Will There Be a Neurolaw Revolution?

ADAM J. KOLBER*

The central debate in the field of neurolaw has focused on two claims. Joshua Greene and Jonathan Cohen argue that we do not have free will and that advances in neuroscience will eventually lead us to stop blaming people for their actions. Stephen Morse, by contrast, argues that we have free will and that the kind of advances Greene and Cohen envision will not and should not affect the law. I argue that neither side has persuasively made the case for or against a revolution in the way the law treats responsibility.

There will, however, be a neurolaw revolution of a different sort. It will not necessarily arise from radical changes in our beliefs about criminal responsibility but from a wave of new brain technologies that will change society and the law in many ways, three of which I describe here: First, as new methods of brain imaging improve our ability to measure distress, the law will ease limitations on recoveries for emotional injuries. Second, as neuroimaging gives us better methods of inferring people's thoughts, we will have more laws to protect thought privacy but less actual thought privacy. Finally, improvements in artificial intelligence will systematically change how law is written and interpreted.

---

* Professor of Law, Brooklyn Law School. For helpful comments, I thank Emad Atiq, Greg Caramenico, Deborah Denno, Joshua Greene, Paul Litton, John Mikhail, Stephen Morse, Kevin Murtagh, and Gideon Yaffe, as well as participants at Georgetown University Law Center's Law, Mind, and Brain Colloquium; the New York State Bar Association's Forensics and the Law III conference at New York University School of Law; Rutgers University School of Law–Camden's Neuroscience and the Law conference; and the SciFoo 2012 conference at the Googleplex in Mountain View, California. This project has been generously supported by a Brooklyn Law School research stipend and a visiting fellowship at New York University School of Law's Center for Research in Crime and Justice.

INTRODUCTION

The central debate in the field of neurolaw has focused on two claims. On the one hand, Joshua Greene and Jonathan Cohen argue that we do not have free will.[1] We are just mechanisms in the universe subject to the laws of nature who should not be held morally responsible for our actions.[2] They predict that advances in neuroscience will lead to a revolution in which the law stops deeming people responsible for their conduct.[3] On the other hand, Stephen Morse argues that we have free will because moral responsibility is compatible with our mechanistic nature.[4] He argues that the kind of advances in neuroscience that Greene and Cohen envision will not and should not affect the law.[5]

In my view, neither side has persuasively made the case for or against a neurolaw revolution. As to whether the law ought to change, neither Greene and Cohen nor Morse purport to offer new solutions to end the millennia-old debate about free will. As to whether our legal system will in fact change, both sides have yet to muster sufficient support. Greene and Cohen speculate that neuroscience will change our views about free will but offer little more than a thumbnail sketch of how and why those changes will occur. Morse claims that the law is at least partly insulated from the changes Greene and Cohen envision because the law holds us responsible in ways that are immune to evidence of mechanism.[6] While Morse may be right, he fails to exclude other plausible interpretations of current law.

While neither side of the debate has convincingly predicted how we will understand responsibility in the future, I claim that there will indeed be a neurolaw revolution. It may arise not from radical changes in our beliefs about criminal responsibility but from a wave of new brain technologies that will change society and the law in a wide variety of ways.

The precise nature of a technology-driven neurolaw revolution is difficult to predict, but I present three plausible hypotheses: First, as new methods of brain imaging improve our ability to measure distress, the law will ease limitations on recoveries for emotional injuries. Second, as neuroimaging gives us better methods of inferring the thoughts of others, we will have more laws to protect thought privacy but less actual thought privacy. And finally, improvements in artificial intelligence will systematically change how law is written and interpreted.

---

1. Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON B 1775, 1776 (2004).

2. *Id.* at 1781.

3. *Id.* at 1776.

4. Stephen J. Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO ST. J. CRIM. L. 397, 402 (2006) ("Many thorough-going naturalists, such as myself, who believe that all the phenomena of the universe are causally explicable by natural physical laws, believe that responsibility is compatible with determinism, a position termed 'compatibilism.'").

5. *See* Stephen J. Morse, *Neuroscience and the Future of Personhood and Responsibility*, *in* CONSTITUTION 3.0: FREEDOM AND TECHNOLOGICAL CHANGE 113, 122 (Jeffrey Rosen & Benjamin Wittes eds., 2011).

6. *See id.* at 119 (stating that contra-causal "free will plays no doctrinal role in criminal law and is not genuinely foundational for criminal responsibility").

I. A WEAK CASE FOR A RESPONSIBILITY REVOLUTION

A. The Free Will Impasse

The problem of free will is often understood as a conflict between determinism and responsibility. In a deterministic universe, the state of the universe today depends only on the state of the universe at some other point in time and on nonrandom laws of nature.[7] If we live in such a universe, we could, in principle, predict at the time of the Big Bang that you would eventually come into existence and read this sentence right now.[8] You may feel like you could have chosen otherwise, but in a deterministic universe, there is no possibility that you would, in fact, be doing something else right now.

Some believe that if we live in a deterministic world, we have no free will.[9] You could not have freely chosen to read this Article, they argue, if the universe allows for no alternative possibilities. Given that you were caused to read it by forces beyond your control, it makes no sense to deem you responsible for doing so. And if you are not responsible for your choices, then murderers are not responsible for theirs.[10] They too are victims of forces beyond their control. We *might* be justified in confining and rehabilitating them and trying to deter similar conduct by others. But we do not have grounds to deem them responsible for their crimes and ought not seek retribution.

As it happens, most scientists believe the universe is *not* deterministic.[11] Some physical events, like the decay of radioactive atoms, are truly random. We may know the average rates at which atoms decay, but the precise timing cannot possibly be predicted. But even if some events are truly indeterministic, we still have no control over them. We may be unable to perfectly predict when you will finish reading this sentence, but you are not responsible for the billions of sometimes randomly colliding particles that make you finish it when you do: How can we be responsible for actions that follow mechanistically from forces beyond our control? Thus, much of the conflict over free will can be framed in terms of mechanism. If we are mechanisms—like clocks that tick but have no moral agency—we arguably cannot be responsible at all.

I will focus on three views about free will that are most pertinent to debates in neurolaw (and I will depart somewhat from traditional practice by describing their relationships to mechanism rather than determinism).[12] According to "free will

---

7. *Cf.* JOHN MARTIN FISCHER, ROBERT KANE, DERK PEREBOOM & MANUAL VARGAS, FOUR VIEWS ON FREE WILL 2 (2007) ("Something is deterministic if it has only one physically possible outcome."); Gary Watson, *Introduction* to FREE WILL 1, 2 (Gary Watson ed., 1982).

8. GALEN STRAWSON, FREEDOM AND BELIEF 4 (rev. ed., 2010) (describing the "stronger" notion of determinism).

9. *See, e.g.*, Greene & Cohen, *supra* note 1, at 1777.

10. *See id.* (arguing that we should "recognize that free will . . . is an illusion and structure our society accordingly by rejecting retributivist legal principles that derive their intuitive force from [an illusion of responsibility]").

11. FISCHER ET AL., *supra* note 7, at 2.

12. For more traditional descriptions, see, for example, STRAWSON, *supra* note 8, at 4–7

skeptics," we cannot be morally responsible because moral responsibility is incompatible with mechanism, and we live in a mechanistic universe. Therefore, we are never responsible for our actions.

"Libertarians," as I will use the term,[13] agree that responsibility and mechanism are incompatible. They hold, however, that the universe is not mechanistic in the way that I presented, so we can still be responsible for our actions. I focus on those libertarians who believe we have free will because our souls make choices independent of the forces of the universe that govern mere things. While there are sophisticated forms of libertarianism that don't rely on souls,[14] I focus on soul-based libertarian theories because they are endangered by scientific advances that explain human behavior without relying on the notion of a soul.

Finally, "compatibilists," hold that moral responsibility is consistent with mechanism. On this view, even if our beliefs and intentions are caused by factors beyond our control, so long as we are rational creatures (or have certain other features compatibilists care about),[15] we can still be responsible for our actions.

There are, of course, other views related to free will, and the three I focus on have numerous variations. Yet the millennia-old debate about free will shows no signs of ending soon. Indeed, the debate has reached something of an impasse.

B. Greene and Cohen's Normative Claim

In a 2003 paper, Joshua Greene and Jonathan Cohen stepped into the fray. Greene and Cohen are free will skeptics who spend much of the paper defending the normative claim that we should stop holding people responsible for their actions and try to banish the retributivist impulses that guide much of the criminal justice system.[16] If they are right, we should radically change not only criminal law but other areas of the law that appear to require responsibility, including contract and tort law.[17] Given its dramatic implications, Greene and Cohen's paper has caught the attention of many legal scholars[18] and shaped a substantial part of the debate in neurolaw.[19]

The attention in legal circles focuses almost exclusively on Greene and Cohen's defense of free will skepticism.[20] But as they readily acknowledge, their normative

---

and Watson, *supra* note 7, at 1–11.

13. The "libertarian" label in free will contexts is unrelated to its usage in political contexts.

14. Watson, *supra* note 7, at 11.

15. *See, e.g.*, HARRY G. FRANKFURT, *Freedom of the Will and the Concept of a Person*, *in* THE IMPORTANCE OF WHAT WE CARE ABOUT 11, 19–25 (1988) (claiming that even mechanistic actions can be freely willed if an individual is capable of developing second-order desires about his first-order desires).

16. Greene & Cohen, *supra* note 1, at 1776.

17. *See* Morse, *supra* note 5, at 121.

18. *See, e.g.*, Michael S. Pardo & Dennis Patterson, *Neuroscience, Normativity, and Retributivism*, *in* THE FUTURE OF PUNISHMENT 133, 134–35 (Thomas Nadelhoffer ed., 2013); O. Carter Snead, *Neuroimaging and the "Complexity" of Capital Punishment*, 82 N.Y.U. L. Rev. 1265, 1299–338 (2007).

19. A search of Westlaw's Journal and Law Review (JLR) database on November 22, 2013 returned seventy-one hits for "Greene /p Cohen /p neuroscience."

20. *See, e.g.*, Pardo & Patterson, *supra* note 18; Snead, *supra* note 18.

claims about free will essentially just rehash familiar arguments in a longstanding debate that has raged for centuries.[21] Greene and Cohen certainly provide an opportunity to reconsider these age-old questions. But, as far as I can tell, they make no new contributions to the philosophical debate about free will, nor do they purport to do so.

C. Greene and Cohen's Prediction

Greene and Cohen make a different claim, however, that has received almost no attention from legal scholars. They predict that, as neuroscience vividly demonstrates the mechanistic nature of our behavior, people will be less inclined to blame criminals and more inclined to punish on consequentialist grounds. This prediction is the central focus of their abstract, which states in pertinent part:

> We argue that neuroscience will probably have a transformative effect on the law, despite the fact that existing legal doctrine can, in principle, accommodate whatever neuroscience will tell us. New neuroscience will change the law, not by undermining its current assumptions, but by transforming people's moral intuitions about free will and responsibility. This change in moral outlook will result not from the discovery of crucial new facts or clever new arguments, but from a new appreciation of old arguments, bolstered by vivid new illustrations provided by cognitive neuroscience. We foresee, and recommend, a shift away from punishment aimed at retribution in favour of a more progressive, consequentialist approach to the criminal law.[22]

Thus, they predict that as people become more vividly acquainted with the mechanistic nature of human decision making, they will find retributivist punishment increasingly unpalatable and adopt consequentialist punishment practices instead. Except when they mention that they recommend the transformation they predict, the abstract focuses exclusively on prediction.

Greene and Cohen's prediction is not entirely original either. As they recognize,[23] Robert Wright made much the same claim in 1994.[24] But this vision of the future has not received much attention, and Greene and Cohen certainly add to it. In particular, they offer the following thought experiment:

---

21. *See* Greene & Cohen, *supra* note 1, at 1776–77 ("We . . . consider the standard responses to the philosophical problem of free will. . . . The problem of free will is old and has many formulations.") (citation omitted); *id.* at 1783 ("[W]e should briefly address some standard concerns about the rejection of free will and conceptions of responsibility that depend on it."); *cf. id.* at 1775 ("New neuroscience will affect the way we view the law, not by furnishing us with new ideas or arguments about the nature of human action, but by breathing new life into old ones.").

22. Greene & Cohen, *supra* note 1, at 1775.

23. *Id.* at 1781.

24. *See* ROBERT WRIGHT, THE MORAL ANIMAL: EVOLUTIONARY PSYCHOLOGY AND EVERYDAY LIFE 351–56 (1994).

> Imagine, for example, watching a film of your brain choosing between soup and salad. The analysis software highlights the neurons pushing for soup in red and the neurons pushing for salad in blue. You zoom in and slow down the film, allowing yourself to trace the cause-and-effect relationships between individual neurons—the mind's clockwork revealed in arbitrary detail. You find the tipping-point moment at which the blue neurons in your prefrontal cortex out-fire the red neurons, seizing control of your pre-motor cortex and causing you to say, 'I will have the salad, please'.
>
> At some further point this sort of brainware may be very widespread, with a high-resolution brain scanner in every classroom. People may grow up completely used to the idea that every decision is a thoroughly mechanical process, the outcome of which is completely determined by the results of prior mechanical processes. What will such people think as they sit in their jury boxes? Suppose a man has killed his wife in a jealous rage. Will jurors of the future wonder whether the defendant acted in that moment *of his own free will*? Will they wonder if it was *really him* who killed his wife rather than his *uncontrollable anger*? Will they ask whether he *could have done otherwise*? Whether he really *deserves* to be punished, or if he is just a victim of unfortunate circumstances? We submit that these questions, which seem so important today, will lose their grip in an age when the mechanical nature of human decision-making is fully appreciated. The law will continue to punish misdeeds, as it must for practical reasons, but the idea of distinguishing the truly, deeply guilty from those who are merely victims of neuronal circumstances will, we submit, seem pointless.[25]

Thus, Greene and Cohen make an "empirical prediction that may or may not hold: as more and more scientific facts come in, providing increasingly vivid illustrations of what the human mind is really like, more and more people will develop moral intuitions that are at odds with our current social practices."[26]

Granted, the truth about free will may bear on their prediction. If you agree with Greene and Cohen that mechanism and moral responsibility are incompatible *and* you expect others to acquire the correct belief over time, then you have some reason to believe in their prediction. But even if a belief is true, there is no guarantee that others will come to adopt it. You may hold particular religious beliefs, but the truth or falsity of your beliefs tells us little about whether others will come to agree with you. To properly evaluate Greene and Cohen's prediction, we must consider evidence from history, psychology, anthropology, religion, and more. But while these nonphilosophical considerations are critical to their prediction, Greene and Cohen say little about them.

---

25. Greene & Cohen, *supra* note 1, at 1781 (emphasis in original).
26. *Id.* at 1781 (citation omitted).

D. Where Their Prediction Needs Strengthening

I am sympathetic to Greene and Cohen's vision of the future. As they and others continue to gather evidence bearing on their prediction,[27] here are three areas where their prediction is most in need of further evidence or clarification:

1. The Thought Experiment Is Weak

The soup-or-salad thought experiment is the principal tool Greene and Cohen use to persuade us that people's beliefs will in fact change. They ask us to imagine watching a film of our brains while choosing between soup and salad. As we come to understand the cause-and-effect relationships between our neurons and our ultimate soup-or-salad response, we are supposedly led to see ourselves as automata rather than as freely willed agents.

It is hardly clear, though, that the proposed illustration—were it possible to create—would have the effect they envision. There is no question that we *feel* like we have free will. If the imagined scanner works in real time (as Greene and Cohen imply), then as we feel inclined to pick soup, we will see the scanner reflect our inclinations. So long as the scanner merely shows how our soup-or-salad response is mediated by our character or preferences, it will not alienate us from our sense of having free will. We would not be disappointed to learn that on hot days we choose salad over soup. The fact that temperature affects our food preferences does not undermine our sense of free will. Moreover, if we could test the machine's accuracy by deliberately changing our inclinations and watching the machine reflect what *feels* like a genuine change of preference, then the imagined scanner might even reinforce our sense of having free will.

The soup-or-salad demonstration might have more bite if it showed how our choice was dictated by factors entirely external to us, such as the state of the world before our births. Such a machine might be immune to my suggestion that we test it by changing our inclinations, since the machine would have predicted the flip-flop in advance. But the causal path from before our births until our soup-or-salad decisions would be so complicated that we humans would be unable to appreciate the pathways. Maybe we would only comprehend a small part of the mechanism in a way that never packs the epiphanic punch that Greene and Cohen imagine.

Moreover, Greene and Cohen speak of a brain scanner, not a "world scanner." Predictions that precede our birth would require the machine to know not only the detailed contents of our brains but also the state of the rest of the world. Even a machine that made short-term predictions would need to know more than just the contents of our brains since a passing breeze moments before deciding could cause you to switch from soup to salad. No one anticipates seeing a "world scanner," except perhaps in the most distant future, and it may be impossible to build in principle (the universe might end before the pertinent calculations could be made).

---

27. *See* E-mail from Joshua Greene, John and Ruth Hazel Assoc. Prof. of the Social Sciences, Harvard Univ. Dep't of Psychology, to author (Oct. 2, 2013, 05:16 PM) (on file with author) (describing an unpublished research study supporting the view that exposure to the neuroscience of decisionmaking reduces retributive impulses).

Hence, it's not clear that the kind of brain scanner they discuss would really persuade. Even vivid neuroscientific displays from the distant future might fail to convince us to become free will skeptics.

2. Recent History Does Not Clearly Support Their Prediction

Though the kind of neurotechnology in the soup-or-salad hypothetical is still far away, neuroscientists have made remarkable progress over the last several decades in understanding the brain. Along the way, they have already conducted several experiments that, like the soup-or-salad brain scanner, seem to vividly remind us that we are mechanisms. Yet these vivid displays have yet to change the legal system in any obvious ways.

In the 1960s, for example, neuroscientist Jose Delgado inserted devices into the brains of animals that he used to control their actions.[28] In one dramatic episode, a bull charged at Delgado until, moments before the anticipated impact, Delgado pressed a button on a radio transmitter that activated a device in the bull's brain and caused it to stop.[29] A front-page story in the *New York Times* called it "probably the most spectacular demonstration ever performed of the deliberate modification of animal behavior through external control of the brain."[30]

By showing that we can neuroscientifically manipulate a bull's behavior, its brain arguably seems more like a mechanism and less like something that enables free choice. And since we could in principle do the same demonstration with humans, our brains also seem more like mechanisms and less like enablers of free choice. According to Greene and Cohen, such vivid demonstrations of mechanism are supposed to make our traditional notions of responsibility seem suspect, but they offer no evidence that experiments like Delgado's actually did.

In the early 1980s, Benjamin Libet and colleagues began reporting experiments on the timing of our intentions to act using electrodes on the scalp to measure brain activity.[31] Subjects were instructed to press a button whenever they felt like it and to note the position of a fast-moving clock hand when they decided to press it.[32] Roughly 350 to 800 milliseconds *before* subjects were consciously aware that they intended to press the button, researchers consistently detected distinctive brain activity signaling that a button press was imminent.[33] In other words, we can predict that a subject is about to press a button before the subject himself.

---

28. *See, e.g.*, John Horgan, *The Forgotten Era of Brain Chips*, SCI. AM., Oct. 1, 2005, at 66, 67–68.

29. *Id.* at 69–70.

30. John A. Osmundsen, *'Matador' With a Radio Stops Wired Bull*, N.Y. TIMES, May 17, 1965, at A1.

31. *See* Benjamin Libet, Curtis A. Gleason, Elwood W. Wright & Dennis K. Pearl, *Time of Conscious Intention to Act in Relation to Onset of Cerebral Activity (Readiness-Potential): The Unconscious Initiation of a Freely Voluntary Act*, 106 BRAIN 623 (1983); DANIEL M. WEGNER, THE ILLUSION OF CONSCIOUS WILL 50–55 (2002).

32. Libet et al., *supra* note 31, at 624.

33. *Id.* at 623.

Supposing the Libet experiments really demonstrate the phenomena just described,[34] the results should come as no surprise to mechanists.[35] Thought processes require brain activity. We cannot develop an intention—including the intention to press a button—without some prior brain activity to instantiate the intention. Nevertheless, vividly seeing how unconscious brain activity precedes mental activity reminds us that we are mechanisms: we don't need to postulate a first-moving soul to explain how we make decisions.

Nevertheless, experiments like those of Libet and Delgado have not obviously led to a neurolaw revolution. If Greene and Cohen are correct that vivid illustrations of brain mechanisms lead to societal reductions in retributive impulses, we would plausibly expect retributive sentiments to have declined over the last several decades. Yet, Greene and Cohen cite no such data.

Indeed, the United States has grown increasingly punitive in recent decades,[36] a period that largely coincides with the development in neuroscience of more vivid illustrations of brain mechanism. The data are surely ambiguous: crime is constantly changing in frequency and severity, and societal retributivist impulses may be getting weaker as incentives to achieve instrumental goals like deterrence and incapacitation are getting stronger. At least among law professors, however, the last several decades have seen a rebirth in retributivist scholarship:

> Thirty years ago, a new generation of philosophers demanded a criminal law founded on blame—on unembarrassed condemnation where condemnation is warranted. They have made themselves dominant on the American philosophical scene, both in our analysis of substantive doctrine and in our general understanding of the propriety of criminal punishment. Indeed, we have had nothing less than a renaissance of retributivist punishment philosophy . . . .[37]

The rebirth in retributivist scholarship largely coincides with these more vivid illustrations of brain mechanism. Nevertheless, Greene and Cohen never say whether existing, fairly vivid illustrations of mechanism in neuroscience, genetics, and social psychology have had an impact on our criminal justice policies. If those illustrations have had little impact, then Greene and Cohen should explain why.

---

34. For doubts about the standard interpretation of Libet's experiments, see, for example, Aaron Schurger, Jacobo D. Sitt & Stanislas Dehaene, *An Accumulator Model for Spontaneous Neural Activity Prior to Self-Initiated Movement*, 109 PROC. NAT'L ACAD. SCI. U.S. AM., at E2904 (2012).

35. *Cf.* Neil Levy, *Libet's Impossible Demand*, 12 J. CONSCIOUSNESS STUD. 67, 68 (2005) ("We do not need experimental results to show that we do not exercise the kind of control that seems to be at issue in the debate over Libet's experiments.").

36. James Q. Whitman, *A Plea Against Retributivism*, 7 BUFF. CRIM. L. REV. 85, 85 (2003) ("[T]he United States has embarked on a campaign of intensifying harshness in criminal punishment over the last three decades or so.").

37. *Id.* at 87.

3. The Path to Social Change Is Unclear

Perhaps the most serious critique of Greene and Cohen's prediction is that they never give a clear explanation of how vivid neuroscience demonstrations are supposed to change people's views in a manner subsequently reflected in the law. The soup-or-salad thought experiment purports to describe an effect on laypeople's views. It seems, at least at first, that we are to imagine a kind of grassroots support for a mechanistic view of the world. Presumably, laws will change because lawmakers and their constituents will no longer view crime in retributivist terms.

But as Greene and Cohen readily acknowledge, "Our intuitive sense of free will runs quite deep, and it is possible that we will never be able to fully talk ourselves out of it."[38] "[O]ne might wonder," they note, "whether one can so much as make a decision without implicitly assuming that one is free to choose among one's apparent options."[39] They even marshal considerable empirical research that recognizes the deep-seated nature of our retributive impulses:

> Regarding responsibility and punishment, one might wonder if it is humanly possible to deny our retributive impulses. This challenge is bolstered by recent work in the behavioural sciences suggesting that an intuitive sense of fairness runs deep in our primate lineage and that an adaptive tendency towards retributive punishment may have been a crucial development in the biological and cultural evolution of human sociality. . . . If retributivism runs that deep and is that useful, one might wonder whether we have any serious hope of, or reason for, getting rid of it. Have we any real choice but to see one another as free agents who deserve to be rewarded and punished for our past behaviours?[40]

Precisely because our retributivist impulses are so strong, we may adopt, as Chris Kaposy has suggested, various strategies to cordon off beliefs that are in conflict. Kaposy notes, for example, that even if science does show that free will is an illusion, people may resist adopting perspectives that challenge deep aspects of their identity, perhaps the way some theists resist evidence of evolution.[41] Or, people might isolate their views about science from the ways in which they conduct their daily lives.[42]

In fact, however, Greene and Cohen at least briefly addressed Kaposy's concerns in their paper by noting that they do not necessarily envision a popular uprising against retributivist criminal law. Rather, they note, expert decision makers will use their belief in mechanism to rid the law of its ancient retributive impulses:

---

38. Greene & Cohen, *supra* note 1, at 1781.

39. *Id.* at 1784.

40. *Id.* (citations omitted).

41. Chris Kaposy, *Will Neuroscientific Discoveries About Free Will and Selfhood Change our Ethical Practices?*, 2 NEUROETHICS 51, 53–54 (2009).

42. *Id.* at 54.

> [M]odern physics tells us that space is curved. Nevertheless, it may be impossible for us to see the world as anything other than flatly Euclidean in our day-to-day lives. . . . Does it then follow that we are forever bound by our innate Euclidean psychology? The answer depends on the domain of life in question. In navigating the aisles of the grocery store, an intuitive, Euclidean representation of space is not only adequate, but probably inevitable. However, when we are, for example, planning the launch of a spacecraft, we can and should make use of relativistic physical principles that are less intuitive but more accurate. In other words, . . . [f]or most day-to-day purposes it may be pointless or impossible to view ourselves or others in this detached sort of way. But—and this is the crucial point—it may not be pointless or impossible to adopt this perspective when one is deciding what the criminal law should be or whether a given defendant should be put to death for his crimes.[43]

Greene and Cohen correctly point out that we can, at least in principle, recognize biases in our decision making and overcome them in special contexts. This response raises questions, however, about the arguments supporting their prediction. The vivid neuroscience displays that are supposed to change people's minds operate more at the level of gut instinct than rational thought. Are the expert decision makers who set criminal justice policy swayed merely by vividness? If they are, why think that the vivid illustrations of neuroscience will speak to them more strongly than their deep retributive impulses? Alternatively, if they are not swayed by gut instincts and vivid illustrations, then why expect their views to change in the future?

Perhaps some dynamic account of political power, legal expertise, and laypeople preferences could put the pieces together. Perhaps there are experts who will support the changes Greene and Cohen recommend when there is more political will to make it a reality. Greene and Cohen's prediction is unconvincing, however, until they explain why wise decision makers are swayed more by vivid displays than by instinctual retributive impulses.

Even if their prediction comes true, more argument is necessary to show that we will adopt the consequentialist policies Greene and Cohen endorse. Perhaps people will be inclined to abolish punishment or punish under some entirely different nonretributivist justification.[44] Thus, Greene and Cohen leave us with no clear sense as to why the future they envision is likely to eventuate.

4. Ways to Bolster Their Prediction

There are several avenues of research that could potentially bolster Greene and Cohen's prediction. First, I have noted that, at least among legal scholars, there is

---

43. Greene & Cohen, *supra* note 1, at 1784.

44. Stephen Morse correctly notes that consequentialist policies are not entailed by the belief that mechanism and responsibility are inconsistent. Stephen J. Morse, *Avoiding Irrational NeuroLaw Exuberance: A Plea for Neuromodesty*, 62 MERCER L. REV. 837, 856 (2011). And even if they were, as a predictive matter, people may or may not adopt conclusions that are entailed by their other beliefs.

little evidence that advances in neuroscience have so far dampened enthusiasm for retributivist punishment. But the claim warrants further attention. Greene and Cohen could argue that as vivid as the Libet-style experiments are, they are still insufficiently vivid to kick-start a neurolaw revolution. Moreover, over the last several years, a growing number of writers, many of them scientists, have taken the position that neuroscience *should* change our criminal justice practices.[45] Perhaps we are merely waiting for a tipping-point change in public opinion. Importantly, since the publication of Greene and Cohen's paper, the Supreme Court has begun citing neuroscience research on issues related to culpability.[46] The neuroscience data in such cases may be offered simply to support conclusions reached by the Justices on other grounds, and either way, the Court has issued not the slightest inkling that all attributions of legal responsibility are in jeopardy. But if such trends continue, they provide some support for Greene and Cohen's prediction.

Second, we need a more detailed account of how vivid illustrations change the entrenched beliefs of both laypeople and experts. Some recent experiments suggest that people induced to disbelieve in free will are more willing to cheat[47] and less inclined to help others in laboratory settings.[48] These studies provide at least some evidence that information about free will and responsibility can change beliefs and actions. But the observed effects are presumably temporary. The researchers who conducted these studies were probably not afraid that subjects leaving their laboratories were going to be more dishonest and unhelpful than they were before the experiment. Exactly how the vivid illustrations Greene and Cohen discuss would affect us, though, is an area ripe for further investigation.

Third, we can probably envision thought experiments more persuasive than the soup-or-salad example. For example, imagine a pill that, for a two-hour period, makes us temporarily addicted to some drug. The experience of taking the pill might make us more sympathetic to addicts. We might find their cravings so

---

45. *See, e.g.*, David Eagleman, *The Brain on Trial*, ATLANTIC, July–Aug. 2011, at 112, 115 ("Discoveries in neuroscience suggest a new way forward for law and order—one that will lead to a more cost-effective, humane, and flexible system than the one we have today."); Gareth Cook, *Neuroscience Challenges Old Ideas About Free Will*, SCI. AM., (Nov. 15, 2011), http://www.scientificamerican.com/article.cfm?id=free-will-and-the-brain-michael-gazzaniga-interview (quoting neuroscientist Michael Gazzaniga saying "I think we will get over the idea of free will").

46. For example, the Supreme Court has cited neuroscience evidence about the impulsivity and risk preferences of juveniles in order to make inferences about juvenile culpability, even though the neuroscience evidence tells us little about culpability that we did not already know from psychological research and our own life experiences. *See, e.g.*, Miller v. Alabama, 132 S. Ct. 2455, 2465 n.5 (2012) (favorably citing extensive neuroscience evidence presented in amicus briefs); Graham v. Florida, 130 S. Ct. 2011, 2026 (2010) ("[D]evelopments in psychology and brain science continue to show fundamental differences between juvenile and adult minds. For example, parts of the brain involved in behavior control continue to mature through late adolescence.").

47. Kathleen D. Vohs & Jonathan W. Schooler, *The Value of Believing in Free Will: Encouraging a Belief in Determinism Increases Cheating*, 19 PSYCHOL. SCI. 49 (2008).

48. Roy F. Baumeister, E.J. Masicampo & C. Nathan DeWall, *Prosocial Benefits of Feeling Free: Disbelief in Free Will Increases Aggression and Reduces Helpfulness*, 35 PERSONALITY & SOC. PSYCHOL. BULL. 260 (2009).

powerful that we decide they should not be held fully responsible for their behavior. While such pills would neither eliminate retributive impulses nor demonstrate that free will does not exist, they might do more than the soup-or-salad example to alter views about punishment.

Fourth, research into other "responsibility revolutions" could bolster Greene and Cohen's prediction. For example, during the last millennium, there have been numerous instances in which nonhuman animals, like pigs and moles, have been put on trial and sentenced for crimes of various sorts. In *The Criminal Prosecution and Capital Punishment of Animals*,[49] E.P. Evans described more than two hundred such trials from 824 to 1906, spanning Europe and many other parts of the world, including the United States,[50] and it is likely that he discovered just a small fraction of the trials actually conducted.

It is difficult to know whether people who participated in animal trials really considered animals morally responsible. Researchers Dorothy Cheney and Robert Seyfarth believe participants did: "People in the Middle Ages were not careless anthropomorphizers; they clearly recognized that animals were not people. Nevertheless, the behavior of their animals often led people to believe that animals could be aware of what they did and held accountable for their acts."[51] Paul Berman agrees, arguing that "[t]he historical evidence indicates that communities viewed these trials seriously" and "jurists and philosophers debated the propriety of holding animals responsible for crimes."[52] As evidence, Berman notes that trial practices of the day seem consistent with the view that people were actually trying to determine whether a particular animal or group of animals was criminally culpable:

> The prosecution was represented by professional advocates, and defense lawyers were also hired. Witnesses and evidence were heard prior to judgment. And though the animals were usually found guilty, such a verdict was certainly not assured. For example, in 1457, the sucklings of a sow that had murdered a five-year-old child were included in the indictment. They had been found at the scene of the crime stained with blood, but "in lack of any positive proof that they had assisted in mangling the deceased, they were restored to their owner, on condition that he should give bail for their appearance, should further evidence be forthcoming to prove their complicity in their mother's crime." Likewise, in 1750 at Vanvres, France, a man and a donkey, discovered in an act of copulation, were both charged with bestiality, but while the man was sentenced to death, the donkey was subsequently acquitted on the ground that she was the victim of violence and had not participated in her master's crime of her own free

---

49. E.P. EVANS, THE CRIMINAL PROSECUTION AND CAPITAL PUNISHMENT OF ANIMALS (1906).

50. *Id.* at 313–34.

51. DOROTHY L. CHENEY & ROBERT M. SEYFARTH, HOW MONKEYS SEE THE WORLD: INSIDE THE MIND OF ANOTHER SPECIES 1 (1990).

52. Paul Schiff Berman, *Rats, Pigs, and Statues on Trial: The Creation of Cultural Narratives in the Prosecution of Animals and Inanimate Objects*, 69 N.Y.U. L. REV. 288, 290 (1994).

> will. At the trial, the defense had presented a statement signed by many inhabitants of the community stating that they had known the donkey for four years, and that "she had always shown herself to be virtuous and well-behaved both at home and abroad and had never given occasion of scandal to anyone, and that therefore, 'they were willing to bear witness that she is in word and deed and in all her habits of life a most honest creature.'" This document seems to have had a decisive influence upon the judgment of the court.[53]

Now such practices seem incomprehensible. The ways in which our views have changed about the responsibility of nonhuman animals (or of criminally insane humans) may tell us a lot about the nature of responsibility revolutions like the one that Greene and Cohen predict.[54]

II. A WEAK CASE THAT LAW IS INSULATED FROM REVOLUTION

Unlike Greene and Cohen, Stephen Morse is a compatibilist. He believes that the universe is mechanistic[55] but that we can still be morally responsible.[56] Morse also disagrees with Greene and Cohen's prediction. He believes "the dystopia that Greene and Cohen predict is not likely to come to pass" because "[t]here is little reason at present to believe that we are not agents."[57]

On Morse's view, it is a mistake to excuse a person's conduct simply because his brain "made him" do it. Essentially all of our actions are caused by our brains, but unless a person lacks the requisite capacity to be rational or has some other excuse, Morse believes he can nevertheless be held responsible. Thinking a person excused merely because his behavior was caused evinces what Morse

---

53. *Id.* at 300–01 (footnotes omitted).

54. Even today, there are modern day equivalents of animal trials. Consider how Yellowstone National Park rangers decide which grizzly bears to euthanize:

> In the mid-1980s, a group of federal and state wildlife biologists called the Interagency Grizzly Bear Committee put out a set of formal guidelines—sort of like a penal code for wild animals. The rules are quite elaborate but essentially they state: If a grizzly hurts someone while acting in a naturally aggressive way, then the bear goes free. If a grizzly acts unnaturally aggressive, though, and injures a person, it must be euthanized. It all comes down to the animal's state of mind.

Jessica Grose, *A Death in Yellowstone: On the Trail of a Killer Grizzly Bear*, SLATE (Apr. 2, 2012, 6:00 AM), http://www.slate.com/articles/health_and_science/death_in_yellowstone/2012/04/grizzly_bear_attacks_how_wildlife_investigators_found_a_killer_grizzly_in_yellowstone_.single.html.

55. Morse, *supra* note 4, at 398.

56. *Id.* at 405 ("If [a] person meets the behavioral criteria for responsibility, the person should be held responsible, whatever the brain evidence may indicate, such as the presence of an abnormality.").

57. Morse, *supra* note 5, at 122. In these two sentences, Morse blurs the line between normative commitment and positive prediction: the strength of the evidence of our agency is just one consideration in determining whether or not we will continue to view ourselves as responsible agents. We may never come to see the light that Morse seeks to shine upon us.

tongue-in-cheek calls "brain overclaim syndrome."[58] People have brain overclaim syndrome when they accept that we are sometimes responsible for our behavior but nevertheless believe that any brain-based causal explanation of behavior is exculpatory.[59] (Of course, if free will skeptics like Greene and Cohen are right, then Morse is suffering from what we might call "brain *underclaim* syndrome," by failing to recognize that mechanism is always exculpatory.)

A. Legal Presuppositions About Responsibility

Morse's central contribution to neurolaw, however, does not concern his substantive views about free will. Like Greene and Cohen, he does not purport to offer new arguments to resolve the free will impasse. His central contribution concerns the relationship between law and advances in neuroscience. He argues that to the extent neuroscience merely gives us a fuller picture of brain mechanisms, it ought not affect the law because the law does not require us to be the ultimate physical cause of our behavior.[60]

Provided we have no excusing condition like insanity, the law deems us responsible for our actions because, Morse writes, "the law's official position" is "that conscious, intentional, rational, and uncompelled agents may properly be held responsible."[61] According to Morse, "[t]he law treats persons generally as intentional creatures and not simply as mechanistic forces . . . ."[62] Legal doctrine is not framed in neuroscientific terms but in the more familiar language of beliefs, desires, and intentions.[63] Neuroscience could justify radical revisions to the law on Morse's view if it were able to show that "humans are not intentional creatures who act for reasons and whose mental states play a causal role in their behavior."[64] But being the ultimate physical cause of our own behavior is not "a criterion of any civil or criminal law doctrine."[65]

In addition to defending compatibilism as a normative matter, Morse makes positive claims about the law and finds a special affinity between compatibilism and current law.[66] He does not explicitly deem the law fundamentally compatibilist,

---

58. Morse, *supra* note 4, at 397.

59. *Cf. id.* at 406 ("[T]he final expression of [brain overclaim syndrome] is to make claims about the relation of the brain to responsibility that cannot be sustained logically or empirically.").

60. *Id.* at 399–400.

61. Morse, *supra* note 5, at 120; *see also* Emad H. Atiq, *How Folk Beliefs About Free Will Influence Sentencing: A New Target for the Neuro-Determinist Critics of Criminal Law*, 16 NEW CRIM. L. REV. 449, 463 (2013) (stating that legal scholars like Stephen Morse "observe that the *legal* concept of 'free will' is . . . *compatibilist*" and "persuasively argue that substantive legal doctrine does not rely on a metaphysically suspect notion of free will" (emphasis in original)).

62. Morse, *supra* note 44, at 840.

63. *See id.* at 841.

64. Morse, *supra* note 5, at 120.

65. Stephen J. Morse, *The Non-Problem of Free Will in Forensic Psychiatry and Psychology*, 25 BEHAV. SCI. & LAW 203, 203 (2007) [hereinafter Morse, *Non-Problem*].

66. *See, e.g.*, Stephen J. Morse, *Compatibilist Criminal Law*, *in* THE FUTURE OF PUNISHMENT, *supra* note 18, at 107.

though he seems amenable to the possibility and excludes certain noncompatibilist interpretations.[67] If current law is rooted in compatibilist presuppositions, a responsibility revolution would be less likely. A fundamentally compatibilist criminal law would be insulated from advances in neuroscience that merely elucidate brain mechanism. The current state of the law would slow the path to revolution.

Indeed, the law may presuppose Morse's compatibilist view of free will. Surely it is generally *consistent* with compatibilism as it holds us responsible without *explicitly* worrying about whether or not we are mechanisms. But there is a difference between being consistent with a particular theory and being fundamentally committed to the theory. After all, the law is also *consistent* with a very different theory. The law may view us as libertarian souls not bound by the laws of physics. Our choices may be viewed as somehow special, occurring outside the boundaries of the natural world.

If the law is rooted in certain libertarian conceptions of responsibility, then it is vulnerable to the kind of neuroscientific evidence Greene and Cohen discuss. The view that we are libertarian souls *is* threatened as neuroscience becomes more powerful and comprehensive. The better neuroscience becomes, and, as Greene and Cohen suggest, the easier it is for us to visualize neuroscientific mechanisms, the less we are inclined to rely on souls to understand human behavior. Consider a judge who believes that all people act because of first-moving decisions they make in their souls. Such a judge may start to question whether someone really has "intent" to kill when the judge subsequently comes to understand intentions in mechanistic terms.

Imagine a set of laws governing the handling of a particular chemical. Under one interpretation, the laws protect the public because the chemical is toxic. Under another interpretation, they conserve the chemical because it is exceedingly rare. So far, the law is *consistent* with both theories, and we don't know yet whether the law is fundamentally committed to one theory or the other (or neither). But suppose new evidence suggests that the chemical is actually quite plentiful. If lawmakers passed the legislation under the mistaken view that the chemical was rare, then they will likely change or eliminate restrictions on its handling. Alternatively, if lawmakers acquiesce in the face of new evidence, courts interpreting the legislation are likely to either adopt the chemical-is-hazardous interpretation or else do what they can to minimize the impact of pointless legislation. Either way, evidence that challenges fundamental legal assumptions can alter the law and its interpretation.

Similarly, criminal law seems consistent with both Morse's compatibilism and soul-based libertarianism. To the extent that new evidence or vivid displays emerge that convince people to question mechanism, they are likely to either: (1) treat the law as fundamentally compatibilist and insulated from evidence demonstrating the mechanistic nature of the universe, or (2) become free-will skeptics and radically rethink the nature of responsibility. The second choice would, of course, feed into a revolution in the legal treatment of responsibility.

---

67. By stating, for example, that free will "is not genuinely foundational for criminal responsibility," Morse, *supra* note 5, at 119, he seems to deny that the law has a fundamentally libertarian conception of responsibility.

In his most recent work, Morse explicitly admits that current law is consistent with both compatibilism and libertarianism but dismisses libertarianism as "extremely implausible in the modern scientific age."[68] When assessing the likelihood of a responsibility revolution, however, we must separate normative views about what the law should assume from more objective interpretations of what law actually does assume. Morse candidly acknowledges that "[m]ost criminal justice actors are probably implicitly libertarian and believe that we somehow have contra-causal free will."[69] He does not, however, recognize that the views of such actors influence the proper interpretation of the law. If courts and lawmakers are soul-based libertarians, then the interpretation of criminal elements like "intent" are plausibly infected by soul-based libertarianism. The fact that soul-based libertarianism seems implausible in the modern scientific age may give us reason to change the law but does not automatically alter centuries-old presuppositions that typically play a significant role in legal interpretation.

One might think the view of responsibility underlying the law is not very important. Why care what people thought about responsibility centuries ago? If the law gets it wrong, the law can be changed. To the extent that views about free will are divided, however, and likely to stay that way for a long time, the current state of the law becomes quite important, especially when considering the likelihood of a responsibility revolution.

B. Reasons to Doubt the Law Is Fundamentally Compatibilist

There are at least four reasons to doubt that the law is fundamentally compatibilist. Indeed, they may even be reasons to suppose the law is fundamentally libertarian. First, as noted, most lawmakers have probably not been compatibilists. The law was crafted over centuries with contributions from thousands of people. For a long portion of that history, lawmakers likely held some version of a libertarian view about free will. They did not consider our choices subject to the ordinary forces of the universe. Rather, they considered us to have souls that make decisions quite independent of the physical world. Evidence of mechanism poses at least some threat to the libertarian worldview that plausibly underlies the legal system.

Indeed, the Supreme Court of Michigan may have reflected a libertarian worldview in the nineteenth-century case of *Maher v. People*.[70] The court sought to determine which provocative circumstances, like adultery, should mitigate what would otherwise be murder to a less severe conviction for manslaughter. The court said that the circumstances must be such that their "natural tendency" is to put a person in a heated emotional state that would interfere with the reasoning of an ordinary person.[71] But the circumstances need only have the natural tendency to create that heated emotional state because—and here is the key point—it need not be "such a provocation as must, by the laws of the human mind, produce such an

68. Morse, *supra* note 66, at 108.
69. *Id.*
70. 10 Mich. 212 (1862).
71. *Id.* at 220–21.

effect with the certainty that physical effects follow from physical causes; for then the individual could hardly be held morally accountable."[72] In other words, if a person's behavior is caused in the way that one physical entity causes another physical effect, then he cannot be held morally or legally accountable at all. While the statement in *Maher* could perhaps be given a compatibilist interpretation, at least taken literally, it seems to deny responsibility for mechanistic actions that follow with certainty from physical effects.[73]

One case hardly generalizes to the entire corpus of law. Still, the criminal law was largely devised by people who held libertarian views like those in *Maher*. When did the law change its official position? Some empirical evidence, though it is controversial, suggests that most people naturally hold libertarian views.[74] The authors of a leading criminal law casebook seem convinced not only that most of us are libertarians but that, contra Morse, the criminal law is libertarian as well:

> We tend to regard a person's acts as the product of his or her choice, not as events governed by physical laws. This view (roughly, the hypothesis of free will and the rejection of determinism) is of course hotly contested in philosophical literature. But whether accurate or not, the assumption of free will reflects the way most people in our culture respond to human action, and it reflects, most importantly, the premise on which notions of blame in the criminal law ultimately rest.[75]

If these authors are correct, the law embodies the false view that human decisions are independent of the mechanistic physical world. To the extent that science corrects that view, law may be amenable to the changes Greene and Cohen envision.

More research is surely warranted into the views of judges and legislators concerning the law's notion of responsibility, both now and over the last several hundred years.[76] But absent such research, Morse too quickly denies the possibility

---

72. *Id.* at 221 (emphasis omitted).

73. The pertinent statements were also endorsed by the Minnesota Supreme Court. *See* State v. Hoyt, 13 Minn. 132, 145 (1868); *see also* Eanes v. State, 10 Tex. Ct. App. 421, 447 (1881).

74. *See* David Rose & Shaun Nichols, *The Lesson of Bypassing*, 4 REV. PHIL. & PSYCHOL. 599, 600 (2013) (arguing that incompatibilist intuitions "run[] even deeper than previously recognized"). There is still much dispute, however, over the nature of lay intuitions about free will. *Compare* Shaun Nichols & Joshua Knobe, *Moral Responsibility and Determinism: The Cognitive Science of Folk Intuitions*, 41 NOÛS 663 (2007), *with* Eddy Nahmias, Stephen Morris, Thomas Nadelhoffer & Jason Turner, *Surveying Freedom: Folk Intuitions about Free Will and Moral Responsibility*, 18 PHIL. PSYCHOL. 561 (2005) *and* Adina L. Roskies & Shaun Nichols, *Bringing Moral Responsibility Down to Earth*, 105 J. PHIL. 371, 376–78, 388 (2008) (attempting to explain the conflicting results).

75. SANFORD H. KADISH, STEPHEN J. SCHULHOFER, CAROL S. STEIKER & RACHEL E. BARKOW, CRIMINAL LAW AND ITS PROCESSES 591 (9th ed. 2012).

76. Gideon Yaffe has argued that John Locke's late-1600s commentary about the nature of volition was highly influential in the development of Britain's voluntary act requirement that we subsequently imported to the United States. Gideon Yaffe, *Libet and the Criminal Law's Voluntary Act Requirement*, *in* CONSCIOUS WILL AND RESPONSIBILITY: A TRIBUTE TO

that the law is embedded with soul-based libertarian presuppositions and too quickly denies that current law is vulnerable to Greene and Cohen's claim that neuroscience will change how people understand blame and responsibility.

Second, the mere fact that criminal statutes are framed around folk psychological concepts like belief and intention[77] reveals little about the law's fundamental presuppositions. The law may speak in terms of beliefs and intentions because it takes us to have souls with nonmechanistic beliefs and intentions. Even free will skeptics can marshal consequentialist reasons for framing statutes in terms of beliefs and intentions: they are much easier for us to understand and apply than terms describing the behavior of neurons or the motion of molecules. Statutes refer to "automobiles" not because we deny that cars are composed of tiny molecules held together by a variety of forces but simply because "automobile" is a much simpler way to describe the entity we care about.

Third, the law of evidence fails to reveal the law's fundamental views on free will. True, judges do not admit evidence that merely shows a person's behavior was caused. But this fact is ambiguous. If the law takes it as an article of faith that human decisions are made by libertarian creatures, we disallow evidence seeking to prove otherwise precisely because such evidence would be inconsistent with a fundamental premise of the legal system. Moreover, particularly in the sentencing phase of death penalty cases, courts are willing to permit a very broad class of evidence about the causes of a defendant's behavior, even when the alleged causal path does not involve a traditional justification or excuse.[78] And if the law tolerates this broad class of evidence in capital cases, it is not obvious why it should be excluded in others. Hence, the law may be ambivalent or confused about precisely how evidence of causation ought to bear on punishment.

Fourth, statutes are virtually always silent on fundamental issues of free will. Morse states that "perusal of any American criminal code or judicial opinions will

---

BENJAMIN LIBET 189, 194–97 (Walter Sinnott-Armstrong & Lynn Nadel eds., 2011). Emad Atiq suggests that because Locke was a compatibilist who influenced the law's voluntary act requirement, we have reason to think that the criminal law has imported Locke's compatibilism. Atiq, *supra* note 61, at 463–64. This analysis, however, is too hasty. First, it is hardly obvious that an unelected commentator's discussion of a legally relevant issue, even if it is influential, is fundamental to our legal interpretation of doctrine related to that issue. The Michigan Supreme Court's contrary view in *Maher*, for example, would seem more legally relevant. Second, even if Locke's views about volition influenced the voluntary act requirement, Atiq has not demonstrated that Locke's *compatibilism* influenced the judges and lawmakers who crafted the voluntary act requirement. And finally, if the deep tradition of criminal law is rooted in libertarian notions of freedom, as seems likely, then it is hardly clear how any one commentator's view about one particular doctrine could transform the fundamental nature of the entirety of criminal law.

77. Morse, *supra* note 44, at 839–41.

78. *See* Lockett v. Ohio, 438 U.S. 586, 604 (1978) (stating that sentencers should ordinarily "not be precluded from considering, as a *mitigating factor*, any aspect of a defendant's character or record and any of the circumstances of the offense that the defendant proffers as a basis for a sentence less than death") (emphasis in original); *see also* Deborah W. Denno, *Courts' Increasing Consideration of Behavioral Genetics Evidence in Criminal Cases: Results of a Longitudinal Study*, 2011 MICH. ST. L. REV. 967, 974 ("Overall, courts today appear far less skeptical about accepting behavioral genetics evidence, and they do so in the majority of cases in which defense attorneys attempt to offer it.").

confirm the absence of libertarian free will as a genuine criterion" of criminal responsibility,[79] but the search will also fail to identify explicit support for compatibilism. Moreover, if I am right that law has historically been crafted by libertarians who predated the mechanistic view of the universe common among scientists today, we might not expect the law to state its explicit libertarian assumptions. Such views were simply fundamental to lawmakers and voters. By contrast, if the law changed course at some point in time, the shift would likely have been explicitly noted in cases or statutes: silence favors the libertarian interpretation of the law.

Thus, we are left with multiple plausible ways of understanding the law, some of which are more insulated from Greene and Cohen's concerns than others. Almost certainly, today's legal and social institutions allow for the possibility of moral responsibility, and these institutions would present tremendous obstacles to the kind of revolution Greene and Cohen envision. Indeed, if a judge were forced to decide a case today that required him to make explicit the law's deep, fundamental assumptions about responsibility, the judge would likely find Morse's approach quite attractive. The judge could declare the law compatibilist in nature and thereby avoid overturning centuries of criminal law. But—and here is my central claim—such a judge would be selecting or even shifting the law's fundamental assumptions rather than simply deciding based on established law. Hence, we cannot confidently assert that current positive law is a major obstacle to the changes Greene and Cohen envision.

C. Who Has the Radical Critique?

Morse distinguishes between "internal" and "external" critiques of the law. Internal critiques accept the basic view of responsibility implicit in the law and simply seek modest reform within that framework.[80] Free will skeptics like Greene and Cohen, however, offer what Morse deems an external critique of the law.[81] They propose not merely to tweak our understanding of responsibility but to abandon the notion of responsibility that represents "the law's official position."[82]

For Morse, the fact that a critique is external seems to make a rhetorical point. If, for example, you think that mere causation excuses, you are making a radical, external claim about the law. But I have shown that the law's view of responsibility is at least as likely to be libertarian as it is to be compatibilist. If it turns out that the law makes soul-based libertarian presuppositions, then it is Morse who offers a radical critique of the law because, as a mechanist, Morse would disagree with a

---

79. Stephen J. Morse, *Determinism and the Death of Folk Psychology: Two Challenges to Responsibility from Neuroscience*, 9 MINN. J.L. SCI. & TECH. 1, 4 n.5 (2008).

80. Morse, *Non-Problem*, *supra* note 65, at 204 ("An internal argument accepts that criminal responsibility is a coherent concept and uses free will to explain the positive rules and practices we have or to criticize these rules and practices normatively for the purpose of improving them.").

81. *Id.* ("An external argument uses free will to demonstrate that the concept of criminal responsibility is incoherent or unjustifiable and therefore it should be abandoned.").

82. Morse, *supra* note 5, at 120.

fundamental feature of such a legal system: namely, its denial of mechanism.[83] In that case, Morse would not merely believe that we need to tweak the law's conception of responsibility, but that we ought to abandon it entirely.

Morse's preferred criminal statutes would superficially look the same whether the law is fundamentally compatibilist or soul-based libertarian. Laws would be framed in familiar folk-psychological terms like "believe" and "intend" instead of neuroscientific terms like "neuron" and "synapse," and they would allow for attributions of responsibility. So, at first, it might not seem to matter whether the law is compatibilist, as Morse thinks, or libertarian, as I have claimed is quite possible.

But superficial appearances aside, the differences are deep and fundamental. Morse believes people can be responsible even when their actions follow mechanistically from circumstances beyond their control. By contrast, the law plausibly embodies the view that we are only responsible when our self-caused souls cause us to act. If science convinced us that there are no souls, the law's criteria for responsibility would never be satisfied. Thus, Morse and the legal system may reach very different conclusions.

In sum, neither Greene and Cohen nor Morse purport to offer a novel solution to the problem of free will. While Greene and Cohen defend an interesting prediction about how neuroscience is likely to shift our views of responsibility, they have yet to make a persuasive case for it. Morse believes the law is insulated from Greene and Cohen's critique but downplays other more vulnerable interpretations of positive law. If a court were forced to decide, they would likely find Morse's compatibilist approach hard to resist. But such a court would be making law rather than merely deciding in accordance with established law. And to the extent that the views of lawmakers *may* change in the manner Greene and Cohen suggest, then our future views about the nature of responsibility are still anybody's guess.

III. A TECHNOLOGICAL NEUROLAW REVOLUTION

The prospects for a revolution in the legal treatment of responsibility, I have argued, are still quite hazy. A clearer case can be made for a neurotechnology-driven legal revolution. Some caution is in order first: predictions of technological change have a poor track record. In the 1970s, many predicted that by now we'd all own flying cars and periodically vacation on the moon. The rate of neurotechnological progress is hard to predict, influenced by such varied factors as general economic productivity, research funding priorities, global politics and conflict, fundamental limits on our ability to understand and manipulate the brain, and much more.

The difficulties of prediction aside, there is no general agreement as to what pace of legal change constitutes a revolution. Has DNA evidence revolutionized the criminal justice system? Even if we could perfectly predict in the 1970s how DNA

---

83. Morse, *supra* note 4, at 398 ("I am a thorough-going, matter-up materialist who believes that all mental and behavioral activity is the causal product of lawful physical events in the brain.").

would be used in cases today, we might still disagree about whether DNA revolutionized the law.

Legal revolutions are also difficult to individuate. For example, many of the changes I foresee in the law relate to emerging forms of brain imaging. But we already use brain images in the courtroom far more often than we did, say, forty years ago.[84] It is entirely unremarkable when evidence from computed tomography (CT) scans or structural magnetic resonance imaging (MRI) is used to demonstrate brain trauma from automobile accidents or child abuse.[85] Has a revolution already occurred? Will the use of new brain imaging techniques in court constitute a revolution or just a century-long upward trend in the forensic use of diagnostic images?

Stephen Morse has issued a plea for "neuromodesty," arguing that claims about how neuroscience will change the law have been exaggerated.[86] He quotes a 2002 editorial in *The Economist* which warned that "[g]enetics may yet threaten privacy, kill autonomy, make society homogeneous and gut the concept of human nature. But neuroscience could do all of these things first."[87] According to Morse, the effect of neuroscience on the law is being overhyped, just as the effect of genetics and other fields were overhyped before it:

> The genome was fully sequenced in 2001, and there has not been one resulting major advance in therapeutic medicine since. Thus, even in its most natural applied domain—medicine—genetics has not had the far-reaching consequences that were envisioned. The same has been true for various other sciences that were predicted to revolutionize the law, including behavioral psychology, sociology, psychodynamic psychology, and others. This will also be true of neuroscience, which is simply the newest science on the block. Neuroscience is not going to do the terrible things *The Economist* fears, at least not for the foreseeable future.[88]

Morse is right that gene therapies have been slower to develop than many expected, but it is too soon to be pessimistic and too soon to discount the technology's eventual effects on the law. The cost of DNA sequencing has declined exponentially since the Human Genome Project began in 1990.[89] We can now

---

84. *See generally* Anthony R. Benedetto, *Not Just "X-Rays" Today: Recommendations for Admissibility of Modern Radiology Images*, 49 S. TEX. L. REV. 113, 126–78 (2007) (describing the history of court room admission of diagnostic images beginning with radiographs in 1896).

85. *See, e.g.*, Chapa v. United States, No. 8:04CV376, 2006 WL 1794763, at *1, *9 (D. Neb. June 26, 2006); Middleton v. State, 2007-KA-01023-COA (¶¶ 13–32) (Miss. Ct. App. 2008); *In re* Pers. Restraint of Brooks, No. 33020-2-II, 2007 WL 1129655, at *2 (Wash. Ct. App. Apr. 17, 2007); *see also* Am. Acad. of Pediatrics, *Diagnostic Imaging of Child Abuse*, 105 PEDIATRICS 1345, 1346–47 (2000).

86. Morse, *supra* note 44.

87. *Id.* at 837 (quoting *The Ethics of Brain Science: Open Your Mind*, ECONOMIST, May 25, 2002, at 93, *available at* http://www.economist.com/node/1143317/print).

88. *Id.* (footnote omitted).

89. RAY KURZWEIL, THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY

sequence an entire human genome for $5000, and some expect the cost to eventually approach that of a routine blood test.[90] In just the last couple of years since Morse published his comments, we can now sequence the fetal genome from a maternal blood test and a paternal saliva specimen.[91] Therapeutic advances have been slow but they look promising.[92] We still await a revolution in gene-related therapies, but reduced costs will surely speed medical and technological breakthroughs.

Moreover, the link between brains and behavior is more direct than the link between genes and behavior. So the impact of neurotechnology on the law may chart a steeper curve than the impact of genetic technology on the law. And technically speaking, by bemoaning the slow progress of genetic technology, Morse is actually *supporting* the quoted statement in *The Economist*, since it makes a comparative claim that neuroscience will impact society more quickly than genetics research.

Nevertheless, Morse is surely correct that neuroscientific advances are often overhyped. Most of his concerns are directed at Greene and Cohen and fellow travelers who predict radical revisions to our conception of responsibility. I, of course, have argued that Greene and Cohen have yet to persuasively support their predictions. In that sense, I suppose I support Morse's call for neuromodesty.

But I am more optimistic than Morse about the pace of neurotechnological progress. It is sometimes said that we overestimate the rate of technological change in the near term but underestimate technological change in the long term.[93] Thirty years ago, it would have seemed immodest to predict the many ways in which personal computers and the Internet have already transformed society and the law. And just five years ago, it might have seemed immodest to predict that we could use functional magnetic resonance imaging (fMRI) to predict with eighty percent accuracy whether or not a particular experimental subject is in pain. Yet, as I will discuss, we can do just that, at least in controlled experimental contexts.[94] Some neuro-*immodesty* may be justified.

Furthermore, many of Morse's concerns about the state of neurotechnology will gradually be ameliorated. For example, Morse notes that fMRI studies should have more subjects with more varied demographics.[95] These concerns will gradually

---

73 (2005) ("The cost of DNA sequencing came down from about ten dollars per base pair in 1990 to a couple of pennies in 2004 and is rapidly continuing to fall . . . .").

90. John Markoff, *Breaking a Gene Barrier*, N.Y. TIMES, Mar. 8, 2012, at B1.

91. *See* Jacob O. Kitzman, Matthew W. Snyder, Mario Venura, Alexandra P. Lewis, Ruolan Qiu, LaVone E. Simmons, Hilary S. Gammill, Craig E. Rubens, Donna A. Santillan, Jeffrey C. Murray, Holly K. Tabor, Michael J. Bamshad, Evan E. Eichler & Jay Shendure, *Non-Invasive Whole Genome Sequencing of a Human Fetus*, 4 SCI. TRANSLATIONAL MED. 137 (2012); Andrew Pollack, *Tests of Parents Are Used to Map Genes of a Fetus*, N.Y. TIMES, June 7, 2012, at A1; *see also* H. Christina Fan, Wei Gu, Jianbin Wang, Yair J. Blumenfeld, Yasser Y. El-Sayed & Stephen R. Quake, *Non-Invasive Prenatal Measurement of the Fetal Genome*, 487 NATURE 320 (2012).

92. Gina Kolata, *In Leukemia Treatment, Glimpses of the Future*, N.Y. TIMES, July 8, 2012, at 1N.

93. *See, e.g.*, KURZWEIL, *supra* note 89, at 14.

94. *See infra* Part III.A.

95. Morse, *supra* note 44, at 849–50.

abate as scanning becomes cheaper, enabling studies with more subjects and greater population diversity.

Morse also notes that many neuroscience studies have been plagued with errors in design.[96] Indeed, neuroscientists have been embarrassed on too many occasions.[97] But the methodological problems in the use of brain-scanning technology will gradually be identified and eliminated, as is the hallmark of good science.

Moreover, some of the recent embarrassments are less applicable to what I call "black box" experiments. In black box experiments, we focus on the outcome relevant to the legal system and can largely ignore the underlying details of how brain images are interpreted. For example, to determine if some brain-based form of lie detection works, we check how accurately a person blinded to a subject's truthfulness can successfully use the technology to assess his credibility. It need not matter precisely which portions of the brain are involved in deceit provided that some mysterious black box process detects credibility with sufficient consistency and in a wide enough variety of contexts that we are confident the results apply to real-world settings. Detailed understanding of the neural pathways of deception may aid application to the real world, but it is not a *sine qua non*. Jurors use seat-of-the-pants techniques to detect lies despite limited evidence about how these techniques work and their success rates. We cannot hold brain-based lie detection to unrealistic standards. The technology will be helpful so long as it helps jurors reach better conclusions than they would without it. Thus, some of Morse's criticism can be blunted, at least a bit, for certain forensic uses of neurotechnology.

Finally, Morse and I may agree completely about the pace of technological change but simply look at different distances along the horizon. All it takes to radically change the pace of neuroscientific progress is a substantial improvement in the imaging techniques we use. If one's predictions about the pace of neurotechnological progress assume we are using the same imaging techniques in thirty years that we use today, then those predictions are far too conservative.

With all the foregoing caveats, I predict that there will be a technological neurolaw revolution and suggest ways in which the law and legal practice will change in coming decades as neurotechnology improves. The revolution that I envision cannot be easily characterized in a large book, let alone a brief article. The

---

96. *Id.* at 851.

97. *See, e.g.*, Nikolaus Kriegeskorte, W. Kyle Simmons, Patrick S.F. Bellgowan & Chris I. Baker, *Circular Analysis in Systems Neuroscience: The Dangers of Double Dipping*, 12 NATURE NEUROSCIENCE 535, 535 (2009) (arguing that many neuroscience studies engage in inappropriate "double dipping" by using the "same data for selection and selective analysis"); Sander Nieuwenhuis, Birte U. Forstmann & Eric-Jan Wagenmakers, *Erroneous Analyses of Interactions in Neuroscience: A Problem of Significance*, 14 NATURE NEUROSCIENCE 1105, 1105 (2011) (arguing that many neuroscience studies comparing two experimental effects inappropriately focus on "the difference between their significance levels" instead of "the statistical significance of their difference"); Edward Vul, Christine Harris, Piotr Winkielman & Harold Pashler, *Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition*, 4 PERSP. ON PSYCHOL. SCI. 274, 279 (2009) (arguing that many fMRI studies report artificially high correlations by committing "nonindependence errors" in their statistical analysis).

potential of just new pharmaceuticals to cure disease or enhance our abilities is staggering.[98] I will focus, instead, on three rather distinct trends that may give a sense of the kinds of changes we will see.

Since I criticize Greene, Cohen, and Morse for offering too little evidence to support their predictions, I am wary of being subject to the same criticism. So my only formal prediction is that new brain-related technologies will dramatically transform the law in the coming decades, and I believe I provide enough evidence, albeit in abbreviated form, to make that case. I cannot fully defend here my predictions of the more precise changes we will see, so I will treat them merely as plausible hypotheses.

A. The Experiential Future

The first hypothesis is that we will move toward what I call our "experiential future."[99] In the experiential future, we will have better methods of assessing experiential states like physical and emotional pain, sadness, anxiety, and so on. The legal system will change because we will consider new forms of evidence at settlements and trials, and we will have good reason to reconsider existing laws that make it harder to recover damages for emotional rather than physical distress.

Consider a recent study from Sean Mackey's lab at Stanford University that I briefly alluded to earlier.[100] Eight people were examined in an fMRI scanner. In some conditions, they were exposed to a painful heat stimulus while in others they were exposed to no painful stimulus at all. The scanner recorded brain activity in the different conditions, and a computer algorithm identified patterns between brain activity and pain exposure. Later, sixteen entirely new subjects were scanned. Each entered the scanner and under some conditions was exposed to a painful heat stimulus and under other conditions was not. Applying what the machine learned from the original subjects, it predicted with about eighty percent accuracy when individual subjects in the second group were in the pain or no-pain condition.

The result is particularly remarkable because, unlike fMRI studies that only compare groups of subjects, researchers in this study assessed the pain state of particular individuals. And they did so without having already put those particular individuals into a scanner to gather background information specific to them. It is not hard to imagine using such a technology in the future to help determine whether a litigant's pain is entirely malingered. It might also help us better understand the experiential states of people who have dementia or otherwise cannot communicate clearly.

---

98. *See generally* WALTER GLANNON, BIOETHICS AND THE BRAIN 76–115 (2007) (discussing current and emerging methods of pharmaceutically manipulating the brain); Adam Kolber, *Give Memory-Altering Drugs a Chance*, 476 NATURE 275 (2011) (discussing efforts to develop memory-dampening drugs).

99. In a prior article I discussed the "experiential future" in enough detail that warrants calling it a *full-fledged prediction*, as opposed to a weaker *plausible hypothesis*. Adam J. Kolber, *The Experiential Future of the Law*, 60 EMORY L.J. 585 (2011).

100. Justin E. Brown, Neil Chatterjee, Jarred Younger & Sean Mackey, *Towards a Physiology-Based Measure of Pain: Patterns of Human Brain Activity Distinguish Painful from Non-Painful Thermal Stimulation*, 6 PLOS ONE, at e24124 (2011).

There are still many caveats, of course. The research was done on college students of similar age. It examined a particular kind of pain on a particular part of the body and ignored countermeasures a subject might use to fool people. Still, if a plaintiff claims that he had a slip-and-fall injury in the defendant's grocery store and now his knee hurts every time he bends it, it is not farfetched to imagine that emerging neurotechnologies will help us evaluate the claim.

Neuroscientists have also made progress in finding neuromarkers for chronic pain. Marwan Baliki and colleagues were recently able to distinguish a group of subjects with chronic back pain from a group of subjects without chronic back pain by examining activity in the brain's nucleus accumbens when participants were exposed to acute pain.[101] The researchers suggest that people with chronic back pain experience acute pain differently than those who do not have chronic back pain and that the differences provide a signal that "distinguishes the two groups at a very high rate of sensitivity and specificity, implying that this signal can be used as an objective marker of chronic pain."[102] While the research speaks to groups of people and not individuals, we will quite plausibly find distinguishing biomarkers of chronic pain at the individual level in the near future.

It is much easier to determine whether or not a person is experiencing pain than to assess its intensity. But we can learn at least something about pain intensity by examining brain activity. The amount of activation in certain regions of the brain increases with the intensity of a painful stimulus.[103] Such findings suggest that brain imaging could someday shed light on the amount of pain a person is experiencing.

If at least some of the technologies I discuss continue to improve, then we will eventually see dramatic changes in the sorts of evidence presented in tort cases, disability hearings, and workers' compensation cases. Neuroscientific evidence of pain could support a claim that a person was injured in any of these venues. Moreover, at least in tort law, the intensity of pain is quite relevant to damage assessments. According to the *Restatement (Second) of Torts*, fact finders are supposed to estimate fair and reasonable compensation for pain and suffering by noting "such factors as the intensity of the pain or humiliation, its actual or probable duration and the expectable consequences."[104] Tort law does not rely on a fixed schedule of compensation, such as $10,000 for the pain of a broken arm or

---

101. Marwan N. Baliki, Paul Y. Geha, Howard L. Fields & A. Vania Apkarian, *Predicting Value of Pain and Analgesia: Nucleus Accumbens Response to Noxious Stimuli Changes in the Presence of Chronic Pain*, 66 NEURON 149, 149 (2010).

102. *Id.* at 157 (citation omitted).

103. *See* M.N. Baliki, P.Y. Geha & A.V. Apkarian, *Parsing Pain Perception Between Nociceptive Representation and Magnitude Estimation*, 101 J. NEUROPHYSIOLOGY 875, 880 fig.4 (2009); Robert C. Coghill, John G. McHaffie & Ye-Fen Yen, *Neural Correlates of Interindividual Differences in the Subjective Experience of Pain*, 100 PROC. NAT'L ACAD. SCI. U.S. AM. 8538, 8538 (2003); Andre Marquand, Matthew Howard, Michael Brammer, Carlton Chu, Steven Coen & Janaina Mourão-Miranda, *Quantitative Prediction of Subjective Pain Intensity from Whole-Brain fMRI Data Using Gaussian Processes*, 49 NEUROIMAGE 2178 (2010) (using fMRI brain data and machine learning algorithms to predict the level of pain an individual subject will report from a painful stimulus).

104. RESTATEMENT (SECOND) TORTS § 912 cmt. b (1979).

$20,000 for the pain of a broken leg, nor does it rely on weeks of compensation in the way that workers' compensation programs do.[105] Rather, we are supposed to actually measure amounts of pain and suffering despite the conceptual and technological difficulties of doing so.[106]

If we are able to better estimate the intensity of painful experiences, we might switch to more standardized methods of awarding damages for pain.[107] Doing so would require the law to address many new questions. For example, pain has sensory, affective, and evaluative components,[108] and we might have to decide how to aggregate these values. Relatedly, people tolerate pain to different degrees and that should arguably be taken into account when awarding damages. The law has generally ignored such issues because we have so little ability to distinguish different aspects of pain. Perhaps we'll have more options in the experiential future. Whatever the specifics, our laws and legal practices will respond to dramatic changes in the way we understand and measure pain.

Researchers are also developing more objective ways of assessing experiences other than pain. For example, chronic stress and depression are associated with structural and functional changes in the brain.[109] People with phobias have atypical brain metabolism and patterns of electrical activity.[110] And the diagnosis of a variety of mental illnesses, like schizophrenia, anxiety disorders, and bipolar disorders, may be aided by brain imaging.[111]

---

105. *Cf.* Federal Employees' Compensation Act, 5 U.S.C. § 8107(c) (2012) (providing a pricing schedule for federal employee compensation, including 312 weeks' compensation for loss of an arm and 288 weeks' compensation for loss of a leg).

106. *See* RESTATEMENT (SECOND) TORTS § 912 cmt. b ("[I]t is impossible to require anything approximating certainty of amount even as to past harm.").

107. Kolber, *supra* note 99, at 611–12.

108. Adam J. Kolber, *Pain Detection and the Privacy of Subjective Experience*, 33 AM. J.L. & MED. 433, 436–37 (2007).

109. *See* Howard J. Aizenstein, Carmen Andreescu, Kathryn L. Edelman, Jennifer L. Cochran, Julie Price, Meryl A. Butters, Jordan Karp, Meenal Patel & Charles F. Reynolds III, *fMRI Correlates of White Matter Hyperintensities in Late-Life Depression*, 168 AM. J. PSYCHIATRY 1075, 1080 (2011); Sonia J. Lupien, Alexandra Fiocco, Nathalie Wan, Francoise Maheu, Catherine Lord, Tania Schramek & Mai Thanh Tu, *Stress Hormones and Human Memory Function Across the Lifespan*, 30 PSYCHONEUROENDOCRINOLOGY 225, 238 (2005) ("[C]hronic exposure to elevated levels of [hormones released when a person experiences stress] is related to both memory impairments and a smaller volume of the hippocampus."); Yvette I. Sheline, Milan Sanghavi, Mark. A. Mintun & Mokhtar H. Gado, *Depression Duration but Not Age Predicts Hippocampal Volume Loss in Medically Healthy Women with Recurrent Major Depression*, 19 J. NEUROSCIENCE 5034, 5039 (1999) (reporting "smaller hippocampal volumes in subjects with a history of depression").

110. Richard J. Davidson, John R. Marshall, Andrew J. Tomarken & Jeffrey B. Henriques, *While a Phobic Waits: Regional Brain Electrical and Autonomic Activity in Social Phobics During Anticipation of Public Speaking*, 47 BIOLOGICAL PSYCHIATRY 85, 85 (2000) ("[Social p]hobics showed a marked increase in right-sided activation in the anterior temporal and lateral prefrontal scalp regions.").

111. *See, e.g.*, Vince D. Calhoun, Paul K. Maciejewski, Godfrey D. Pearlson & Kent A. Kiehl, *Temporal Lobe and "Default" Hemodynamic Brain Modes Discriminate Between Schizophrenia and Bipolar Disorder*, 29 HUM. BRAIN MAPPING 1265 (2008); Katharina Domschke & Udo Dannlowski, *Imaging Genetics of Anxiety Disorders*, 53 NEUROIMAGE

Among other uses, these technologies could someday help us more accurately assess emotional pain in court. The law currently employs a variety of doctrines to limit recoveries for emotional distress. To recover, some jurisdictions require evidence of a physical manifestation of the emotional distress, like vomiting, or some kind physical impact that was concurrent with the emotional distress,[112] and some jurisdictions require that the emotional injury occur within a zone of danger.[113] Part of the reason for these limitations is that not every negligent infliction of distress warrants state intervention and compensation. But part of the reason is that courts are skeptical of hard-to-measure emotional distress claims.[114]

As I have argued elsewhere in more detail,[115] new technologies may eventually spark revisions to aspects of current law that limit recovery for emotional distress. During the centuries in which the common law developed, there was little we could do to measure subjective experiences so we often ignored them or downplayed their significance. In the experiential future, however, we will have new methods of understanding and assessing experiences and good grounds for modifying the law to better take them into account.

Indeed, a number of jurisdictions are already loosening policies that limit emotional distress claims.[116] One case in Michigan offers a particularly interesting peek at the experiential future. In *Allen v. Bloomfield Hills School District*,[117] Charles Allen was operating a train at approximately sixty-five miles-per-hour when it collided with a school bus that maneuvered passed the lowered gate blocking the tracks.[118] When the train came to a stop, Allen ran back to the bus and was told that, though there were no children on the bus, the driver was seriously injured.[119] Allen developed post-traumatic stress disorder (PTSD) and sued the school district alleging negligent operation of a government-owned school bus.[120]

The case turned on the interpretation of a Michigan statute that waived sovereign immunity of local government entities when their officers, agents, or employees cause "bodily injury" through the negligent operation of a vehicle.[121]

---

822 (2010); Mary L. Phillips & Eduard Vieta, *Identifying Functional Neuroimaging Biomarkers of Bipolar Disorder: Toward DSM-V*, 33 SCHIZOPHRENIA BULL. 893 (2007).

112. RESTATEMENT (SECOND) OF TORTS §§ 313(1), 436A (1965); John J. Kircher, *The Four Faces of Tort Law: Liability for Emotional Harm*, 90 MARQ. L. REV. 789, 810, 815–16 (2007).

113. Kircher, *supra* note 112, at 815–16.

114. *See, e.g.*, Johnson v. Sampson, 208 N.W. 814, 815–16 (Minn. 1926) (allowing a cause of action for intentional infliction of emotional distress but warning of "trumped-up" claims that rely on "subjective symptoms").

115. Kolber, *supra* note 99; Kolber, *supra* note 108. On the same topic, see Betsy J. Grey, *Neuroscience and Emotional Harm in Tort Law: Rethinking the American Approach to Free-Standing Emotional Distress Claims*, *in* LAW AND NEUROSCIENCE 203 (Michael Freeman ed., 2011).

116. *See* Kircher, *supra* note 112, at 816 ("Of late, a number of states have removed any limitation on the recovery of damages for negligent infliction of emotional distress in non-bystander situations.").

117. 760 N.W.2d 811 (Mich. Ct. App. 2008).

118. *Id.* at 812.

119. *Id.*

120. *Id.*

121. *See* MICH. COMP. LAWS § 691.1405 (2000).

Allen claimed his PTSD constituted a "bodily injury" (an expression left undefined by the statute) "because the accident caused physical damage to his body as evidenced by a positron emission tomography (PET) scan of his brain."[122] The doctor who interpreted the PET scan claimed it showed "decreases in frontal and subcortical activity consistent with depression and post-traumatic stress disorder."[123] The Michigan Court of Appeals was ultimately persuaded that the plaintiff offered sufficient evidence of bodily injury to survive summary judgment because he presented "objective medical evidence that a mental or emotional trauma can indeed result in physical changes to the brain."[124]

One can criticize aspects of the court's decision. We don't need a PET scan to know that PTSD is associated with physical changes in the brain. PTSD causes recurring fear symptoms, so it presumably has some physical representation in the brain. Nevertheless, the court's decision to treat an emotional injury as a bodily injury may anticipate the experiential future, for there is probably no good policy reason to waive sovereign immunity for physical injuries but not mental injuries except that mental injuries are more difficult to prove and are easier to exaggerate or fake. As diagnostic imaging techniques improve and give us more objective evidence of mental distress, we will have less justification for entrenched laws that make it harder to recover for emotional injuries than physical ones.

B. More Privacy Laws but Less Privacy

Researchers are working on a variety of technologies aimed at what can loosely be referred to as mind reading. For example, based on measurements of brain activity, researchers can make pretty good guesses about what images are shown to a subject in a brain scanner, be it a still image[125] or even, to some extent, a video.[126] One recent study demonstrated that subjects under fMRI can be taught to mentally spell words in a manner that can be decoded in real time by researchers,[127] a technique that could prove especially helpful for people with locked-in syndrome or other conditions that make it difficult to communicate. Neuroscientist Jack Gallant predicts that "[w]ithin a few years, we will be able to determine someone's natural language thoughts using fMRI-based technology."[128]

---

122. *Allen*, 760 N.W.2d at 815.

123. *Id.*

124. *Id.*

125. *See, e.g.*, Kendrick N. Kay, Thomas Naselaris, Ryan J. Prenger & Jack L. Gallant, *Identifying Natural Images from Human Brain Activity*, 452 NATURE 352 (2008); Thomas Naselaris, Ryan J. Prenger, Kendrick N. Kay, Michael Oliver & Jack L. Gallant, *Bayesian Reconstruction of Natural Images from Human Brain Activity*, 63 NEURON 902 (2009).

126. *See, e.g.*, Shinji Nishimoto, An T. Vu, Thomas Naselaris, Yuval Benjamin, Bin Yu & Jack L. Gallant, *Reconstructing Visual Experiences from Brain Activity Evoked by Natural Movies*, 21 CURRENT BIOLOGY 1641 (2011).

127. Bettina Sorger, Joel Reithler, Brigitte Dahmen & Rainer Goebel, *A Real-Time fMRI-Based Spelling Device Immediately Enabling Robust Motor-Independent Communication*, 22 CURRENT BIOLOGY 1333 (2012).

128. Jack Gallant, Professor of Psychology, Univ. of Cal. Berkeley, Remarks at SciFoo Conference (Aug. 5, 2012). Gallant predicts that early attempts will be only modestly

These new brain imaging techniques point to a future where our thoughts will not be as private as they are now. We will not read minds directly in any spooky sense, but we will continue to get better at identifying correlations between brain activity and mental activity and using brain activity to make predictions about mental activity.

Legal scholars have focused their attention on efforts to develop more accurate lie detectors. Brain-based methods of deception detection are still in the early stages. Much of the research compares the brain activity of a group of "honest" subjects relative to a group of "dishonest" subjects.[129] More helpful research to determine whether a particular person is lying is beginning to accumulate, but the testing has always been done in somewhat artificial contexts.[130] If we put aside concerns about how well these experiments apply to real-life contexts, most published studies report using fMRI to distinguish honesty and deception at accuracies "between 70% and slightly over 90%."[131]

But even if we develop a lie detector that works well with the cooperative subjects that tend to participate in experiments, very little research examines the possible countermeasures people could take to fool such a device. One fMRI study was 100% accurate in detecting the lies of individual subjects, but accuracy fell to 33% when subjects used countermeasures they were trained to apply.[132] So even though at least two companies have marketed brain-based methods of lie detection,[133] many neuroscientists are skeptical of the current state of the technology.[134] Indeed, two recent attempts to introduce fMRI evidence of deception in court were unsuccessful.[135]

---

successful, "but some time in the further future, it will work well enough to be useful." E-mail from Jack Gallant, to author (Aug. 24, 2012) (on file with author).

129. Anthony Wagner, *Can Neuroscience Identify Lies?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 13, 13–14 (Michael S. Gazzaniga & Jed S. Rakoff eds., 2010).

130. For one study that does an impressive job of studying lies in a more real-world context, see Joshua D. Greene & Joseph M. Paxton, *Patterns of Neural Activity Associated with Honest and Dishonest Moral Decisions*, 106 PROC. NAT'L ACAD. SCI. U.S. AM. 12,506 (2009).

131. Frederick Schauer, Lie-Detection, Neuroscience, and the Law of Evidence 18 (Oct. 22, 2012) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm ?abstract_id=2165391.

132. Giorgio Ganis, J. Peter Rosenfeld, John Meixner, Rogier A. Klevit & Haline E. Schendan, *Lying in the Scanner: Covert Countermeasures Disrupt Deception Detection by Functional Magnetic Resonance Imaging*, 55 NEUROIMAGE 312, 312 (2011).

133. *See* CEPHOS, http://www.cephoscorp.com/lie-detection/index.php; NO LIE MRI, http://noliemri.com.

134. *See, e.g.*, Wagner, *supra* note 129, at 14 ("It is my conclusion that there *are* no relevant published data that unambiguously answer whether fMRI-based neuroscience methods can detect lies at the individual-subject level." (emphasis in original)).

135. United States v. Semrau, 693 F.3d 510, 516 (6th Cir. 2012) (affirming exclusion of allegedly exculpatory fMRI lie detection evidence under Federal Rules of Evidence 403 and 702); Wilson v. Corestaff Servs. L.P., 900 N.Y.S.2d 639, 642 (N.Y. Sup. Ct. 2010) (excluding fMRI lie detection evidence in an employment discrimination case principally on the ground that witness credibility is a jury question).

Nevertheless, deception detection has so many potential uses that the incentives to improve it are quite strong. Someday, the technology will at least be a useful aid in assessing credibility. When that day comes, many questions will be raised about how, if at all, the technology should be used in court. The real question we ought to ask ourselves when considering some supposed lie detector is: will we tend to get more accurate outcomes with or without it?

The answer may depend on the context. Lie detection evidence offered by prosecutors to provide evidence of guilt beyond a reasonable doubt would have to be extremely accurate, while lie detection evidence offered by a defendant to generate a reasonable doubt could be much more imperfect.[136] Deciding whether or not brain-based lie detection will improve outcomes, however, will put us in an awkward position: we will have to compare the error rates of lie detection technology to our current technology, namely, the jury, and we know relatively little about how well juries assess credibility. What we do know is that people are not very good at detecting deception,[137] and there is little correlation between people's confidence in their ability to detect deception and their accuracy.[138] Our entrenched preference for jury decision making is largely a result of the path of history, rather than an empirically validated conclusion about how good juries are at discerning credibility.

In an opinion in *United States v. Scheffer*,[139] Justice Clarence Thomas, joined by three other Justices, wrote that a rule banning all polygraph evidence in military trials serves the legitimate government interest of preserving jurors' "core function of making credibility determinations in criminal trials."[140] According to Thomas, "[a] fundamental premise of our criminal trial system is that 'the *jury* is the lie detector.'"[141] His remarks admit the possibility that even perfectly accurate lie-detection evidence could be excluded from the courtroom on the ground that it would infringe the province of the jury.

In my view, excluding accurate lie-detection information to protect the province of the jury makes a mockery of the justice system. The most important role of trials is to uncover the truth as best we can. To do so, we ought to use the best technology that cost-effectively helps us do so. There are legitimate concerns that poor quality lie detection evidence could irrationally sway jurors. They may not understand how the technology works or how to interpret known rates of error. But it would be foolish to keep some high-quality future lie detector out of the courtroom—under a blanket rule—simply because credibility determinations have traditionally been made by jurors.

---

136. Frederick Schauer, *Neuroscience, Lie-Detection, and the Law*, 14 TRENDS IN COGNITIVE SCI. 101, 101 (2009).

137. *See* Charles F. Bond, Jr. & Bella M. DePaulo, *Individual Differences in Detecting Deception: Accuracy and Bias*, 134 PSYCHOL. BULL. 477, 477 (2008) (stating the "consensus among psychologists" that "people are not very accurate at detecting deception").

138. Michael G. Aamodt & Heather Custer, *Who Can Best Catch a Liar? A Meta-Analysis of Individual Differences in Detecting Deception*, 15 FORENSIC EXAMINER 6, 9–10 (2006).

139. 523 U.S. 303 (1998).

140. *Id.* at 312–13.

141. *Id.* at 313 (quoting *United States v. Barnard*, 490 F.2d 907, 912 (9th Cir. 1973)) (emphasis in original).

Of course, even a perfectly accurate lie detector could not usurp all jury functions. Some cases do not depend on credibility assessments at all. For example, whether or not conduct was consistent with that of a reasonably prudent person cannot be determined by a lie detector alone. Moreover, when cases do depend on witness credibility, there is an important difference between honesty and truth. Honest assertions are not necessarily true. A person may believe he committed a crime that, in fact, never occurred. Similarly, a dishonest assertion can turn out to be true. A gunman may believe he fired the coup de grâce shot that ended the life of a rival gang member. Denying that he killed the rival would be dishonest, even if unbeknownst to him, the deceased was already dead before he fired.

If direct attempts at brain-based lie detection fail, other mind reading efforts may still prove helpful. The technologies discussed in the preceding section on the experiential future can serve as indirect methods of lie detection by telling us whether a person's pain claims are likely to be false. (In fact, pain measurement techniques could give us information that cannot be obtained from truthful subjects. Even when a person honestly reports his pain as "9" on a scale of 1 to 10, we cannot easily compare his report to those of others.)

Researchers are improving their understanding of other experiences, as well, including sexual arousal. One study examined the brain activity of male pedophiles and male non-pedophiles when shown images of nude children.[142] Researchers used brain activity to accurately classify the pedophilia status of more than 90% of subjects.[143] While this technique may be subject to countermeasures, it may be less so than other techniques used to classify pedophiles.[144] Another study looked at the brain activity of subjects while they looked at male and female human genitalia.[145] Researchers could determine sexual orientation with more than 85 percent accuracy.[146]

Of course, all of this work on mind reading raises privacy concerns. The pedophilia research suggests that fMRI could someday be used to assess the likelihood that a person has committed or will commit a sex crime. The research on sexual orientation could potentially bear on the distribution of assets in a divorce or the way prisoners are segregated. Other neuroscientific research may uncover conscious or unconscious racial biases.[147] People could be scanned for one purpose, say, to see how an advertising

---

142. Jorge Ponseti, Oliver Granert, Olav Jansen, Stephan Wolff, Klaus Beier, Janina Neutze, Günther Deuschl, Hubertus Mehdorn, Hartwig Siebner & Hartmut Bosinski, *Assessment of Pedophilia Using Hemodynamic Brain Response to Sexual Stimuli*, 69 ARCHIVES GEN. PSYCHIATRY 187 (2011).

143. *Id.* at 191–92.

144. *Id.* at 193 (stating that fMRI assessments of pedophilia "might be less susceptible to manipulation [than phallometry] because the participant has no time to elicit prepared responses to varying stimuli in a fast, event-related fMRI setting").

145. Jorge Ponseti, Oliver Granert, Olav Jansen, StephanWolff, Hubertus Mehdom, Hartmut Bosinski & Hartwig Siebner, *Assessment of Sexual Orientation Using the Hemodynamic Brain Response to Visual Sexual Stimuli*, 6 J. SEXUAL MED. 1628 (2009).

146. *Id.* at 1628.

147. *See generally* William A. Cunningham, Marcela K. Johnson, Carol L. Raye, Chris Gatenby, John C. Gore & Mahzarin R. Banaji, *Separable Neural Components in the Processing of Black and White Faces*, 15 PSYCHOL. SCI. 806 (2004); Elizabeth A. Phelps, Kevin J. O'Connor, William A. Cunningham, E. Sumie Funayama, J. Christopher Gatenby, John C. Gore & Mahzarin R. Banaji, *Performance on Indirect Measures of Race Evaluation*

campaign affects their brains, while they inadvertently generate information that bears on their racial biases, sexual orientation, and other sexual preferences. One group of researchers recently demonstrated that the very simple electroencephalography (EEG) sensors in certain mass-market video games can already be used to make plausible inferences about gamers' private "information related to credit cards, PIN numbers, the persons known to the user, or the user's area of residence,"[148] and may enable more confident inferences as these sensors improve.[149]

Brain imaging may even inform questions about mens rea. It might help us assess a person's capacity to generate some mental state or bear on the credibility of a person's statements about his past mental states. Brain imaging might even have more direct applications. For example, one group of researchers is trying to use fMRI to identify the culpable mental states described by the Model Penal Code.[150] Imagine a border crossing where someone is transporting a suspicious container. Before opening it, we could scan the brain of the person carrying the container to see if his brain is consistent with a culpable mental state of knowledge, recklessness, or negligence with respect to its contents. (The person might have to believe he was randomly selected for screening so that the mere fact of being selected does not significantly alter his beliefs.)

Accurate mind-reading technologies would raise a host of questions: For example, when, if ever, could prosecutors use brain-based lie detectors to incriminate or defendants to exculpate? How would police and other investigators use such tools? Could they be used by employers to make hiring and firing decisions?[151]

Even if accurate mind-reading techniques are still decades away, we already have reason to think about their implications because of what I call the technological look-back principle.[152] If we develop an accurate lie detector thirty years from now, you can be asked in 2044 about your conduct today in 2014. When you are in such a scanner in 2044, your spouse could ask if you have ever been unfaithful, and the police could ask if you have ever killed someone. And just as campaigning politicians often make their tax returns public even though they are under no legal obligation to do so, voters may expect politicians to go into a scanner and tell them what their intentions really are and whether or not they have ever acted corruptly.

Predicts Amygdala Activation, 12 J. COGNITIVE NEUROSCIENCE 729 (2000); Mary E. Wheeler & Susan T. Fiske, *Controlling Racial Prejudice and Stereotyping: Social-Cognitive Goals Affect Amygdala and Stereotype Activation*, 16 PSYCHOL. SCI. 56 (2005).

148. Ivan Martinovic, Doug Davies, Mario Frank, Daniele Perito, Tomas Ros & Dawn Song, *On the Feasibility of Side-Channel Attacks With Brain-Computer Interfaces* 13 (August 8–10, 2012) (21st Usenix Security Symposium Conference Paper), *available at* https://www.usenix.org/system/files/conference/usenixsecurity12/sec12-final56.pdf.

149. *Id.* at 4.

150. E-mail from Gideon Yaffe, Professor of Law and Professor of Philosophy, Yale Law School, to author (Sept. 30, 2013, 11:43 AM) (on file with author).

151. *See* Employee Polygraph Protection Act, 29 U.S.C §§ 2001–2009 (2006) (limiting most uses of the polygraph in civilian employment).

152. *See* Kolber, *supra* note 99, at 603–04.

I am not arguing that we need legislation today to prepare for all of the potential future uses of mind-reading techniques.[153] We would have little confidence that such legislation would survive the intervening period or that it would it take the appropriate form. Moreover, we often worry too much about the privacy concerns raised by new technologies in ways that unnecessarily hinder their development.[154]

But those expecting to be alive in coming decades or who care about those who will should begin to think about the privacy implications of mind-reading technologies. Many who shed their DNA while committing crimes before DNA sequencing became common are now in prison, prosecuted with evidence they never imagined could be used against them. Our memories may become the evidence that embarrasses or incriminates us in the future.

I offer two general predictions about how our rights to privacy may change in a world with better mind-reading technology. First, as the preceding suggests, we will have less mental privacy as advances in neuroscience make it easier to infer thoughts and thought patterns. We strike a balance between the societal value of making information public and the value to a person or group of people of keeping it private. These costs and benefits push and pull each other to reach a certain equilibrium. Neuroscience will reduce the costs of obtaining otherwise private information and will likely enable access to information that would otherwise be unavailable. Given that societal demand for information is likely to stay the same or increase, the equilibrium is likely to shift toward more information gathering.

In the days before the Internet, one could hire a private investigator to learn about people's occupations, family members, and various likes and dislikes. Today, such information is frequently easy to obtain. Indeed, many people publicize it themselves on social networking sites. Even when people try to keep their own information private, their associates still generate information about them. As technology makes information easier to obtain, it becomes harder to keep private.

Second, I speculate that we will craft more laws to protect thought privacy. Right now, there is little we can do to penetrate the thoughts of people who prefer to keep them secret. Only when we have plausible methods of doing so will we fully see the need to create laws to protect thought privacy. For example, as polygraphs became more reliable and widespread,[155] Congress passed the Federal Employee Polygraph Protection Act in 1988 to prohibit most private employers from subjecting employees to polygraphs and other forms of lie detection.[156] And

---

153. For one call to begin regulating brain-based lie detection, see Henry T. Greely & Judy Illes, *Neuroscience-Based Lie Detection: The Urgent Need for Regulation*, 33 AM. J. L. & MED. 377 (2007).

154. *See, e.g.*, Stewart Baker, *Privacy's Memory Lane: From Furor to Fail in Eight Years*, VOLOKH CONSPIRACY (Aug. 19, 2009, 1:17 PM), http://www.volokh.com/2012/08/19/privacys-memory-lane-from-furor-to-fail-in-eight-years.

155. There continues to be much debate over the accuracy of polygraphs. *See, e.g.*, Joseph R. Simpson, *Functional MRI Lie Detection: Too Good to Be True?*, 36 J. AM. ACAD. PSYCHIATRY & L. 491, 491 (2008) ("Estimates of [polygraph] accuracy range from a high of 95 percent to a low of 50 percent, with the best estimate probably around 75 percent sensitivity and 65 percent specificity." (footnotes omitted)).

156. 29 U.S.C. §§ 2001–2011; *see id.* at § 2001 ("The term 'lie detector' includes a polygraph, deceptograph, voice stress analyzer, psychological stress evaluator, or any other

just as we have seen an onslaught of laws to protect electronic privacy,[157] we will see new laws directed at protecting the privacy of our thoughts. Laws addressing rights to read minds or to be free of mind reading will grow more prevalent, complex, and controversial in a world with more accurate neurotechnology. Hence, we will have more law protecting thought privacy but less actual thought privacy.

C. Concretization of the Law

Not all neurolaw relates to neurons. Broadly construed, neurolaw also addresses legal issues raised by nonhuman forms of intelligence. Over the last few decades, progress in artificial intelligence has generally been viewed as a disappointment.[158] The consensus is beginning to shift, however, as researchers are making tremendous advances in speech recognition, language translation, face recognition, and more that are beginning to affect the average person. For example, Apple iPhones have a digital assistant named Siri that can process a wide range of natural language expressions,[159] and IBM's Watson computer dominated two human expert *Jeopardy!* players using technology now being tested in hospitals for its ability to advise healthcare practitioners.[160] Computers are still ill-equipped to tackle many basic cognitive tasks,[161] but at tasks where they do excel—sifting through enormous amounts of data on the Internet, for example—they can dramatically surpass human abilities.

One of the most revolutionary new uses of artificial intelligence with the promise of radically changing our lives and the law comes from efforts by Google and other companies to develop self-driving cars. Google has built a fleet of vehicles that has logged more than 500,000 miles of travel under no human control or limited human control, including plenty of driving in high-traffic conditions.[162] Since these cars can travel without passengers, we can imagine a vast network of

---

similar device (whether mechanical or electrical) that is used, or the results of which are used, for the purpose of rendering a diagnostic opinion regarding the honesty or dishonesty of an individual.")

157. *See, e.g.*, CAL. GOV'T. CODE § 6267 (West 2008 & Supp. 2013); MINN. STAT. §§ 325M.01 to .09 (2011 & 2013 Supp.); NEV. REV. STAT. § 205.498 (Supp. 2012).

158. *See, e.g.*, *2001: A Disappointment?*, ECONOMIST, Dec. 22, 2001, at 106, *available at* http://www.economist.com/node/883645 ("After half a century of frustrations and dead-ends, AI research has become famous not for success, but for failure.").

159. *See, e.g.*, Walter Mossberg, *The iPhone Finds Its Voice—Features in the 4S Include a System That Answers Questions Out Loud and Learns a User's Speech*, WALL ST. J., Oct. 12, 2011, at D1.

160. John Markoff, *Computer Wins on 'Jeopardy!': Trivial, It's Not*, N.Y. TIMES, Feb. 17, 2011, at A1.

161. *See, e.g.*, Gary Marcus, *Why Can't My Computer Understand Me?*, NEW YORKER BLOG, (Aug. 16, 2013), http://www.newyorker.com/online/blogs/elements/2013/08/why-cant-my-computer-understand-me.html.

162. Burkhard Bilger, *Auto Correct*, NEW YORKER, Nov. 25, 2013, at 106; John Markoff, *Look Officer, No Hands: Google Car Drives Itself*, N.Y. TIMES, Oct. 10, 2010, at A1; Rebecca J. Rosen, *Google's Self-Driving Cars: 300,000 Miles Logged, Not a Single Accident Under Computer Control*, ATLANTIC (Aug. 9, 2012, 12:29 PM), http://www.theatlantic.com/technology/archive/2012/08/googles-self-driving-cars-300-000-miles-logged-not-a-single-accident-under-computer-control/260926.

shared autonomous vehicles parked throughout a city. When you need a car, you simply access the network and wait for the nearest available car to pick you up.

The technology behind autonomous vehicles is rapidly improving.[163] The chief executive of Nissan Motor Company predicts that self-driving vehicles will go on sale around 2020.[164] Progress has been so quick that Google successfully lobbied for legislation in Nevada to allow self-driving vehicles on the road for testing purposes.[165] California passed a law which, among other things, requires its department of motor vehicles to come up with rules for self-driving cars by 2015,[166] and legislation related to self-driving cars has been enacted or is under consideration in several other states.[167]

While it may seem dangerous to ride in an autonomous vehicle, Google has had no accidents with cars running in self-driving mode.[168] So even though there is some danger in driving an autonomous vehicle, it will eventually be safer than driving ourselves. According to one observer describing a Google test car:

> [It] begins to seem like the Platonic ideal of a driver, against which all others fall short. It can think faster than any mortal driver. It can attend to more information, react more quickly to emergencies, and keep track of more complicated routes. It never panics. It never gets angry. It never even blinks. In short, it is better than human in just about every way.[169]

Semiautonomous and eventually more fully autonomous vehicles and other robots will become increasingly common, and they will need to be programmed to respond to a virtually infinite array of events and circumstances. More pervasive use of artificially intelligent entities will have systematic effects on the law and its interpretation. One speculative possibility is that the law will "concretize," by which I mean that it will become more clearly expressed and more transparently applied. Here are three ways in which the law may concretize.

First, laws on the books may converge more closely with the legal norms we are actually expected to follow. Most laws are principally interpreted by humans: there are lots of vague laws, but we often have a shared understanding of their meaning and how they are meant to be applied. Ideally, rules for autonomous entities would

---

163. *See, e.g.*, Tom Vanderbilt, *Let the Robot Drive*, WIRED, Feb. 2012, at 86, 88–90, *available at* http://www.wired.com/magazine/2012/01/ff_autonomouscars.

164. Dan Strumpf, *Liability Issues Create Potholes on the Road to Driverless Cars*, WALL ST. J, Jan. 27, 2013, at B1.

165. *See* Amy Lee, *Autonomous Vehicle Law Passes in Nevada: Driverless Cars Could Hit the Road in 2012*, HUFFINGTON POST (Aug. 24, 2011, 6:12 AM), http://www.huffingtonpost.com/2011/06/24/autonomous-vehicle-law-nevada_n_884307.html; *see also* Bill No. 511, 76th Assemb. (Nev. 2011), http://www.leg.state.nv.us/Session/76th2011/Bills/AB/AB511_EN.pdf.

166. CAL. VEH. CODE § 38750 (West 2013).

167. *Automated Driving: Legislative and Regulatory Action*, CTR. FOR INTERNET & SOC'Y, http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action.

168. Rosen, *supra* note 162; Bilger, *supra* note 162, at 106.

169. Vanderbilt, *supra* note 163, at 91.

not require them to have human attitudes or understand human conventions. On the other hand, if we can develop self-driving cars that recognize pedestrians, road debris, and traffic signs, cars can surely recognize that it is generally permissible to drive a few miles-per-hour above the posted speed limit.

A more significant push to concretize may emerge from corporations that design self-driving cars. They will fear the accident liability from even de minimis vehicle infractions, like driving a little bit above the speed limit. Thus, the law may concretize as corporations push for convergence between laws on the books and the laws that we are expected to follow. More concretized speed limits, for example, may be somewhat faster than those we have now but with more strict enforcement around the limit.

Second, the law may become more concrete as computers play a larger role in making legally relevant decisions. For example, a group of German researchers is working to develop a computer system "to make automatic decisions on child benefit claims to the country's Federal Employment Agency . . . probably with some human auditing of its decisions behind the scenes"[170] and is in talks with the agency about how to deploy it.[171] One researcher "hopes that one day, new laws will be drafted with machines in mind from the start, so that each is built as a structured database containing all of the law's concepts, and information on how the concepts relate to one another."[172] In other words, when legally relevant tasks are performed by computers,[173] legislation may itself be crafted more algorithmically to facilitate processing. That is a kind of concretization although whether or not such laws are clearer than current laws may be a matter of taste (and of whether you're a human or a computer).

Third, the law might concretize by creating greater pressure to clarify the theoretical underpinnings of the law. For example, many copyright holders already use automated software systems to scan the Internet looking for copyright violations.[174] Some users make constitutionally protected "fair use" of others' copyrighted material,[175] but it is difficult to know precisely what constitutes fair use. Before the Internet age, copying audio, visual, and written materials was more difficult, so there was less need to police violations. Furthermore, it was more expensive to police each violation when you could not simply search for violations on the Internet. Thus, fair use determinations were made less frequently. In the Internet age, such determinations are made much more frequently, and there is

---

170. Hal Hodson, *AI Gets Involved with the Law*, NEW SCIENTIST (May 17, 2013), http://www.newscientist.com/article/mg21829175.900-ai-gets-involved-with-the-law.html#.UpJbKsRwrzg.

171. *Id.*

172. *Id.*

173. On some of the obstacles, see generally James Franklin, *How Much of Commonsense and Legal Reasoning is Formalizable? A Review of Conceptual Obstacles*, 11 L., PROBABILITY & RISK 225 (2012) (discussing difficulties computers have in understanding context, conditionals, counterfactuals, degrees of similarity, and more).

174. Geeta Dayal, *The Algorithmic Copyright Cops: Streaming Video's Robotic Overlords*, WIRED (Sept. 6th, 2012, 6:00 AM), http://www.wired.com/threatlevel/2012/09/streaming-videos-robotic-overlords-algorithmic-copyright-cops/all/.

175. Copyright Act of 1976, 17 U.S.C. § 107 (2006).

more political pressure to understand the principles underlying fair-use doctrine in order to make the law more concrete.[176]

In the future, such pressures may apply to some of the most central questions facing moral and legal philosophers. Consider the tricky theoretical issues that underlie the famous trolley thought experiments:[177] A runaway trolley is heading toward five entirely innocent people who are, for some reason, strapped to the trolley tracks. If the trolley continues along its current path, all five will die. You can flip a switch to divert the trolley to an alternate track, but it will still kill one innocent person strapped to the alternate track.

This trolley problem and its numerous variations raise interesting questions about when it is mandatory or permissible to take an action that will save several lives, when the action will also knowingly cause the death of some smaller number of people. There is no consensus solution to all trolley problems. Nevertheless, autonomous agents, especially unmanned military drones,[178] will likely be confronted with real-life trolley problems. We will want these entities to follow rules of some sort, but we cannot program those rules unless we agree on what they should be. It is possible that we will have different rules for humans and nonhumans, but we will at least have to codify some rules for autonomous machines that will require more theoretical clarity and agreement than we have today.[179]

Of course, humans already face trolley-like situations from time-to-time, and we still do not have clear rules to follow. The difference, however, is that after humans have confronted an emergency situation, there is usually quite a bit of uncertainty about what they knew and when they knew it. With autonomous entities, we will know more precisely what information the entity had available to it and how it was processed. Indeed, we will typically have video footage of the pertinent events, along with all of the other data available to the entity. Being clear about the rules is more important when we can no longer hide behind ambiguous facts.

Quite independent of neuroscience and artificial intelligence, the law may already be concretizing. As more laws and regulations are created and cases are decided, the law's interstices may be shrinking. It is surely difficult to measure what I am calling the law's concreteness. But if the law is concretizing already, I hypothesize that the rate will increase, at least a bit, as autonomous machines become more prevalent.

---

176. According to one source, "copyright 'bots' don't have the ability to take fair use into account." Dayal, *supra* note 174 (quoting Kembrew McLeod). On the contrary, however, it seems more likely that bots could take fair use into account, even if it's an open question as to how well they could make the determination relative to humans. Either way, more concretized rules about fair use would make the job of copyright-enforcing bots easier.

177. *See, e.g.*, Philippa Foot, *The Problem of Abortion and the Doctrine of Double Effect*, *in* VIRTUES AND VICES AND OTHER ESSAYS IN MORAL PHILOSOPHY 19, 23 (1978); Judith Jarvis Thomson, *The Trolley Problem*, 94 YALE L.J. 1395 (1985).

178. *See generally* Nick Paumgarten, *Here's Looking at You: Should We Worry About the Rise of the Drone?*, NEW YORKER, May 14, 2012, at 46.

179. *See, e.g.*, Patrick Lin, *The Ethics of Saving Lives with Autonomous Cars are Far Murkier Than You Think*, WIRED (July 30, 2013, 6:30 AM), http://www.wired.com/opinion/2013/07/the-surprising-ethics-of-robot-cars/.

CONCLUSION

The emerging field of neurolaw addresses two major topics that have only limited overlap. The "neurolaw of responsibility" concerns how neuroscience will and should affect laws related to responsible action. It was traditionally addressed by punishment theory and the philosophy of action. The "neurolaw of technology," by contrast, concerns the ways the law will and should respond to new brain-related technologies. It covers issues traditionally addressed by applied ethics. Both topics require familiarity with law and neuroscience, but they otherwise examine rather different issues. Nevertheless, since both fields happen to involve law and neuroscience, the neurolaw moniker seems to have stuck.

Greene, Cohen, and Morse write principally about the neurolaw of responsibility. They spend much of their energy defending their substantive views about free will, though none of them purport to offer a new argument to break the free will impasse. Greene and Cohen also claim that advances in neuroscience will change the way we think about punishment, but they have yet to persuasively defend the claim. Similarly, Morse may be right that we ought to understand the law in compatibilist terms, but current law may be rooted in contrary assumptions.

While prospects for a responsibility revolution remain hard to predict, I claim that there will be a technology-driven neurolaw revolution. The law will change in many ways, and I focus on three hypotheses: (1) the differences in how the law treats emotional and physical injuries will diminish as neuroscientists develop more objective methods of identifying and assessing emotional injuries; (2) new methods of "mind reading" will lead us to have less thought privacy but more thought privacy laws; and (3) as autonomous and semiautonomous machines become more integrated into human life, they will have systematic effects on the law and its interpretation, perhaps by increasing the concretization of the law. The precise details of how technology will develop are hard to predict, but by trying to predict the path of technology, we can hope to make the law better prepared for the changes to come.