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LACK OF FREE WILL DUE TO GENETIC FACTORS AS A MITIGATING FACTOR IN SENTENCING

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I INTRODUCTION

In September 2009 a man convicted of murder in an Italian court was given a reduction of sentence on the basis that his genetic makeup made him more likely to commit violent acts. The idea of a genetic link to crime is not new, in fact it can be seen in the writings of Plato and has been argued numerous times in US courts, but this case is thought to be the first time a judge actually accepted such an argument and considered it relevant in sentencing.

Monoamine Oxidase A (MAOA) has been referred to as both the ‘criminal gene’ and the ‘warrior gene’ for the reason that a defect in the gene, resulting in low levels of MAOA being produced, is thought to result in impulsive aggressive conduct. This paper considers recent scientific studies on the effect of an individual having low MAOA, and the applicability of these studies in criminal cases, in particular for sentencing purposes. It will suggest that while the studies demonstrate a link between low MAOA and behaviours that can lead to criminal conduct, there is also enough inconsistencies in the studies to indicate that the effect of low MAOA on behaviour has not yet reached the level of scientific understanding necessary for it to play a part in criminal proceedings.

II EARLY USE OF GENETIC FACTORS IN SENTENCING

The idea that there was a genetic link to crime first appeared in recorded history in the writings of Plato, where the banishment of a man from a Greek city state was justified on the basis that he was the third generation in his family to be found guilty of committing a crime.¹ His status as third generation criminal was considered important evidence against him. While two generations may be regarded as a coincidence, three generations forms a pattern, which will therefore continue in subsequent generations. Banishment meant that no further generations of this criminal family would be born in that city.

In the 1900s the eugenics movement became popular worldwide. Eugenics was the idea that certain characteristics and behaviours could be inherited. Those people with characteristics considered beneficial to society were encouraged to have children to pass on these characteristics. Those with non-beneficial characteristics were to be discouraged from having children. Discouragement often took the form of segregation from society until the individual became naturally infertile, and at its most extreme, resulted in sterilisation of that individual.

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¹ Plato, *Laws* Book IX, 856d.

Eugenics adopted the ‘three occurrences’ idea first seen in Plato. In *Buck v Bell*² a feeble-minded woman was sentenced to be sterilised on the basis that her mother and daughter were also feeble-minded. The paragraph long judgment concluded ‘three generations of imbeciles are enough.’ Eugenecists also considered criminal tendencies as a behaviour which could be inherited. In the most famous example, *Skinner v Oklahoma*,³ the validity of a three strikes eugenics law to sterilise a man who had committed three, minor, criminal offences was considered. The extreme eugenics actions of the Nazis in World War II resulted in eugenics being discredited as a science, and its decline in support. The idea of a genetic link to crime, however, has never entirely faded.

III THE “CRIMINAL GENE” IN MODERN SCIENCE

In 1965 an article suggested that there was a link between XYY Syndrome and criminal conduct.⁴ XYY Syndrome, which results in a male receiving an extra Y chromosome, is thought to be present in 1 in 1000 males. The article reported a study in which 197 men in a maximum security prison were tested. The results showed that 8 men had XYY Syndrome, a higher ratio than would have been expected to occur outside the prison environment. It was argued that aggression was a behavioural characteristic of XYY Syndrome, and therefore it could be considered a ‘criminal gene’. Studies over subsequent years, however, cast doubt on these findings. One study found only 2 in 208 tested had XYY syndrome, and other studies failed to replicate the results of the 1965 study.⁵

The next report of a ‘criminal gene’ occurred in 1993 when Han Brunner published a study of a Dutch family.⁶ He had been approached by members of this family, who reported that male members had a history of aggressive and criminal behaviour (including impulsive aggression, arson, and attempted rape). On performing urine analysis on 5 male members and 3 female members, Brunner found that the male members had a mutation in the Monoamine Oxidase A (MAOA) structural gene, and concluded that ‘isolated complete MAOA deficiency in this family is associated with a recognisable behavioural phenotype that includes disturbed regulation of impulsive aggression.’⁷ MAOA was immediately referred to as the ‘criminal gene’ by the media, even though later studies showed that the mutation in the Dutch family was one that was unique to their family. A complete MAOA deficiency has never been found since.

A The Monoamine Oxidase A Gene

The MAOA gene is located on the X chromosome. It encodes the MAOA enzyme, which metabolises serotonin and dopamine, therefore rendering them inactive.⁸ The regulatory

² 274 US 200 (1927).

³ 316 US 535 (1942).

⁴ Patricia Jacobs, Muriel Brunton, Marie Melville et al, ‘Aggressive Behavior, Mental Subnormality, And The XYY Male’ (1965) 208 *Nature* 1351.

⁵ Matthew Jones, ‘Overcoming The Myth Of Free Will In Criminal Law: The True Impact Of The Genetic Revolution’ (2002-2003) 52 *Duke Law Journal* 1031.

⁶ Gary Raumat Hook, ‘Warrior Genes And The Disease Of Being Maori’ (2009) *MAI Review* 2.

⁷ Han Brunner, Willianne Nelen, Xandra Breakefield et al, ‘Abnormal Behavior Associated With A Point Mutation In The Structural Gene For Monoamine Oxidase A’ (1993) 262 *Science* 578.

⁸ Avshalom Caspi, Joseph McClay, Terri Moffitt et al, ‘Role of Genotype in the Cycle of Violence in Maltreated Children’ (2002) 297 *Science* 851, 851.

region of the gene contains a sequence of DNA which is repeated a variable number of times. If the sequence is repeated four times, the individual is referred to as having high MAOA. If the sequence is repeated three times, the individual has low MAOA.⁹ In the case of the Dutch family, the sequence was completely absent, meaning no MAOA was produced.

The effect of the gene only repeating three times is that it will produce up to 10 times less MAOA than the four repeat gene. If less MAOA is produced, less serotonin and dopamine is metabolised, and higher levels of these therefore remain in the system. High levels of serotonin and dopamine are known to lead to various behavioural disorders, particularly aggressive behaviour.¹⁰

The fact that the gene is located on the X chromosome explains why it was only the male members of the family studied by Brunner that were affected. Females have two X chromosomes. If one chromosome had the mutation, this could be compensated for by the other. Males, who only have one X chromosome, could not compensate for this lesser producing MAOA gene.

IV THE CRIMINAL GENE BECOMES THE “WARRIOR GENE”

The term ‘warrior gene’ was first used to describe MAOA in 2004.¹¹ The name derived from the fact that studies had shown that there is a higher proportion of people with low MAOA amongst peoples with a history of warfare. Chinese males, for example, have the highest frequencies of low MAOA, at 77%, followed by Pacific Islanders at 61%. In comparison, the frequency in Caucasian males is only 34%.¹²

In 2006 a New Zealand researcher, Dr Rod Lea, presented a paper at a genetics conference in Australia. He was quoted by the press as stating that there is an ‘overrepresentation of the warrior gene in Maori men’, reporting a study which found the frequency of low MAOA in Maori males to be 56%.¹³ This paper received an immediate negative public response. Scientists argued that the results were not significant enough to be of value¹⁴ and others disagreed with Lea’s reported conclusion that ‘obviously this means they [Maori] are going to be more aggressive and violent.’

In 2009 another scientist, Dr Gary Raumati Hook, undertook a review of Lea’s research.¹⁵ Without replicating the study, he considered the conclusion reached by Lea and himself concluded that despite the fact that ‘Maori, who account for only 14.7% of the New Zealand population, commit more acts of violence than any other group’, this was not due to the existence of a warrior gene.

⁹ Tony Merriman and Vicky Cameron, ‘Risk Taking: Behind The Warrior Gene Story’ (2007) 120(1250) *New Zealand Medical Journal* U2440.

¹⁰ Laura Baker, Serena Bezdjian and Adrian Raine, ‘Behavioural Genetics: The Science Of Anti-Social Behaviour’ (2006) 69-SPG *Law and Contemporary Problems* 7.

¹¹ Ann Gibbons, Tracking The Evolutionary History Of A “Warrior” Gene’ (2004) 304 *Science* 818–9.

¹² Rod Lea and Geoffrey Chambers, ‘Monoamine oxidase, addiction and the ‘warrior gene’ hypothesis’ (2007) 120(1250) *New Zealand Medical Journal* U2441.

¹³ ‘Maori Warrior Gene Linked To Aggression’ 8 August 2006, available online at <http://news.ninemsn.com.au/article.aspx?id=120718> at 29 January 2010.

¹⁴ The 56% frequency was based on a study of only 17 people.

¹⁵ Gary Raumati Hook, “‘Warrior Genes’ And The Disease Of Being Maori” (2009) *MAI Review* 2.

In fairness to Lea, it should be noted that he claimed he had been misquoted and that his reported conclusion had resulted from the study considering a combination of the low MAOA and negative childhood environments.¹⁶ This interaction between genes and environment, which will be discussed further below, was not referred to by Hook.

V THE CRIMINAL GENE ARGUMENT IN THE COURTS

A criminal gene argument has two potential applications in a criminal case. First, it could be used to argue that the appropriate mens rea for a crime did not exist. As an example, murder is defined in s 167 of the New Zealand Crimes Act as being culpable homicide where ‘the offender means to cause the death of the person killed.’ There is an obvious requirement of intention in this offence. This requirement opens the door to an argument that a person did not mean or intend to kill someone, but that their genetic makeup mandated that in the circumstances that had occurred, the person simply had no choice but to act in a particular way. Their genes predetermined their conduct, giving them no room for freedom of choice, and therefore the mens rea requirement could not be established.

The second potential use for a criminal gene argument is as a mitigating factor for the purpose of sentencing. In New Zealand, s 9 Sentencing Act 2002 states relevantly:

(2) In sentencing or otherwise dealing with an offender the court must take into account the following mitigating factors to the extent that they are applicable in the case:

(e) that the offender has, or had at the time the offence was committed, diminished intellectual capacity or understanding;

(4) Nothing in subsection (1) or subsection (2)—

(a) prevents the court from taking into account any other aggravating or mitigating factor that the court thinks fit;

Section 9(2)(e) could potentially be used to argue that the individual had a diminished ability to understand what he was doing. The person was not able to understand the consequences of his actions and decide to act, but was merely genetically programmed or required to act in the way he did. Section 9(4)(a) is phrased in broader language, allowing for a criminal gene argument to be introduced even if it was rejected under s 9(2)(e) on the basis that the person understood what he was doing, but just had little or no self control to stop himself from doing it.

The first potential use of a criminal gene argument, to argue lack of mens rea, is unlikely to be accepted by society in the foreseeable future. It requires acceptance of the idea that our genes determine our behaviour, leaving no room for freedom of choice. The second potential use, however, may be considered more acceptable and believable. There are already precedents in criminal cases where it is argued that a person at a given time had a diminished ability to choose whether or not to act in a particular way. An argument that an individual had the low MAOA gene and was therefore more likely to engage in criminal conduct, and less able to prevent himself from doing so, may be relevant in determining an appropriate sentence.

¹⁶ Rod Lea and Geoffrey Chambers, ‘Monoamine oxidase, addiction and the ‘warrior gene’ hypothesis’ (2007) 120(1250) *New Zealand Medical Journal* U2441.

A United States Cases

In the US there have been two major cases in which a person convicted of murder has used a genetic argument in an attempt to mitigate the sentence of death imposed.

Shortly after the Brunner study was published, the presence of a criminal gene argument appeared in the US courts. Stephen Mobley had been convicted of the murder of a manager of a Domino's Pizza store during an armed robbery and sentenced to death. At trial, his lawyers requested funding to explore the possibility that his behavioural history was the result of a genetic condition, specifically 'a deficiency of enzymatic activity for monoamine oxidase A', and was therefore beyond his control. There was evidence presented by Mobley's aunt of familial history over several generations of violent behaviour, alcoholism and abuse to support a possible genetic link to Mobley's behaviour.

Funding for public testing was rejected by the Georgia Supreme Court, on the basis that 'the theory of genetic connection... is not at a level of scientific acceptance that would justify its admission' and that it could not be shown that such a stage would ever be reached.¹⁷ In 1995, Mobley's new attorney claimed that trial counsel had been inadequate, particularly for attempting the 'unorthodox mitigating defence' of genetics without the use of an expert in genetics. The claim succeeded, but was overturned in 1997 by the Georgia Supreme Court, which considered that counsel had been adequate.¹⁸ Although a genetic defence was unorthodox, there were no other mitigating factors for counsel to argue,¹⁹ and the lack of an expert was due to the rejection of the funding application. While genetic evidence was not permitted in this case, the decision did leave open the possibility of such an argument being introduced in subsequent cases, should the science behind it develop further.

The next case to consider a genetic link to crime occurred shortly after Mobley. Jeffrey Landrigan was sentenced to death after being found guilty of murder, committed following an escape from prison where he was serving time for another murder.²⁰ Landrigan argued on appeal that counsel had been ineffective for failing to present mitigating evidence of a genetic link to crime. This was initially rejected as being 'rather exotic', but accepted by the appellant panel, which remanded the case for an evidentiary hearing.²¹

While the appellant panel considered that genetic evidence might be relevant for mitigation purposes, it warned that if accepted, genetic evidence could also be applied to Landrigan's detriment. The panel considered that:²²

[i]t is highly doubtful that the sentencing [court] would have been moved by the information that Landrigan was a remorseless violent killer because he was genetically programmed to be violent, as shown by the fact that he comes from a family of violent people, who are killers also.

There have been subsequent attempts to argue a genetic link to crime following Landrigan. One academic reported 27 cases in the US involving such an argument between 1994 and

¹⁷ *Mobley v State* 455 SE 2d 61, 65 (Ga 1995).

¹⁸ *Turpin v Mobley* 502 SE 2d 428 (Ga 1998).

¹⁹ Mobley was white, the son of a multimillionaire, and had denied suffering any abuse or neglect as a child.

²⁰ *State v Landrigan* 859 P 2d 111 (Ariz 1993).

²¹ *Landrigan v Schriro* 441 F 3d 638 (9th Cir 2006) (en banc).

²² *Landrigan v Stewart, Landrigan II* 272 F 3d 1221, 1228.

2004, most of which relied on descriptions of family histories of mental illness or alcoholism,²³ and another academic knows of over 200 in the US from 2004-2009.²⁴

The problem in most of these cases is the lack of scientific authority for a genetic argument. In the last decade, however, more scientific studies are emerging on MAOA, which may provide the authority needed for a genetic argument to be considered seriously.

B *The Recent Italian Case*

In 2007 Abdelmalek Bayout stabbed and killed a man who had insulted him because of the heavy eye makeup he wore for religious reasons.²⁵ He was originally sentenced to 9 years 2 months, a reduction of approximately 3 years from the standard sentence due to evidence of mental illness. The sentence was appealed, and in May 2009 the appeal court in Trieste asked for further psychiatric reports. One of these reports revealed that Bayout had the three repeat MAOA gene resulting in low MAOA. The judge found this evidence ‘particularly compelling’ and accepted that this ‘would make him particularly aggressive in stressful situations.’ Bayout’s sentence was therefore reduced by one year.

The decision was not considered significant in Trieste, only being reported in the newspaper a month after the decision, but attracted immediate attention from newspapers, academics and scientists. It appears to be the first example of a genetic argument being successful in courts, and will probably lead to its increased use.

VI SCIENTIFIC STUDIES ON MAOA

Following the Brunner study of the Dutch family, a series of studies attempted to examine the link between MAOA and criminal conduct. Some of these will be discussed below.

A *The Dunedin Study*

The first major study of the effects of MAOA was published in 2002.²⁶ The study followed 1037 children born in Dunedin, New Zealand, in a particular year. The group of children, who were 52% male, were then assessed every few years.²⁷ The main purpose of the study was to look at the relationship between childhood maltreatment and later criminal offending. It was already known that while childhood maltreatment increases a person’s chance of engaging in criminal conduct by 50%, most maltreated children do not engage in criminal conduct. The study was looking to find an explanation for this.

²³ Deborah Denno, ‘Revisiting The Link Between Genetics And Crime’ (2006) 69-SPG *Law and Contemporary Problems* 209, 220.

²⁴ Referred to in Emiliano Feresin, ‘Lighter Sentence For Murderer With “Bad Genes”’ 30 October 2009 reported online at <<http://www.nature.com/news/2009/091030/full/news.2009.1050.html>> at 28 January 2010. The article also refers to 20 cases in the UK in past 5 years.

²⁵ Emiliano Feresin, ‘Lighter Sentence For Murderer With “Bad Genes”’ 30 October 2009 reported online at <<http://www.nature.com/news/2009/091030/full/news.2009.1050.html>> at 28 January 2010.

²⁶ Avshalom Caspi, Joseph McClay, Terri Moffitt et al, ‘Role of Genotype in the Cycle of Violence in Maltreated Children’ (2002) 297 *Science* 851.

²⁷ By the time children were 26, 96% were still being assessed.

The study showed that there was little difference between those with low MAOA and high MAOA in terms of tendency towards criminal conduct where there was no childhood maltreatment. In fact, those with high MAOA were more likely to commit crime than those with low MAOA in this situation. Where childhood maltreatment was present, however, this position changed. In considering cases of probable maltreatment, individuals with low MAOA were more likely to commit crime. In cases of severe maltreatment, those with low MAOA were significantly more likely to commit crime.

The study found that while only 12% of the cohort had low MAOA, they accounted for 44% of the cohort's violent convictions. 85% of those with MAOA who were severely maltreated developed some form of antisocial behaviour.²⁸

B *The Hot Sauce Study*

Another interesting study occurred in 2008.²⁹ This study involved 78 males who were given the opportunity to earn money (a maximum of US\$10) by sitting a vocabulary test and being rewarded for each correct answer. The males were then told that someone in another room had the ability to take either 20% or 80% of their earnings, and that this person would take a few minutes to decide how much he wished to take. Once the other person had taken the money, the male participants were given an option to punish the other person by forcing him to drink hot (spicy) sauce.³⁰ They could require him to drink up to 10 doses, but they would have to pay for each dose at 3 points per dose, or approximately 30 cents. The maximum 10 doses would cost them \$3. If the other party did not drink the hot sauce he could not keep the money, which would go back to the administrators and not to the male participant.

The results showed that when 20% of the money was taken, 39% of all participants chose to pay for some hot sauce. When the results were separated into low and high MAOA, there is little difference in the results. 40% of low MAOA participants paid for some hot sauce, compared to 34% of high MAOA participants. When 80% was taken, 66% of all participants chose to pay for some hot sauce. There was more of a difference between low and high MAOA in this scenario, with 75% of low MAOA participants paying, compared to 62% of high MAOA participants.

Most interesting, however, is the analysis of the participants who chose to give the maximum amount of hot sauce. When 20% was taken, the figures are again reasonably similar: 12% of low MAOA participants and 6% of high MAOA participants. When 80% was taken, the difference was significant. 44% of the low MAOA participants gave the maximum dose, compared to only 19% of the high MAOA group.

The study suggested that in a situation of slight provocation, low and high MAOA individuals react in a similar way, but under more severe provocation low MAOA individuals are not only more likely to respond aggressively, but are also more likely to respond in a significantly more aggressive way than high MAOA individuals.

²⁸Avshalom Caspi, Joseph McClay, Terri Moffitt et al, 'Role of Genotype in the Cycle of Violence in Maltreated Children' (2002) 297 *Science* 851, 854.

²⁹ Rose McDermott, Justin Tingley, Jonathan Cowden et al, 'Monoamine Oxidase A (MAOA) Predicts Aggression Following Provocation' (2009) 106 *Proceedings of the National Academy of Science* 2118.

³⁰ Each dose was 1/8 teaspoon. No hot sauce was actually ingested. The 'other person' was a computer.

VII HOW RELIABLE ARE THE STUDIES?

The two studies discussed above show similar results. In situations where low or probable forms of mistreatment occur (whether physical or emotional abuse in the Dunedin study, or depriving someone of a small proportion of earnings in the hot sauce study) low MAOA individuals may act slightly more aggressively, but the difference between low and high MAOA individuals is slight. When the mistreatment is more severe, a low MAOA individual is likely to act in a more aggressive manner. If this is correct, this could be used as a mitigating factor. An individual's genes, combined with their environment, makes this person less able to exhibit self control, and more likely to act impulsively and aggressively.

There have also been other studies looking at the impact of low MAOA and childhood maltreatment. Some of these studies have replicated the results of the Dunedin study,³¹ but others have not reached the same results. An analysis of these studies suggests that there are several points relevant to an understanding of the effect of having the low MAOA gene.

A MAOA Is Not A 'Criminal Gene'

The presence of low MAOA does not mean a person is going to commit crime, even when that person has been maltreated as a child. This was not the conclusion of the Dunedin study. That study showed that low MAOA individuals are more likely to commit crime when faced with childhood maltreatment when compared to high MAOA individuals. The effect of low MAOA and childhood maltreatment is a change in rank.³² With no maltreatment, high MAOA individuals are more likely to commit crime when compared to low MAOA individuals. With some maltreatment, this reverses, and low MAOA individuals have the higher probability of criminal conduct. With severe maltreatment, the probability of the low MAOA individual increases significantly over that of a high MAOA individual. To say that someone with low MAOA and a history of childhood mistreatment is likely to commit crime is therefore incorrect. The accurate statement is that he is more likely to commit crime than someone with high MAOA and the same history.

Science would not, therefore, support an argument that because an individual has low MAOA and has been maltreated as a child, he is genetically likely to commit crime and therefore should not be held as accountable as someone with high MAOA. This is supported by a 2006 study which tested 247 males entering a residential treatment centre for persistent criminal conduct.³³ It found that there was no significant occurrence of low MAOA males with

³¹ Avshalom Caspi, Joseph McClay, Terri Moffitt et al, 'Role of Genotype in the Cycle of Violence in Maltreated Children' (2002) 297 *Science* 851, 854; Debra Foley, Lindon Eaves, Brandon Wormley et al, 'Childhood Adversity, Monoamine Oxidase A Genotype And Risk Of Conduct Disorder' (2004) *Archives of General Psychiatry* 738; Julia Kim-Cohen, Avshalom Caspi et al, MAOA, 'Maltreatment And Gene-Environment Interaction Predicting Children's Mental Health' (2006) *Molecular Psychiatry* 903; Cathy Spatz-Widom, Linda Brzustowicz, 'MAOA And The "Cycle Of Violence"' (2006) *Biological Psychiatry* 684.

³² James Tabery, 'From A Genetic Predisposition To An Interactive Pre-Disposition: Rethinking The Ethical Implications Of Screening For Gene-Environment Interactions' (2009) 34 *Journal of Medicine And Philosophy* 27, 30.

³³ Susan Young, Andrew Smolen, John Hewitt et al, 'Interaction Between MAOA Genotype And Maltreatment In The Risk For Conduct Disorder: Failure To Confirm In Adolescent Patients' (2006) 163 *American Journal of Psychiatry* 1019.

childhood maltreatment among the group. The study concluded that its results were therefore inconsistent with the Dunedin study. This is actually not the case. This study looked solely at criminals with a history of maltreatment, and then compared the numbers of low and high MAOA. It did not factor in those members of the community that did not commit crime, which would have been necessary for a replication of the Dunedin study.

B *The Environment Plays A Crucial Factor*

One study carried out brain imaging of the amygdala of subjects while they were shown neutral and emotionally aversive images (including fearful faces).³⁴ Those subjects with low MAOA were hyperresponsive to the fear images, which the study explained meant that they 'had problems regulating their emotions, which would make them more likely to act on aggressive impulses.'

It is thought that low MAOA results in an increased fear of social rejection, meaning that those with low MAOA are more likely to conform to group norms. This is consistent with the Dunedin study, which showed that where there was no maltreatment, low MAOA individuals were less likely to commit crime than high MAOA individuals, but that where there was maltreatment, they became increasingly more likely in comparison to commit crime.³⁵ It is also consistent with another study which showed that low MAOA boys growing up in neighbourhoods with gang activity were more likely to join the gangs, and be among the most violent members.³⁶

C *The Dunedin Study Results May Not Be Replicated In All Racial Groups*

The Dunedin study, and the subsequent studies which replicated its findings, have one important additional feature in common. The participants of the study were predominantly Caucasian. In one study, which used both Caucasian and non-Caucasian participants, the Dunedin study results were replicated for the Caucasian cohort, but not for the non-Caucasian cohort.³⁷ A commentator on this study concluded:³⁸

The lack of evidence for involvement of this [low MAOA] variant with violence and antisocial behaviour in American non-whites demonstrates that extreme caution is needed when translating MAOA genetic findings between racial groups. A central tenet of complex phenotype genetics is that genetic associations are likely to vary between racial groups.

The study reached the conclusion that:

³⁴ Constance Holden, 'Parsing The Genetics Of Behaviour' (2008) 322 *Science* 892

Andreas Meyer-Lindenberg

³⁵ Rose McDermott, Justin Tingley, Jonathan Cowden et al, 'Monoamine Oxidase A (MAOA) Predicts Aggression Following Provocation' (2009) 106 *Proceedings of the National Academy of Science* 2118.

³⁶ Kevin Beaver, 'Monoamine Oxidase A Genotype Is Associated With Gang Membership And Weapon Use' (2009) *Comprehensive Psychiatry* available online at <www.sciencedirect.com>.

³⁷ Cathy Spatz-Widom, Linda Brzustowicz, 'MAOA And The "Cycle Of Violence"' (2006) *Biological Psychiatry* 684.

³⁸ Tony Merriman and Vicky Cameron, 'Risk Taking: Behind The Warrior Gene Story' (2007) 120(1250) *New Zealand Medical Journal* U2440.

The genotype associated with high levels of MAOA did not appear to protect non-white abused and neglected children and, if anything, appeared to have the opposite effect.

In other words, the finding in the Dunedin study that those with high MAOA and mild or severe maltreatment as a child were less likely to commit crime than those with low MAOA, was in fact reversed in a study of non-caucasians.

In a more recent, 2008, study it was found that in a cohort of mixed racial backgrounds, the Dunedin study was replicated until the consideration of extreme trauma, where low or high MAOA was not relevant.³⁹ This indicates that further studies are needed to understand the effect of low MAOA among all racial groups.

One of the major causes for concern with the Italian case is that Bayout's ethnic group was not taken into account. He is described as being Algerian. When his lawyers were asked by a scientific journal whether his ethnicity was tested before relying on studies which tested Caucasians, they responded 'the ethnicity of the defendant is irrelevant' but that he did not belong to any of the non-white ethnic groups considered in the 2006 study that raised issues about the applicability of the Dunedin study results to non-Caucasians.⁴⁰ The effect of low MAOA on his particular ethnic group was therefore unknown, making the decision to rely on the previous studies questionable.

VIII CONCLUSION

In *Mobley*, the court commented that 'the theory of genetic connection... is not at a level of scientific acceptance that would justify its admission.' Fifteen years later, further studies have been carried out, and the findings suggest that we are closer to understanding the impact of low MAOA on criminal conduct, but that we have still not reached the level where this could be argued convincingly in court.

The studies of Caucasian males appear to be consistent in their findings that low MAOA and childhood maltreatment make a person more likely to exhibit aggressive behaviour which leads to criminal conduct than males with high MAOA and childhood maltreatment. These studies, however, demonstrate only trends in groups in society. It does not necessarily follow that because a male has low MAOA and a history of childhood maltreatment, he will automatically exhibit this aggressive behaviour. The result of this is that simply screening for the three repeat, low MAOA, gene and providing evidence of childhood maltreatment cannot be sufficient to mitigate a sentence at this stage of scientific understanding. There have not been sufficient studies on non-Caucasian groups to determine how low-MAOA affects these groups.

The introduction of genetic factors in sentencing is something that needs to be considered closely for several reasons. First, although the studies so far suggest that the impulsive aggressive behaviour that might lead to criminal conduct is a result of a combination of the low MAOA gene and childhood maltreatment, media reports are likely to drop the childhood

³⁹ Natalie Weder, Bao Zhu Yang, Heather Douglas-Palumberi et al, 'MAOA Genotype, Maltreatment And Aggressive Behaviour: The Changing Impact Of Genotype At Varying Levels Of Trauma' (2008) 65 *Biological Psychiatry* 417.

⁴⁰ Emiliano Feresin, 'Lighter Sentence For Murderer With "Bad Genes"' 30 October 2009 reported online at <<http://www.nature.com/news/2009/091030/full/news.2009.1050.html>> at 28 January 2010.

maltreatment and focus on the genetic angle, in order to use sensational headlines. This was demonstrated in both the reporting of Lea's 'warrior gene' paper and the recent Bayout case.⁴¹ Phrases like 'criminal gene' and 'warrior gene' are inaccurate, and can clearly have a negative impact on society's trust in the criminal justice system. Had Bayout been Caucasian, or had his sentence not been mitigated on the basis that the supporting studies involved Caucasians only, then the newspapers might just have easily reported on 'the white man's defence to crime'.

Second, the studies provide a double edged sword. While Bayout's sentence was reduced on the basis of his low MAOA gene, it could also have as easily been increased. Evidence that Bayout 'reacts particularly aggressively in stressful situations' or that Landrigan was a 'remorseless, violent killer' might persuade a judge that rehabilitation was not possible and society should be protected as long as possible from this individual.

Third, might society start considering a form of predictive sentencing as appropriate? When XYY Syndrome was first identified as a possible criminal gene, there were discussions about testing all males for this Syndrome, with the idea of segregating, or otherwise discriminating against these males, in the background. Might this argument reappear in relation to those with low MAOA and childhood maltreatment? It could start small, with a judge giving an increase on a sentence to a relevant male on the basis that he will reoffend, violently.

Medical research can play a valuable part in sentencing. If it can explain why a person acted in a particular way, this is clearly a relevant factor to be taken into account when determining an appropriate sentence. At the present time, however, the research into MAOA and its interaction with childhood maltreatment has not sufficiently developed to the stage where it should be relied on by the courts to help determine an appropriate sentence.

⁴¹ As an example, see Anjana Ahuja, 'The Get Out Of Jail Free Gene' *The Times* (London) 17 November 2009, available online at <<http://www.timesonline.co.uk/tol/news/science/genetics/article6919130.ece>>.