



# The use of neuroscientific evidence in the courtroom by those accused of criminal offenses in England and Wales

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## ABSTRACT

This examination of the extent of the use of neuroscientific evidence in England and Wales identifies 204 reported cases in which such evidence has been used by those accused of criminal offenses during the eight-year period from 2005–12. Based on the number of reported cases found, the use of such evidence appears well established with those accused of criminal offenses utilizing such evidence in approximately 1 per cent of cases in the Court of Appeal (Criminal Division). Neuroscientific evidence is used to quash convictions, to lead to convictions for lesser offenses and to lead to reduced sentences. In addition, cases are identified where neuroscientific evidence is used to avoid extradition, to challenge bail conditions and to resist prosecution appeals against unduly lenient sentences. The range of uses identified is wide: including challenging prosecution evidence as to the cause of death or injury, challenging the credibility of witnesses and arguing that those convicted were unfit to plead, lacked *mens rea* or were entitled to mental

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condition defenses. The acceptance of such evidence reflects the willingness of the courts in England and Wales to hear novel scientific argument, where it is valid and directly relevant to the issue(s) to be decided. Indeed, in some of the cases the courts expressed an expectation that structural brain scan evidence should have been presented to support the argument being made.

**KEY WORDS:** appeals, crime, defendants, expert evidence, neuroscience

## BACKGROUND TO THE RESEARCH

This article examines the extent to which neuroscientific evidence is used in the courtroom by those accused of criminal offenses<sup>1</sup> in England and Wales. Over recent years, there has been a considerable amount written about the use of neuroscientific evidence in the courtroom.<sup>2</sup> However, much of the debate has focussed on the potential future use of neuroscience as evidence rather than on its current use in court. A lot of the discussion has centered around the relevance of neuroscience in discussions of freewill,<sup>3</sup> the importance (or otherwise) of freewill in the criminal justice system,<sup>4</sup> and the idea that neuroscience will provide a route for defendants to present claims that their brains made them do it.<sup>5</sup> Data on the extent of usage of neuroscientific evidence in the courtroom is scant,<sup>6</sup> as Owen Jones et al. state: 'Clear statistics are hard to find'.<sup>7,8</sup> Both nationally and internationally much of what has been written has tended to look at

<sup>1</sup> The research does not focus on the use of neuroscientific evidence by defendants in criminal trials as these trials are largely unreported. Instead the research focuses primarily on appeals by those convicted of criminal offenses. However, the research is not limited to such appeals, but also includes a range of other types of case. For these reasons, the terminology 'those accused of criminal offenses' has been adopted as it best encapsulates the group whose use of neuroscientific evidence is examined in this article. Some of these, for example, those appealing against conviction or sentence have already been convicted. Others such as those facing extradition or those appealing against bail conditions have not yet faced trial. This approach to inclusion is more fully explained in the sections headed 'Researching the English and Welsh caselaw' and 'Determining which cases are criminal' below.

<sup>2</sup> For example, for a list of publications by members of the Research Network on Law and Neuroscience see <http://www.lawneuro.org/publications.php> (accessed Jan. 5, 2015).

<sup>3</sup> See eg WALTER SINNOTT-ARMSTRONG & LYNN NADEL (EDS.), *CONSCIOUS WILL AND RESPONSIBILITY* (2011).

<sup>4</sup> See eg Stephen Morse, *Avoiding Irrational NeuroLaw Exuberance: A Plea for Modesty*, 3 L. INNOVATION TECHNOL. 209 (2011); MICHAEL S. PARDO & DENNIS PATTERSON, *MINDS, BRAINS, AND LAW: THE CONCEPTUAL FOUNDATIONS OF LAW AND NEUROSCIENCE* (2013).

<sup>5</sup> See eg ADRIAN RAINES, *THE ANATOMY OF VIOLENCE: THE BIOLOGICAL ROOTS OF CRIME* (2013).

<sup>6</sup> Hopefully this lacuna is now being addressed—see the other articles in this special edition and see 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 (2015). Additionally, there has also been research on the use of genetic evidence in the criminal courts—see eg Deborah Denno's examination of 33 cases involving behavioral genetic evidence that came before the US courts in the period 2007–11; Deborah W. Denno, 'Courts' Increasing Consideration of Behavioral Genetics Evidence in Criminal Cases: Results of a Longitudinal Study', MICH. ST. L. REV. 967, (2011); also see Deborah W. Denno, *Behavioral Genetics Evidence in Criminal Cases: 1994–2007*, in *THE IMPACT OF BEHAVIORAL SCIENCES ON CRIMINAL LAW* 317, 354 (Nita A. Farahany ed., 2009), examination of 48 cases.

<sup>7</sup> Owen D. Jones et al., *Law and Neuroscience*, 33 J. NEUROSCI. 17,624 (2013).

<sup>8</sup> Works such as Jane C. Moriarty's, *Flickering Admissibility: Neuroimaging Evidence in the U.S. Courts*, 26 BEHAV. SCI. L. 29 (2008), provide a very good source of examples of the use of brain scan evidence in the US courts but does not provide quantitative data on the extent of such usage.

individual high profile cases,<sup>9</sup> or cases which raise particularly interesting legal conundrums.<sup>10</sup>

### Aims

This article aims to help to address the gap in current scholarship. By attempting to assess the extent to which neuroscientific evidence is being used in the courtrooms of England and Wales by those accused of criminal offenses, this research will provide evidence not only of the extent of its usage, but also the ways it is being utilized and the success (or otherwise) of those using arguments based on neuroscientific evidence to support their case. This is the first publication of our initial findings.<sup>11</sup>

Our research mirrors the research undertaken by Nita Farahany in the United States of America examining the extent to which neuroscientific evidence is being used by defendants in criminal trials. Additionally, this research project complements parallel studies by Jennifer Chandler in Canada, Katy de Kogel in the Netherlands, and Calvin Ho in Singapore and Malaysia. Our aim is to gain a much greater understanding as to the use of such evidence and be able to compare the experience of different jurisdictions. This will permit insights into how justice systems should respond to scientific advances in this area. The project is still in its infancy. This first publication looks at the use of neuroscientific evidence by those accused of criminal offenses during the period 2005–12. This eight-year period provides the opportunity to assess the extent of usage of neuroscientific evidence. It also aims to gauge whether the use of such evidence is increasing, declining, or remaining broadly constant. It provides evidence as to how the neuroscientific evidence is being used, and the extent to which it is being used successfully.

Much media and academic interest in the potential of neuroscience to transform the law has focussed on criminal cases and in particular on the potential use by defendants blaming brain abnormalities for their criminal behavior.<sup>12</sup> Much of this discussion has been speculative, and there has been a tendency to adopt extreme positions. A tendency encapsulated beautifully in the oft quoted comment of Greene and Cohen that ‘for the law, neuroscience changes nothing and everything’.<sup>13</sup>

### Expectations

Therefore, when embarking on the research, the authors had some expectations as to what they might find in the case law. Our previous work<sup>14</sup> had given us insights into the use of neuroscientific evidence in English cases in relation to criminal capacity, fitness

<sup>9</sup> For example, the Aditi Sharma case in India; see eg Caroline Rödiger, *Das Ende des BEOS-Tests? Zum jüngsten Lügendetektor-Urteil des Supreme Court of India*, 30 NERVENHEILKUNDE 74 (2011).

<sup>10</sup> For example, the discussion in Jeffrey M. Burns & Russell H. Swerdlow, *Right Orbitofrontal Tumor with Pedophilia Symptom and Constructional Aspraxia Sign*, 60, ARCH. NEUROL. 437 (2003).

<sup>11</sup> We are also grateful for the work of our team of researchers: Amanda Alexander, Rachel Ansell, Mark Coombs, Ed Johnston, Nicola Firth, and Amy Howard on this project. We are particularly indebted to Rachel Ansell and Ed Johnston who undertook a large part of the initial analysis of the cases.

<sup>12</sup> For examples of media interest see eg *Brain Injuries ‘Link’ To Young Offenders*, BBC WEBSITE, [www.bbc.co.uk/news/uk-19998710](http://www.bbc.co.uk/news/uk-19998710) (accessed Jan. 5, 2015).

<sup>13</sup> Joshua Greene & Jonathan Cohen, *For the Law Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANS. ROYAL SOC’Y 1775, 1785 (2004).

<sup>14</sup> In particular, Lisa Claydon & Paul Catley, *Neuroscientific Evidence in the English Courts*, in INTERNATIONAL NEUROLAW A COMPARATIVE ANALYSIS, (Tade M. Spranger ed., 2011); see also Lisa Claydon, *Law, Neuroscience, and Criminal Culpability in LAW AND NEUROSCIENCE — CURRENT LEGAL ISSUES* 13 (Michael

to plead, diminished responsibility, addiction, and involuntary action. We anticipated that the use of such evidence was likely to be on the increase. This would be in line with the experience in the United States where commentators indicated that there was an increase in the use of such evidence.<sup>15</sup> Evidence from the Netherlands supported our expectation that insights gained by experts in neuropsychology and neuropsychiatry would be presented in cases where mental disorders were used to support excusing conditions or where a claim of unfitness to plead was made.<sup>16</sup> The use of such evidence to mitigate sentencing was also predicted.<sup>17</sup> It was expected that some evidence of genetic inheritance that might explain and in part excuse behavior would be presented to English courts.<sup>18</sup> It was also felt likely that the risk/lack of risk posed by a defendant might be informed by neuropsychological profiling of risky offenders to inform sentencing decisions. Furthermore, it was anticipated that, given discussion of deaths caused by non-accidental head injury (NAHI) in case law, the use of the neuroscientific knowledge to help understand degree of injury and cause or timing of injury would be apparent in case reports.<sup>19</sup>

It was anticipated that certain types of neurological testing would be unlikely to appear such as the use of evidence obtained from lie detection or memory detection<sup>20</sup> testing, though its use has been widely discussed in neurolaw literature.<sup>21</sup> This is because such evidence remains highly controversial and any English case in which such evidence was admitted was likely to attract significant media as well as academic attention. Similarly, the authors were not aware of any cases in which the presence of the monoamine oxidase A (MAOA) gene had been utilized by a defendant to refute liability or to mitigate sentence.<sup>22</sup> Finally, in the list of uses that was considered unlikely,

Freeman ed., 2011), and Lisa Claydon, *Mind the Gap: Problems of Mind, Body and Brain in the Criminal Law, in LAW, MIND AND BRAIN* 55, 80 (Michael Freeman & Oliver Goodenough eds., 2009).

<sup>15</sup> See eg Owen D. Jones & Francis X. Shen, *Law and Neuroscience in the United States*, in INTERNATIONAL NEUROLAW A COMPARATIVE ANALYSIS, (Tade M. Spranger ed., 2011). In which, it is stated that the number of cases involving neuroscience doubled in the USA from 2006 to 2009, 349–80.

<sup>16</sup> Laura Klaming & Bert-Jaap Koops, *Neuroscientific Evidence and Criminal Responsibility in the Netherlands*, in INTERNATIONAL NEUROLAW A COMPARATIVE ANALYSIS 227–56 (Tade M. Spranger ed., 2011).

<sup>17</sup> Mark Henaghan & Kate Rouch, *Neuroscience and the Law in New Zealand*, in INTERNATIONAL NEUROLAW A COMPARATIVE ANALYSIS 257–67 (Tade M. Spranger ed., 2011).

<sup>18</sup> This would be in line with the experience in the United States of America see eg Nita A. Farahany & James E. Coleman Jr., *Genetics, Neuroscience, and Criminal Responsibility*, in THE IMPACT OF BEHAVIORAL SCIENCES ON CRIMINAL LAW 183, 240 (Nita A. Farahany ed., 2009). Also see Deborah W. Denno, *Courts' Increasing Consideration of Behavioral Genetic Evidence in Criminal Cases: Results of a Longitudinal Study*, MICHIGAN STATE L. REV. 967 (2011).

<sup>19</sup> *R v Harris; R v Rock; R v Cherry; R v Faulder* [2005] EWCA Crim 1980.

<sup>20</sup> The extent of the use of BEOS tests in India is discussed in D.A. Puranik et al., *Brain Signature Profiling In India: Its Status As An Aid In Investigation And As Corroborative Evidence—As Seen From Judgments*, 2009 PROC. XX ALL INDIA FORENSIC SCI. CONF. 815, 822, [http://forensic-centre.com/wp-content/uploads/2013/07/BEOS-IN-INDIA-IT\\_222S-STATUS-AS-AN-AID-IN-INVESTIGATION-AND-AS-CORROBORATIVE-EVIDENCE-AS-SEEN-FROM-JUDGMENTS\\_.pdf](http://forensic-centre.com/wp-content/uploads/2013/07/BEOS-IN-INDIA-IT_222S-STATUS-AS-AN-AID-IN-INVESTIGATION-AND-AS-CORROBORATIVE-EVIDENCE-AS-SEEN-FROM-JUDGMENTS_.pdf) (accessed Jan.4, 2015).

<sup>21</sup> See eg Hank T. Greely & Judy Illes, *Neuroscience—Based Lie Detection: The Urgent Need For Regulation*, 33 AM. J. L. & MED. 377 (2007); see also Editorial, *Deceiving the Law*, 11 NAT. NEUROSCI. 1231 (2008).

<sup>22</sup> There have been a number of Italian cases where the MAO-A gene has been used to mitigate sentence—see eg Francesco Foranzo et al., *Italian Appeal Court: A Genetic Predisposition To Commit Murder?*, 18 EUR. J. HUM. GENET 519 (2010); Hank Greely, *Another 'Brain Mitigation' Criminal Sentence from Italy*, THE CENTER FOR LAW AND THE BIOSCIENCES, STANFORD LAW SCHOOL, Sept. 3, 2011, <http://blogs.law.stanford.edu/lawandbiosciences/2011/09/03/another-brain-mitigation-criminal-sentence-from-italy/> (accessed Jan. 5, 2015).

the decision of the House of Lords in *R v JTB*<sup>23</sup> made it unlikely that neuroscientific advances in understanding the brains of adolescents relevant to the age of criminal responsibility would appear in English case law.<sup>24</sup>

This article explains the research methodology adopted, some of the main findings and then based on those findings, examines a number of cases in detail in order to illustrate some of the ways in which neuroscientific evidence has been used in the courtroom by those accused of criminal offenses.

### What should count as neuroscientific evidence?

The Royal Society in their report *Neuroscience and the law*<sup>25</sup> describe neuroscience in the following terms: ‘The relatively young field of neuroscience is the study of the brain and nervous system. Neuroscientists seek to determine how brain function affects behavior’. This focus on a scientific approach to understanding the brain and the nervous system, and how the brain affects behavior is central to our approach to classification. However, it still leaves overlaps with other scientific disciplines, particularly psychology and psychiatry. Clearly, there are no hard lines delineating the boundaries between these disciplines. Whilst brain scan evidence might be accepted by all or virtually all commentators as being neuroscientific evidence, tests developed in whole or in part on the basis of brain scan findings but which do not themselves involve scans could arguably fall either side of the line. Artificial distinctions are difficult. New science builds on previous understandings. Where that new science appears to offer valuable new insights, the old science may learn from the new science and adapt its practices. The experts who appear in the case reports are not described as ‘neuroscientists’. They are described as: ‘neuropsychiatrists’, ‘neuropsychologists’, ‘neurologists’, ‘neurosurgeons’, ‘neuroconsultants’, ‘neuroradiologists’, and ‘neuropathologists’.

The problem of determining whether evidence is neuroscientific is exacerbated by the fact that English appeal case reports are reports of the decision of the judges in the appellate court. They are not verbatim reports of the evidence given to the court. Appeal court judges sometimes relate the main evidence given and issues that emerged at the initial trial. However, they do not always do so. The focus of the judgment tends to be the legal issue(s) to be determined by the appellate court. The scientific evidence may be central to this—for example, where the scientific evidence relates to the cause of the victim’s injury, and this issue is central to the determination of the appeal. Another example where the scientific evidence may be central is where a mental condition defense is claimed,<sup>26</sup> or an argument is made that the defendant is unfit to plead. In cases

<sup>23</sup> [2009] UKHL 20.

<sup>24</sup> This was expected to be the case even though in other jurisdictions, notably the United States, considerable use of neuroscientific evidence relating to the development of the juvenile brain has been introduced to mitigate sentence. See eg Alexandra O. Cohen & B. J. Casey, *Rewiring Juvenile Justice: The Intersection Of Developmental Neuroscience And Legal Policy*, 18 TRENDS COGN. SCI. 63 (2014); Laurence Steinberg, *The Influence Of Neuroscience On US Supreme Court Decisions About Adolescents' Criminal Culpability*, 14 NAT. REV. NEURO. 513 (2013).

<sup>25</sup> The Royal Society, *Brain Waves Module 4: Neuroscience and the law*, 2011, <https://royalsociety.org/policy/projects/brain-waves/responsibility-law/> (accessed Jan. 6, 2015).

<sup>26</sup> In the cases under examination, the most common was diminished responsibility. A defense which only applies to a charge of murder and which if successfully pleaded leads to conviction for manslaughter. In England and Wales, murder carries an automatic sentence of life imprisonment. Whilst the maximum sentence for manslaughter is also life imprisonment, lower sentences can and often are imposed.

where such scientific evidence is central to the determination of the case, judgments commonly include a reasonably detailed examination of the expert evidence. However, even in these cases important details are often lacking. The case report may, for example, recount that the accused's performance in a number of tests indicated that she/he had cognitive impairment; however, the report may and typically will fail to detail precisely what tests were undertaken. This evidence would, doubtless, have been given at trial, but is not repeated by the judge in giving his decision in the appellate court. What marks out the neuroscientific evidence in the cases selected is its basis in cognitive neuroscience. Such evidence is often used, by the appellant's legal team, to challenge previous explanations of the appellant's behavior or to question previous psychological or psychiatric assessments of the risk or dangerousness posed by the appellant.

The search terms are set out in the Appendix. Once a case was identified as of interest<sup>27</sup> a further question had to be answered, namely whether the evidence was being used by the party accused of the crime. Our analysis indicates that the most common use of neuroscientific evidence in criminal cases is by the prosecution. Primarily, neuroscientific evidence is being given by the prosecuting authorities to provide evidence of the extent of injuries or the cause of death or injury. Based on the reports of the appeal courts, this evidence usually appeared uncontested. This does not necessarily mean that it was not contested at trial, just that this challenge was not pursued on appeal. In some cases, evidence as to the cause of death or injury was challenged either simply through detailed cross examination of prosecution witnesses<sup>28</sup> or by the introduction of expert evidence by the defense.<sup>29</sup>

### Researching the English and Welsh case law

Law reporting in England and Wales is largely limited to appeal cases. Few first instance decisions are reported. Therefore, a major limitation of any analysis of English case law databases is that they largely exclude trial evidence and only report cases which have gone to appeal. This is a significant limitation of any research findings based on searching English case law databases. Very significant usage of neuroscientific evidence may be under the radar because the cases in which such evidence is presented are not appealed, and hence not reported. Even where such a case is appealed, the appeal may not relate to the neuroscientific evidence, and therefore the existence of this evidence at trial may not be apparent from the appeal court decision.<sup>30</sup>

<sup>27</sup> As explained in the appendix on occasions, the words identified through the search did not in fact relate to neuroscientific evidence.

<sup>28</sup> *R v Burridge* [2010] EWCA Crim 2847.

<sup>29</sup> For a discussion of the rules relating to the admissibility of expert neuroscientific evidence in English law during the period under examination see Lisa Claydon & Paul Catley, *Neuroscientific Evidence in the English Courts* in INTERNATIONAL NEUROLAW: A COMPARATIVE ANALYSIS 305, 328 (Tade Spranger ed., 2011). The rules on the admissibility of evidence in criminal cases have subsequently been amended by the Criminal Procedure Rules 2014 (SI 2014/1610); see particularly Part 33 and by a new Practice Direction issued by the Lord Chief Justice which supplements Part 33. The Practice Direction examines the factors that should be taken into account by courts in determining the reliability of expert evidence. These factors draw on the Law Commission's recommendations set out as in their Report: *Expert Evidence in Criminal Proceedings* published in 2011. For a discussion of the changes; see Michael Stockdale & Andrea O'Cain, *Expert Evidence Reliability*, 179 CRIMINAL LAW AND JUSTICE WEEKLY, 2015, JPN 136.

<sup>30</sup> Also, as stated in the main body earlier, the research findings outlined in this article are only the first stage of the research project. The case analysis has identified expert witnesses who have given neuroscientific evidence

However, one would expect that decisions involving the use of fairly novel techniques would be more likely to be subject to appeal. If defendants are being convicted on expert evidence based on new understandings of the brain, one would anticipate that the decisions to admit this evidence would be appealed against. Similarly, if defendants are being acquitted on the basis of such evidence, one would expect to see prosecution appeals challenging the use of and weight given to such evidence. Therefore, though the research focuses largely on appeal decisions the expectation is that it will still identify the areas of use and the attitude of the courts to that use.

#### **Determining which cases are criminal cases**

In seeking to gather data on the use of neuroscientific evidence by those accused of criminal offenses, one issue that had to be resolved was which cases to include. As stated the research focus is on criminal cases and as explained law reporting in England and Wales means that by examining reported cases this means the focus is largely on appeal decisions.

In English law, a person who is convicted of a criminal offense can appeal against conviction, against sentence or against both conviction and sentence. There is no automatic right to appeal against conviction. Simply disputing the trial court's verdict is not a ground for appeal. Individuals seeking to appeal against conviction must base their appeal on a recognized ground for appeal. Generally, appeals can be based on challenging the handling of the case by the judge, on the handling of the case by the defense lawyers or on the basis of new evidence. In relation to the conduct of the trial by the judge, issues that might arise and which could, depending on the facts, be grounds for appeal include: the judge's decision to admit or not admit evidence, to fail to accept a submission of no case to answer, or failure to allow the presentation of a defense argument. The appeal can raise issues regarding the fairness of the judge's summing up of the evidence to the jury, and the accuracy and comprehensibility of the judge's guidance to the jury on the law which they must apply. Appeals may also be based on the performance of the defense lawyers at trial, but these are less common as the threshold to succeed in such a claim is set at a high level. New evidence may be provided to argue that the decision of the trial court is unsafe. Such appeals on the basis of new evidence require the appellant to show not only that there is new evidence material to the determination of the case, but that the new evidence was not available at the time of the trial.<sup>31</sup> However, as neuroscientific understanding increases, the potential to found appeals on such new evidence is considerable.

Under English law, there are time limits within which a convicted person can appeal. Applications to be allowed to appeal out of time can be viewed as an area of administrative law rather than criminal law. However, we included such cases because they often involve an assessment of the merits of the appeal. A further group of cases which we included are those cases brought by the State appealing against what the prosecution authorities consider to be an unduly lenient sentence.<sup>32</sup> In resisting such appeals, some of

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and subject to funding the possibility exists to work with them to gain a better understanding as to the use being made of neuroscientific evidence in the trial process.

<sup>31</sup> This is governed by § 23 of the Criminal Appeal Act 1968. § 23 also allows evidence to be presented where there is a reasonable explanation of why the evidence was not adduced at trial.

<sup>32</sup> *Attorney General's reference no. 30 of 2012; R v T [2012] EWCA Crim 2021.*

those who had been convicted presented neuroscientific arguments to resist the appeal including arguments relating to their own medical condition,<sup>33</sup> the medical condition of relatives<sup>34</sup> and the facts of the offense. Less numerous, but still significant, were cases where the prosecution appealed against acquittal<sup>35</sup> or appealed against a finding of no case to answer.<sup>36</sup> Again, where the acquitted person resisted such appeals on the basis of neuroscientific evidence we included these cases in our analysis.

We also included cases in which prisoners were seeking judicial review of decisions that they should not be released,<sup>37</sup> decisions as to their categorization within the prison system<sup>38</sup> and decisions about compensation for being wrongly imprisoned.<sup>39</sup> We included these judicial review cases where they involved the introduction of neuroscientific evidence by the prisoner/former prisoner. Linked to these cases, we included cases brought to the Special Immigration Appeals Commission (SIAC) where those detained without trial supported their arguments either against their continued detention without trial or the conditions of that detention by utilizing neuroscientific evidence.<sup>40</sup>

A final group of cases that are included are cases in which individuals in order to resist extradition to face criminal charges in other countries, advanced arguments based on neuroscientific evidence.<sup>41</sup> We excluded the considerably larger number of cases where individuals facing deportation<sup>42</sup> were fighting through the courts to be allowed to remain in the country. Some of these cases may have involved alleged breaches of the criminal law, for example, contraventions of immigration laws. However, as the criminal law issues were not the primary focus of these cases, they were excluded. Reading these case reports it became apparent that the neuroscientific arguments raised in these cases were similar to those raised in the extradition cases. Therefore, in excluding these cases, we were not omitting from our study any novel uses of neuroscientific evidence.

## FINDINGS—AN OVERVIEW

In the period covered by the research, we identified 204 reported cases in which neuroscientific evidence was used (or appeared from the case report to have been used) by those accused of criminal offenses. The evidence was used to appeal against conviction, to appeal against sentence and for other purposes including resisting extradition, resisting prosecution appeals that the sentence imposed was unduly lenient, seeking to have bail conditions lifted, and by prisoners seeking recategorization.

Over the period under examination, there was a marked increase in the number of reported cases in which neuroscientific evidence was presented by those accused of criminal offenses. In the period 2005–08, each year the maximum number of reported

<sup>33</sup> *Id.*

<sup>34</sup> *Attorney General's reference no. 54 of 2005; R v Mann* [2005] EWCA Crim 1896.

<sup>35</sup> *R v Whittle (Barry Gordon)* [2010] EWCA Crim 2934.

<sup>36</sup> *R v G* [2006] EWCA Crim 3276.

<sup>37</sup> *R (on the application of Riley) v. Governor of HMP Frankland and another* [2009] EWHC 3598 (Admin).

<sup>38</sup> *Whittaker (R on the Application of) v Secretary of State for Justice* [2011] EWHC 2166 (Admin).

<sup>39</sup> *R (on the application of Harris) v Secretary of State for the Home Department* [2007] EWHC 3218 (Admin).

<sup>40</sup> *R (on the application of Y) and the Secretary of State for the Home Department* [2011] EWHC 3410 (Admin).

<sup>41</sup> *Government of the United States of America v Tollman and another* [2008] EWHC 184 (Admin).

<sup>42</sup> As a result of failed asylum claims, alleged breaches of conditions of entry or lack of appropriate documentation.

**Table 1. Reported cases by year and court.**

Year	Number of reported cases by year and court in which those accused of criminal offenses made use of neuroscientific evidence			
	High Court	Court of Appeal (Criminal Division)	House of Lords/ Supreme Court	Total
2005	0	14	1	15
2006	1	19	1	21
2007	2	14	0	16
2008	3	12	0	15
2009	2	22	1	25
2010	3	41	1	45
2011	3	32	0	35
2012	9	22	1	32
Total	23	176	5	204

cases did not exceed 21, and the annual average was just under 17. From 2009 to 2012, the lowest number of cases any year was 25 and the annual average doubled to just over 34.

As evidenced in Table 1, out of the 204 reported cases, 176 were decisions of the Court of Appeal (Criminal Division) (86.3 per cent). The increased number of cases in which those accused of criminal offenses made use of neuroscientific evidence appears to be in part the product of increased reporting of Court of Appeal (Criminal Division) cases.

As shown in Table 2, over the period the percentage of Court of Appeal (Criminal Division) case reports in which those accused of criminal offenses made use of neuroscientific evidence remained fairly constant. The increase in the number of reported cases in which neuroscientific evidence was used by those accused of criminal offenses shown in Figure 1 would seem, at least in part, to be explained by the increased number of case reports in the period 2009–12. Once again it needs to be stressed that the focus is on the reported decisions of the appellate courts. The activities of these courts may or may not reflect proceedings in the courts of first instance.

#### Types of case in which neuroscientific evidence is used

Of the 204 reported cases in which those accused of criminal offenses used neuroscientific evidence 57 related to homicides (27.9 per cent) of which 44 (21.6 per cent) related to defendants convicted at first instance of murder (Figure 2). Crimes of violence amounted to 37 of the cases (18.1 per cent) and of these 24 were more serious crimes of violence,<sup>43</sup> 33 cases related to crimes of dishonesty<sup>44</sup> and 30 cases related to

<sup>43</sup> Attempted murder, grievous bodily harm, and wounding.

<sup>44</sup> Crimes of dishonesty included fraud, robbery, burglary, and theft.

**Table 2. Number and percentage of cases.**

<i>Year</i>	<i>Number of reported cases in the Court of Appeal (Criminal Division) in which neuroscientific evidence was used by the accused</i>	<i>Number of Court of Appeal (Criminal Division) case reports recorded on Lexis<sup>a</sup></i>	<i>Approximate percentage<sup>b</sup> of Court of Appeal (Criminal Division) case reports in which neuroscientific evidence was used by the accused</i>
2005	14	1766	0.79%
2006	19	1756	1.08%
2007	14	2554	0.55%
2008	12	1841	0.65%
2009	22	3192	0.69%
2010	41	3731	1.10%
2011	32	3713	0.86%
2012	22	3472	0.63%
2005–12	176	22025	0.80%

<sup>a</sup>Note, this is the number of case reports. Some cases are reported more than once. Therefore, the number of cases will be slightly lower.

<sup>b</sup>The figures given are based on the number Court of Appeal (Criminal Division) cases in which neuroscientific evidence was used by those accused of criminal offenses as a percentage of the number of Court of Appeal (Criminal Division) case reports. The percentage of Court of Appeal (Criminal Division) cases in which neuroscientific evidence was used by those accused of criminal offenses will be slightly higher (see note <sup>a</sup> above).

sexual offenses. Of the 11 driving cases all but one were cases of causing death by dangerous driving. Several of the reported cases involved multiple offenses.<sup>45</sup>

### **Purpose for which the evidence was being used**

The main ways in which the neuroscientific evidence is being used is to appeal against conviction (61 cases, 29.9 per cent of the cases), to appeal against sentence (92 cases, 45.1 per cent), or to appeal against both conviction and sentence (20 cases, 9.8 per cent) (see Figure 3). The largest groupings amongst the remaining cases were where individuals were resisting extradition (11 cases, 5.4 per cent), and cases where they were resisting prosecution appeals against allegedly unduly lenient sentences (8 cases, 3.9 per cent).

### **Measuring the success of the use of neuroscientific evidence**

In measuring the success of the use of neuroscientific evidence by those accused of criminal offenses, one needs to measure not just whether those accused won their cases, but also whether, if they did so, the cause of that success was the neuroscientific

<sup>45</sup> Where cases involved offenses drawn from more than one category they have been classified on the basis of the offense for which the most severe penalty was imposed or, where the individual has not yet been convicted, the offense carrying the maximum penalty under English law.

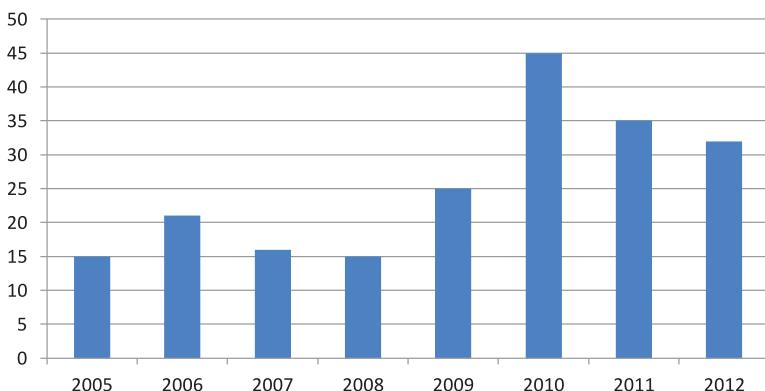


Figure 1. Number of reported cases in which those accused of criminal offences used neuroscientific evidence.

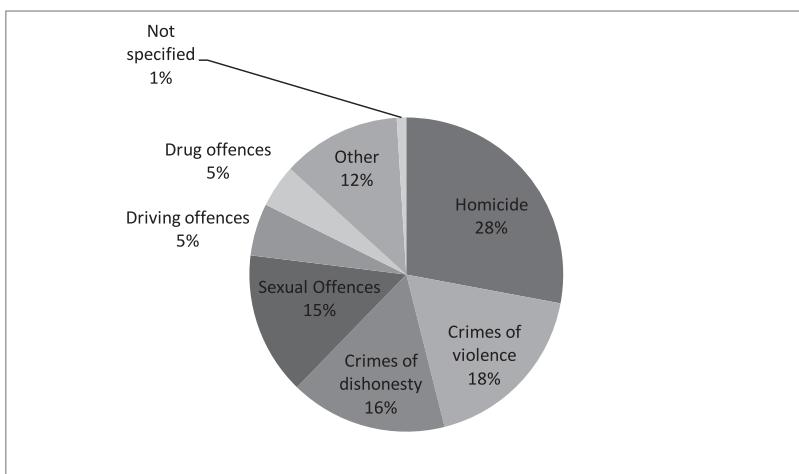


Figure 2. Types of offence.

evidence. Measuring success is possibly more straightforward for appeals against conviction. An accused appealing against conviction who has that conviction quashed can clearly be viewed as having succeeded. Likewise, an accused who appeals against a conviction for murder arguing that the conviction should have been for manslaughter and achieves his/her aim could similarly be viewed as succeeding.<sup>46</sup>

Judging the success of an appeal against sentence is arguably more problematic. Should any reduction of sentence be viewed as a success?<sup>47</sup> For the purposes of this

<sup>46</sup> Under English law a conviction for murder carries a mandatory sentence of life imprisonment. A conviction for manslaughter, for example because the defendant had the partial defense of diminished responsibility or because the defendant though he had killed lacked the *mens rea* for murder, allows the judge much greater discretion in sentencing—though the maximum penalty for manslaughter is still life imprisonment.

<sup>47</sup> For example, in *R v Cape (Stephen)* [2011] EWCA Crim 2877, the appellant had his sentence of six years imprisonment for causing death by dangerous driving upheld, but had his period of disqualification from driving reduced by one year from seven years to six.

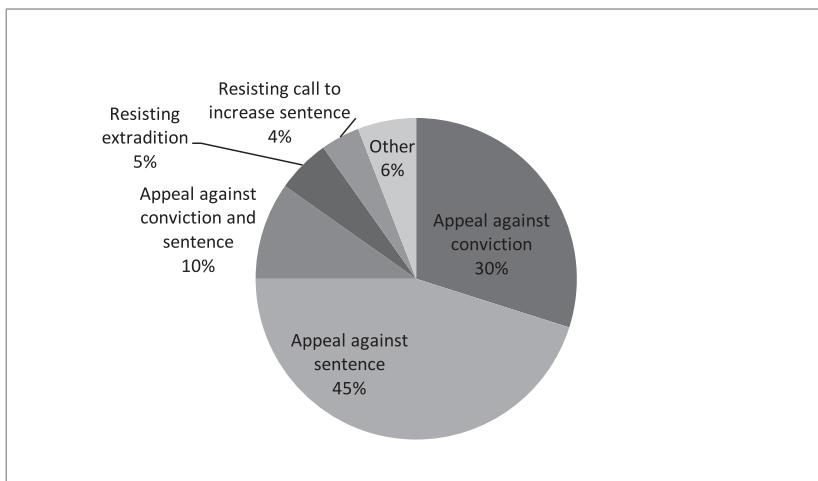


Figure 3. Use of neuroscientific evidence.

analysis, any individual who gained a reduction of sentence of 50 per cent or more is viewed as having succeeded. In a number of cases, appellants were seeking the removal of an indeterminate sentence for public protection (IPP),<sup>48</sup> appellants who succeed in having such sentences lifted have similarly been viewed as having succeeded even if the minimum term that they were to serve has been left unchanged. Similarly, appellants who have succeeded in having a custodial sentence replaced by a non-custodial sentence have been classed as being successful. Where a sentence has been reduced, but by less than 50 per cent, then, for the purposes of this research, such a success has been classed as being a partial success.

Appeal court judges in England and Wales give reasons for their decisions. Therefore, it is, generally, possible to ascertain why they have arrived at a particular outcome. In some cases, it is very clear that the neuroscientific evidence is central to their reasoning. In other cases, there are a range of factors which are identified as having led to the decision which either expressly or impliedly include the neuroscientific evidence. Finally, there are cases where the accused has made use of neuroscientific evidence and has been successful, but it is clear that the neuroscientific evidence was not material to achieving that outcome.

Table 3 shows that in most cases where appellants who appealed against conviction used neuroscientific evidence they were unsuccessful. However, when they succeeded, the neuroscientific evidence was nearly always central to the successful appeal.

Almost half of appellants<sup>49</sup> using neuroscientific evidence to appeal against sentence succeeded, at least partially (see Table 4). In most of these cases,<sup>50</sup> the neuroscientific evidence formed at least part of the reasons for their success. In 10 cases, the

<sup>48</sup> The imposition of an IPP means that the prisoner will not be released unless the parole board is satisfied that it is safe so to do. The conditions to be fulfilled before an IPP could be made are set out in § 225(1)(b) of the Criminal Justice Act 2003 as amended. Subsequently, IPPs have been abolished by § 123 of the Legal Aid, Sentencing and Punishment of Offenders Act 2012.

<sup>49</sup> 54 out of 114 = 47.4 per cent.

<sup>50</sup> 44 out of 54 = 81.5 per cent.

**Table 3.** Success of appeals against conviction.

<i>Appeals against conviction</i>		
<i>Result</i>	<i>Number of appellants</i>	<i>Percentage</i>
Not successful—conviction upheld	59	70.2%
Successful largely because of the neuroscientific evidence	22	26.2%
Successful for a range of reasons including the neuroscientific evidence	2	2.4%
Successful for other reasons not linked to the neuroscientific evidence	1	1.2%
<b>Number of appellants<sup>a</sup></b>	<b>84</b>	

<sup>a</sup>The number of appellants exceeds the number of reported cases in which there were appeals against conviction because in some cases there was more than one appellant using neuroscientific evidence.

**Table 4.** Success of appeals against sentence.

<i>Appeals against sentence</i>		
<i>Result</i>	<i>Number of appellants</i>	<i>Percentage</i>
Not successful—sentence upheld	60	52.6%
Successful largely because of the neuroscientific evidence	7	6.1%
Partially successful largely because of the neuroscientific evidence	3	2.6%
Successful for a range of reasons including the neuroscientific evidence	13	11.4%
Partially successful for a range of reasons including the neuroscientific evidence	21	18.4%
Successful for other reasons not linked to the neuroscientific evidence	4	3.5%
Partially successful for other reasons not linked to the neuroscientific evidence	6	5.3%
<b>Number of appellants</b>	<b>114</b>	

neuroscientific evidence appeared to be the main reason for the appellant succeeding in having the sentence reduced.

#### The type of scan evidence used

Table 5 sets out the number of reports containing reference to different brain scan technology.

**Table 5.** Cases by type of scan (2005–2012).

Type of scan	Number of case reports (all cases civil and criminal)	Number of reported cases in which those accused of criminal offenses used neuroscientific evidence
EEG or electroencephalography	43	6
fMRI or ‘Functional magnetic resonance imaging’	1	0
‘Magnetic resonance imaging’ or MRI	278	21
‘cat scan’ or ‘Computed tomography’ or ‘ct scan’	277	17
‘pet scan’ or ‘Positron emission tomography’	4	0
‘SPECT scan’ or ‘single photon emission computed tomography’	4	1
‘Brain scan’ <sup>a</sup>	55	4

<sup>a</sup>‘Brain scan’ was not part of our search terms. Cases where the term brain scan arose were, however, caught by the fact that ‘brain’ was one of our search terms. The four cases identified in the right-hand column are cases in which evidence of a brain scan was given, but no details were provided in the case judgments as to the type of scan undertaken.

Table 5 demonstrates that when scan evidence is identified it is almost always a structural scan rather than a functional scan. Whilst there has been considerable academic<sup>51</sup> and commercial interest<sup>52</sup> in the use of functional scans, for example, in the area of lie detection and/or memory detection; this type of usage has not gained a foothold in the English courts. The one case report in which fMRI was referred to was a civil case<sup>53</sup> in which the potential use of such a scan was discussed in relation to assessing the condition of a patient (J) believed to be in a vegetative state.

#### DETAILED EXAMINATION OF SOME CASES

What follows is a detailed review of some of the cases identified by the research. The aim is to provide a better understanding of how the evidence is used. It needs to be reiterated that this case analysis is based upon the legal discussion of neuroscientific

<sup>51</sup> See eg Paul S. Applebaum, *Through a Glass Darkly: Functional Neuroimaging Evidence Enters the Courtroom*, 60 PSYCHIATRY SERV. 21(2009); Teneille R. Brown & Emily R. Murphy, *Through A Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States*, 62 STAN. L. REV. 1119 (2010); Daniel D. Langleben, & Jane C. Moriarty, *Using Brain Imaging for Lie Detection: Where Science, Law, and Policy Collide*, 19 PSYCHOL. PUB. POL'Y L. 222 (2013); Edward Johnson & Dan Jasinski, *Neuroscientific Evidence: A Criminal Justice Dream, or an Adversarial Nightmare?*, 6 INT. J. LIAB. SCI. ENQUIRY 193 (2013).

<sup>52</sup> See eg No Lie MRI's, website <http://noliemri.com/> (accessed Jan. 5, 2015).

<sup>53</sup> *An NHS Trust v J* 94 BMLR 15. In this case the Official Solicitor, having considered the use of fMRI, did not suggest that it would be in the interests of J to undergo such a scan.

evidence as reported in the case reports. Detailed accounts of such evidence itself may not appear in the reports. Where it does appear it takes the form of selected highlights, usually utilized to underpin the judge's legal argument to support the decision reached on appeal.

In England and Wales, liability for criminal wrongs is based on the proof by the prosecution that the accused committed the act in the circumstances required for the crime (*actus reus*) and they must also establish the accused committed the act in a manner which demonstrates she/he also fulfils the elements of mental culpability required by the crime (the *mens rea*). In cases where liability is strict or absolute the mental element required is much reduced or totally absent. Crimes are defined by statute and by case law, and the system is one of precedent. The lower courts are bound by the decisions of higher courts.

One means of arguing that a defendant is not guilty is to raise doubts about the prosecution evidence. This may be done in a number of ways. One way is to raise the possibility that the defendant did not commit the crime in the circumstances required for establishing guilt. This could entail making the argument that the accused did not cause the precise harm identified by the *actus reus* of the crime, or that the degree of harm required to satisfy conviction has not been established. It could also be that the argument is that the defendant did not—though committing the criminal act—do so in the required manner or circumstances; for example, the neglect of a child was not willful. This argument might be based upon the fact that the defendant lacked the ability to appreciate the damage she/he might potentially cause her/his child.<sup>54</sup> However, issues of cognitive impairment relevant to *mens rea* may be harder to establish.<sup>55</sup>

One area where it has been accepted that proof of mental capacity impairing *mens rea* is a complete defense is the defense of insanity. In insanity cases, it has been argued by the defense and accepted by the courts that deficiencies in cognitive abilities may lead to a not guilty by reason of insanity verdict.<sup>56</sup> Interestingly, no insanity cases were returned in the research.<sup>57</sup> One explanation for this is that in England and Wales the insanity defense is only available to a defendant who satisfies the M'Naghten rules.<sup>58</sup> These rules have been interpreted in a manner that it is the cognitive rather than the volitional ability of the defendant to appreciate either 'the nature and quality of the act he was doing; or, if he did know it, that he did not know he was doing what was wrong' that is being assessed. As Moriarty suggests such a requirement is likely to make court proceedings 'resistant to neuroimaging as substantive proof of mental illness or injury unless the expert can satisfy the court that the neuroimage is actual proof that the defendant is unable to appreciate the nature and quality or wrongfulness of his acts'.<sup>59</sup>

<sup>54</sup> *R v Ratnasabapathy* [2009] EWCA Crim 1514.

<sup>55</sup> *Id.*

<sup>56</sup> If it is established in a manner which meets the M'Naghten Rules: *M'Naghten's Case* 10 Cl & Fin 200, [1843–60] All ER Rep 229.

<sup>57</sup> Research carried out by Professor R.D. Mackay of De Montfort University into the use of the insanity defense in England for the Law Commission revealed very low use of the defense. Approximately, 30 cases a year are estimated to arise in the Crown Court. Law Commission for England and Wales: *Insanity and Automatism: Supplementary Material to the Scoping Paper* [3.24].

<sup>58</sup> *M'Naghten's Case* 10 Cl & Fin 200 [1843–60] All ER Rep 229.

<sup>59</sup> Jane C. Moriarty, *Flickering Admissibility: Neuroimaging Evidence in the U.S. Courts*, 26 BEHAV. SCI. LAW 29 (2008); See also Richard E. Redding, *The Brain Disordered Defendant: Neuroscience and Legal Insanity in the Twenty-First Century*, 56 AM. UNIV. L. REV. 51 (2006).

The cases examined below raise a variety of technical criminal law issues, but for an audience which may not be specifically interested in the more technical aspects of the English law a choice has been made to group cases by theme and to only cover the technical issues in sufficient detail to explain each case. The explanations of the law are limited to the law relevant to those issues considered and in force at the time of the trial and, where appropriate, the appeal. English criminal law is constantly developing and therefore some areas of law considered in this article have been subject to legislative change. The partial defense of diminished responsibility is a case in point.<sup>60</sup> The reason for this approach is that whilst there are plenty of technical legal arguments which may be made, it is the manner of the use of the evidence and how it is received by the courts that is of importance to this research.

Obviously, in the cases which are returned by the search the issues are framed in a manner which fits within the appeal framework.<sup>61</sup> One way of doing this is to argue that some of the factual evidence used by the court to convict is quite simply wrong or that new evidence has emerged in relation to a point argued at trial. This usually arises through the framework that admits new probative evidence that casts doubt on the safety of the previous judgment. This will not necessarily mean that the convicted person succeeds and has her/his conviction quashed without more unless the appeal court considers this an appropriate response to the facts argued before them. The court may alternatively order a retrial where the new evidence may be properly considered.

At trial, the prosecution in all cases has to persuade the jury or magistrates of its case beyond reasonable doubt. This raises another interesting point often neglected by those who are not lawyers. In England and Wales, as in many other adversarial jurisdictions, the defense does not have to prove innocence. This is because a person is presumed to be innocent until convicted. The role of the defense is to raise a doubt in the jury's collective mind about the prosecution case sufficient to mean that the case is not proven to the level required by the criminal law.

An example of the use of neuroscientific evidence to question the facts relevant to a jury conviction is *R v Hendy*.<sup>62</sup> Hendy was convicted of murder. There was no dispute about the cause of death. The evidence given at court revealed that the fatal attack followed Hendy drinking a large amount of alcohol at a party. Whilst at the party Hendy had kicked a friend in the face and seemed very distressed by his own behavior. He had then attempted to throw himself in front of a car and as a result the police were called. The police concluded that Hendy was not drunk, though he had been drinking.<sup>63</sup> They took him home where his mother reported that he ate a meal and had a non-alcoholic drink. The evidence given at trial stated that: 'He then wrote a note to his mother that read "sorry mum, goodbye". He took a knife from his room and went out'.<sup>64</sup> Hendy fatally stabbed a total stranger 18 times with a sheath knife in an unprovoked attack. The alleyway in which the stabbing occurred was 100 yards from his home. Hendy was 16 at the time of the offense.

The appeal against his conviction for murder was based upon the decision of the jury to reject the plea of diminished responsibility which has the effect, if successfully

<sup>60</sup> See *infra* note 153 and accompanying text.

<sup>61</sup> See *supra* note 34 and accompanying text.

<sup>62</sup> *R v Hendy* [2006] EWCA 819.

<sup>63</sup> *Id.* at [4].

<sup>64</sup> *Id.* at [5].

pledged, of reducing murder to manslaughter. There was an abundance of expert evidence regarding the plea of diminished responsibility.<sup>65</sup> One of the defense experts at trial, Dr Reeves, had noted that whilst a child:

the Applicant had suffered a head injury following a road accident. In his opinion that injury may have caused damage to the Applicant's temporal lobe, that part of the brain which governs temper control and learning. He thought that a striking theme was the Applicant's despair and realisation that there was something wrong with him. In the doctor's opinion these were not the thoughts of a young delinquent of his age. In his opinion it was very probable that the Applicant had sustained a mild to moderate degree of cerebral pathology at some stage particularly in the left temporal lobe but his problems were more complex than being solely related to this.<sup>66</sup>

The trial was informed by another expert witness for the defense that Hendy's use of alcohol was 'a symptom of his emotional problems and not their cause'.<sup>67</sup> The prosecution's experts tended to take a different view of the evidence of alcohol use and one argued that:

the question of whether the Applicant's loss of temper would constitute an abnormal state of mind was complicated by the fact that he had taken a considerable quantity of alcohol on the night of the offence ... Dr Warren did not support a defence of diminished responsibility.<sup>68</sup>

Subsequent to his conviction in 1993, whilst in a young offenders' institution, an EEG was undertaken. This revealed that he had damage to the left 'temple' lobe, a fact supported by subsequent neuropsychometric testing. Following conviction, Hendy appealed on the basis that the judge's summing up to the jury was incorrect with regards to the partial defense of diminished responsibility and that there was fresh evidence to support the original plea which made his conviction for murder unsafe. Before the Court of Appeal the main evidence supporting a plea of diminished responsibility at the time of the killing was given by two witnesses who were both forensic psychiatrists. Using new evidence, available to them subsequent to conviction, they argued successfully that Hendy's responsibility was diminished at the time of the killing.<sup>69</sup> It seems highly likely that the evidence of Hendy's head injury and his subsequent diagnosis of

<sup>65</sup> Three forensic psychiatrists and two neuro psychologists gave evidence for the defense. Two experts were also called by the Crown to rebut the evidence. Thus, the jury heard conflicting evidence from seven experts. *Id.* at [16, 17].

<sup>66</sup> *Id.* at [12].

<sup>67</sup> *Id.* at [13]; Dr Meux a forensic psychologist.

<sup>68</sup> *Id.* at [16]; Dr Warren expert witness for the prosecution.

<sup>69</sup> *Id.* at [20]; The fresh evidence in the first ground is in the form of psychiatric reports made by Dr David Somekh, a consultant forensic psychiatrist and Professor Pamela Taylor, Professor of Forensic Psychiatry at Cardiff University. In his report, Dr Somekh criticizes the opinions and conclusions of the prosecution expert evidence called at trial. Professor Taylor in her report, relying on treatment and examinations carried out by her on the Applicant since the trial, expresses the opinion that the psychiatric evidence called by the prosecution at trial was flawed. In the opinion of both these two doctors, the Applicant at the date of the killing was suffering from such an abnormality of mind as substantially to diminish his responsibility for the killing. On behalf of the Applicant, it is submitted that this court should receive this evidence pursuant to § 23 of the Criminal Appeal Act 1968. In the second ground, it is submitted that the judge in written questions provided for the jury to answer incorrectly directed the jury on the effect of alcohol as a factor for consideration in the defense of diminished responsibility. In support of this ground of appeal, counsel relied on the case of *R v Dietschmann* [2003] UKHL 10 [2003] 1 AC 1209 [2003] 2 Cr App Rep 54.

a depressive disorder assisted the Court of Appeal in reaching the decision to quash Hendy's conviction for murder. The court did not order a retrial substituting a verdict of guilty of manslaughter on the grounds of diminished responsibility.

Interestingly, a significant focus of the decision of the court is on the disposal of Hendy following his successful appeal. The court adopts what it feels is an appropriate disposal and makes a hospital order under §37 of the Mental Health Act 1983 and a restriction order without limit of time under § 41 of the same Act.<sup>70</sup>

Hendy provides a good illustration of issues which arise in a number of the cases where neuroscientific or neurocognitive evidence is utilized by the courts. It involves consideration of recognized mental disorders, issues of developmental immaturity, and the relationship between intoxicants and responsibility for criminal acts. It also highlights the fact that evidence of neurocognitive defects may lead to an elevated view of the risk of harm posed by a defendant to the population at large. This is suggested by the imposition of a restriction order without limit of time.

### Evidence of causation

Where appeals are based on the actual legal cause of the harm then the claim may be that: the defendant's actions do not contribute to the resulting crime, that the actual cause of the harm is something other than that argued by the prosecution or that the degree of harm caused is not as severe as presented at trial. This latter example may actually result in a plea that the sentence imposed by the sentencing judge should be reviewed with a view to reducing the time to be served.<sup>71</sup>

Increasing understanding of the pathology of the brain and the structural insights provided by technologies such as MRI have assisted both prosecution and defense in establishing degrees of harm caused. Previously, such insights would not have been available where the victim survived. One area where greater knowledge of neuropathology would assist the courts is in establishing the causes of alleged NAHI in infants and young children. This is an area of law where some defendants have found neuroscientific evidence useful in getting their arguments heard on appeal. But before considering this area it is also useful to look at how gaining information as to the precise timing or cause of an injury by decoding the evidence provided by neuropathology could assist a defendant.

In *Halling*<sup>72</sup> the success or failure of the Crown case arguably rested on the timing of the blow that caused the victim's death. If the blow was delivered whilst the victim was standing the defense argued that it would not be an unlawful blow because Halling could be said to be acting in self-defense. But if the fatal blow occurred when the victim had fallen to the floor then Halling's conviction for murder would be safe because blows at this point could be deemed to be unlawful. The judge in his final summing up to the court had said 'The prosecution would have to prove that the fatal blow was struck during the second aggressive unlawful stage, not during the first'. No expert evidence had been produced at trial to inform the jury's decision as to the precise cause of death.<sup>73</sup> Nonetheless, the appeal is refused on the grounds that such expert evidence would not

<sup>70</sup> *Id.* at [54].

<sup>71</sup> *R v Foster* [2009] EWCA Crim 221.

<sup>72</sup> *R v Halling (Jason)* [2012] EWCA Crim 1774.

<sup>73</sup> *Id.* at [26].

have been determinative. The defense had argued at trial that the fatal blow could have occurred in the initial stages of the altercation and the jury had rejected this line of argument. In cases such as this where the scientific evidence is contested, and there is other material evidence from which the jury may have reached an informed conclusion then the courts may reject the appeal. Any expert evidence will face this problem; whilst the evidence on its own may seem highly probative if the appeal court feels that the jury reached a safe verdict using other relevant evidence, then the neuroscientific or other expert evidence will not be sufficient to overturn the previous decision.

A highly contentious area is the issue of sudden infant death (SID) or NAHI to children where a number of appeals have been made on the grounds that the neuropathology of death has been too dependent on a particular scientific or medical argument as to cause of death. In the case of sudden death, there has also been an issue with the interpretation of probability of death regarding the incidence of death within families. The neuropathology of death and injury in the case of acquired head injury has been the basis of appeal in a number of cases.<sup>74</sup> The route that led to the appeals is somewhat unusual. Following concern after the review of Angela Cannings' conviction<sup>75</sup> as unsafe two of the four appellants were asked as part of a review of 'battered babies'<sup>76</sup> cases whether they wished to appeal against conviction; another had already appealed. In an appeal hearing covering four cases of alleged NAHI, the Court of Appeal had to consider the strength of the neurological evidence. Ten expert witnesses gave evidence for the appellants and 11 for the Crown. Four further expert witnesses submitted evidence to the court. The central argument revolved around the issue of whether the accepted manner of diagnosis for unlawful assaults on children was correct given new advances in the scientific understanding of causes of injury. The basis of this challenge was a hypothesis based on recent research concerning NAHI in infants.<sup>77</sup>

All of the infants had received a diagnosis of NAHI. At the time this diagnosis was by the identification of some or all of what was known as a 'triad of injuries' which were interpreted as an indication that the injuries were caused by shaking.<sup>78</sup> Against this accepted diagnostic technique the court considered the hypothesis that this approach was incorrect. Dr Jennien Geddes gave evidence of this alternative hypothesis to the court.

Unusually the court took it upon itself in its judgment to explain brain function and to include two appendices: one containing diagrams of the brain. The explanation of brain function was as follows:

[60] In order to explain the two hypotheses it is necessary to set out some of the anatomy involved in terms which can be understood by laymen and which from a medical viewpoint may seem somewhat simplistic. At the outset, in order to assist the reader, we attach

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<sup>74</sup> *R v Harris; R v Rock; R v Cherry; R v Faulder* [2005] EWCA Crim 1980.

<sup>75</sup> *R v Cannings* [2004] EWCA Crim 1.

<sup>76</sup> *R v Harris; R v Rock; R v Cherry; R v Faulder* [2005] EWCA Crim 1980[4].

<sup>77</sup> *Id.* at [5].

<sup>78</sup> 'The accepted hypothesis depends on findings of a triad of intracranial injuries consisting of encephalopathy (defined as disease of the brain affecting the brain's function); subdural haemorrhages (SDH); and retinal haemorrhages (RH). For many years the coincidence of these injuries in infants (babies aged between 1 month and 2 years) has been considered to be the hallmark of NAHI. Not all three of the triad of injuries are necessary for NAHI to be diagnosed, but most doctors who gave evidence to us in support of the triad stated that no diagnosis of pure SBS (as contrasted with impact injuries or impact and shaking) could be made without both encephalopathy and subdural haemorrhages'. *Id.* at [56].

as annexes to this judgment a glossary of medical terms (appendix A), and diagrams of the head (appendix B).

[61] The brain is encased in three membranes. The one immediately surrounding the brain is the pia mater. The next one is the arachnoid. Between the pia and the arachnoid is an area known as the subarachnoid space. The third membrane, which surrounds the brain and continues down the body surrounding and protecting the spinal cord, is the dura. Between the dura and the arachnoid is the subdural space. Between the dura and the arachnoid there are veins running between the two membranes which are called bridging veins.

[62] The brain is divided into two halves or cerebral hemispheres. The two hemispheres are separated by the falx which itself is part of the dura. Below the cerebral hemispheres the brain is joined to the spinal cord at the craniocervical junction, which, as its name implies, is situated in the neck. The spinal cord extends down from the brain, through the foramen magnum and into the spine.

Having set out the constituents of the brain relevant to the appeals in hand, the appeal court continues to review the two hypotheses used to diagnose NAHI in some detail. It considered evidence from experts regarding the 'biomechanics' of shaking infants. The court identified the crux of the matter as being the medical evidence required to show shaking was the cause of death or injury. Those presenting the biomechanical evidence doubted that subdural hemorrhages (SDH) and retinal hemorrhages (RH) necessarily identified NAHI. The evidence of two experts was considered key to considering this issue.<sup>79</sup> Three experts gave evidence with regard to retinal hemorrhages. There was very little agreement amongst the experts as to how NAHI should be correctly diagnosed.

Given the puzzle with which it was faced, the Court of Appeal examined the case law with regard to the problems created by conflicting expert evidence. It reviewed the precedents in this area: *Pendleton*<sup>80</sup> and a case which came up in the course of this research *Kai-Whitewind*<sup>81</sup> concluding that the focus of the court should be the safety of the verdict. In reviewing this evidence, the court examined the nature of scientific discourse and considered the application of expert evidence in the context of an area where the knowledge of experts is changed by new discoveries. The court affirmed the comments in *Cannings*:

Much work by dedicated men and women is devoted to this problem. No doubt one urgent objective is to reduce to an irreducible minimum the tragic waste of life and consequent life-scarring grief suffered by parents. In the process however much will also be

<sup>79</sup> One of the experts views were reported as follows: 'Dr Thibault is a biomechanical engineer whose work has a particular emphasis on 'Paediatric Head Injury Mechanics'. Dr Thibault is not a doctor of medicine and holds a Ph.D. in mechanical engineering. He has apparently performed experiments that have sought to mirror the age-dependant mechanical behavior of the infant skull, sutures and brain. Part of the work in this field is to determine the amount of physical force that a living system can tolerate and thereby identify the 'injury threshold' or 'injury tolerance criteria'. When the relevant threshold or criteria is exceeded the system or tissue will fail; for example, stress on a bone will cause the bone to fracture if the stress exceeds the injury threshold'. *R v Harris; R v Rock; R v Cherry; R v Faulder* [2005] EWCA Crim 1980 [89].

<sup>80</sup> [2001] UKHL 66.

<sup>81</sup> [2005] EWCA 1092.

learned about those deaths which are not natural, and are indeed the consequence of harmful parental activity. We cannot avoid the thought that some of the honest views expressed with reasonable confidence in the present case (on both sides of the argument) will have to be revised in years to come, when the fruits of continuing medical research, both here and internationally, become available. What may be unexplained today may be perfectly well understood tomorrow. Until then, any tendency to dogmatise should be met with an answering challenge.<sup>82</sup>

The court concluded before turning to consider the individual cases that robust science not fanciful doubts are required to cast doubt on the safety of cases.<sup>83</sup> The court decided that in two cases this meant the convictions should be quashed and in one the murder conviction reduced to manslaughter. In Cherry's case, the evidence surrounding the death of the child was such that the conviction for manslaughter remained safe. Interestingly, the lack of certainty as to the precise cause of the injury was relevant to *mens rea* issues in relation to Rock's conviction for murder. The lack of evidence as to the level of violence required to kill a young child cast doubt on whether the unlawful killing was intentional. The court expressed the view that:

A brief period of violence (going beyond even rough play) was all that was required to cause Heidi's fatal injuries; such violence undoubtedly furnishes the mental element necessary for a conviction of manslaughter; but it does not necessarily demonstrate an intention to cause grievous bodily harm, the relevant intention if the conviction of murder was to be upheld.<sup>84</sup>

Rock's conviction for murder was quashed, and a conviction for manslaughter was substituted. Such cases were said by the appeal court to need close case management by the trial judge. The Court of Appeal repeated these comments in a subsequent case where the neurological evidence as to the cause of death was complex and the appellant's conviction was quashed.<sup>85</sup>

#### Evidence of cognitive impairment

Another line of cases in which neuroscientific evidence is adduced on appeal are those where the evidence is utilized to establish a defect in the accused's cognitive ability and its relevance to the offense charged. The impairment may be relevant at the time of the offense, at trial or the cognitive ability of a witness may be relevant in suggesting that a

<sup>82</sup> *R v Cannings* [2004] EWCA Crim 1 [22].

<sup>83</sup> *R v Harris; R v Rock; R v Cherry; R v Faulder* [2005] EWCA Crim 1980 [102].

<sup>84</sup> *Id.* at [184].

<sup>85</sup> In the subsequent case, *R v Holdsworth* [2008] EWCA Crim 971, the appeal court heard detailed expert evidence from neurologists concerning the possible cause of the death of a child. Holdsworth, who was babysitting the child, had been convicted of her murder. The new expert evidence led to the quashing of her conviction and the ordering of a retrial. The appeal court recommended as the evidence was so complex case management be employed:

we grant permission to appeal and quash the Applicant's conviction for murder. We add as a postscript that any re-trial will require a high level of case management. We draw attention, in particular, to the observations of this court in *R v Harris* [2005] EWCA Crim 1980... regarding the powers of the court to make provision for experts to consult together and, if possible, agree points of agreement or disagreement with a summary of reasons [59].

\*在生命的前五年，大腦的額葉迅速變化，這種物質無法保留在記憶中。

conviction is unsafe.<sup>86</sup> In *R v X*<sup>87</sup> Professor Conway, a cognitive psychologist, gave evidence that memories of childhood were ‘qualitatively different from later memories’.<sup>88</sup> He stated that: ‘during the first five years of life, the frontal lobes of the brain rapidly change and that material was not retained in memory’.<sup>89</sup> He expressed the opinion that:

where a detailed account of an early childhood event, with extraneous material, was given, the account might be unreliable. Research showed that, in seeking to recall life events, people could ‘remember’ events that it was known had not, in fact, taken place. In other cases, some surrounding detail about the account would arise from what the person knew about their childhood (conceptual knowledge); however, details that did not arise from conceptual knowledge might be false or unreliable, in that they might have been ‘added on’ at a later stage. A narrative account of an event during childhood amnesia should be treated with caution, especially where extraneous details were present, as the effect of those details was to give the account ‘enhanced credibility’. There was the danger that a confident account, with details, of a childhood event might be unreliable because of childhood amnesia.<sup>90</sup>

In X’s case, the witness had given a very detailed account of events remembered from childhood. As a result of Professor Conway’s evidence, the conviction of X for sexual abuse was quashed.

The issue of cognitive impairment in relation to trial and the giving of evidence by defendants to explain their criminal conduct are explored in a number of the cases returned by the search terms. One of the areas of law considered is fitness to plead. Fitness to plead concerns the ability of an accused person to, *inter alia*, understand the charges laid against him, understand the distinction between pleading guilty or not guilty, follow trial proceedings and to instruct counsel, to give evidence and to comprehend the evidence laid against him. An interesting case that was identified in the course of the research is the case of *R v Mohammed Sharif*.<sup>91</sup>

This case concerns an appeal against the conviction of Sharif for conspiracy to defraud and it contains a considerable amount of medical evidence about the state of Sharif’s brain at the time of the crime and subsequent trials. It was referred to the Court of Appeal by the Criminal Cases Review Commission (CCRC) which will investigate cases where there is sufficient evidence that a miscarriage of justice may have occurred. Whilst the decision of the appeal court is given in 2010, the actual events took place in 1985.

Sharif’s father submitted a number of fraudulent claims on behalf of members of his family. This case concerns a claim that the father submitted to the Criminal Injuries Compensation Board. He alleged that Sharif had sustained a head injury as a result of a

<sup>86</sup> See *R v S; R v W* [2006] EWCA Crim 1404 where the appeal court considered the admissibility of expert evidence concerning memories of childhood experience. The defense expert Professor Martin Conway gave evidence that: ‘Research techniques which allowed a study of what people were ‘remembering’ had only been developing in recent years’[18]. However, in this case the court concluded the research was not yet sufficiently advanced to answer the point at issue.

<sup>87</sup> [2005] All ER (D) 06 (Jul).

<sup>88</sup> *Id.*

<sup>89</sup> *Id.*

<sup>90</sup> *Id.*

<sup>91</sup> [2010] EWCA Crim 1709.

criminal assault in the family shop. The claim alleged that the head injury led to a severe deterioration in Sharif's physical and mental condition. Sharif's father received money from the Board. Sharif always denied that he had known of the claim made by his father and denied being involved in a conspiracy to defraud.

There was some video evidence submitted at the time of the trial alleged to be of Sharif which Professor Deakin, an expert witness for the prosecution at the first trial had examined. This evidence was said to establish that Sharif's behavior at the time of the false claim was 'normal'. In the report of the appeal case, the court notes that Professor Deakin felt 'that this confirmed his view that the neurological examination was normal. At that time he was of the view that this was a clear case of malingering and that there was no psychiatric or neurological component'.<sup>92</sup>

Indeed, Dr. Guly, acting as an expert for the defense', agreed with Professor Deakin. Though this conclusion was based on the same unproven assumptions that it was Sharif who was shown in the videos and that it was Sharif who had completed the documents as was alleged by the prosecution:

Her conclusion was that, if it was indeed the appellant who was depicted on the videos and who had carried out the execution of certain other documents as alleged by the prosecution, he was not suffering from any serious mental illness and should be regarded as fit to plead. She thought it highly improbable that he was suffering from any serious mental illness or organic brain disorder.<sup>93</sup>

Sharif was asked to stand trial in April 1998 but refused to answer when asked if he pleaded guilty or not guilty. It then had to be decided by the court whether he was 'mute of malice', that is deliberately silent, or 'mute by visitation of God', that is he could not speak because of some medical condition. The resolution of this issue entailed further expert evidence from Professor Deakin. The views he expressed at this trial of fitness to plead were described by the Court of Appeal as 'less robust ... He left scope for other possibilities but the thrust of his evidence was consistent with a finding that the appellant had been mute of malice'.<sup>94</sup> The jury found that he was 'mute of malice'. This meant that the judge entered a not guilty plea on Sharif's behalf.

At this point Sharif's condition seems to have caused some concern, because the Court of Appeal case report shows that an MRI scan was ordered. This revealed 'that there was enlargement of the extra cerebral spaces in the brain which, in the opinion of Dr Forbes, the reporting consultant neuroradiologist, indicated mild generalised atrophy of the brain'. There was no agreement between the experts giving evidence. One doctor, Dr Launer, 'tended to the view that the MRI scan reinforced his opinion that the appellant was unfit to plead and to stand trial'.<sup>95</sup>

On the other hand the main prosecution witness, Professor Deakin, 'as a matter of probability ... remained of the opinion that it was a case of malingering'.<sup>96</sup> On 21st January 1999 Sharif was found fit to stand trial. The trial in relation to the criminal charge began in the last week of January and lasted until 23rd March 1999. Sharif did not give

<sup>92</sup> *Id.* at [6].

<sup>93</sup> *Id.* at [7].

<sup>94</sup> *Id.* at [9].

<sup>95</sup> *Id.* at [10]; all quotations in the paragraph.

<sup>96</sup> *Id.* at [14].

evidence but medical evidence was presented on his behalf by the defense. Following conviction Sharif's brother attempted an appeal on Sharif's behalf but this failed. It was not until 2001 that the application which led to the review by the CCRC was lodged. This time the appeal was lodged by Sharif's wife. She produced fresh medical evidence with regard to the issue of whether Sharif had been fit to stand trial. The appeal application relied on two reports dated 2000. The evidence contained in the first report referred to a recent MRI scan carried out in January 2000 which 'showed that the appellant's neurological condition had deteriorated since trial'. A second report written in March 2001 contained the views of Professor Neary, a Professor of Neurology at Greater Manchester Neuroscience Centre. He expressed the opinion that the appellant was suffering from a chronic degenerative disorder, probably related to the consanguinity of his parents and some sort of autosomal disorder.<sup>97</sup>

The decision of the Court of Appeal notes the importance to the appeal of having a wide range of medical opinions to support the application. The CCRC sought the views of many medical experts with regard to Sharif's condition at the time of the trial. This required them to look back to his condition in 1998–99. There was however a need for one expert who could coordinate and make sense of the range of expert views. This expert was Professor Tony Holland. The Court of Appeal describes him as the 'ringmaster' of the investigations. Collating the various reports and identifying where further medical evidence was required. The three reports he prepared were felt to be useful. His first report was made in 2002 and the last in 2007. He identified that the problem that Sharif was suffering from may have a genetic origin and introduced a further medical expert, Dr David Crauford, a consultant in neuropsychiatric genetics:

Dr Crauford's opinion is that the clinical picture is strongly suggestive of a severe degenerative disorder of the central nervous system and that the most likely explanation for the appellant's medical problems is a previously unrecognised autosomal recessive disorder occurring as a result of multiple consanguineous marriages in his family.<sup>98</sup>

Thus, a great deal of medical evidence was placed before the Court of Appeal by the CCRC on behalf of Sharif. As the CCRC were funding the appeal they were able to investigate the disparity between the existing MRI scans, and ask neurologists to consider the issue of the ability of Sharif to be able to plead in 1998–99. The focus of the appeal became the January 2000 MRI scan. The Commission instructed Dr W J Gunawardena, a consultant neuroradiologist, to help with understanding the relevance of the scan to Sharif's appeal. The law report states: 'that the comparison of the two MRI scans demonstrated a progression of brain atrophy as shown by a marked increase in the fluid spaces around the brain stem and the cerebellum'.<sup>99</sup>

The CCRC sought the help of another consultant neurologist regarding the claims considered at trial that Sharif was faking his difficulties with answering the charge.

He opined that the brain scans provide strong evidence against the proposition that the appellant had been faking his impairments. They were important objective evidence of a

<sup>97</sup> *Id.* at [17].

<sup>98</sup> *Id.* at [19].

<sup>99</sup> *Id.* at [22].

progressive organic brain disease at the time of the fitness to plead trial. His final opinion is that it is highly likely that the impairments were so severe that the appellant was unfit to plead.<sup>100</sup>

In securing the quashing of Sharif's conviction, the issue of his fitness was key and pivotal to the case was the change of opinion in the key prosecution expert witness at the time of the earlier trials. Professor Deakin was invited to look again at the evidence relevant to Sharif's appeal:

His conclusion is that there is now new evidence from the repeat MRI scan in January 2000 of a neuro degenerative process. ... Professor Deakin also observes that there has been no evidence of normal functioning since 1999, that suggesting an irreversible neurological process.<sup>101</sup>

The Court noted the change and congratulated Professor Deakin on being prepared to change his view because of the new neurological evidence: 'he has radically altered his opinion. We do not think that he should be criticized for that'. The appeal court notes the advances in the understanding of brain function and genetic diseases. '[I]t is understandable that even the most competent medical practitioners might not have been able to reach their present conclusions in 1999 on the basis of the evidence then available and the available learning'.<sup>102</sup>

The change in the approach adopted by Professor Deakin is clearly key. In addition, the Crown, which is represented at the appeal, did not seek to resist the appeal. These two factors are stated by the Court of Appeal to be important reasons for permitting the appeal and quashing the conviction. The reason given being that the official findings in respect of unfitness to plead were unsafe.

The Court of Appeal clearly express the view in the judgment that it was Sharif's father who was the mastermind of the conspiracy rather than Sharif, and in the light of the medical evidence referring Sharif for retrial would be inappropriate. It is interesting that this finding is largely based on information provided a long time after the trials took place and much of the evidence of the existence of organic brain disease rests heavily on the experts' interpretation of the neuroscientific evidence.

Sharif is a very unusual case both in terms of the resources devoted to establishing the relevant neurological information and in the identification of genetic issues. The sheer amount of scientific expertise called upon by the CCRC enabled Sharif's lawyers to put forward a very strong case. Highly cogent evidence is required to support an appellant's case if it is to succeed. A review of the reported cases returned by the research suggests resourcing at this level is rare.<sup>103</sup>

Another case identified by the research, *S v R*<sup>104</sup>, concerned not only fitness to plead but also new evidence of Asperger's syndrome at the time of the alleged offense and at trial. The new evidence suggested that S could not instruct counsel and might not

<sup>100</sup> *Id.* at [23].

<sup>101</sup> *Id.* at [24].

<sup>102</sup> *Id.* at [24] both quotations.

<sup>103</sup> Examples of problems with funding were directly referred to in a number of cases for example *R v Gwaza* [2009] EWCA Crim 1101 and *R v Hanson* [2005] EWCA Crim 1143.

<sup>104</sup> [2008] EWCA Crim 6.

have had the *mens rea* required for the alleged offenses. The case involved an alleged rape and indecent assault. The question for the Court of Appeal was the safety of S's conviction. Significant to the success of the appeal was new evidence from clinical and psychometric assessment of S: who had not previously been assessed for the possibility of Asperger's syndrome. S's behavior at trial had been unusual. It is reported that he had read a book whilst the victim, his ex-wife, was giving evidence. The prosecution expert, who had assessed S, did not dispute that Asperger's syndrome was a possible diagnosis. No tests had been carried out on S, prior to the trial, to establish whether Asperger's was a possible diagnosis, mainly because the clinic that assessed him did not diagnose or treat the syndrome. Therefore, two of the experts reporting to the appeal court felt unable to rule out the possibility that the defendant was suffering from the syndrome at the time of the trial. If S was suffering from Asperger's, the view of the Court of Appeal was that this would have affected his fitness to plead and may have affected his ability to form the *mens rea* necessary for the crime. In view of this, the Court quashed S's conviction and ordered a retrial.<sup>105</sup> Again new expertise, resources, and developing knowledge of an area seem to have impacted on the decision of the appeal court.

### Requiring evidence from brain scans?

Brain scans are sometimes viewed by prosecution and defense teams as making visible an appellant's problem(s) with mental functioning. In *R v Gwaza*, the trial judge refers to the absence of a brain scan as part of the reason for his sentencing Gwaza to indefinite detention for public protection:<sup>106</sup>

We had to rule out any possible mental illness because you refused to be examined, and you refused to have a brain scan, or any other test which might show whether you were suffering from some real illness, so the only basis one can sentence you is on the basis that you suffered this episode because you were taking cannabis. The point is this: if you were to take cannabis again it seems to me there is every likelihood you might suffer a similar psychotic disorder and if I were simply to sentence you in the normal course of events to a term of five years' imprisonment, which I think is the appropriate sentence, once you are released there would be nobody, if you weren't deported, there would be nobody to ensure that if you had another such incident that you could be taken back into custody before you attacked anybody, and I think this is an ideal case for imposing a sentence of imprisonment for the public protection.<sup>107</sup>

On appeal Gwaza was successful in gaining a slight reduction in his sentence and having the indeterminate part of his sentence removed. The evidence that was persuasive to the court was the opinion provided by a consultant forensic psychiatrist following a CT scan:

With the advantage of now assessing him two and a half years after the index offending, there is still no evidence that there was an organic cause for the acute mental illness he suffered at the time of his arrest. Indeed, he remains impressively fit. His brain appears

<sup>105</sup> *S v R* [2008] EWCA Crim 6 [36].

<sup>106</sup> *R v Gwaza* [2009] EWCA Crim 1101.

<sup>107</sup> *Id.* at 8.

physically normal from the recent CT scan and there were no other indications of relevant physical or metabolic disorder.<sup>108</sup>

On first view, this appears a somewhat quixotic result. The trial judge imposes an IPP on the basis of the absence of medical evidence as to the cause of Gwaza's behavior. The Court of Appeal quashes the IPP having heard evidence that his brain 'appears physically normal'. However, other cogent evidence presented to the Court of Appeal suggested that on release he would not pose a significant risk to members of the public.<sup>109</sup> Again this highlights the fact that the neuroscientific evidence is only one part of the argument presented to the court; other evidence may appear more convincing.

In *R v Barry*,<sup>110</sup> an appeal against a conviction for murder, there were two grounds of appeal. Firstly, that the judge had erred in instructing the jury to draw adverse inferences from Barry's silence at trial, which he claimed, was induced by alcoholic amnesia. Secondly, that the defense of diminished responsibility should have been available to him; the defense being advanced on the grounds that he suffered from Alcohol Dependency Syndrome (ADS). The appeal failed on both grounds and significantly the courts refer to the results of MRI scans: 'Magnetic resonance imaging scans disclosed no evidence of brain damage as a result of alcoholism'.<sup>111</sup> This suggests that where there is brain scan evidence of impairment that evidence will add weight to the appellant's arguments.<sup>112</sup>

### Evidence of developmental immaturity

Other jurisdictions have case law that demonstrates acceptance of some of the arguments made by cognitive science regarding developmental immaturity as a mitigating or excusing factor in criminal trials.<sup>113</sup> Despite the fact that the age of criminal responsibility in England and Wales is 10, English law is reluctant to view developmental immaturity as an excusing factor. Although it clearly does recognize it as a mitigating factor when sentencing takes place. The Crime and Disorder Act 1998 removed the rebuttable presumption that a person aged under 14 could be *doli incapax*.<sup>114</sup> In *R v JTB*,<sup>115</sup> the House of Lords had to consider whether this statute removed the defense previously available. This old common law defense had the effect, if successfully argued, of exempting children under 14 from criminal responsibility by reason of their age and inability to tell right from wrong. The question before the court was whether the statute

<sup>108</sup> *Id.* at 10.

<sup>109</sup> *Id.*

<sup>110</sup> *R v Barry* [2010] EWCA Crim 195.

<sup>111</sup> *Id.* at [10].

<sup>112</sup> See discussion under heading Evidence of Alcohol Dependency Syndrome below.

<sup>113</sup> See as an example of mitigation *Roper v. Simmons*, 543 U.S. 551 (2005) in which the US Supreme Court held that the death penalty should not be imposed on those aged under 18 at the time of the offense; See as an example of excusing criminal responsibility jurisdictions where the age of criminal responsibility is greater than 10 eg Belgium 18, Luxembourg 18, and Portugal 16; See Howard League for PENAL REFORM, PUNISHING CHILDREN: A SURVEY OF CRIMINAL RESPONSIBILITY AND APPROACHES ACROSS EUROPE (2008).

<sup>114</sup> § 34. Crime and Disorder Act 1998 abolished the common law rebuttable presumption of '*doli incapax*'. This permitted a rebuttable presumption that under the age of 14 a child was not responsible for his criminal acts. The section states: 'The rebuttable presumption of the criminal law that a child aged ten or over is incapable of committing an offence is hereby abolished'.

<sup>115</sup> [2009] UKHL 20.

left intact the defense, thus permitting evidence to establish that a particular defendant was *doli incapax* to be admitted.

Lord Phillips examined the history of the defense tracing it to the 1778 edition of Hale's History of the Pleas of the Crown as a privilege of infancy. He continues '*doli incapax* is contrasted with *doli capax*, who can discern between good and evil at the time of the crime committed'.<sup>116</sup> Having reviewed the authorities from the 18th to 20th century Lord Phillips concluded that the need for the presumption of *doli incapax* was removed in the 20th Century by the education system. He reasons that this was achieved by compulsory schooling: 'Children in the 20<sup>th</sup> Century had to go to school where they were supposed to be taught right from wrong'.<sup>117</sup> In reaching their decision their Lordships utilized Parliamentary materials recording discussions in committee and other bill stages. This was used as evidence to support their conclusion that their interpretation reflected the will of Parliament when it enacted the Crime and Disorder Act 1998. No genetic or neuroscientific evidence is referred to in their Lordships' decisions. Our research returned no cases of juveniles under the age of 14 claiming that their age impacted their criminal responsibility. Given the wording of the 1998 Act this is hardly surprising. This failure to acknowledge that age can impact the degree of criminal responsibility was commented on by The Royal Society working group on *Neuroscience and the law* as an area which merited further examination and discussion.<sup>118</sup>

However, issues of disabilities which affect the mental age of the defendant have been argued in cases captured by the research. The courts' approach to such pleas has been robust. Pelham, a defendant who was said to have an IQ within a range of 73–82, was convicted of racially aggravated harassment. The jury heard evidence from the defense expert that Pelham had been subject to harassment herself and that she had learning disabilities which were borderline 'learning disabled' 'typical of only 6 per cent of the population'.<sup>119</sup> The court noted that a brain scan had taken place, but it did not support the behavioral diagnosis that Pelham might have been suffering from epilepsy at the time of the offense. The court seemed to take the view that such a scan might have provided, in part, an explanation for her behavior.

The prosecution expert was unable to establish how her learning difficulty affected her ability to understand racist language. 'In my opinion her knowledge of racial terminology is in line with her overall level of ability. The exact threshold of understanding needed for the offence to be proved is unclear to me. . .'.<sup>120</sup> It is also clear from comments made by the judge that the lack of scan evidence to support the behavioral evidence of epilepsy had an adverse impact on her appeal: 'It is clear from what we have been told today that further steps were taken in relation to seeing if evidence in relation to the Appellant's epilepsy should be adduced, but a scan revealed no matter on which reliance could be placed'.<sup>121</sup>

<sup>116</sup> *Id.* at [8].

<sup>117</sup> *Id.* at [20].

<sup>118</sup> 'There is concern among professionals in this field that the age of criminal responsibility in the UK is unreasonably low and the evidence of individual differences suggests that an arbitrary cut-off age may not be justifiable'. The Royal Society, *Brain Waves Module*, 4NEUROSCI. L.13 (2011). <https://royalsociety.org/policy/projects/brain-waves/responsibility-law/> (accessed Jan. 6, 2015).

<sup>119</sup> *R v Pelham* [2007] EWCA Crim 1321 [10].

<sup>120</sup> *Id.* at [14].

<sup>121</sup> *Id.* at [16].

Precedent dictated that, as Pelham suffered from a borderline learning disability, the evidence of difficulties in comprehension could not be allowed to be considered by the jury when assessing the *mens rea* required for the offense. The appeal court applied *R v Masih*<sup>122</sup> and said that the cut off point for disability which might go to *mens rea* was an IQ of 69 and therefore rejected Pelham's appeal against conviction.

Similarly developmental immaturity has been unsuccessfully argued in a number of cases where the length of sentence is the focus of the appeal. *R v Case and others*<sup>123</sup> provides an example of this; particularly in its consideration of the argument made on behalf of Case that the sentence was excessive. Case had been part of a gang that was responsible for unprovoked and unpleasant attacks on eight people. The charges faced at trial were murder and conspiracy to cause grievous bodily harm. Case would have pleaded guilty to manslaughter at the time of trial, but the appeal court report states this was 'impractical'.<sup>124</sup> The consideration of Case's appeal revolves around his Attention Deficit Hyperactivity Disorder (ADHD) which is said to have both an 'environmental and genetic component'. This was not linked by the defense expert precisely to his criminal behavior, but rather to the feelings he was suffering at the time of lack of self-worth. He was said to be suffering from depression at the time of the attack and his IQ was recorded as being 89.<sup>125</sup> But the most relevant factor on appeal was the violent and dangerous nature of the offenses committed by the gang:

The single judge, refusing leave to appeal the sentence in respect of these Applicants, wrote:

'The reality is that the circumstances and consequences of this rampage were such that the sentence imposed cannot be viewed, even arguably, as manifestly excessive'.

We agree. These applications must be refused.<sup>126</sup>

This approach has been maintained even where the defendant's ability to function may be severely affected by his learning disability. In *R v Gilbert*,<sup>127</sup> the appeal was against the imposition of an IPP. Gilbert was 19 at the time he was sentenced. He had a criminal record and committed the robbery of a mobile phone with threats of violence. He was serving a suspended sentence at the time of the offense. Gilbert submitted a plea of guilty. When sentencing him the judge remarked that he had a criminal record of anti-social behavior. Both the judge and the probation officer expressed the view that the behavior showed a pattern of escalation. Gilbert's probation officer wrote: 'Perhaps the

<sup>122</sup> [1986] Crim LR 395 in which Lord Lane CJ said: 'Generally speaking, if a Defendant is mentally defective, or otherwise comes in the last class, '69 and below mental defective', then in so far as that defectiveness is relevant-relevant that is to the particular case—it may be that expert evidence should be admitted about it. That is in order to enlighten the jury upon a matter which is abnormal, and therefore ex hypothesi, presumably, outside their own experience. If it is admitted it should be confined to the assessment of the Defendant's Intelligence Quotient, and to an explanation of any relevant abnormal characteristics which such an assessment involves. ... Where the Defendant however is within the scale of normality, albeit, as this man was, at the lower end of that scale, expert evidence, in our judgment, is not as a rule, necessary and should be excluded'.

<sup>123</sup> [2006] EWCA Crim 1746.

<sup>124</sup> *Id.* at [19].

<sup>125</sup> *Id.* at [16].

<sup>126</sup> *Id.* at [32].

<sup>127</sup> [2012] EWCA Crim 1221.

most worrying aspect of Mr Gilbert's behaviour is the very unpredictability of it. On this basis alone the risk of harm remains high'. Leading the sentencing judge to comment: 'It cannot confidently be predicted what will happen next'.<sup>128</sup>

The judge when sentencing had a number of sentencing reports in front of him and paid particular attention to the question: 'is there a significant risk to members of the public of serious harm by the commission by [the Applicant] of further specified offenses?'.<sup>129</sup> To assist him the judge considered the report of a neuropsychologist, and the record of previous offending from which he assessed the risk posed by Gilbert to be serious. This placed Gilbert in a 'Catch 22' situation. There was no facility available which could cope with his disability in such a way as to make him address his offending and therefore have the opportunity to fulfill the requirements for release by the Parole Board. The sentencing judge's review of the neuropsychological evidence was as follows:

He had a mild to moderate learning disability which derived from an overall IQ of 58, which put him in the lowest 0.1 per cent of the adult population and enabled him to function around the chronological age of eight. Although his daily living skills were those of a ten year old, his socialisation and communication skills are those of a much younger child. His receptive skill was the lowest of all. Moreover, although he suffers from no mental illness, he has a personality disorder which expresses itself in impulsive and anti-social behaviour. These difficulties mean that although he can function on his own to a limited extent, he is unable to respond constructively to assistance. This latter is clearly demonstrated by two convictions for assaulting carers. Dr Emad Yousif proposes what he needs and the probation officer simply has to record that no such facilities are available.<sup>130</sup>

Having heard this evidence the Court of Appeal rejected his appeal against the imposition of the IPP. They concluded that in terms of the 'what next' question the sentencing judge had reached an appropriate conclusion.<sup>131</sup>

### Evidence of dangerousness and risk

The issue of the dangerousness and risk to the public from offenders is addressed in a number of the cases. In England and Wales, appeals against sentence may be made by both the Crown, via the agency of the Attorney General who may refer sentences that he considers too lenient, or by the defense on behalf of the convicted person on grounds that the sentence is manifestly excessive or wrong in principle.

Sexual offending particularly attracts great attention from sentencing judges when assessing dangerousness and risk. *R v H*<sup>132</sup> is a case which concerns the sexual abuse of a young child. The abuse in question was six counts of rape of a child under 13 and two counts of sexual assault of a child under 13. The judge attached an IPP to one of the sentences for rape. The appeal against sentence was in part against the imposition of the IPP. The appeal court therefore considered the argument that the sentencing judge

<sup>128</sup> *Id.* at [9].

<sup>129</sup> *Id.* at [6].

<sup>130</sup> *Id.* at [8].

<sup>131</sup> *Id.* at [15].

<sup>132</sup> [2012] EWCA Crim 3172.

'was not justified in concluding that the threshold of dangerousness had been passed; or if it was an IPP rather than an extended sentence was called for'.<sup>133</sup>

The appellant had no previous convictions though there was reference in the pre-sentencing report to sexual assaults when he was under the age of criminal responsibility.<sup>134</sup> It was accepted, both at the time of sentencing and on appeal, that these allegations were unsubstantiated.<sup>135</sup> The neuropsychological evidence showed him as having an IQ of 79, which is described in the appeal report as 'borderline disability'. The conclusions drawn from the tests were that although H had a learning disability, he was fit to plead. He was able to understand that his behavior was seriously wrong and understand its effect on his victim.<sup>136</sup> The distinction between this and Gilbert's case seems to be that the neuropsychological evidence pointed toward a suitable 'total protective sentencing package'.<sup>137</sup> Therefore, despite the appeal court being in agreement with the sentencing judge's designation of the appellant as dangerous, there was a provision in the sentencing system to meet the need to protect the public from harm. The sentencing judge had imposed a sexual offenses preventative order, a requirement that the defendant register on the sex offenders' register and a disqualification from working with children for the rest of his life.<sup>138</sup> This was seen by the appeal court as sufficient for public protection, and therefore the IPP was quashed and an increased custodial sentence to 10 years and an extension period of eight years was made.

The appeal courts have been anxious to respond to neuroscientific evidence which points to the wrong categorization of a prisoner<sup>139</sup> and to incorrect sentencing. In *R v Chapman (Matthew)*,<sup>140</sup> the Court heard argument on behalf of the appellant that the sentence imposed following Chapman's plea of guilty to a charge of sexual assault was not correct. Chapman was 16 at the time of the assault. The neuropsychological test results had at an early stage following the offense pointed toward a need for treatment to prevent further offending. The defendant had been treated in the eight months leading up to the trial at the Maudsley Hospital in London.<sup>141</sup> The advice to the sentencing judge from the psychologist treating Chapman was that he should continue the treatment. The judge chose to impose a sentence of 12 months detention effectively preventing the continuation of the treatment.<sup>142</sup> Quashing the 12 month sentence and substituting a 'Community Order coupled with a supervision requirement'<sup>143</sup> the appeal court relied on the psychologist's assessment of the appropriate disposal for the appellant. The information being drawn from the neuropsychiatric tests and the experience of treating Chapman, the appeal court concludes:

The psychiatric reports and the pre-sentence report were informed and insightful. They recognised, as do we, the seriousness of the offence. Each report carefully considered a

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<sup>133</sup> *Id.* at [13].

<sup>134</sup> Under English law the age of criminal responsibility is 10.

<sup>135</sup> [2012] EWCA Crim 3172 [7].

<sup>136</sup> *Id.* at [9].

<sup>137</sup> *Id.* at [19].

<sup>138</sup> *Id.* at [2].

<sup>139</sup> Whittaker (*R on the application of*) v Secretary of State for Justice [2011] EWHC 2166 (Admin).

<sup>140</sup> [2010] EWCA Crim 565.

<sup>141</sup> *Id.* at [7].

<sup>142</sup> *Id.* at [19].

<sup>143</sup> *Id.* at [23].

means of sentencing which would protect the public and provide a framework to address the complex mental needs of the appellant in order to minimise the risk of further offending. This is critically important in a young offender.<sup>144</sup>

Chapman had been drinking before the crime was committed and was likely to have been suffering from 'Alcoholic Blackout, a period of anterograde amnesia'.<sup>145</sup>

Alcohol or intoxicants frequently figure in the case reports and it is not uncommon to come across defendants arguing lack of memory of the crime.

### Evidence of Alcohol Dependency Syndrome

Many of the reports returned by the research concerned unlawful killing. In England and Wales, a partial defense to a murder charge is diminished responsibility.<sup>146</sup> If successfully pleaded, it will reduce a charge of murder on conviction to manslaughter. As explained earlier, a manslaughter conviction avoids the mandatory life sentence, though a life sentence may still be imposed if the sentencing judge feels that this is appropriate. There are a significant number of cases returned by the research which raise the issue of ADS and consider its relationship to the plea of diminished responsibility.

R v Wood<sup>147</sup> is the leading case, returned by the research, in which the Court of Appeal grappled with the issue of whether ADS could be viewed as an abnormality of mind. At the time of Wood's offense, the partial defense<sup>148</sup> required that a legally recognized abnormality of mind be established which substantially impaired responsibility for the unlawful killing. At trial it was accepted that the defendant was extremely drunk at the time of the killing, but there were differences of opinion between experts regarding whether Wood's consumption of alcohol once he passed a certain amount could be viewed as involuntary rather than voluntary consumption.<sup>149</sup>

The first part of the trial judge's direction to the jury was approved by the Court of Appeal as a correct summary of the law at the time of the trial. At trial the judge stated:

it is accepted by all four psychiatrists that alcohol dependency syndrome can produce changes in the brain which may impair judgment or cause loss of self control. .... If you are satisfied that it was more likely than not, by reason of alcohol dependency syndrome and its effect on this Defendant's brain, he was suffering from an abnormality of mind and that in consequence his mental responsibility for killing Francis Ryan was substantially reduced, your verdict would be ... guilty of manslaughter.<sup>150</sup>

The dispute to be resolved by the appeal court revolved around the issue of whether to substitute a finding of diminished responsibility. Wood needed to establish that the

<sup>144</sup> *Id.* at [21].

<sup>145</sup> *Id.* at [9].

<sup>146</sup> Homicide Act 1957 § 2.

<sup>147</sup> [2008] EWCA Crim 1305.

<sup>148</sup> Homicide Act 1957 § 2 (1). Where a person kills or is a party to the killing of another, he shall not be convicted of murder if he was suffering from such abnormality of the mind (whether arising from a condition of arrested or retarded development of mind or any inherent causes or induced by disease or injury) as substantially impaired his mental responsibility for his acts and omissions in doing or being a party to the killing....

<sup>149</sup> [2008] EWCA Crim 1305 [13], [14], and [15].

<sup>150</sup> *Id.* at [16].

drinking immediately before the unlawful killing was involuntary.<sup>151</sup> The precise dispute concerned the accuracy of the judge's instruction to the jury that: 'Giving in to a craving is not an involuntary act'.<sup>152</sup> As in the case of *R v Barry*,<sup>153</sup> in Wood's case there was no observable brain damage. Two experts argued that such damage might not be accessible to present measurement techniques. The Court of Appeal reviewed the opinion of one expert, Dr Van Woerkum, as follows:

the Appellant was a 'dependent chronic alcoholic', who was 'having to drink continuously, due to chronic alcohol dependency'. This constituted a disease of the mind. In his evidence he accepted that his conclusion that an abnormality of mind was present required some evidence of damage to the brain, but he said that such damage would not necessarily be evident on the macroscopic scale. Subtle sub-macroscopic changes, which impair mental function, take place in the brain after years of excessive drinking. Such changes could be diagnosed clinically, and in his opinion the mental functioning of the Appellant indicated subtle brain damage.<sup>154</sup>

The appeal court applied the House of Lords' decision in *R v Dietschmann*.<sup>155</sup> Considering all the psychiatric evidence the appeal court concluded that quite simply the question of whether ADS could be an abnormality of mind in cases where evidence of actual brain damage was lacking should be left to the jury. Implicit in the appeal court's reasoning is that in such cases there should be sufficient expert evidence to raise the issue. The issue for the jury would be whether ADS 'is of such an extent and nature that it constitutes an abnormality of mind induced by disease or illness'. The failure of the defense to adduce actual evidence of brain damage was not fatal to Wood's case provided that the expert, factual and circumstantial evidence suggested that a finding of abnormality of mind could be made on the evidence by a properly instructed jury. The critical issue was whether the abnormality of mind rather than the voluntary ingestion of alcohol substantially impaired his responsibility for the killing. The Court of Appeal quashed Wood's conviction for murder and substituted a conviction of manslaughter on the grounds of diminished responsibility. Again the psychiatric evidence with regard to behavior, based on the neuroscientific understanding of the defendant's brain, forms an important part of the appeal court's reasoning. Subsequent to this decision the partial defense has been substantially amended, and the defense requirements are now very different.<sup>156</sup>

<sup>151</sup> *Id.* at [17, 18].

<sup>152</sup> *Id.* at [18].

<sup>153</sup> [2010] EWCA Crim 195 [10]; see *supra* note 148 and accompanying text for a discussion of *R v Barry*.

<sup>154</sup> [2008] EWCA Crim 1305 [13]. A second expert Dr M Al-Urzi also supported this view:

he expressed the view that the Appellant was 'under the influence of a significant amount of alcohol, which clearly can cause impaired judgment [and] would jeopardise his ability to control his behaviour'. In his evidence he observed that subtle, sub-macroscopic levels of damage could only be detected by clinical diagnosis. In his view the Appellant's level of mental functioning suggested that he had indeed suffered such brain damage [14].

<sup>155</sup> [2003] UKHL 10.

<sup>156</sup> The amended defense reads '(1) A person ("D") who kills or is a party to the killing of another is not to be convicted of murder if D was suffering from an abnormality of mental functioning which—(a) arose from a recognised medical condition, (b) substantially impaired D's ability to do one or more of the things mentioned in subsection (1A), and (c) provides an explanation for D's acts and omissions in doing or being

## CONCLUSION

Neuroscientific evidence is being used in court by those accused of criminal offenses. As far as we can tell where brain scan evidence is being used, it is structural rather than functional brain scan images. Assessing the extent of usage in the courtroom by those accused of criminal offenses accurately is problematic as the data being examined almost entirely consists of decisions of the appellate courts. However, on the basis of the available evidence, it would appear that the use of neuroscientific evidence is increasing: the annual average number of case identified doubled from approximately 17 per year in the period 2005–08 to 34 per year in 2009–12, though this may be explained by the increased number of Court of Appeal cases being reported.

In a number of cases, neuroscientific evidence has been central to successful appeals against conviction. This is particularly the case where it is being used to dispute prosecution evidence as to the cause of death or injury, particularly in cases of NAHI and SID.<sup>157</sup> Neuroscientific evidence has also been at the heart of a number of appeals to have murder convictions reduced to manslaughter. This can be seen in several cases relating to ADS where neuroscientific evidence has helped challenge the original decision and has led to the quashing of convictions for murder. The appeal court has then used its powers to substitute a conviction for manslaughter on the grounds of diminished responsibility.<sup>158</sup> Neuroscientific evidence has assisted defendants to argue that they were not fit to stand trial<sup>159</sup> and has also been used to cast doubt on the credibility of witnesses. This issue has arisen in a number of cases in relation to childhood amnesia,<sup>160</sup> and in *R v X* led to the conviction being quashed.<sup>161</sup>

Neuroscientific evidence has also been utilized by those convicted of crimes who, on appeal, have succeeded in having their sentence reduced. Generally, this evidence has formed part of the circumstances of the case that the appeal court considers makes the sentence manifestly excessive,<sup>162</sup> or has led to IPPs being lifted because, on the basis of the neuroscientific evidence, the risk posed by the convicted person was not considered to warrant an indeterminate sentence.<sup>163</sup> In a few cases, the decision to reduce the sentence rested largely or wholly on the neuroscientific evidence.<sup>164</sup>

Aside from appeals against sentence and conviction, neuroscientific evidence has also been used to resist extradition,<sup>165</sup> to challenge bail conditions,<sup>166</sup> and by prisoners

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a party to the killing. (1A) Those things are—(a) to understand the nature of D's conduct; (b) to form a rational judgment; (c) to exercise self-control. (2A) For the purposes of subsection (1)(c), an abnormality of mental functioning provides an explanation for D's conduct if it causes, or is a significant contributory factor in causing, D to carry out that conduct'. (2) In § 6 of the Criminal Procedure (Insanity) Act 1964 (c. 84) (evidence by prosecution of insanity or diminished responsibility), in paragraph (b) for 'mind' substitute 'mental functioning'. The new law came into force in Oct. 2010.

<sup>157</sup> See eg *R v Harris; R v Rock; R v Cherry; R v Faulder* [2005] EWCA Crim 1980; *R v S* [2009] EWCA Crim 838; *R v Henderson; R v Butler; R v Oyediran* [2010] EWCA Crim 1269.

<sup>158</sup> See eg *R v Wood* [2008] EWCA Crim 1305.

<sup>159</sup> See eg *S v R* [2008] EWCA Crim 6; *R v Norman* [2008] EWCA Crim 1810; *R v MB* [2010] EWCA Crim 1684; *R v Sharif* [2010] EWCA Crim 1709; *R v Walton* (aka Wright) [2010] EWCA Crim 2255.

<sup>160</sup> See eg *R v X* [2005] All ER D 06; *R v S; R v W* [2006] EWCA Crim 1404; *R v Bowman* [2006] EWCA 417. *R v X* [2005] All E.R.D. 06.

<sup>161</sup> See eg *R v Martin* (Anthony) [2010] EWCA Crim 1960; *R v Adrian Andre Young* [2009] EWCA Crim 2576.

<sup>162</sup> See eg *R v Prosser* [2008] EWCA Crim 1506; *R v H* [2012] EWCA Crim 3172.

<sup>163</sup> See eg *R v Hendy* [2006] EWCA 819; *R v Swinscoe* [2006] EWCA Crim 2403; *R v Chapman* (Matthew) [2010] EWCA Crim 565.

<sup>164</sup> See eg *Government of the United States of America v Tollman and another* [2008] EWHC 184 (Admin).

<sup>165</sup> See eg *Carson v Ealing Magistrates' Court* {2012} EWHC 1456 (Admin).

seeking recategorization.<sup>167</sup> The use of the evidence and the care taken by courts in admitting it suggests that the courts are generally utilizing the growing areas of understanding of the brain to develop the approach of the criminal law to defense claims. The impact has not, however, been revolutionary. Neuroscience has not provided new defenses which previously did not exist. It has, however, in some cases provided a new source of important evidence to support other previously existing evidence. In some cases, such as those relating to NAHI, it has provided evidence of a kind not previously available. The cases also suggest that in time the value of neuroscientific evidence will increase as noted in *Cannings*: 'What may be unexplained today may be perfectly well understood tomorrow'.<sup>168</sup> For as the Court of Appeal noted in *Sharif* when considering the recent advances in scientific understanding of brain function and genetic diseases: 'it is understandable that even the most competent medical practitioners might not have been able to reach their present conclusions in 1999 on the basis of the evidence then available and the available learning'.<sup>169</sup> As scientific understanding increases the ability of neuroscience to inform and influence legal decision making will increase.<sup>170</sup>

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## Appendix

### METHODOLOGY

#### *Search Terms*

In order to elicit data which would enable comparisons to be drawn with the findings from the USA, we started with the American search terms used by Nita Farahany in her research:

INHERITED GENETIC! NEURO! BIOLOG! 'FAMILY HISTORY' BRAIN! 'HEAD INJURY' 'EEG' 'fMRI' 'CAT scan' 'PET scan' 'lobe' 'serotonin' 'MAOA' & TI(PEOPLE STATE CORRECTION! WARDEN 'UNITED STATES' 'IN RE' SUPERINTENDENT PENITENTIARY) & da(aft 1/1/2005 & bef 1/1/2010)% (ENTRAPMENT 'BIOLOGICAL DIVERSITY' 'BLOW BRAINS' 'BRAINS OUT' 'BIOL! DAUGHTER' 'BIOL! FATHER' 'BIOL! SISTER' 'BIOL! PARENT' 'BIOL! CHILD' NEURON-TIN)% (VICTIM /3 BRAIN) and not 'shaken baby'.

Some of these terms were clearly more relevant to a search of USA databases than they would be for English databases.<sup>171</sup> Although we share a common language, some terms did not appear often within

<sup>167</sup> See eg *R(on the application of Riley) v Governor of HMP Frankland and another* [2009] EWHC 3598 (Admin); *Whittaker (R on the Application of) v Secretary of State for Justice* [2011] EWHC 2166 (Admin)

<sup>168</sup> *R v Cannings* [2004] EWCA Crim 1 [22].

<sup>169</sup> *R v Mohammed Sharif* [2010] EWCA Crim 1709 [24].

<sup>170</sup> For example in *R v Barry* two experts suggested that though there was no observable brain damage, it might simply be that there was brain damage, but that it was not identifiable using present measurement techniques.

<sup>171</sup> For example, PEOPLE STATE CORRECTION! WARDEN 'UNITED STATES' 'IN RE' SUPERINTENDENT PENITENTIARY.

the English case law databases.<sup>172</sup> For example, the phrase 'inherited genetic' was found only five times when searching the English case law databases for the period 2005–12, whereas the term 'genetic' arose on 384 occasions. Therefore, whilst we were interested in discovering whether defendants were arguing for example that they were less culpable because of an inherited genetic condition that affected their cognitive faculties, we adopted the search term 'genetic' rather than 'inherited genetic' to avoid mistakenly excluding some cases which might be of interest. Similarly, we were unsure precisely how English<sup>173</sup> courts would refer to scan evidence and chose therefore to search using the full names of scans as well as their initials.<sup>174</sup> Following discussions with neuroscientists as to the sort of scan evidence which might be presented in court, we added 'SPECT scan' both in short and long form to our search terms.<sup>175</sup> We were aware of a number of high-profile cases where neuroscientific evidence had been used by defendants to challenge evidence as to the cause of death in so-called 'shaken baby' cases, and we therefore did not exclude these cases from our search terms. After a number of practice runs, we settled on the following search terms as the best means to identify cases which might possibly be relevant:

'genetic!' or neuro! or biolog! or 'family history' or brain! or 'head injury' or eeg or Electroencephalography or fmri or 'Functional magnetic resonance imaging' or 'Magnetic resonance imaging' or mri or 'cat scan' or 'Computed tomography' or 'ct scan' or 'pet scan' or 'Positron emission tomography' or 'SPECT scan' or 'single photon emission computed tomography' or serotonin or lobe or MAOA or 'Monoamine oxidase A' or 'Monoamine oxidase gene'.<sup>176</sup>

Having decided on our search terms, we then produced coding sheets for completion by the research team.

### *Coding Sheet*

#### Variables

- Initials of coder
- Case name
- Citation (neutral citation first if available)
- Court
  - ^ High Court
  - ^ Court of Appeal (Criminal Division)
  - ^ House of Lords
  - ^ Supreme Court
- Date of decision in the format: dd/mm/yy (e.g. 25/05/09)
- Criminal case
  - ^ Yes
  - ^ No

<sup>172</sup> There are two main commercial case law databases in England and Wales: Lexis Library and Westlaw UK. The Westlaw database available at our universities proved unable to handle the number of alternatives in our search terms. The analysis has therefore been undertaken using Lexis Library.

<sup>173</sup> In this article, the terms English law and the English courts should be read as referring to the law and courts of England and Wales.

<sup>174</sup> We therefore searched for example for both MRI and for 'Magnetic Resonance Imaging'.

<sup>175</sup> Single photon emission computed tomography.

<sup>176</sup> The use of '!' as in for example 'neuro!' when conducting a search using Lexis Library finds all words with 'neuro' as their stem so will for example identify words such as: neuroscience, neurology, and neuropsychiatric.

- Relevant
  - ^ Yes
  - ^ No
- Hearing type
  - ^ Trial
  - ^ Appeal
- Human Rights issue raised
  - ^ Yes
  - ^ No
- Result
  - ^ Prosecution authorities successful
  - ^ Accused successful
- Type of offense
  - ^ Assault (any)
  - ^ Fraud
  - ^ Manslaughter
  - ^ Multiple (specify)
  - ^ Murder
  - ^ Other (specify)
  - ^ Other sexual offense (excluding rape)
  - ^ Rape
  - ^ Theft (including robbery and burglary)
- Type of issue (where more than one the 'core' issue)
  - ^ Diminished responsibility
  - ^ Evidence / process issue
  - ^ Extradition
  - ^ Fitness to plead
  - ^ Judicial directions
  - ^ Multiple (specify)
  - ^ Other (specify)
  - ^ Sentencing
  - ^ Unsafe conviction
- Who brings neuro evidence
  - ^ D of defendant
  - ^ D of victim
  - ^ D of witness
  - ^ Multiple (specify)
  - ^ Other
  - ^ P of victim
- Cases raises evidential principle
  - ^ Yes
  - ^ No
- Evidence admitted
  - ^ Yes
  - ^ No
- Evidence probative
  - ^ Yes
  - ^ No
- Evidence determinative
  - ^ Yes
  - ^ No

- Search terms appearing in judgment
  - ^ Genetic!
  - ^ Neuro!
  - ^ Biolog!
  - ^ Family history
  - ^ Brain
  - ^ Head injury
  - ^ EEG
  - ^ fMRI
  - ^ MRI
  - ^ Cat scan / ct scan
  - ^ Pet scan
  - ^ Spect scan
  - ^ Serotonin
  - ^ Lobe
  - ^ MAOA
- Comments (note any relevant additional details of all potentially relevant cases, including anything to be identified as needing specifying from earlier questions)
- Checked by

#### *The number of cases*

Over the eight years, there were 5049 case reports identified by the search criteria. There is a danger of reading too much into the above Table A1. As stated in the main body of the article, the reports relate almost exclusively to appeal decisions. However, three further important caveats need to be noted. First, the number of case reports does not equate to the number of appeals. Whilst most cases are only reported once, a significant number are reported by more than one law reporting service; therefore, the same case may be appearing more than once. Conversely, some appeal decisions are decisions on more than one appeal. When a similar issue is arising in several cases at roughly the same time the Court of Appeal particularly will often choose to hear the appeal arguments related to those cases

**Table A1.** Case reports identified by the search criteria.

Year	<i>Number of case reports containing the search terms<sup>a</sup></i>
2005	553
2006	677
2007	618
2008	645
2009	644
2010	628
2011	607
2012	677
<b>Total 2005–12</b>	<b>5049</b>

<sup>a</sup>Cases have been allocated to years according to the date on which judgment was given. A number of cases were reported one or very occasionally more than one year after the judgment date. It is therefore possible that a very few case reports may yet be published for cases decided in 2012 or even earlier.

**Table A2.** Case reports containing the search terms in relevant courts.

Year	<i>Number of case reports<sup>a</sup> containing the search terms in relevant courts<sup>b</sup></i>
2005	166
2006	199
2007	147
2008	211
2009	281
2010	288
2011	238
2012	264
Total 2005–12	1794

<sup>a</sup>As with Table 1, it is therefore possible that more case reports may be published for cases decided in 2012 or even earlier.

<sup>b</sup>High Court, Court of Appeal (Criminal Division), House of Lords, and Supreme Court. The Supreme Court replaced the House of Lords as the highest appellate court in England and Wales in 2009.

together and will give a single judgment in which they will deal with all the cases under consideration. The second caveat is that the above data relates to all reported English cases during the period. Many of those included were not criminal cases. The third important caveat is that the reports identified above are reports in which the search terms appear. This does not mean they are actually cases in which neuroscientific evidence has been presented; let alone that they are criminal cases in which neuroscientific evidence has been presented by those accused of criminal offenses.

Notwithstanding all these caveats it may be noted that the number of case reports has remained fairly unchanged throughout the period. If one excludes the figure for 2005, the annual number has between 607 and 677 each year. This, possibly, might lead to the conclusion that there has been no dramatic rise, or indeed fall, in the use of neuroscientific evidence over the period. However, as stated, drawing conclusions on such evidence is dangerous—the number of case reports does not equate to the number of cases, and the appearance of search terms in case reports does not necessarily indicate the use of neuroscientific evidence in those cases.

Having decided upon the types of cases on which we would focus,<sup>177</sup> we were then able to refine our search to look only at those courts in which such cases might appear. The refined search identified.

As with Appendix Table A1, it would be dangerous to read too much into Appendix Table A2.

The refined search identified more case reports containing the search terms in the period 2009–12 than there were in the preceding four-year period.<sup>178</sup> However, as stated previously case reports do not exactly equate to the number of cases. The presence of search terms within a case report does not necessarily mean that neuroscientific evidence was used in the case or, if it was, that it was used by the party accused or convicted of a criminal offense.

The refined search identified 1794 cases for further examination. This amounted to approximately a third (36.6 per cent) of the cases originally identified<sup>179</sup> as containing the search terms. All these cases were read initially by the research team.<sup>180</sup> In each case, the researchers completed the coding

<sup>177</sup> See ‘determining which cases are criminal’ in the main body of the article.

<sup>178</sup> The average number of case reports per year from 2005 to 2008 was 180.75. The average number of case reports per year from 2009 to 2012 was 267.75. An increase of just over 48 per cent.

<sup>179</sup> See Appendix Table A1.

<sup>180</sup> For details of the research team see footnote 11 in the main article.

sheet. All 1794 cases were then read by the authors to check the initial assessment. A large number of cases were excluded because though the search terms appeared they did not relate to neuroscientific evidence.<sup>181</sup> Other cases were excluded because though neuroscientific evidence was utilized there was no indication that such evidence was being used by someone accused of a criminal offense.

### *Revised Coding Sheet*

After the initial coding assessment several additional lines of coding were added and completed by the authors.

- Year<sup>182</sup>
  - ^ 2005
  - ^ 2006
  - ^ 2007
  - ^ 2008
  - ^ 2009
  - ^ 2010
  - ^ 2011
  - ^ 2012
- Purpose of case<sup>183</sup>
  - ^ Appeal against conviction
  - ^ Appeal against conviction and sentence
  - ^ Appeal against sentence
  - ^ Other (specify)
  - ^ Resisting appeal against allegedly unduly lenient sentence
  - ^ Resisting extradition
- Result<sup>184</sup>
  - ^ Not successful
  - ^ Successful largely because of neuroscientific evidence
  - ^ Partially successful largely because of the neuroscientific evidence
  - ^ Successful for a range of reasons including the neuroscientific evidence
  - ^ Partially successful for a range of reasons including the neuroscientific evidence
  - ^ Successful for other reasons not linked to the neuroscientific evidence
  - ^ Partially successful for other reasons not linked to the neuroscientific evidence
- Comment<sup>185</sup>

All cases in which neuroscientific evidence was arguably used by those accused of criminal offenses were coded against the additional criteria, and final decisions were made by the authors working together as to whether each case met or did not meet the criteria for inclusion. As discussed in the main body of the article, it was concluded that 204 cases met the criteria for inclusion.

<sup>181</sup> Take for example the search term 'brain'. This regularly appeared in court reports. However, it often was irrelevant to our investigation revealing for example that the defendant was the 'brains' behind the operation, the events took place in 'Braintree' or that counsel was called Miss 'Brain'.

<sup>182</sup> This line was added to ease analysis by year.

<sup>183</sup> This enabled the cases to be categorized simply on the basis of the five main types of case under consideration.

<sup>184</sup> This enabled a more nuanced assessment of success than that provided by the initial coding line which had simply categorized on an either / or basis. The analysis enabled the data to be extracted which is set out in Tables 3 and 4 of the main article.

<sup>185</sup> A further comment line enabled the authors to comment on cases, whilst preserving as a separate entry the initial comments of the original case reviewer.