Finally! That was my reaction upon seeing the publication of these four studies. Now, for the first time, the field of neurolaw has received what it has long needed: systematic comparative data to replace anecdotes on how, and under what circumstances, neuroscientific evidence is actually being introduced into courtrooms.

The authors (and their numerous research assistants) are to be commended for their hard work in searching, identifying, and carefully coding cases. These are time-consuming tasks, and the field owes them a debt for their work.

In the first part of this commentary, I suggest that these studies lead to four broad conclusions about the current state of neuroscientific evidence in criminal courts. First, neuroscientific evidence is being used more than in years past, but still being used quite infrequently. Second, the legal contexts in which neuroscientific evidence is proffered vary widely, both within and across countries. Third, prosecutors as well as criminal defense attorneys are introducing brain evidence. Fourth, differences in legal structures and legal doctrine help to explain some of the variation in the introduction of neuroscientific evidence. In the second part of the commentary, I consider a series of unanswered questions that the studies also raise.

I finish in the third part of the commentary with a prediction: the future use of neuroscientific evidence in court will be similar to the use of instant replay in contemporary sports. That is, although neuroscientific evidence is likely to be used in only a small percentage of cases, it can still have a transformative impact. Like instant replay, neuroscientific evidence is more likely to be used when the stakes are high, and when judgments...
Table 1. Comparing the number of criminal cases in which neuroscientificevidence was introduced, 2008–2012

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<tr>
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<td>196</td>
<td>184</td>
<td>315</td>
<td>323</td>
<td>252</td>
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1 Because 2008 is the first year in which data was collected in each of the four jurisdictions, Table 1 begins with 2008. But three studies collected pre-2008 data as well: 52 cases in England and Wales; 63 cases in the Netherlands, and 315 cases in the United States.

Table 1 based on other observational data are on a borderline. And just as the use, and effect, of instant replay depends critically on the availability of proper camera angles, so too will the utility of neuroscientificevidence depend on the ability of medicine and science to provide brain data that is legally relevant. I expect that if this future comes to pass, then the legal system will – just as professional sports have – struggle at first. Ultimately, however, the law will find a workable solution to the use of neuroscientificevidence that will advance more just outcomes while not unduly delaying proceedings.

I. FOUR THINGS WE NOW KNOW ABOUT NEUROSCIENTIFIC EVIDENCE IN COURT

A. We know that neuroscientificevidence is now being used in courts in multiple countries, and that its use is likely on the rise

There is much we do not yet know about the use of neuroscientificevidence in law. As Paul Catley and Lisa Claydon write in their study of English courts, the ‘project is still in its infancy’. But despite the early stage of the research, the four studies all lead to the same conclusion: neuroscientificevidence has been appearing in courts for over five years, and that trend is not dissipating. In Table 1, I summarize the number of cases per year from 2008–2012, analyzed in the four published studies.

The authors of all four studies are appropriately cautious in drawing broad inferences from the data, given its preliminary nature and limited size. But all four suggest that the trend is an upward one. In English courts, ‘... it would appear that the use of neuroscientificevidence is increasing.’ In Canada, ‘there appears to be an upward trend in the number of cases in which evidence of brain injury or cognitive impairment linked to some neurological cause was accepted ....’ In the United States, 5 per cent of all murder trials, and 25 per cent of death penalty trials include this type of evidence. Moreover, in these US cases, Farahany finds that the quality of discussion by judges has improved as well.

2 Catley & Claydon, supra note 1, at 512.
3 Catley & Claydon, supra note 1, at 543.
4 Chandler, supra note 1, at 557.
5 Farahany, supra note 1, at 486.
6 Farahany, supra note 1, at 492 (finding that in ‘later opinions, judges spilled substantial ink discussing the neurobiological evidence often in significant detail and with citations to scientific literature and the experts who testified in the case’).
Yet despite the rise of neuroscientific evidence, as I discuss at the end of this commentary, it remains the case that the vast majority of criminal proceedings (and I would imagine civil proceedings as well) do not contemplate the use of neuroscientific evidence.

**B. We know that the use of neuroscientific evidence is quite diverse**

Across all four studies, another consistent finding is that neuroscientific evidence is being used in a wide variety of ways. In England, the ‘range of uses … is wide,’⁷ in the Netherlands, the ‘cases are diverse,’⁸ and in the United States, the use of neurobiological data is ‘haphazard, ad hoc, and often ill conceived’.⁹ These uses of neuroscientific evidence are not just in death penalty and murder cases, but in many legal contexts such as determinations of future dangerousness, guilt phase accountability, drug cases, criminal mental states, competency, assault, robbery, fraud, and ineffective assistance of counsel.

Both within and across countries, there appears to be great variation in when attorneys proffer the evidence, and what courts then decide about its admissibility. In Canada, for instance, there were a large number of cases involving brain data related to fetal alcohol syndrome. But such cases did not arise at all in the Dutch courts, and were not as prominent in the United States and England.

**C. We know that the prosecution is using brain science too**

Scholars have debated whether neuroscientific evidence will be a ‘double-edged sword’, both helping and hurting criminal defendants.¹⁰ In these four studies, we see evidence of brain science being introduced by the prosecution.¹¹ First, prosecutors are using brain evidence to show the extent of a victim’s injuries.¹² Second, in more than one English case discussed by Catley and Claydon, the lack of a brain scan to support a diagnosis was noted by the Court.¹³ Finally, in Canada, ‘a large number of cases showed that judges viewed brain damage as a source of increased risk of recidivism or pessimism about treatment’.¹⁴ One Canadian case quote was particularly illustrative of the potential prosecutorial power of neuroscientific evidence: ‘[e]verything that I have heard or read indicates to me unfortunately that this young man, through no fault of his own, is likely beyond redemption’.¹⁵ The defendant was then given a life sentence.

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⁷ Catley & Claydon, supra note 1, at 510.
⁸ de Kogel & Westgeest, supra note 1, at 582.
⁹ Farahany, supra note 1, at 488–89.
¹⁰ Legal scholar Deborah Denno has gone so far as to call it the ‘myth of the double-edged sword’, finding that ‘neuroscience evidence is only rarely used to bolster a defendant’s future dangerousness and that prosecutors employ a variety of purported strategies in making such arguments’. Deborah W. Denno, The Myth of the Double-Edged Sword: An Empirical Study of Neuroscience Evidence in Criminal Cases, 56 B.C. L. Rev. 493, 498–544 (2015).
¹¹ de Kogel & Westgeest, supra note 1, at 594.
¹² Catley & Claydon, supra note 1, at 515.
¹³ Catley & Claydon, supra note 1, at 537.
¹⁴ Chandler, supra note 1, at 564.
¹⁵ Chandler, supra note 1, at 571.
D. We know that legal structures and doctrine have an effect on the frequency of introducing neuroscientific evidence.

At times in neurolaw debates, the phrase ‘not ready for primetime’ has been offered as an explanation for why we don’t see a particular type of neuroscientific evidence in the courtroom. As typically used, this primetime perspective focuses primarily on the state of neuroscience knowledge, with the idea that only when the neuroscience further develops will questions of admissibility become ripe.

But these four studies remind us that legal doctrine and structures can make the introduction of neuroscientific evidence more (or less) hospitable. A simple cross-national comparison illuminates the point. In the same 2008–12 time span, each of the countries studied witnessed a markedly different portfolio of neuroscientific evidence. Do we explain this cross-country variation on the basis that the neuroscience knowledgebase and technology varied so markedly across national borders? It’s possible that access to technology and experts explains some of the difference. But I suspect that most of the variation in the introduction of neuroscientific evidence is a product of each country’s unique legal, historical, and sociocultural context. For instance, in Canada the relative prevalence of brain data in cases involving Aboriginal Canadians stems from Supreme Court case law directing sentencing judges to make particular considerations in such cases.

II. WHAT NEXT? UNANSWERED QUESTIONS AND THE FUTURE OF NEUROSCIENTIFIC EVIDENCE IN COURT

In addition to the data they provide, the four studies focus our attention on a series of foundational questions for the field.

A. What counts as ‘neuroscientific’ evidence?

Each study answers the ‘what counts?’ question similarly, if not identically, for purposes of coding. But the studies also recognize that something bigger is at stake here than just coding precision. Where, exactly, are the boundaries of ‘neuroscience and law’ as compared to ‘psychology and law’ or ‘medicine and law’ (each of these latter two being longer-standing fields of inquiry)?

Catley and Claydon write that ‘[a]rtificial distinctions are difficult’, and I agree. I have previously advocated for a big tent approach to neurolaw, and I was glad to see the studies embracing a liberal conception of neuroscientific evidence to include genetic and neuropsychological testimony.

B. Whither imaging? The mismatch between neurolaw scholarship and courtroom practice

Neurolaw scholarship, like neuroscience in court, is on the rise. But these four new empirical studies reveal that scholars’ focus on neuroimaging generally, and fMRI in

16 de Kogel and Westgeest recognize, for instance, that in the Netherlands the pool of available qualified experts is not large enough.
17 Chandler, supra note 1, at 560.
particular, may be partially misplaced. In the Canadian courts, ‘[b]rain imaging and
electroencephalography were infrequently mentioned,’ and in English courts, the
only fMRI case was a single civil case (involving vegetative state). In the United States,
only 15 per cent of the coded cases had any sort of brain scanning, and less than 1 per
cent overall (2 per cent of the 15 per cent) included fMRI evidence. In the Netherlands, de Kogel and Westgeest observe that ‘an MRI-scan is made in about half’ of the
cases where an assessment is made of defendants in serious offenses. Yet even in the
Netherlands, neuroimaging plays a marginal role. As de Kogel and Westgeest write, at
‘the individual level, neuropsychology may at present have more to offer than brain
imaging.’ Future neurolaw scholarship might be improved by spending more time
wrestling with the types of evidence that lawyers are actually using.

C. Does the neuroscientific evidence affect outcomes? Maybe ... but if so, mostly at
sentencing
Each of the studies attempts to explore, as best their data will allow, whether the pro-
ferred neuroscientific evidence actually changes legal outcomes. Of course, as Chandler
notes, the ‘impact of the neuroscientific evidence was often challenging to identify …’ That said, each study found examples of neuroscience making a difference.

But a consistent trend emerging from the data is that if neuroscience matters, it is
more likely to be at the sentencing as opposed to the guilt phase. In the Dutch courts,
in ‘the majority of the cases found, neuroscientific information is introduced as mitigat-
ing information in sentencing’. Similarly, in the United States, Farahany finds that ‘at-
ttempts to use neurobiological evidence for determinations of guilt or innocence seems
to make far less of an impact than attempts in pretrial and sentencing determinations’.
In Canada too, ‘[n]euroscientific evidence was most commonly mentioned in sentenc-
ing decisions and decisions on whether to designate an offender as a dangerous or long-
term offender’.

D. What next?
The data in these studies make clear that while neuroscience is beginning to show up in
courts, it is just that—a beginning. They challenge the field to ask itself: where do we
go from here?

More research: for starters, I hope that we see more of this work. We need to look
at civil cases, for instance, and we need data from more countries. Not only would addi-
tional countries and years of data be useful, so too would a study of slightly different
design. At present, each study has, in social science parlance, selected cases on the de-
pendent variable. Incredibly valuable (though also incredibly time consuming) would

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be a database in which we compare cases in which neuroscience was used with similar cases in which the evidence was not used. In the meantime, as we wait for more data, my hope is that all of these authors, as well as others who have done similar analyses, will make their data publicly available for download and further analysis.

More dialogue: as the Executive Director of Education and Outreach for the MacArthur Foundation Research Network on Law and Neuroscience, it will not be surprising that I agree wholeheartedly with Farahany’s suggestion that we ought to have more educational programming about the responsible use of neuroscientific evidence in the courtroom. The data from these four studies makes clear that attorneys are proferring the evidence. Courts ought to have available to them resources for the proper assessment of neuroscientific evidence.

III. A PREDICTION: NEUROSCIENTIFIC EVIDENCE AS INSTANT REPLAY

One headline from these four studies might be, ‘Use of Neuroscience in Courtrooms is Rising’. That would be fair, but I think misses part of the story. I would instead start with the fact that the vast majority of cases don’t now, and likely won’t in the future, consider neuroscientific evidence.

Consider that the annual number of incoming criminal cases in United States state courts is roughly 20 million cases. Thus, not even including federal cases, the rough denominator of all criminal cases for the time period 2005–12 is 160 million cases. For illustrative purposes, let’s say that the 1585 reported US cases undercounts the frequency of cases by 100,000 per cent, so that in fact in this time period there were 1,585,000 neurolaw cases. Even then, this would mean that over 99 per cent of criminal cases did not involve neuroscientific evidence. If we focus primarily on the number of cases involving neuroscientific evidence, I think we miss this big picture.

I would focus instead on when neuroscientific evidence is being used, and an analogy to the use of instant replay in sports is instructive.

In the National Football League, instant replay is now used to review about 400 plays per season (and this has ticked upwards over the past decade, not unlike the increase in neuroscience cases.) But 400 plays is only 1 per cent of the estimated 39,000 plays that constitute an NFL season.

Do we conclude that instant replay means little to the outcomes of NFL games? Not at all. Indeed, as well-known sports broadcaster Dick Enberg has observed, instant replay has ‘completely changed how we all look at sports’.

Instant replay has accomplished this not by its frequency, but by its timeliness. We turn to instant replay when the stakes are high (eg to review whether or not a

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30 de Kogel & Westgeest, supra note 1, at 591.
touchdown was made), and when the play is a tough call (eg the player’s toe is just next to the out-of-bounds line.) We don’t need instant replay for the majority of calls because they are easy to make without the extra help.

My prediction is that neuroscientific evidence is likely to play a similar role in courtroom adjudication as instant replay does in sports. It will be used sparingly, but critically, when the stakes are high and the case is at a borderline.

To carry the analogy further, the value of instant replay in sports depends on the technology available. If the camera angle did not, or could not, capture the play then video replay will be of little use. Some judgment calls in sports are, by rule, not reviewable. Similarly, if the neuroscience technology is not available, or cannot add useful information, it will be of little use in the courtroom.

The analogy to instant replay is not perfect, but it’s useful because it reminds us that neurolaw cases need not be numerous to be noteworthy. The evidence gathered in these four empirical studies shows us that in the criminal law, neuroscientific evidence is already making a difference in multiple jurisdictions. It will be exciting to see what happens in the years to come.