to physical testing for identifying evidence." *Id.* at 370. This Article also categorizes static information scans as brain reading (not mind reading) evidence, which does not receive Fifth Amendment protection. Professor Farahany's analysis also suggests the same result for functional scanning, such as the PET scan, of automatic brain functioning (for instance, to see if the defendant's brain is functioning normally a few weeks after a traumatic event). *See id.* Here I would distinguish not between automatic and non-automatic, but between brain reading and mind reading. A test case might be an automatic emotional response that we know is likely to be elicited from a certain stimulus, though this may be an argument over the semantics of the word "automatic."

285. *Id.* at 406.

> stitutional doctrines currently contemplate or afford adequate protection against such intrusions.[286]

Professor Farahany's logic has appeal. If we care primarily about seclusion, then our analysis should focus on the physical intrusiveness of the search, and as neuroscience methods allow for increasingly less intrusive searches, they might increasingly be allowed.[287] Less intrusive brain searches may well lead to more brain data in the hands of the government. But making use of this brain data to reliably infer mental states will require a significantly expanded neuroscientific knowledge base about the brain-mind relationship. It is not clear that such expansion will occur in the near future.

V. ADDITIONAL THREATS TO MENTAL PRIVACY

There may be only limited threats to mental privacy from government-compelled neuroimaging mind reading techniques in the criminal law arenas governed by the Fourth and Fifth Amendments. This does not mean, however, that there are no real threats to mental privacy; it simply means they are likely to appear in other places. This Part briefly discusses several areas of concern.[288]

A. Competency and Parole

Brain-based methods to assess competency may pose a significant threat to individuals' mental privacy.[289] Although de-

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286. *Id.* Farhany's suggested replacement is a spectrum that includes "identifying, automatic, memorialized, and uttered" types of evidence, with the "privilege against self-incrimination most naturally protect[ing] a defendant from being compelled to utter new evidence by which his condemnation will be secured." *Id.* at 400.

287. *See* Farahany, *Searching Secrets*, *supra* note 15, at 1282.

288. One additional area that I do not reach here is the use of brain data in determinations of future dangerousness. Predicting dangerousness is fraught with difficulty, and is an area where we should tread carefully. One review of the research comes to the conclusion that neuroimaging may be an extra tool, but not a replacement tool, for clinical evaluation. *See* J.W. Looney, *Neuroscience's New Techniques for Evaluating Future Dangerousness: Are We Returning to Lombroso's Biological Criminality?*, 32 U. ARK. LITTLE ROCK L. REV. 301, 307–08, 310 (2010).

289. For one of the few recent treatments, see Michael L. Perlin, *"And I See Through Your Brain": Access to Experts, Competency to Consent, and the Impact of Antipsychotic Medications in Neuroimaging Cases in the Criminal Trial Process*, 2009 STAN. TECH. L. REV. 4 (2009), *available at* http://stlr.stanford.edu/pdf/perlin-and-i-

fendants typically raise the competence question, it can also be raised by the state.[290] The government may file a motion to determine the defendant's competency.[291] As a result, "the court may order that a psychiatric or psychological examination of the defendant be conducted, and that a psychiatric or psychological report be filed with the court."[292] The standard for whether a defendant has competency to proceed is "whether he has sufficient present ability to consult with his lawyer with a reasonable degree of rational understanding and whether he has a rational as well as factual understanding of the proceedings against him."[293] Courts focus specifically on the defendant's competency to stand trial, not competence more generally.[294] Although it is not the norm, modern neuroimaging techniques are now supplementing competency evaluations in some cases.[295]

The uncertainty of brain-mind-behavior linkages becomes important in this context. Because the cases concern the defendant's demonstrated behavioral abilities to stand trial, "the existence of anatomical abnormalities [in a defendant's brain] is irrelevant in itself, provided that the court determines that the defendant displays sufficient cognitive capabilities to fulfill the *Dusky* [requirements]."[296] As a policy matter, the question is: Does adding the brain evidence improve our assessment of competence?[297] But as a matter of mental privacy protection, the question is: What if the defendant refuses to cooperate with

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see.pdf. Perlin also notes that the issue of competency is underexamined in the neuroimaging literature. *Id.* ¶ 4.

290. Note, *Requiring a Criminal Defendant to Submit to a Government Psychiatric Examination: An Invasion of the Privilege Against Self-Incrimination*, 83 HARV. L. REV. 648, 648 n.1 (1970) ("In the great majority of cases, the defendant will assert any incompetency or insanity 'defense.' However the state will sometimes raise the issue of the accused's incompetency.").

291. 18 U.S.C. § 4241(a) (2006).

292. *Id.* § 4241(b).

293. Dusky v. United States, 362 U.S. 402, 402 (1960) (per curiam).

294. *See, e.g.*, People v. Tolefree, 960 N.E.2d 27 (Ill. App. Ct. 2011).

295. Nugent, *supra* note 220, at 277 (noting that "increasing deference given during competency hearings to reliable and relevant neuroimaging evidence . . . is emerging in modern case law.").

296. *Id.* at 278.

297. Nugent reaches the same conclusion when she argues that "[g]iven the shortcomings of traditional psychological testing, particularly with respect to defendants who are skilled at disguising their true mental status, utilizing an array of methodologies will (at least sometimes) be the preferable approach in competency determinations." *Id.*

the exam? The Supreme Court has held that "[a] criminal defendant, who neither initiates a psychiatric evaluation nor attempts to introduce any psychiatric evidence, may not be compelled to respond to a psychiatrist if his statements can be used against him at a capital sentencing proceeding."[298] If a defendant does not cooperate, the American Bar Association's (ABA) guidelines suggest that the defendant can be observed for a limited period of time.[299] Perhaps someday this will include observation via a brain monitoring device.

Turning from the start of proceedings to the end, a mental health evaluation may be required as a precondition for parole.[300] At present, such mental health regulations do not explicitly require neuroimaging evidence as part of the mental health exam, nor do they explicitly exclude neuroimaging evidence. This might change, and one can imagine a future parole office where individuals, in addition to undergoing a drug test, go through a battery of neuroimaging tests.[301]

B. Police Investigation, Employee Screening, and National Defense

Although the polygraph is inadmissible in most courts, it is used regularly during police work.[302] And even though the polygraph is outlawed as a screening device for most private employ-

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298. Estelle v. Smith, 451 U.S. 454, 468 (1981).

299. AM. BAR ASS'N, CRIMINAL JUSTICE STANDARDS 7-4.6, *available at* www.americanbar.org/publications/criminal_justice_section_archive/crimjust_standards_mentalhealth_blkold.html.

300. In Delaware, for instance,

> No person who has been convicted of and imprisoned for any class A felony, felony sex offense or any felony wherein death or assault to a victim occurred shall be released from incarceration by the Parole Board until the Parole Board has considered a mental health evaluation of such person. The Parole Board, in its discretion, may request mental health evaluations on persons convicted and imprisoned for any offense not enumerated [in the code].

DEL. CODE ANN. tit. 11, § 4353(a) (2012).

301. *Cf.* Nugent, *supra* note 220, at 297 ("If a criminal defendant introduces neuroimaging evidence during trial . . . it is reasonable to wonder whether that same neuroimaging evidence could be either resurrected itself or used as impetus for additional neurological testing before the defendant's release . . . .").

302. Charles R. Honts & Mary V. Perry, *Polygraph Admissibility: Changes and Challenges*, 16 L. & HUM. BEHAV. 357, 357–58, 362 (1992).

ers through the Employee Polygraph Protection Act of 1988,[303] there are exceptions.[304] In short, the polygraph is used extensively despite significant legal protections against the use of polygraph results in criminal proceedings and employee hiring. The same may become true of neuroimaging mind reading if it is thought to aid in criminal investigation and employee screening.

Indeed, there is evidence that such methods may be useful in terrorist interrogations,[305] and a U.S. senator asked the General Accountability Office (GAO) to report on the value of brain fingerprinting for national security.[306] Whether such mind reading with neuroimaging is employed in practice will depend on how sensitive and precise the technology proves to be and on how resistant it is to countermeasures.[307]

C. Future Developments

Discussions of brain-based mind reading with neuroimaging necessarily involve predictions about the future. These predictions, as Murphy and Greely emphasize, are difficult to make.[308] But these predictions about the future have ramifications for the present because they focus our limited resources and attention on particular potential threats to mental privacy. Although it is important to be prepared, it is also important to stay grounded in what is likely to develop.

What follows is a brief, and tentative, prediction about the future use of neuroimaging data to make accurate assessments of higher order cognition in legally relevant ways.

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303. Pub. L. No. 100-347, 102 Stat. 646 (1988) (codified at 29 U.S.C. §§ 2001–09 (2006)).

304. *See* Yvonne Koontz Sening, Note, *Heads or Tails: The Employee Polygraph Protection Act*, 39 CATH. U. L. REV. 235, 236 (1989) (noting exemptions from the Act for government employers, national defense and security employers, the FBI, and employers involved in the manufacture, distribution, or dispensation of controlled substances).

305. *See, e.g.*, Meixner & Rosenfeld, *supra* note 162, at 153.

306. Farwell, *supra* note 151, at 144.

307. *See generally infra* Part V.C. Many researchers are skeptical. For example, Tong and Pratte suggest that, "[g]iven the conceptual challenges of developing reliable fMRI lie detection and the fact that people can use countermeasures to alter their patterns of brain activity, [it is] doubtful that the technology will progress to being truly reliable" in the foreseeable future. Tong & Pratte, *supra* note 136, at 503.

308. Murphy and Greely predict that there are "good reasons to expect neuroscience-based mind reading to hit major technical barriers before it reaches impressive levels of detail." Murphy & Greely, *supra* note 17, at 636.

When considering the striking visual reconstructions from fMRI data, one should find solace in the observation that "[t]he visual cortex is relatively easy to read compared to other parts of the brain that work together and influence our private thoughts."[309] Thus, impressive results about visual reconstruction may not be soon followed by reconstructions of memories and higher-level cognition.[310]

That said, there are important developments to note. First, the mobility of brain reading technology is improving rapidly.[311] Second, functional near-infrared imaging (fNIRI) is now being explored as an additional way to monitor brain function.[312] This approach "capitalizes on the absorption and scattering properties of near-infrared light to provide information about brain activity."[313] There is significant value in such a technology: "For the psychiatric researcher, these additional strengths can bring otherwise previously unthinkable projects into the realm of possibility."[314] A significant restriction is that it can only monitor the cortex.[315] But for some applications, that may not be an obstacle.[316] Third, researchers are improving their experimental tech-

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309. Yuhas, *supra* note 177, at 2.

310. *See, e.g.*, Tong & Pratte, *supra* note 136, at 498–99. "In studies of higher-level cognition, predefined regions of interest usually are not available, and multiple distributed brain areas might be involved in the cognitive task." *Id.* at 499.

311. *See, e.g.*, Amber Dance, *Notion in Motion: Wireless Sensors Monitor Brain Waves on the Fly*, SCI. AM., Jan. 27, 2012, http://www.scientificamerican.com/article.cfm?id=wireless-brain-wave-monitor.

312. Sergio Fantini et al., *Monitoring brain activity using near-infrared light*, 33 AM. LAB. 15, 15 (2001); Gary Strangman et al., *Non-Invasive Neuroimaging Using Near-Infrared Light*, 52 BIOLOGICAL PSYCHIATRY 679, 679 (2002).

313. Strangman et al., *supra* note 313.

314. *Id.* at 680.

315. Mateo Calderon-Arnulphi, Ali Alaraj, & Konstantin V. Slavin, *Near Infrared Technology in Neuroscience: Past, Present, and Future*, 31 NEUROL. RES. 605, 606–07 (2009) ("For typical absorption and scattering values of the human head and source-to-detector distances of 4 cm, a depth of the brain cortex of at least .3 cm is monitored.").

316. Infrared technology is also the backbone for some popular breathalyzer tools.

> An infrared breath testing instrument takes a picture/spectra of the alcohol present on the individuals [sic] breath. An infrared "picture" of an organic compound can positively identify the compound to the exclusion of all other organic compounds. A fingerprint identifying a person is analogous to an infrared "picture" identifying an organic compound. Not only can infrared technology be used to identify ethanol, it can also be used to determine how much alcohol is present in the breath sample. This quantitative ability of infrared technology is what makes infrared such a valuable tool to law enforcement. Infrared breath

niques. A scientific review in 2008 asked the question: "Brain Imaging and Brain Privacy: A Realistic Concern?"[317] After reviewing sixteen published fMRI studies relevant to the question of distinguishing individual differences in psychological traits, the authors concluded that "a modest degree of brainotyping capability already exists. The potential use of functional brain imaging to gain knowledge of someone's psychological traits is not science fiction, but rather a realistic possibility, albeit limited in important ways."[318] Such a conclusion would seem to suggest that we are on the verge of a mental privacy crisis, especially when combined with even a modest belief in scientific progress. But is this so? Is a mental privacy panic justified?

Neuroscientist Emily Murphy and legal scholar Hank Greely have argued that "both the excitement about and the fear of the consequences of mind reading are too extreme."[319] It is true that, despite major technical barriers preventing detailed mind reading, the law might still be interested in using "good enough" science.[320] As such, we need continued and careful monitoring of developments in neurolaw and mental privacy. But we need not fall into full-scale panic. Putting an MRI scanner in the police station will not trample on our mental freedoms because the complexity of the mind-brain relationship will prevent the government from using the brain data to reliably read individual minds.

Just how complex is the brain? It has been called "perhaps the most complex entity known to science."[321] Nobel laureate Roger Sperry has commented that "the centermost processes of the brain with which consciousness is presumably associated are simply not understood. They are so far beyond our comprehension that no one I know of has been able to imagine their nature."[322] MIT

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testing instruments have been used by law enforcement since the early 1980's.

STEPHEN L. JONES, DRUNK DRIVING DEFENSE, 50 MASS. PRACTICE SERIES: DRUNK DRIVING DEFENSE app. B-1 § 6.2 (2012).

317. Martha J. Farah et al., *Brain Imaging and Brain Privacy: A Realistic Concern?*, 21 J. COGNITIVE NEUROSCIENCE 119 (2008).

318. *Id.* at 124.

319. Murphy & Greely, *supra* note 17, at 636.

320. *Id.* at 649.

321. GAZZANIGA, *supra* note 17, at 9 (quoting T.M. Preuss, *The Discovery of Cerebral Diversity*, *in* EVOLUTIONARY ANATOMY OF THE PRIMATE CEREBRAL CORTEX 138, 138 (D. Falk & K. Gibson eds., 2001)) (internal quotation marks omitted).

322. *Id.* at 246 (quoting DENIS BRIAN, GENIUS TALK, CONVERSATIONS WITH NOBEL SCIENTISTS AND OTHER LUMINARIES 376 (1995)).

neuroscientist Sebastian Seung encourages us to think about a map of the brain (which he calls the "connectome") as similar to the "Where We Fly" maps used by airlines: "What you need to imagine is that every city is a neuron, and every flight between cities is a connection," except that "in our brains we would need to start with a hundred billion cities and thousands of flights per city."[323] Understanding this map, and even the relevant sub parts of it, will take an extremely long time. Even with rapid advances in neuroscience, it seems unlikely that in this generation or the next we will uncover enough about the brain to do the sort of mind reading imagined by Philip K. Dick.[324]

This is not to say that we will not learn much that has clinical applications; indeed, we already have. And this is not to say that neuroscience will not change law and policy; again, it already has. This *is* to say that as amazing as neuroscience is, it remains science and not science fiction.[325]

CONCLUSION

This Article has argued that the legal system is readily equipped to provide citizens with adequate protection against government-compelled or coerced mind reading with neuroimaging. The law has seen, and protected citizens from, previous analogs, and the technology itself is unlikely to be as dangerous as some prognosticators believe. We should certainly be concerned about the government tracking our minds, but we should be most concerned about government carrying out that tracking by observing and inferring mental states from our behavior, not our brains.

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323. *FiveBooks Interviews: Sebastian Seung on Identity and the Mind*, THE BROWSER (2012), http://thebrowser.com/interviews/sebastian-seung-on-identity-and-mind. *See generally* SEBASTIAN SEUNG, CONNECTOME: HOW THE BRAIN'S WIRING MAKES US WHO WE ARE (2012).

324. *See also* Tong & Pratte, *supra* note 136, at 503 (noting "major concerns" with the reliability of prospective lie detection technology, and the need for "[m]uch more research" on its validity).

325. As one commentator puts it, at present we do not "have the faintest clue about the biggest mystery of all—how does a lump of wet grey matter produce the conscious experience you are having right now, reading this paragraph? How come the brain gives rise to the mind? No one knows." Poole, *supra* note 80.