NEUROSCIENCE AND THE LAW — SCIENCE AND SOCIETY

Neuroscientists in court

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Abstract | Neuroscientific evidence is increasingly being offered in court cases. Consequently, the legal system needs neuroscientists to act as expert witnesses who can explain the limitations and interpretations of neuroscientific findings so that judges and jurors can make informed and appropriate inferences. The growing role of neuroscientists in court means that neuroscientists should be aware of important differences between the scientific and legal fields, and, especially, how scientific facts can be easily misunderstood by non-scientists, including judges and jurors.

In 2005, convicted child-rapist Grady Nelson brutally murdered his wife Angelina. After stabbing her 61 times, he left a butcher knife embedded in her brain. Later, his own life hung in the balance as the Florida jury that convicted him of murder next had to decide whether he would be executed or spend his life behind bars. Nelson's attorney offered to provide neuroscientific evidence — specifically, quantitative electroencephalography (QEEG), introduced through the testimony of a neuroscientist — to suggest that Nelson had potentially relevant brain abnormalities. The jury should hear this evidence, the attorney argued, because although it may not excuse Nelson's behaviour, it should mitigate his punishment[1].

In a different case, in 2010, psychologist Lorne Semrau went on trial in federal court for allegedly masterminding healthcare fraud in connection with psychiatric care that two of his companies provided for patients in nursing homes. His attorney offered to introduce neuroscientific evidence — specifically, the results of a functional MRI (fMRI) test, introduced through the testimony of a neuroscientist — to suggest that Semrau was truthful when he claimed that any overbillings were accidental (rather than purposeful, as the government would have to prove). Among the evidence[2,3] he offered to introduce was the neuroscientist's conclusion that: "Dr. Semrau's brain indicates he is telling the truth in regards to not cheating or defrauding the government" (REF. 2).

In these cases, and a steadily increasing number of similar cases in both criminal and civil courts, neuroscientific evidence has been introduced to support a party's legal claim as well as to argue its irrelevance or invalidity (by the opposing party)[4–6] (N. Farahany, personal communication). That evidence comes sometimes in the form of documentary neuropsychological reports and sometimes in the form of neuroscientists testifying in court proceedings. Some of these neuroscientists appear willingly, and some reluctantly. It appears that sometimes their involvement in a case sparks a plea bargain or settlement before trial[7,8]. The principal importance of the example cases above is to raise this question: when and how should neuroscientists participate in litigation?

In barely a decade, a distinct field of 'law and neuroscience' has emerged[4,6–20], accompanied by a sharp rise in both conceptual and empirical scholarship (FIG. 1), conferences (see neurolaw conferences on The MacArthur Foundation Research Network on Law and Neuroscience website), international neurolaw societies (see the external links page on The MacArthur Foundation Research Network on Law and Neuroscience website), 'law and neuroscience' courses being taught in law and other departments internationally, a forthcoming coursebook[21], new neuroscience–law joint-degree programmes, and so on. In light of the possibility that technological advances might aid the legal system, and in view of how important it is for law to separate neuroscientific wheat from chaff, the John D. and Catherine T. MacArthur Foundation has funded two consecutive interdisciplinary, collaborative research initiatives in the United States — the Law and Neuroscience Project and The MacArthur Foundation Research Network on Law and Neuroscience. These developments as well as the rising number of references to neuroscientific evidence in court opinions[4,22] (N. Farahany, personal communication), suggest that neuroscientists may be called upon with increasing frequency — and with implications and consequences yet unknown — to lend their expertise to matters of legal import.

Whether this will provide a net gain in the fair and effective administration of justice is a topic of current debate[23–26]. But the new types and increasing quality of neuroscientific evidence — particularly brain imaging techniques, on which we primarily focus here — ensure that the interaction between law and neuroscience is both unavoidable and intensifying. This article explores some of the reasons why neuroscientific evidence is being offered in legal proceedings, several key features of law that neuroscientists may wish to know and several important clarifications about and limitations of neuroscience that the legal system needs to learn from neuroscientists.

Why neuroscience?

Why is the legal system increasingly turning to neuroscientists? The answer is simple: it does so in the hope that new technologies may help to satisfy many acute and long-lingering needs, including the law's need to answer questions such as: is this person responsible for his behaviour? What was this person's mental state at the time of the act? How much capacity did this person have to act differently? What are the effects of addiction, adolescence or advanced age on one's capacity to control behaviour? How competent is this person? What does this person remember? How accurate is this person's memory? What are the effects of emotion on memory, behaviour and motivation? Is this person telling the truth? In how much pain is this person? How badly injured is this person's brain?

Because society uses the legal system to help regulate the behaviour of its citizens, the legal system turns to disciplines (typically social science disciplines, such as psychology, economics and sociology) that claim to have special insights into the causes of human behaviour, what patterns human behaviour manifests and how people are likely to react as law shapes incentive structures within social environments[27]. Neuroscience may in part be 'hot' in law because its technological sexiness may lend it persuasive power and because legal advocates are, in turn, always alert for potentially persuasive ways to aid their clients. However, in our view, neuroscience has become attractive mainly because many legal professionals, courts and commentators hope or believe that it can provide a tool that not only usefully supplements traditional social science perspectives but that also may be, in some contexts, more objective and powerful.

Not surprisingly, some substantial fears accompany that hope. In our collective experience at the neuroscience–law

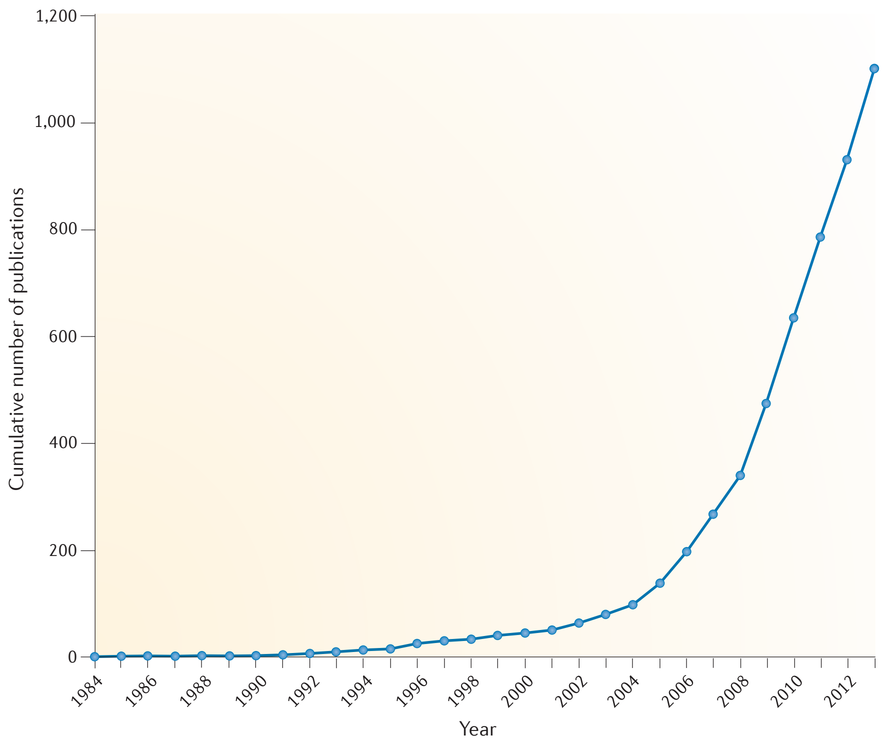

Figure 1 | **Cumulative growth in the number of 'law and neuroscience' publications.** The figure shows a sharp rise in the number of publications in the 'neurolaw' field between 2003 and 2013. These publications include both conceptual and empirical scholarship in the neurolaw field. Figure is reproduced from the Law and Neuroscience Bibliography on the website of The MacArthur Foundation Research Network on Law and Neuroscience.

(neurolaw) intersection, it has become clear that many people — both inside and outside of the legal professions — worry that neuroscience is too complex and too technical in nature for laypeople to understand and apply, even when particular neuroscientific evidence could, if it is properly understood, be useful to law's purposes. In addition, they worry about the risks of over-reductionism, the possible low explanatory power of neuroscientific evidence (that is, when the neuroscience evidence adds little beyond the behavioural evidence) and — more importantly — about the general problem of drawing inferences about the consequences of brain states that are defensible both scientifically and within the specific legal context that each case may present. These worries are fanned by concerns about, among others, the ecological validity of laboratory-based studies, the challenges of drawing inferences relevant to an individual from group-based studies and the potential over-persuasiveness of neuroimages[18,25,26,28–46]. We believe that neuroscientists can play crucial roles in addressing these concerns during legal proceedings.

Four roles for neuroscientists

There are four main ways in which a neuroscientist may become involved in litigation. The first is as a so-called 'fact witness' (sometimes called 'lay witness'). Fact witnesses can testify about the underlying facts of a case on the basis of their own personal knowledge, which is grounded in direct experience with the parties involved in the case or issues in the case. For example, the neurologist who first examined a plaintiff after his injury in an accident may be called upon to recount her examination and findings.

The second way is as a non-witness consultant. In this role, they may help attorneys to evaluate neuroscientific evidence offered by the opposing side, suggest questions an attorney should ask opposing witnesses or provide general, non-testimonial advice about the strength of a claim, about the significance of a finding or about who else should be consulted as the case develops.

The third way is to join an effort to prepare a so-called 'amicus brief' for cases before the US Supreme Court. In suitable circumstances, such briefs can be submitted by individuals or organizations that are not party to a lawsuit but who nonetheless believe they have information or perspectives that the Court should consider when deciding the case. For instance, in the past decade, amicus briefs involving neuroscientists were filed in three prominent Supreme Court cases regarding criminal punishments of juvenile offenders[47–49].

The fourth way to become involved in litigation is as an expert witness[50]. If the judge in the case decides that a proposed witness is qualified (on the basis of specialized knowledge that has typically been acquired through education, training and experience) to be designated as an expert witness, then that person can offer opinions about, or interpretations of, the facts in the case — something that fact witnesses are ordinarily not allowed to do. In the remainder of this article, we focus on issues that neuroscientists might encounter when acting as an expert witness.

Legal and scientific cultures

Suppose that, after much discussion, review and reflection, a neuroscientist agrees to be an expert witness. The neuroscientist's experience as an expert witness will depend on (among other things) his or her understanding of a number of things about the distinct cultures and contexts of neuroscience and law. We will discuss six crucial matters of which neuroscientists should be aware when acting as expert witnesses.

Decisions under uncertainty. At the most general (and therefore over-simplified) level, we can consider science to be about facts and law to be about values. More specifically, we could say that science aims to discover facts, and thus to increase our collective knowledge of reality through various inductive and deductive means, including hypothesis-driven experimentation. By contrast, law aims to pursue the ends of society's values — with respect to orderly, productive and just behaviour. It does this through various legislative, executive and judicial means, including through courts that exist for one single reason: to resolve disputes.

There are of course many other important aspects of the legal system that distinguish it from the scientific system. One is that trial courts typically must decide who wins and who loses a case. There are no ties, there are no maybes and there is no tabling the issue for further court-managed study. A second key aspect is that courts cannot completely control when they must decide. As a case progresses, there comes a time when the decision must be made. At that moment, a civil plaintiff either wins or loses, and a criminal defendant is either freed or not.

A third and crucial aspect is a function of the prior two: jurors and judges must almost always make decisions under conditions of considerable uncertainty. The decisions they make depend not only on the level of uncertainty but also on the specific legal context. Roughly speaking, the more consequential the decision, the more certain the decision-makers must be (that is, the higher the 'burden of proof' must be) before they should decide that a claim or allegation is meritorious. For example, when life or liberty is at issue in criminal cases, the US Constitution requires proof "beyond a reasonable doubt". By contrast, to win a civil trial, at which only amounts of money are at issue, a mere "preponderance of the evidence" (the US standard, akin to the "balance of the probabilities" in the United Kingdom) is required. Of course, research scientists can and do have to deal with uncertainties of various kinds in their own research. However, the nature, range and contexts of that uncertainty in science are considerably distinct from those in law. The key point is that courts cannot avoid — as scientists generally can (and often should) by continuing their own research — making high-impact decisions in the face of imperfect information. Keeping this systemic constraint in mind helps to make sense of many otherwise puzzling features of litigation.

How to approximate truth. Because science and law have different functions and therefore different attitudes with respect to conditions of uncertainty, science and law often pursue truth quite differently[51,52]. Science engages in an iterative process of trial, error and refinement in pursuit of generalizable knowledge; indeterminate experiments can be followed by new and better experiments. By contrast, at least one major component of the legal system — the resolution of disputes in court — requires individual courts to repeatedly engage in particularized, one-shot decision-making that often has no generalizable bearing on other disputants or on the systemic accumulation of a greater body of knowledge. Courts cannot conduct experiments, nor order any, in pursuit of the truth. Instead, they depend on an adversarial process that should, it is hoped, reveal the relevant truths by harnessing, within an ultimately gladiatorial arena, the competitive spirits, economic interests and ethical obligations of each party's lawyers.

Put another way, science generally approximates truths by hypothesis-testing, whereas the legal system frequently approximates truths by evaluating what happens when two highly incentivized teams shoulder a legally imposed duty to gather evidence and to argue in favour of two directly opposite propositions. This difference has major implications for the experience of neuroscientists in court.

Experts on the stand. One consequence of the legal system's trying to grind truth from between the abrasive surfaces of two opposing parties is the unpleasant phenomenon of cross-examination — the process by which the other side tries to expose flaws in the expert witness's background, credentials and reasoning. This can come as a shock to the expert witness, especially if he or she fails to anticipate it or fails to take it in stride. The way this process works, systemically, is that after the attempt at undermining is over, the opposing attorney will undermine the undermining in an effort to expose the cross-examination as misleading, irrelevant and futile, and to show that the expert witness is indeed an expert in both the scientific and the legal sense.

The role of experts. Neuroscientists may have been called upon because of their expertise, which a court may have recognized by 'qualifying' them as expert witnesses. They may therefore think (at least the first time they appear in court) that they are being asked to provide a little lecture, with their own preferred organizational structure, about what they know that others do not. But that is not what being an expert witness entails. Rather, expert witnesses are typically required to answer specific questions, which often emerge from prior discussions with the lawyer. The lawyer uses this approach to elicit the relevant opinions in such a way that they are understandable to the judge and jury. The answers will ultimately be weighed by non-expert jurors alongside other evidence presented by both sides. Depending on the circumstances of the trial, among the factors that usually influence jurors' acceptance of expert testimony are their perceptions of the witness's accomplishments, of any bias that may be revealed and of the clarity and accessibility of the testimony[53–58].

Admissibility of expert testimony. Expert opinions must first be evaluated for admissibility — that is, the judge will decide whether to even allow the jury to hear the opinions. In the United States, the federal system and each of the constituent states can develop their own rules about, for example, how to define 'murder' and can likewise develop their own procedural rules about, for example, how to decide whether to admit the testimony of scientific experts.

Many state courts in the United States continue to use the so-called 'Frye test' (articulated in 1923 in the case *Frye v. United States*)[59] for determining the admissibility of scientific evidence. Under the Frye test, which is sometimes referred to as the 'general acceptance test', the opinions of scientific expert witnesses are admissible if they are based on principles or techniques that are generally accepted as reliable in the relevant scientific community.

Since 1993, all US federal courts have been required to apply a different test to determine admissibility, and many state courts have chosen to adopt this test as well. That test is reflected in Rule 702 of the Federal Rules of Evidence[60], which instantiates the so-called 'Daubert standard' (named after the 1993 US Supreme Court case *Daubert v. Merrell Dow Pharmaceuticals*[61] and further articulated in several subsequent cases[62,63]). Under the Daubert standard, which is sometimes described as the 'gatekeeping standard', the opinions of scientific expert witnesses are admissible only if a judge is satisfied that they are helpful and appropriately scientific and that they have been correctly applied to the case at hand. Unlike the Frye test, which calls upon judges to inquire whether the science is generally accepted by the field, the Daubert standard requires that judges themselves assess whether the expert's testimony is grounded in valid science. Relevant (but emphatically non-exclusive) factors in making this assessment include: first, whether the theory or technique can be tested and has been tested; second, whether the theory or technique has been subjected to peer review and publication; third, the known or potential rate of error of the method used; fourth, the existence and maintenance of standards controlling the technique's operation; and fifth, whether the theory or method has been generally accepted by the relevant scientific community[64,65].

Importantly, the decision of whether a neuroscientist's evidence has passed the applicable test (Frye or Daubert) does not end the admissibility analysis. That is because the legal system not only requires that scientific testimony be directly relevant to a decidable issue but also recognizes that the value added by some kinds of evidence may be outweighed by the potentially prejudicial effect the evidence may have on jurors. For example, an undisputedly accurate but extremely lurid and graphic photograph of a murder victim's maimed body may risk unfairly inflaming the jurors' passions in such a way as to prevent a fair trial of the accused, who may actually be innocent. Judges have the discretion to exclude such evidence, and they often do.

The ability of judges to exclude relevant evidence if its effect is very likely to be disproportionately and unfairly strong provides an important check on the admissibility of scientific evidence. For example, Rule 403 of the Federal Rules of Evidence empowers judges to "exclude relevant evidence if its probative value is substantially outweighed by a danger of … unfair prejudice, confusing the issues, misleading the jury…" (REF. 66). Some commentators worry that the visual impact of brain images may be so great, and the memory of them so vivid, that they unfairly prejudice the jury in favour of the party offering them and that for that reason alone they should sometimes be excluded from evidence. For example, in Illinois — which uses the Frye test — the judge presiding over the trial of murderer Brian Dugan allowed a neuroscientist to describe to the jury his methods and findings but prohibited him from showing the jurors any images of Dugan's brain itself[67]. (Experiments with potential jurors suggest that brain images sometimes have an outsized impact in actual court proceedings[68] — by having a more persuasive effect on jurors than the facts warrant — and sometimes do not[69].)

Two founts of confusion. There is a wide variety of resources on the subject of how experts should handle questions (both on direct examination and under cross-examination), how they should communicate in ways that judges and jurors can understand, and so on[70–79]. Our collective and extensive personal observations of interactions between lawyers and neuroscientists — both inside and outside of litigation contexts — suggest there are some additional, important, terminology-centred issues of communication between the two fields that transcend the courtroom context.

Each field has its jargon. A neuroscientist may mention the 'dorsolateral prefrontal cortex' and a lawyer may use common Latin legalese, such as '*res ipsa loquitor*'. In these obvious cases of jargon use, the neuroscientist and lawyer are probably aware that the terms need explanation. However, a more insidious problem concerns words that are used in both fields but that mean completely different things to members of the two disciplines.

The first fount of confusion is when each discipline has a different but specialized meaning of the term in question. For example, whereas in psychology the word 'normative' quickly invokes the meaning 'representative of the group being studied', the same word in law is just as automatically understood to be referring to an 'ought' proposition. That is, in law, the word 'normative' is used in reference to how something should be done. Other examples are terms such as 'theory', 'trial', 'threshold', 'representation,' 'evidence' and even 'fact'.

The second fount of confusion is when one field uses a very common word in a very technical way and the other does not. To a neuroscientist, the word 'significant' brings *p*-values to mind, whereas the use in law is typically synonymous with 'important'. A neuroscientist may use the word 'development' to mean the process by which the brain matures, whereas a lawyer recognizes the word to mean 'a thing that happened'. Similar confusion follows the use of terms such as 'plastic', 'reliability' and many others. The same is true in the reverse, when law imbues common words with technical meanings. For example, to a neuroscientist, the question of whether a person behaved 'knowingly' is largely an inquiry into what the person knew, whereas within criminal law, in which not only a bad act but also a culpable state of mind is required for someone to be convicted of a crime, 'knowingly' means something quite different. It is one of four highly defined and specific culpable states of mind within the Model Penal Code[80] — the four being purposefully, knowingly, recklessly and negligently. Each term carries the baggage of hundreds of thousands of cases and hundreds of scholarly articles parsing its contextual nuances.

Consequently, when neuroscientists and lawyers talk with one another, it is quite common that they focus on trying to understand the obvious jargon and therefore miss and, as a result, misunderstand the non-obvious jargon.

What courts need from neuroscientists

As mentioned earlier, neuroscience is increasingly being offered as evidence in litigation. The legal system needs solid evidence that can aid just decision-making, and although neuroscience is not always relevant, there are many cases in which it can be. In these cases, the legal system needs neuroscientists who are willing to serve as experts to enable the evidence to be heard. Similarly, when one party plans to introduce neuroscience-based evidence that has been improperly gathered, inappropriately analysed, misrepresented or is otherwise insufficient for the inferences that legal decision-makers are being urged to draw from it, then again the legal system needs neuroscientists who are willing to serve as experts, so that countervailing views of the evidence can be aired.

Neuroscientists can provide crucial information and perspectives for juries and judges, and in many cases this information will be highly case-specific. Below, we discuss a number of more general science-related points on which jurors and judges often need guidance.

How technologies that acquire brain data work — and do not. Jurors and judges do not need in-depth courses in neuroanatomy or need to learn, for example, how flip angles and T2 weightings work in fMRI. Nevertheless, no one can draw legitimate inferences from data if they do not have a good sense of how the data were obtained and what they actually mean. For instance, with respect to fMRI evidence, it is essential that legal decision-makers understand that when they see an image of colours inside the skull, they are not looking at something meaningfully analogous to an X-ray of brain activity in those locations but rather at the outcomes of statistical analyses performed on the data.

Structural and functional images are different. There are many contexts in which neuroscientific testimony could be relevant to law, such as interpreting neurotransmitter deficits, explaining the memory deficits of patients with Alzheimer's disease or explaining why someone seeking disability benefits has impaired brain function after a car accident, notwithstanding the absence of cranial penetration. Those different contexts and the different kinds of structural or functional evidence will carry different opportunities for neuroscientists to help the legal system to avoid important misunderstandings.

Take MRI and fMRI as examples. Individuals who are unfamiliar with brain imaging can be forgiven for not knowing that functional images are meaningfully different from structural images. After all, both types of image may show structural features in high resolution and both may have embedded features, such as a carpenter's nail in a structural MRI scan, and a colourized representation of varying statistical significance in an fMRI scan. Neuroscientists are in the best position to point out that scanners do not actually generate fMRI brain images and that the images are instead generated through a series of (human) decisions about how the data should be processed, what statistical comparisons should be made and what statistical thresholds should be used in those comparisons. Relatedly, neuroscientists can usefully note that fMRI enables inferences to be made about the mind that are based on inferences about neural activity that are based on the detection of physiological functions, which are thought to be reliably associated with brain activities. These are the sorts of clarifications and caveats that the legal system will often need to hear. Neuroscientists can also explain that other types of neuroscience evidence are similarly dependent on data acquisition and analysis procedures.

Base rates are important and often unknown. The third point can be illustrated with this example: Herbert Weinstein, a 65-year-old advertising executive, strangled his wife and threw her out of the apartment window, apparently to make it look like suicide. It turned out that he had a large subarachnoid cyst — highly visible on a positron emission tomography scan — the growth of which had displaced and thereby compressed brain tissue.

Connecting the location of the cyst with results of a number of academic studies could give reason to believe that some of the defendant's cognitive capacities were impaired at the time of his violent act. However, many brain regions are involved in a wide variety of functions, and this considerably complicates any effort to directly connect a particular and unusual brain feature with a particular past behaviour[81]. And, perhaps more importantly, we do not know the base rate of the phenomenon: how many people are walking around with similar cysts in their heads who do not strangle their wives and throw them out of windows?

Correlation is not causation. Suppose that the brains of nine out of ten killers-for-hire, when scanned after being arrested, each have the same and statistically significant abnormality in brain function (compared with law-abiding matched controls). A neuroscientist can help to point out that neither this statistic nor the functional abnormality — nor the combination of the two — can legitimately support a strong inference of causal connection between the abnormality and the violent acts. The neuroscientist could explain, for example, that although it is possible that a causal connection exists, there are other possibilities too. For example, it could be that the experience of being a repeated contract killer results, over time, in this particular statistical abberation in brain function. Or it could be that the two things co-vary because of something else entirely. Neuroscientists are in the best position to help decision-makers navigate the narrow path between under-interpreting and over-interpreting neuroscientific evidence.

Brains differ. Sometimes group-averaged data about brain function are presented in court to help prove something about the brain of, for example, the accused. Although this may in some cases provide useful information, it is far from certain how often it does. In some cases, the law needs neuroscientists to clarify that although aspects of brain structure, brain activity and neurotransmitter function may be similar between subjects, there is often a great deal of variation across individuals. That is, scientific findings from studies of a group of individuals are not automatically or necessarily relevant to individual cases[82–85].

Brains change. Today's brain is not yesterday's brain. People do not walk around with miniature brain scanners on their heads just in case brain functioning at a particular moment may turn out to be important later. Some factors that influence brain function enable reasonable guesses about prior brain states. For example, knowing the growth rate of a certain tumour detected now may render it reasonable to believe that the tumour was already there, a bit smaller, 6 months ago. But other factors that influence brain function are more transient and dynamic. It can therefore be difficult to know today how the brain was functioning 6 months (or more) ago, at the time of the legally relevant event.

For example, it has become extremely common in death penalty appeals for the defence counsel to offer the results of a recent brain scan of a client who has been on death row for many years. Interpreting the relevance and meaning of such a scan is not easy. It is possible that it reveals a late-discovered structural or functional condition of such a massive nature, about which so much is known from research studies, that it calls into question the prior conclusion of the legal system about the person's culpability at the time of the criminal act. But it is more often the case that a brain scan that shows some functional abnormality is indeterminate. It is often not possible to conclude that because the brain is functioning or malfunctioning in a particular way now it was necessarily functioning or malfunctioning in the same way at the time of the criminal act. In addition to the question of whether one can deduce any causal connections between the brain function and the act on the basis of a scan, it is also by no means certain that any 'abnormality' in the brain or in brain function that is detected on a scan caused the act that landed a person in jail rather than being a consequence of being in jail.

Conclusions

In order for wife-killer Grady Nelson to be sentenced to death, seven of the twelve jurors (a simple majority) had to vote in favour of executing him. Only six did, so his life was spared by the narrowest possible margin. Following the vote, it appeared that the neuroscientific evidence had been crucial. Two of the jurors who voted against executing Nelson told the press that the neuroscientific QEEG evidence had changed their minds, given that they had each initially favoured his execution. One of them said: "It turned my decision all the way around. The technology really swayed me… After seeing the brain scans, I was convinced this guy had some sort of brain problem." (REF. 86)

By contrast, in the case of Lorne Semrau, the psychologist charged with fraud, his fMRI 'truth verification' evidence was not admitted to the jury. After 2 days of intense testimony from two neuroscientists (S. Laken and M.E.R.) and one statistician (P. Imrey), the court excluded the neuroscientific evidence because (among other things) it failed two of the four recommended Daubert factors. Specifically, the error rates of using fMRI for lie detection were not known (third Daubert factor), and using fMRI for this particular purpose is not generally accepted within the relevant scientific community (fifth Daubert factor)[87]. Following the trial, Semrau was subsequently convicted of three counts (out of sixty) of healthcare fraud.

Whatever the merits of these two results, they illustrate a growing intersection of neuroscience with law. It is becoming increasingly common for lawyers to offer neuroscientific evidence — particularly brain images — in both criminal and civil litigation. In our view, this development is both promising and perilous depending on whether and how well courts can come to distinguish, within the contours of distinctly adversarial proceedings, between justifiable and unjustifiable inferences. Neuroscientists have crucial parts to play in a legal system that needs to understand and interpret neuroscientific evidence and to separate wheat from chaff.

The ability of neuroscientific techniques to shed light on important aspects of human cognition has generated hope that neuroscience can help to answer some perennial questions in courts of law. However, one should keep in mind that it is easier to misunderstand or misapply neuroscience data than it is to understand and apply them correctly, and this is crucially important when lives and livelihoods depend on it. Whether courts can successfully navigate these challenging waters will depend on the level of engagement by neuroscientists.

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