The Implications of Neuroscience on Sentencing

At a seminar I conducted on 11 December 2018 at the Institute for Judicial and Legal Studies, my concluding remark was that from a legal perspective, progress made in neuroscience could thus far be traced to three milestones: first, neuroscience has presented many jurisdictions across the world with novel methods of collecting evidence; second, it has provided defendants with the possibility of raising new defences that could affect either the verdict or the sentence, or both. Third, it has rendered the notion of a jail sentence as being redundant and even oppressive, since "punishment" in the aftermath of crime is being reconsidered to be rehabilitative rather than retributory. I added that these practices could be expected to seep into our jurisdiction in the next few years, or at most, in the next decade to come.

i Preliminary considerations

In the Q & A session that followed, one of the attendees, a psychiatrist, spoke about the developmental process of the prefrontal cortex that she said, continued until the age of 25—this implied that decision-making capacities were not fully developed until that time.[1] More poignantly, a practising lawyer, reflecting the views of many in attendance, said that evidence from neuroscience was unnecessary—we had many other means to come up with defences for our clients, he added. Another point of contention for him was that research in neuroscience tended to negate the fact that we are all free willing, autonomous individuals who do exercise unfettered *choice* in the decisions we make.

His reaction was not surprising. It is not uncommon that such evolutionary insights of the law are dismissed by mainstream professors and practitioners for being a passing fad.[2] Indisputably, he was coming from the perspective that in preparing a defence, there was a wealth of resources at the disposal of any lawyer, and judging from the data I had presented that day, we in Mauritius were very far from welcoming a new (and especially, unsettled) means of gathering evidence.

It is noteworthy however that in the UK, David Omerod who headed the Law Commission's review on the fitness to plead, said that "Modern criminal law should be informed by modern science and by modern psychiatric thinking".[3] Moreover in the US, the UK, Italy, India and a few

[1] For further details, see Chris Willmott, *Biological Determinism, Free Will and Moral Responsibility*, Springer Briefs in Ethics (Switzerland: Springer International Publishing 2016), 61.
[2] See E. A. O'Hara, "How Neuroscience Might Advance the Law," *Philos Trans R Soc Lond B Biol Sci* 359, no. 1451 (2004): 1677.
[3] Willmott, 71-72.

other countries, "neurolaw" has already caught on.[4] Proof of the growing trend of neurolaw is also corroborated by the following: in a few universities, "Neuroscience and Law" is also offered as a subject in the LL.B programme.[5] Furthermore data shows that between 2005-2012, 1500 cases were identified where evidence from neuroscience or behavioural genetics was used by the defendant to aver that the he/she was under some form of automatism, or was simply predisposed to being aggressive and impulsive. (But it is to be noted that in most cases, such arguments did not result in acquittals or decreased sentences).[6] Brain imaging scans, drawn from more modern equipment such as EEGs and fMRIs have been admitted in courts to assess the veracity of a statement by a defendant, or even to reveal abnormalities that may have accounted for criminal behaviour.

But let us return to the concerns of our lawyer. The implications of neuroscience are troubling to anyone involved with the practice of law, and perhaps even to any philosopher or person who had embraced the implications of evolution for us human beings. In the first case, it undermines free will, casting suspicion on the legal fiction that individuals are entirely responsible for their actions and decisions, justifying the imposition of punishment in the aftermath. In the second case, the philosophically minded individual would find it hard to accept that we are merely automats in the end, merely "a pack of neurons"[7] with no true hold over our actions and decisions. But anyone with a passion or at least an understanding of Immanuel Kant's works would know that what neuroscience is trying to tell us is contrary to what we know about human beings.[8] For Kant, what makes us human is our ability for spontaneity, the unpredictability in the way we do things, that account for the fact that social scientists can only come up with approximations about our behaviour, because we all have in us that ability to be impulsive, spontaneous, and to defy any all-encompassing or Grand Explanatory Theory made about how we will decide on our next move. It should not be surprising then that Stephen J. Morse avers that the professional lawyer today would be a compatibilist, believing in the influence of both free will and deterministic factors over a person's actions.[9]

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[4] J. Sherrod Taylor was the first to use this term, to describe the expert testimony proferred by neurologists to provide evidence of brain damage in personal injury trials.

[5] See for example, the law programme (LL.B) offered by University of Edinburgh, that includes "Law and Neuroscience" as a subject: http://www.drps.ed.ac.uk/14-15/dpt/cxlaws10176.htm, or The Open University Law School (UK): http://law-school.open.ac.uk/research/clusters/law-and-neuroscience, or Maastricht University (Netherlands): https://www.maastrichtuniversity.nl/meta/324733/law-and-neurosciences , or still Harvard Law School: https://hls.harvard.edu/academics/curriculum/catalog/default.aspx?o=67993.

[6] Elizabeth Shaw, "Neuroscience in Justice," *Scottish Justice Matters* 2, no. 2 (June 2014): 19.

[7] The Nobel Prize winner, Francis Crick famously stated: The Astonishing Hypothesis is that 'You', your joys and your sorrows, your memories and your ambitions, your sense of identity and free will, are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules.
As Lewis Carroll's Alice might have phrased it: 'You're nothing but a pack of neurons.'

[8] See also Stephen J Morse, "Inevitable Mens Rea," *Harvard Journal of Law and Public Policy* 51, no. 2 (2003): 63.

[9] See Nicole A Vincent, ed. *Neuroscience and Legal Responsibility* Oxford Series in Neuroscience, Law, and Philosophy (New York: Oxford University Press, 2013).

One of the earliest cases cited by experts in the field of neuroscience introducing the subject, is that of Phineas Gage. In 1848, a railway worker in New England, with a soft, compassionate and amiable personality, who through an accident during the course of performing his duties at work, suffered a rupture of his skull when a metre-long tamping iron rod shot through his cheek and and came out of the top of his skull. Surprisingly, he survived the incident but his behaviour changed overnight. He became rude, short-tempered, and anti-social, to the point that he had to be dismissed from employment.[10] Another oft-quoted case is that of a middle school teacher, a 40 year-old man who began to show paedophilic tendencies towards his step-daughter. A tumour was discovered at the base of his skull, which accounted for the alteration in his behaviour. Interestingly, he began to show the same regressive behaviour ten months later, and not surprisingly, when a brain scan was done, it was found that the tumour had returned.[11] These two cases are illustrative of how changes within the brain can alter behaviour. But having said that, it must also be pointed out that out of 40 percent of cases where brain abnormalities are discovered, in only 8 percent of these are there concrete effects on the alteration of one's behaviour. We must also not ignore the fact that there may be cases where defendants could introduce brain images in court as a last resort-defence—arguably the case of Maurizio Gucci could be said to be such a situation, where his ex-wife who had ordered his killing, sought to introduce evidence in court that at the time of the murder, she had a tumour growth in her brain. The court ruled that the evidence was not conclusive, and the issues were whether i. the tumour actually existed at the time the order for the murder was made (this was difficult to establish as the scan was done many years after the time she had ordered the killing), and ii. there was a causal link between the existence of the tumour and the defendant's conduct, or that they were independent of each other.

To what extent have courts been open to the admission of evidence from neuroscience? In terms of detecting lies being told by the defendant, the courts have not gone very far. A valuable study of various jurisdictions reveals that such evidence is scarcely used.[12] Instead, at most, those writing authoritatively about these countries, have focused on the *possibility* of admitting such evidence in the future, or contemplated the possibility of devising a code of ethics that would regulate the admission of such evidence. It is a fact that when it comes to the determination of the verdict, courts have avoided the use of evidence from neuroscience; at most, it has been used to mitigate sentences.

ii. Philosophical implications

[10] Steve Twomey, "Phineas Gage: Neuroscience's Most Famous Patient," *Smithsonian*January 2010., see also Willmott, 35-36.
[11] Shaw, 19. See also Willmott, 36.
[12] See Tade Matthias Spranger, ed. *International Neurolaw - a Comparative Analysis* (Berlin Heidelberg: Springer-Verlag, 2012).

In terms of philosophical implications, the existence of neuroscientific evidence shows that we now have a better system in hand to understand crime and criminals. No longer need we subject ourselves to the approximate language of philosophy to understand the psychology of violence, the thought process, or even what constitutes intention. In fact all these philosophical musings about the nature of action, and the causal relationships involving it, are now being relegated to the reductive term of "folk psychology".[13] With neuroscience, which is a "hard science" (although not a very precise one as yet), it has become easier for example to understand in scientific terms, why an adolescent ought not be punished harshly for his/her crimes—it is said that at that age, the prefrontal cortex is undeveloped, making him/her impulsive, easily influenceable, basically incapable of making up his/her own mind when making choices. This was in fact the argument used in the 2005 US case of *Roper v Simmons* to prevent the court from imposing the death penalty on 16-17 year olds. [14]

The above also implies that if the prefrontal cortex of adolescents is still undeveloped, they may still have the capacity to shed the habits that led to criminal behaviour. This would mean that with this understanding, courts may approach punishment and sentencing with rehabilitative, rather than retributive objectives in mind. In fact, the entire concept of punishment through incarceration or imprisonment, with the progress made in neuroscience, may be expectedly discarded once and for all, and replaced with measures of neurointervention. "Punishment" may therefore be imposed for the sole purpose of rehabilitation. This would make a lot of sense to countries like the US and UK where there is constant talk about how burdensome it is to the State and to taxpayers to keep a person in jail all this life. In other words, crime and evildoing—albeit two diferent concepts if analysed deeply—may be looked upon not as a reason for punishing the individual, as much as a signal of his lack of health, of a possible abnormality in his brain function, that may have accounted for the behaviour.[15]

On one end of the spectrum is free will, and on the other end, determinism (or "hard determinism"). The first, based on the principle of libertarianism, implies that the thoughts, intentions and resulting behaviour of an individual are wholly controlled by him, justifying the imposition of legal and individual responsibility on him. This is also the approach of religion and psychiatry where the individual is wholly accountable for his actions.[16] Determinism on the other hand implies that the individual is subjected to external forces governing his

[13] Morse, 52. See also Vincent, 31.

[14] The Supreme Court barred capital punishment of juveniles who killed while they were under the age of 18. Lack of complete mycelination of the corticol neurons in 16-17 year olds was used in court to allege that murderers of that age were insufficiently responsible to deserve capital punishment. See Roper v Simmons 543 US 551 (2005), and also Graham v Florida 560 US 48 (2010) and Miller v Alabama 567 US (2012).

[15] J. Greene and J. Cohen, "For the Law Neuroscience Changes Everything and Nothing," *The Royal Society* 359 (2004).

[16] See Philip Zimbardo, *The Lucifer Effect* (USA: Random House, 2007)., and Michel Foucault, *Abnormal* (New York: Picador, 2003).

behaviour. It could take the form of environmental determinism or biological determinism (which also encompasses neurological changes or abnormalities discussed in this paper).[17] But there is a conciliatory theory—compatibilism (or "soft determinism")—which asserts the influence of both, individual and external factors over behaviour.[18] All in all, it is trite that the legal system would be redundant if lawyers and jurists were to acknowledge that determinism accounts for all human behaviour. Arguably one has to make do with the "legal fiction" that an individual is entire responsible for his actions and decisions, for it is the only measure to give legitimacy to the legal system in operation. On the other hand, a belief in radical libertarianism, or in the operation of an individual's free will in the decisions and choices he/she makes, so that he/she is entirely culpable for any misdemeanour, would seem very harsh to social justice advocates[19] who are familiar with the correlation between socio-economic factors and criminal behaviour.

In support of neuroscientific findings, according to the theory of epiphenomenalism, our actions are not really caused by conscious effort, but by unconscious ones. This has been established by the fact that the brain has been seen to launch in active mode before an intention is even made.[20] It would certainly imply that our legal responsibility is not entirely ours.[21] But there are many who oppose this view being taken of personal responsibility. One such person is Stephen J. Morse who ridicules the overreliance on neurological explanations to account for criminal behaviour—he coined the term "Brain Overclaim Syndrome" to denote it, and defined it as "[making] claims about the implications of neuroscience for criminal responsibility that cannot be conceptually or empirically sustained".[22]

Recently, Flanagan and Caruso came up with the term "Neuroexistentialism" to denote the angst suffered by us upon realising that research in neuroscience indicates that we are not as autonomous as we thought we were.[23] It is a reversal of the belief in our endless capacity for reason, and hence self-control, emulated by the peak of the Enlightenment. Instead, with the results of the research done in neuroscience, we are starting to realise that Darwin was right after all: we are more animal than we think, and perhaps entirely so, and

[17] Proponents of determinism or behaviourism were more famously, B.F Skinner and J. B Watson. For more details, see Erich Fromm, *The Anatomy of Human Destructiveness* (Holt, Rinehart and Winston 1973).
[18] For more details, see Willmott, 3-8.
[19] Stephen J. Morse interpreted Judge Bazelon's premises further, saying that the social justice advocate "is willing to believe that large numbers of persons have little choice regarding their behaviour and should not be held responsible for it" while the law-and-order advocate believes that "most persons do choose their behaviour and should be held accountable for it." See Stephen J Morse, "The Twilight of Welfare Criminology," *Southern California Law Review* 49 (1976): 18.
[20] For more details on this finding, see B. Libet et al., "Time of Conscious Intent to Act in Relation to Onset of Cerebral Activity (Readiness-Potential)," *Brain*1983. Also, "Libet's exceptionally creative and careful studies demonstrate that measurable brain activity associated with intentional actions occurs about 550 milliseconds before the subject acts and for about 350-400 milliseconds before the subject is consciously aware of the intention to act." See Morse, "Inevitable Mens Rea," 58.
[21] Shaw, 20.
[22] Stephen J Morse, "Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note," *Ohio State Journal of Criminal Law* 3 (2006): 397.
[23] Owen Flanagan and Gregg D. Caruso, "Neuroexistentialism," *The Philosophers' Magazine*06 November 2018.

therefore lacking in control over our actions and the choices we make. This thought about the lack of self-control we suffer from, is indubitably depressing, and one that we are forced to reconcile ourselves with.[24] With it, comes the realisation that instilling changes in our lives is strictly about physiologically restructuring neurological pathways—a feat which may seem harder to accomplish than merely setting goals for oneself, or changing one's habits, as preached by the majority of motivating and self-help material. Therefore as Flanagan and Caruso aver, "introspection is a poor instrument for revealing how the mind works". This dire thought then reduces that search for meaning many of us have embarked on, and the resulting answers or partial answers we have found, to elaborate or sophisticated pieces of rationalisms that have suited our needs, fulfilled the criterion of making us *feel* they are right, when in truth as Hannah Arendt once said, finding truth and finding meaning are not always coterminous.[25]

iii. Brain imaging used in courts to raise the defence of insanity

A few cases have appeared before the courts where the defendant has resorted to brain images to raise insanity as a defence. This strategy has however been unsuccessful. In *People v Goldstein*[26] for example, the defendant had pushed Kendra Webdale under a subway train in an unprovoked assault. The PET (Positron Emission Tomography) scan that was produced in court showed decreased level of activity in the frontal lobe area, but the court refused to recognise the causal link between this and the legal definition of insanity. Thus the defence was not substantiated. In another case, *United States v Gigante*,[27] a similar test was conducted in order to raise the defence of insanity, but the court averred that the conditions in which the test had been conducted were less than perfect. The issue was that the control group in question had not been treated with the same psychotropic medicines as the defendant. A similar decision was made in the case of *People v Weinstein*[28] where the accused who had no previous history of violent behaviour had strangled his wife, thrown her out of the window and made it look like a suicide. A MRI (Magnetic Resonance Imaging) scan revealed the existence of an arachnoid cyst and a PET scan later confirmed that it had an impact in a region where the accused was then metabolising less glucose. The court acknowledged that the cyst could have such an effect but based on the literature, refused to acknowledge the causal link between the abnormality and the defendant's violent behaviour. In *California v Carrizalez*,[29] where the case involved gang-related activity, a PET scan was introduced so as to establish a causal link between a bullet that had been lodged before the incident in the

[24] For more details on the substance of these arguments, see Owen Flanagan and Gregg D. Caruso, eds., *Neuroexsitentialism - Meaning, Morals, and Purpose in the Age of Neuroscience* (United Kingdom: Oxford University Press, 2018).
[25] Hannah Arendt, *The Life of the Mind* (New York Harcourt Brace & Co, 1978).
[26] People v Goldstein (2001)14 AD3d 32.
[27] United States v Gigante, 982 F. Supp. 140 (E.D.N.Y. 1997).
28 People v Weinstein 591 N.Y.S.2d 715 (N.Y. Sup. Ct. 1992).
[29] California v Carrizalez (2011), No. VCF 169926C

defendant's brain, and his actions in the aftermath. Once again, the evidence was deemed inconclusive to exonerate the defendant, but it is worth nothing that it had an impact on the mitigation of the sentence. Instead of the death penalty, the defendant was given a life sentence. However note the opposite stance taken in the case of *United States v Montgomery*[30] where the court refused to allow the evidence from the PET scan to have an influence even at the sentencing stage: here the defendant tricked a pregnant victim she had met at a dog show into meeting her, and thereupon murdered her, and kidnapped her baby which she removed through caesarian section. The defence sought to prove through the admission of evidence that the defendant suffered from anomalies in regions of her brain that controlled emotions. The court rejected this evidence averring that this practice had no precedent.

A case that was decided differently however was the US case of *State v Grady Nelson*[31] where the court allowed the admission of an EEG scan. A neuroscientist testified in court that the scan showed abnormal activity in the left frontal lobe of Nelson's (the accused) brain, a region important in the control of behaviour. Nelson had brutally murdered his wife Angelina Martinez, stabbing her sixty times and slashing her throat. Although the evidence was deemed to be unclear and untrustworthy by the prosecution, the presiding judge declared: "The methodologies are sound, the techniques are sound, the science is sound." The jury decided on a verdict and a sentence based on this, and later on, at least two of them declared that they had definitely been influenced by the expert opinion of the neuroscientist in deciding the matter.[32]

It can safely be said that in the context of adducing evidence to show abnormalities in brain function that account for criminal behaviour, the courts have generally been hesitant to establish a causal link.[33]

iv. Lie Detection through Neuroscience

In a 2008 Indian case, the defendant who was accused of poisoning his ex-fiancée was willingly subjected to a brain scan using the method of Brain Electrical Oscillation Signature (BEOS). The scans revealed that he had experiential knowledge of the crime, so that at first instance, he was convicted of the murder. However on appeal, the court declared that the evidence was inadmissible, as its quality was deemed to be questionable.

In the US case of *United States v Semrau,*[34] the court similarly decided against the admission of evidence collected through the fMRI brain

[30] United States v Montgomery 635 F.3d 1074 (8th Cir. 2011).
[31] Grady v. Nelson, Civil Action No. 12-cv-03004-RM-KMT (D. Colo. Sep. 29, 2014)
[32] For more details on these cases, see Willmott.
[33] J. Wright, "My Brain Made Me Pull the Trigger: Neuroscience-Based Defenses Are Flooding the Courtroom," *Scientific American Mind* 25, no. 3 (2014).

scans, as the judge said that the technology was unproven in the "real world" as opposed to laboratory conditions. In this case the defendant had been made to reply to a series of questions about his guilt with regard to the overcharging of medical and psychiatric bills for services he had rendered. He passed the first round of tests, failed the second, and passed the third. The incongruence of the second set was justified by the fact that the defendant was probably fatigued because he had taken the tests back to back.

It must however be pointed out that the means employed to detect lies are still not entirely accurate. Evidence of more than the average brain activity in response to say a stolen object, which to observers may signal a lie involving it, could also simply mean that the subject under study associates more memories or textuality, and hence emotions to the object in question.[35] In other words, other processes can lead to similar patterns in terms of brain responses.

v. The Foreseeable Future of Neurolaw

Moving on from the trial stage, findings in neuroscience can also be applied in the case of rehabilitating offenders. This new subarea is called *neurointervention*, and has become an important focus of countries such as the US and the UK where the costs of keeping people in jail has become a big burden on the public purse. Thus in the UK it is said that it costs £40,000 per annum to keep an individual in jail.[36] A basic but salient question however emerges: to what extent for example do neurointerventions interfere with free will?[37]

Six areas can be identified where biological neurointerventions are already being used, or will be used in the near future. These are: pharmaceutical interventions intended to suppress libido, treat substance abuse, or attention deficit-hyperactivity disorder (ADHD), or modulate serotonin activity; nutritional interventions; and electrical and magnetic brain stimulations.[38] The obvious ethical question on this subject is whether consent is necessary for neurointervention, especially in facing the controversy that consent is not required when incarcerating an individual. (It may come as a surprise to those who have never considered it, but even the administration of lethal injection can be deemed to be a form of biological intervention for the prevention of crime.)[39]

Another area often mentioned by academics writing on neurolaw, is the use of neuroscience in screening judges and jurors for the biases they

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[34] United States v Semrau 693 F.3d 510 (6th Cir. 2012)
[35] World Science Festival, "Brains on Trial: Neuroscience and Law," (YouTube, 14 October 2014).
[36] V. Abedowale, "Diversion Not Detention, Public Policy Research " *Public Policy Research* 17, no. 2 (2010): 73.
[37] Elizabeth Shaw, "Direct Brain Interventions and Responsibility Enhancement " *Criminal Law and Philosophy* 8, no. 1 (2014).
[38] David Birks and Thomas Douglas, eds., *Treatment for Crime: Philosophical Essays on Neurointerventions in Criminal Justice*, Engaging Philosophy (UK: Oxford University Press, 2018), 45.
[39] Ibid., 47.

possess, which may unfairly influence the outcome of cases. Neuroscience it is felt, could develop a reliable method of differentiating deception from self-deception, so that judges and jurors who are (erroneously) convinced of their impartiality before the trial, may thus be identified and disqualified from presiding over the case.[40]

vi. Challenges in studying the brain

Many challenges have to be faced for a mastery in understanding how the brain functions. One is that the brain is caged inside a hard cranium, so that studying it in depth can often be possible only when the subject of the study is dead. And being dead poses another set of challenges.[41] Second, many conclusions to the studies conducted so far are still probabilistic, and not based on certainties.[42] Third, various limitations exist as to the types of imaging techniques used. Most techniques so far have exposed subjects to potentially harmful ionising radition, while newer methods such as fMRI, although non-invasive, could be unsuitable for those who have implants or are claustrophobic. Fourth, scanning brains do not come cheap. For an image obtained from fMRI, it costs 500 dollars per hour for 2-4 sessions. Fifth, it is apparent that some of the images that are coloured vividly to show blood flow movements may be received too impressionably by jurors analysing such data. In doing so, this may exert what is known as the "Christmas tree effect" on them, unduly influencing them into deciding a matter perhaps too leniently. In effect to avoid undue influence on the jurors, in *People v Cruz*[43] the court asked for a substitution of the brain images with verbal explanations. Sixth, comparisons are normally made between the images obtained from groups of individuals and the one particular individual under srcutiny. This is known as the G2i inference. Often this method may be flawed as it may either overlook or exaggerate the importance of the individual's peculiarities. One ought to remember that differences in brain structure in terms of its shape and cellular neuroarchitecture, are normal and expected and ought not be construed as abnormalities.[44]

vii. Final remarks

The debate of what influences a person in his thoughts, actions, and behaviour has moved from the classic Nature versus Nurture one to something more complex, illustrated as Gene x Environment.[45]

Before ending this paper it is important to point out that other evidence has been put forward to account for the deterministic aspect of our

[40] O'Hara, 1682.
[41] Willmott, 20.
[42] For more details, see Kathleen Taylor, *The Brain Supremacy - Notes from the Frontiers of Neuroscience* (United Kingdom: Oxford University Press, 2012).
[43] People v Cruz 643 N.E.2d 636 (1994)
[44] Willmott, 72.
[45] Ibid., 26.

behaviour, negating or if not that, at least reducing the impact of the operation of free will. This is through genetic research. Recent findings involving the MAOA gene, reveal that there are two permutations (or "alleles") of it—MAOA-H and MAOA-L. The latter, which is low in reactivity, may not on its own result in the display of adverse behaviour. If coupled with a history of childhood maltreatment or abuse, it may then account for aggressive (and criminal) behaviour where the individual is expected to act disproportionately to a trigger.[46] In a well-known US case,[47] the judge reduced the charge, and not just the sentence from first degree murder to voluntary manslaughter based on the adducement of this gene-related evidence in court.

So what are the risks that lawyers run if they ignore evidence proffered by their clients regarding genetic predispositions or neurological abnormalities? The answer is that there are cases where clients have filed cases against their lawyers for "ineffective assistance of counsel". Thus Willmott recounts that between June 2007 and July 2011, out of a total of 33 cases involving behavioural genetics evidence, in 26 of these, claims of this nature were brought before courts.[48]

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[46] Ibid., 29-30. It would be important to consider the Italian case of Abdelmalek Bayout, where evidence of his MAOA-L gene was taken into consideration to reduce his sentence, although this was done without the presence of any history of childhood abuse or maltreament. See ibid., 48.

[47] State of Tennessee v. Davis Bradley Waldroup, Jr (2011) No. E2010-01906-CCA-R3-CD - Filed October 20, 2011

[48] Ibid., 46.

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