Born to Kill - Aggression Genes and Their Potential Impact on Sentencing and the Criminal Justice System

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Comments

Born to Kill? “Aggression Genes” and Their Potential Impact on Sentencing and the Criminal Justice System

Cecilee Price-Huish

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I. INTRODUCTION

ARE violent criminals genetically programmed to be criminals, or is their behavior better explained by environmental factors such as family dynamics, psychosocial stressors, or socioeconomic status? During the last few years, geneticists have been searching for possible genetic roots of violent, antisocial behavior, which has led to the discovery of a number of controversial aggression genes. The past two years have seen these so-called aggression genes gain increasing attention from both the scientific and legal communities, as scientists and scholars consider the implications such genes may have on theories of criminal defense, punishment, and personal responsibility. The burgeoning scientific evidence of aggression genes poses two interesting and opposite propositions: first, the promise of predicting and preventing future crime among affected individuals through incapacitation;¹ and second, reducing individual culpability by excusing a perpetrator’s responsibility for his criminal behavior. While “recourse to genetics offers an easy and apparently science-based way to clarify [legal] ambiguities,”² there is a risk that society might turn to genetic information as a “quick-fix” way to lower societal responsibility in dealing with problematic, violent criminals by either ignoring other potential environmentally-based causal factors or denouncing rehabilitative punishment.

¹. Dorothy Nelkin, After Daubert: The Relevance and Reliability of Genetic Information, 15 Cardozo L. Rev. 2119, 2124 (1994). Nelkin discusses a correlation between violent tendencies and increased serotonin levels in the brain which has been linked to Chromosome 11, theoretically posing the possibility of predicting those predisposed to violent behavior, even in utero. Id.
². Id. at 2127.
II. THE SEARCH FOR AN AGGRESSION GENE—A NEW SCIENTIFIC FRONTIER

A. CHALLENGES FACING GENETIC RESEARCH

Efforts to discover potential genetic roots of violent behavior have been met with both enthusiasm and skepticism. While many in the legal and scientific communities believe that evidence of genetic causal factors can and will be used to help those who are predisposed to violence, others fear that this information will more likely be abused to justify racism and imposition of unduly severe punishment.3

1. Ciba Symposium

In February 1995, a Symposium on the Genetics of Criminal and Antisocial Behavior ("Symposium") was held at the Ciba Foundation, an international scientific and educational charity, based in London. The purpose of the Symposium was to examine "some of the newer evidence on [genetic factors and differences in antisocial behavior] and, . . . [to] consider some of the crucial ethical, legal and criminal implications that stem from those findings."4 The Symposium was not open to the public, but the findings and conclusions of the participants were published in Genetcs of Criminal and Antisocial Behaviour.5

The Symposium generated considerable controversy and debate, much of which centered around the fear that genetic explanations of differences among ethnic groups and between the sexes will be "used to account for and justify the inferior social status of women and minority ethnic groups."6 Unlike past attempts to offer genetic hypotheses for behavioral differences, new genetic research seemingly offers explanations that are no longer simply theoretical. This is because genetic technology has made enormous strides in the last ten years, making the isolation and study of individual gene sequences possible.7 Private and public genetic research have further been bolstered by the founding of the Human Genome Project, a multinational effort to map and explain the functions of all 100,000 human genes.8

A conference similar to the Ciba Symposium, which was partially funded by the National Institutes of Health (NIH), was scheduled in 1992, but was canceled due to accusations of racism and eugenic regres-

5. Genetics of Criminal and Antisocial Behaviour, supra note 4.
8. Id. at 7-8.
sion. The NIH eventually renewed its funding, and the conference, *Research in Genetics and Criminal Behavior: Scientific Issues, Social and Political Implications*, was finally held in September 1995 amid denunciations of racial prejudice.9 As would be expected, views on the genetics of criminal behavior span the spectrum. Diana Fishbein, a criminologist with the U.S. Department of Justice believes that “‘there are areas where we can begin to incorporate biological approaches’ to fighting crime and . . . that medical treatment [for some] violent offenders should be mandatory.”10 Still, others argue that identifying social problems with biology simply allows a society to deflect responsibility away from the state and its social welfare appendages.11

During one Symposium presentation, Sir Michael Rutter, a child psychiatrist at the Institute of Psychiatry in London, argued that genetics and environmental factors are not mutually exclusive in causing violent propensities. Rutter explained that the genetic research designs presented and discussed at the Symposium were crucial for the testing of hypotheses about environmental risk mechanisms as well as for the study of genetic factors.12 The real importance of research into the existence of aggression genes, according to Rutter, lies in learning more about their potential causal processes when coupled with environmental elements, not solely in the predictive strength of such genes.13 This holistic approach seems to be shared by legal scholars who are attempting to reconcile this new evolving science with traditional theories of culpability and punishment.14 Examination into the relationship between genetic and environmental causal factors of violent behavior, as espoused by Rutter, is hypothetical at this point since most of the new genetic research is conducted in a “causal vacuum” and does not explore the effects that psychosocial stressors have on those carrying aggression-causing genes.

2. *Fears of Eugenic Masterminding*

The danger of modern genetic research, some say, is “like the danger of the old eugenics, [in that] society will mistakenly believe it proves more than it does and use it as an excuse to injure further those who are already disadvantaged.”15 Despite attempts to neutralize the political fallout of both the Symposium and the NIH-sponsored conference, the fact that scientific knowledge concerning genetics and aggressive criminal be-

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10. *Id.* (citations omitted).
11. *Id.* Dr. Dorothy Nelkin of New York University argues that the question of how a society addresses criminal behavior should not be a scientific issue, but rather a moral issue. *See generally* Nelkin, *supra* note 1, at 2124-27.
13. *Id.* at 11.
14. Nelkin, *supra* note 1, at 2125. “The presence of a biological condition should not be confused with a specific behavioral trait or even a disease. The gene is not a completely deterministic force, independent of history or environment.” *Id.*
behavior is so emotionally charged may prevent some people from making a distinction between scientific and political inquiry. The fear that eugenic theories, which attempt to validate the genetic dominance or superiority of one race, will resurface is justified. Such fears have strong roots that can be linked to at least three major historical events: (1) Nazi theories of genetic determinism in racial difference; (2) Soviet adoption of Marxist theories of genetic determinism of individual differences; and (3) the prevailing theory of racial/genetic inferiority of African-Americans prior to the civil rights movement in the United States.

Increased knowledge about the genetic underpinnings of aggressive or violent behavior can potentially lead to the adoption of socially destructive eugenic theories centered around the idea that it is possible to stock the genetic pool with "desirable" people. Evidence of this type of eugenic abuse is found in the U.S. Supreme Court decision, Buck v. Bell.

In Buck, the Court upheld a Virginia law that mandated forced sterilization of "feeble-minded" and criminally inclined individuals. Therefore, under the Virginia statute, Carrie Buck, the alleged "feeble-minded" mother of an illegitimate, "feeble-minded" child, who was herself the daughter of a "feeble-minded" mother, was forced to undergo sterilization. Justice Holmes validated this final solution approach when he stated, "Carrie Buck 'is the probable potential parent of socially inadequate offspring' . . . . It would be strange if [the state] could not call upon those who already sap the strength of the State for these lesser sacrifices . . . . Three generations of imbeciles are enough."

While history has shown the abuse of individuals based on raw genetic information, it is important that society not become frozen by fear. Society must move responsibly forward with valuable genetic research and examine both the positive and negative implications it may have on those who operate and live within the criminal justice system.

B. DISCOVERY OF NEW AGGRESSION-CAUSING GENES AMONG MICE MODELS

Although geneticists are currently conducting research with the hope of finding an aggression-causing gene, many scientists believe that there

17. Id. Theories of racial inferiority still exist today. Some sociologists argue that there is a genetic basis for an inherent difference between the IQs of various races and that this difference accounts for a higher incidence of crime among African-Americans because they lack a consequential understanding of their actions. See generally RICHARD J. HERRNSTEIN & CHARLES MURRAY, THE BELL CURVE: INTELLIGENCE & CLASS STRUCTURE IN AMERICAN LIFE 9-10 (1994).
19. Id. at 205. The statute provided that the welfare of society would be promoted by the sterilization of "mental defectives." Id.
20. Id. at 207. Mr. I.P. Whitehead, who argued for Ms. Bell, highlighted the potential for eugenic abuse when he stated, "A reign of doctors will be inaugurated and in the name of science new classes will be added, even races may be brought within the scope of such regulation, and the worst forms of tyranny practiced." Id. at 202.
may actually be several isolated genetic abnormalities that contribute to aggressive, violent behavior, as opposed to one single "aggression gene." In the last couple of years, however, two distinct genetic abnormalities studied in mice and humans have gained and maintained a great deal of scientific and legal attention: the absence of nitric oxide and the absence of monoamine oxidase A.

1. Efficacy of Mice Models

While research into aggressive behavior among mice began nearly fifty years ago, molecular genetics has only recently advanced enough to identify specific genes that effect such complex traits as aggressive behavior. Mice are particularly valuable in mapping out the genes for aggression because mice and humans have many homologous genes mapped to homologous chromosome regions. Because of this similarity, some scientists believe that individual genes identified for mouse aggression may be developed as animal models for human aggression. Identification of genes for other behaviorally complex mouse traits has led to the development of animal models for parallel human traits such as diabetes and obesity.

2. Nitric Oxide Link to Aggression

Scientists at Johns Hopkins University have found that male mice lacking the gene that produces nitric oxide are highly prone to aggressive, violent behavior against other mice. Nitric oxide is a neuron-produced gas that is used by the brain as a neurotransmitter allowing neurons to communicate. The genetically abnormal male mice sexually pursued female mice for hours even though the female mice were not in heat. Normal male mice, on the other hand, will give up the chase when a female is not in heat. Additionally, normal mice will usually stop an attack when an opponent surrenders, but abnormal mice were found to fight other mice to the death, even after the opposing mice surrendered by lying on their backs. Based on this study, it is speculated that nitric oxide is the neurotransmitter that curbs sexual and aggressive behavior. "These animals were very, very aggressive—dramatically so," said Dr. Randy J. Nelson, professor of psychology at Johns Hopkins University.

23. Id. at 22.
24. Id.
25. Id. at 26.
26. Douglas Birch, Scientists Link Missing Gene in Mice to Violent Behavior; Only Males Affected by Induced Defect, BALT. SUN, NOV. 23, 1995, at 1A.
27. Id.
28. Id.
and co-sponsor of the study. "They don’t seem to recognize social cues which would normally turn off reckless, impulsive or violent behavior."

Speculative treatment models for nitric oxide deficiency are already being discussed. According to Dr. Solomon H. Snyder, a neurobiologist at Johns Hopkins University and co-sponsor of the study, examining the DNA in families with a history of aggression may lead to discovery of a defect in the “knocked out” gene that enables the brain to produce nitric oxide. Furthermore, additional research could lead to the development of new nitric oxide-boosting drugs to treat people genetically predisposed to aggressive, violent behavior. While human studies have yet to be conducted, the mouse study provides important insight into understanding human aggression due to the neurological similarity between mice and people.

3. The Absence of Monoamine Oxidase A and Aggressive Behavior

Using genetic “knockout” technology, a multinational research team has developed a family of mice that lack monoamine oxidase A (MAOA), an enzyme that severely affects the amount of serotonin and norepinephrine in the brains of affected mice. Normal amounts of MAOA in the brain serve to inactivate production of serotonin, a neurotransmitter that influences moods and perception, and norepinephrine, a neurotransmitter that helps control body movement. In the genetically altered mice, however, MAOA catalytic activity ceased altogether, causing the production of unusually high levels of serotonin and norepinephrine, which in turn led to impulsive aggressive behavior.

Abnormally aggressive behavior was displayed by MAOA-deficient adult male mice, even though housed in normal rearing conditions from the time they were pups. Researchers found that these male mice repeatedly attacked one another, primarily by biting each other on the genitals and the rump. The adult males also displayed abnormal sexual aggression by grasping females repeatedly. Dr. Isabelle Seif, a molecular biologist who directed a team of MAOA researchers, believes that since the MAOA-deficient mice displayed abnormal aggression under normal rearing conditions, absent psychosocial stressors, drugs could be developed to help control enhanced aggression in human males that lack

References:
29. Id.
30. Id.
31. Id.
32. Id.
33. Maxson, supra note 22, at 22.
35. Id.
36. Id. (footnote omitted).
37. Id.
38. Id.
39. Id. at 1764.
The absence of psychosocial stressors among the disturbed mice suggests a very strong genetic link to the abnormal behavior.

C. Aggression-Causing Genetic Abnormalities in Humans

1. Monoamine Oxidase A Deficiency in Humans—Dutch Family Study

A recent study of a large Dutch extended family, which spanned four generations, found fourteen males exhibiting borderline mental retardation (IQ of about eighty-five) and impulsive aggressive behavior manifested in acts of verbal and physical aggression, which included arson, aggravated assault, sexual assault, attempted rape, and exhibitionism. In all of the affected men, MAOA activity was completely absent. The Dutch family was selected for the study because a sharp, unexplainable behavioral contrast between affected and unaffected males had been noted by family members for years.

Researchers found that stagnant MAOA activity among affected males resulted in the excretion of abnormally high amounts of the neurotransmitters serotonin, norepinephrine, dopamine, and epinephrine, all of which are normally broken down in the body using MAOA. According to Xandra Breakefield, a neurogeneticist and collaborator of the Dutch family study, when these neurotransmitters accumulate in abnormal amounts due to a defect on the MAOA gene, affected individuals will have trouble handling stressful situations, causing them to respond excessively and at times, violently. While MAOA deficiency suggests a causal link for increased impulsive, aggressive behavior among male members of the Dutch family, scientists acknowledge that research is in the infancy stages and that additional MAOA-deficient families must be studied in order to test the validity of the causal association.

Because MAOA deficiency is among several tentative genetic abnormalities linked with unusually aggressive behavior, Han G. Brunner, a clinical geneticist and author of the Dutch family study, warns against viewing the data in a vacuum. While Brunner strongly supports the theory that behavior is influenced by genetic factors, he states that, "the notion of an 'aggression gene' does not make sense, because it belies the fact that behaviour should and does arise at the highest level of cortical organization, where individual genes are only distantly reflected in the anatomical structure, as well as in the various factors that influence behavior."

40. Tim Hilchey, The Aggression Enzyme?, INT'L HERALD TRIB., June 29, 1995, at 1; see also Cases et al., supra note 34, at 1765.
41. Virginia Morell, Evidence Found for a Possible "Aggression" Gene, SCIENCE, June 18, 1993, at 1722; Brunner, supra note 21, at 156.
42. Brunner, supra note 21, at 156.
43. Id.
44. Morell, supra note 41, at 1722.
45. Id.
46. Id. at 1722-23.
47. Brunner, supra note 21, at 162.
48. Id. at 161.
neurophysiological and biochemical functions of the brain.\textsuperscript{49}

Brunner also believes that genetic studies can be best used to improve our understanding of how, not why, impulsive aggressive behavior occurs.\textsuperscript{50}

The ramifications that the nitric oxide-deficient mouse study, the MAOA-deficient mouse study, and the Dutch family study will have on the criminal justice system are far from clear. As scientists continue to identify behavior-modifying genetic abnormalities that cause increased aggression and violence, this groundbreaking research will surely have an impact on sentencing violent criminals.

2. Twin Studies

Many studies of twins have been conducted over the last number of years in an effort to determine the genetic correlation to criminal or antisocial behavior. Twin studies have gained popularity among scientists because twins are raised in a common environment, so that trends among identical and nonidentical twin sets may be contrasted to illustrate genetic influences on behavior.\textsuperscript{51} While the researchers of the two studies discussed below did not attempt to identify a single aggression-causing gene, they found that genetic factors played a key role in predicting the incidence of criminal behavior among twins.\textsuperscript{52} Environmental factors were not considered.

a. Vietnam Era Veteran Twin Registry

A study involving 3226 pairs of twins, born between 1939 and 1957 and who served in the military during the Vietnam War, was conducted in order to determine the incidence of criminality among the twin sets.\textsuperscript{53} From the data, it was discovered that genetic factors, rather than environmental factors, more strongly influenced the following: (1) whether the subjects were ever arrested after age fifteen; (2) whether they were arrested more than once after age fifteen; and (3) whether they engaged in later adult criminal behavior.\textsuperscript{54} While no single gene was identified as the culprit for twin pair criminal behavior similarity, the scientists concluded that genes are highly influential in the occurrence of adult criminal behavior among twins by “contributing to dispositions that make a given individual more or less likely to behave in a criminal manner.”\textsuperscript{55}
b. Danish Twin Study

A Danish twin study conducted over the last twenty-five years also sheds light on the inheritability of criminal-type aggression. Researchers investigated the criminal records of pairs of nonidentical and identical twins to compare the concurrence of criminal records among the twins.\(^{56}\) The researchers found that if a male identical twin had a criminal record, his twin was fifty percent more likely than the average Danish male to have a criminal record, compared to only a fifteen to thirty percent increased likelihood for nonidentical twins.\(^{57}\) While the twin studies indicate a genetic predisposition to criminal behavior without pinpointing the specific genes involved, Irving Gottesman, a psychologist who worked on the study, believes the study shows that "criminals are not born, but the odds at the moment of birth of becoming one are not even."\(^{58}\)

Clearly, much of the research searching for a genetic predisposition for criminal behavior to date has produced inconclusive results. Yet, as research into potential "aggression genes" and their links to impulsive, aggressive behavior continues, it is imperative that the impact of such research on criminal sentencing be anticipated and analyzed.

### III. AGGRESSION GENE AS MITIGATING FACTOR IN SENTENCING

#### A. Stephen Mobley Case

In 1991, during the commission of a robbery at a Georgia pizza store, Stephen Mobley shot the store manager in the back of the head with a semi-automatic pistol while the victim was on his knees. Three weeks after the pizza store incident, Mobley used the same pistol to rob a dry cleaning store. After the dry cleaning robbery, Mobley threw the pistol out of his car window when he saw he was being followed by a police car. Following a high-speed chase, Mobley was apprehended and confessed to both robberies as well as the murder of the pizza store manager.\(^{59}\) In 1994 Mobley was convicted of malice murder and felony murder. Based on the aggravating circumstance of armed robbery, the jury recommended the death penalty for the murder, and the trial court subsequently sentenced Mobley to death.\(^{60}\)

On appeal, Mobley argued that the trial court erred in denying his motion requesting that the court grant him funds for expert witnesses to conduct tests to determine whether he suffered from a genetic deficiency of monoamine oxidase A, the enzymatic neurotransmitter that predisposed him to violent, impulsive criminal behavior.\(^{61}\) The request for genetic

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57. Id.
58. Id.
60. Id.
61. Id. at 65-66.
testing and admissibility of genetic evidence was based on Mobley's family history that contained a record of four generations of violence and behavioral disorders. Mobley planned to use the test results as evidence of a mitigating factor at his sentencing hearing, relying on recent scientific studies "that suggest a possible genetic basis for violent and impulsive behavior in certain individuals." The Georgia Supreme Court upheld the trial court's denial of the motion on grounds that the "theory behind the request for funds will not [reach] a scientific stage of verifiable certainty in the near future and that Mobley could not show that such a stage will ever be reached."

The Mobley case is likely the first of many cases that will attempt to use genetic testing to prove the existence of an MAOA deficiency in the defendant. It is interesting to note that although both the trial court and the Georgia Supreme Court rejected Mobley's genetic factor-based mitigation attempt, neither court completely ruled out the possibility of using the results of genetic testing in the future. The court simply affirmed the trial court's ruling that in order for genetic evidence to be used as a mitigating factor in the sentencing phase of a capital case, the evidence must reach a "scientific stage of verifiable certainty normally required for the introduction of scientific evidence." The court's choice of proceeding with caution seems prudent if juries are going to be required to determine the relationship between a defendant's mental capacity and the claimed genetic disorder.

As additional scientific research is conducted on genetic factors such as MAOA deficiency and as the movement to identify biologically caused links to violent, aggressive behavior continues to gain momentum, it is foreseeable that genetic predisposition evidence could reach the required "scientific stage of verifiable certainty" sooner than some may expect. One legal scholar believes that "the question is not whether genetic evidence will ever be admitted into court, but when and under what kinds of circumstances." While progress in genetic understanding continues, the evidentiary standards for admitting genetic evidence appear to be easing. The United States Supreme Court, in Daubert v. Merrell Dow Pharmaceuticals, Inc. recently loosened the standards for admitting scientific evidence in federal court cases, requiring only that the evidence be reliable and rele-

63. Mobley, 455 S.E.2d at 65-66 (citations omitted); Denno, supra note 62, at 251-52. At the trial, Mobley introduced into evidence the Dutch family study in which an MAOA deficiency was found to exist in four generations of males prone to impulsive, violent behavior. Denno, supra note 62, at 252; see supra notes 41-50 and accompanying text.
64. Mobley, 455 S.E.2d at 66; see also Harper v. State, 292 S.E.2d 389 (Ga. 1982) (admissibility test depends on whether technique has reached verifiable certainty, not whether technique is generally accepted in scientific community).
65. Mobley, 455 S.E.2d at 66.
66. Denno, supra note 62, at 249.
It is likely that state courts will soon follow Daubert. The Daubert Court acknowledged that the seventy-year-old "general acceptance" test had been superseded by the Federal Rules of Evidence: 69 "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise." 70 This decision could have far-reaching implications if genetically based criminal defenses become more commonplace, since under Daubert, the scientific evidence must only be relevant and pertain to scientific knowledge—by definition, a somewhat ambiguous evidentiary standard. 71

Deborah Denno points out that the Mobley court's refusal to allow genetic testing is at odds with the "increasingly liberal acceptance of biological and psychological evidence to justify defenses." 72 Specifically, Denno cites the admission of positron emission tomography (PET) scans by courts in sentencing. 73 While Denno recognizes that evidence of a genetic abnormality cannot legitimately be used in a vacuum as a sentencing solution, she suggests it could be utilized as a single mitigating factor in the same way that other types of biological, psychological, sociological, and environmental factors are currently considered. 74

B. Mitigation Mandates

1. Supreme Court Guidance for Genetic Evidence

The United States Supreme Court has clearly established that during the sentencing phase of a capital case the sentencer may not refuse to consider any relevant mitigating evidence. 75 The consideration of mitigating factors in death penalty cases was characterized by the Court as constitutionally mandated when it stated:

[The Eighth and Fourteenth Amendments require that the sentencer, in all but the rarest kind of capital case, not be precluded from considering, as a mitigating factor, any aspect of a defendant’s character or record and any of the circumstances of the offense that the defendant proffers as a basis for a sentence less than death.] 76

Underscoring the importance of mitigating factors, the Court in Penry v. Lynaugh 77 stated, "[I]t is precisely because the punishment should be di-

68. Id. at 590-91.
69. Id. at 587.
70. FED. R. EVID. 702.
71. See Daubert, 509 U.S. at 598-601 (Rehnquist, C.J., concurring in part).
72. Denno, supra note 62, at 253 (citation omitted).
73. See infra notes 148-51 and accompanying text.
74. Denno, supra note 62, at 254.
rectly related to the personal culpability of the defendant that the jury must be allowed to consider and give effect to mitigating evidence relevant to a defendant's character or record or the circumstances of the offense."\(^\text{78}\)

It is clear that the Supreme Court requires evidence of mitigating factors to be considered during the sentencing phase of certain cases and that these factors may include evidence of a defendant's background, character, or circumstances surrounding the crime. What is less clear, however, is how evidence of a genetic predisposition to criminality can and will be viewed by courts in the future. As genetic research becomes more conclusive, it seems foreseeable that in the wake of Mobley, criminal defendants will claim that evidence of an "aggression gene" is exactly the type of evidence that a "'sentencer' may not refuse to consider or 'be precluded from considering' [as] relevant mitigating evidence."\(^\text{79}\)

2. Reliability of Genetic Information for Use as a Mitigating Factor

While consideration of mitigating factors in criminal cases is an established rule of law, the role genetic evidence will play in future criminal cases is not yet established. In Daubert,\(^\text{80}\) the Supreme Court held that judges should assess the scientific validity or reliability underlying scientifically based expert testimony before allowing such evidence to be considered as a mitigating factor.\(^\text{81}\) The Daubert Court established some loosely defined guarantees of evidentiary scientific reliability that included: first, whether the evidence has been tested; second, whether it has been subjected to peer review and publication; third, whether the conclusions are derived from a set of standards with a known error rate; and finally, whether the information is generally accepted in the scientific community.\(^\text{82}\)

Addressing the use of genetic information as a mitigating factor, Dorothy Nelkin suggests that when applying the Daubert standards, the reliability of scientifically tested genetic information depends on three factors: first, the intrinsic accuracy of the measurements; second, the consistent result of what is being measured; and third, the ability of the observer to accurately interpret the results.\(^\text{83}\) Using either the Daubert or the Nelkin standards for scientific reliability, current scientific information regarding a genetic predisposition to impulsive, aggressive criminal behavior would fail because the available information is not yet generally accepted in the

\(^{78}\) Id. at 327-28. The Penry jury was not given instructions as to Penry's mental disability or the definition of "deliberately." The Supreme Court held that such deficiencies did not clearly direct the jury to fully consider Penry's mitigating evidence. Id. at 327; see Lockett, 438 U.S. at 604.


\(^{80}\) Daubert, 509 U.S. at 579.

\(^{81}\) Id. at 592-95.

\(^{82}\) Id.

\(^{83}\) Nelkin, supra note 1, at 2123.
scientific community and initial test results have not been replicated to demonstrate consistent results.

Still, as more information comes to light regarding genetic predispositions to criminality and "[o]ld themes of biological determinism [become] prevalent . . ., empowered by new scientific developments," public sentiment may demand that genetic information be used in sentencing decisions. As the fear of criminal violence escalates, Nelkin suggests that it may be "comforting to believe that there is definitive, science-based information relevant to understanding and resolving social problems. . . . Recourse to genetics offers an easy and apparently science-based way to clarify ambiguities."85 Growing public sentiment regarding the efficacy of using genetic information to predict or identify those individuals carrying a violence-causing gene,86 supported by controversial scientific evidence, may ultimately combine to lower the required level of scientific acceptance, thus rendering genetic information admissible sooner than expected. After all, "[t]here is no absolute threshold level of certainty that must be surmounted for an idea to become scientific."87

It seems that the problem for the legal system may soon shift from what the new and burgeoning scientific research will show, to the vague and inconsistent ways the legal system will approach it.88 Unfortunately, the current culture of fear that exists in America may lead to the Daubert standards being stretched beyond their protections of certainty, leading courts and juries to view information of genetic predisposition to violence as an aggravating factor instead of a mitigating factor.

3. Genetic Predisposition to Mental Illness as a Mitigating Factor

The defendant in Mobley currently stands alone in his attempt to use evidence of an MAOA deficiency as a mitigating factor during the sentencing phase of punishment. At least one court, however, has held that in a death penalty case evidence of a defendant's genetic predisposition to mental illness must be presented as a mitigating factor during sentencing if the absence of such evidence would result in prejudice.89 As the relevant body of research grows regarding neurotransmitters such as MAOA and nitric oxide and as this research becomes more widely accepted in the scientific community, Hendricks v. Calderon90 may assist

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84. Id. at 2125.
85. Id. at 2126-27.
86. Increasingly, Parents Would Say Yes to Gene Engineering in Womb, BIOTECHNOLOGY NEWSWATCH, Nov. 6, 1995, at 1. The author cites a British study in which it was shown that over a 12-month period the number of people who would find genetic manipulation acceptable to prevent aggressive behavior more than tripled, from 5% to 18%. Id.
88. See Denno, supra note 62, at 255.
90. Id.
AGGRESSION GENES

In Hendricks, the defendant, Edgar Hendricks, was convicted of two counts of first-degree murder and was sentenced to death. On appeal, Hendricks argued that his trial counsel denied him his Sixth Amendment right to effective assistance of counsel by failing to call, during both the guilt and sentencing phases, two expert witnesses who could offer evidence of mitigating circumstances.\(^{91}\) The witnesses, Dr. Lisak and Dr. Dudley, testified during an evidentiary hearing that mental illness is highly prevalent in Hendricks's extended family and that he was genetically predisposed and vulnerable to serious mental illness. The doctors further testified that this genetic predisposition was exacerbated by a violent and traumatic upbringing that included years of physical, emotional, and sexual abuse.\(^{92}\) It is undisputed that had Dr. Dudley been called by the defense to testify at trial, he would have testified that Hendricks was genetically predisposed to insanity and thus had diminished capacity at the time of the killings.\(^{93}\)

The court found that while it was reasonable for trial counsel not to call the doctors to testify as to an insanity defense during the guilt phase, withholding this potential mitigating evidence of a genetic predisposition to mental illness and insanity at the sentencing phase was not reasonable under the circumstances and was prejudicial.\(^{94}\) Hendricks's trial counsel did not personally investigate the mental illness mitigating evidence, nor were reasonable efforts made to locate the witnesses and documents in order to present this evidence during sentencing.\(^{95}\)

The Supreme Court has held that this type of haphazard approach to presenting mitigating evidence during the punishment phase is not allowed when dealing with the seriousness of a potential capital sentence.\(^{96}\) Quoting Penry, the Hendricks court reiterated that "the jury must be able to consider and give effect to any mitigating evidence relevant to a defendant's background, character, or the circumstances of the crime."\(^{97}\) In Hendricks's case, evidence of a genetic predisposition to mental illness would certainly be classified as "relevant to a defendant's character."\(^{98}\) Thus, the court held that Hendricks's trial counsel's failure to offer, among other things, mitigating evidence of a genetic predisposition to

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91. Id. at 931-35. Hendricks relied on the Strickland test for prejudice: "the question is whether there is a reasonable probability that, absent the errors, the sentencer . . . would have concluded that the balance of aggravating and mitigating circumstances did not warrant death." Id. at 933 (citing Strickland v. Washington, 466 U.S. 668, 695 (1984)).

92. Id. at 934-35.

93. Id. at 935.

94. Id. at 942-46.

95. Id. at 944-45.


98. Id. at 947 (emphasis added).
mental illness and insanity at the sentencing phase resulted in prejudice.99

Hendricks illustrates that as evidence of the causal effect of aggression genes to criminal and antisocial behavior becomes more accessible and scientifically reliable, the combined effect of the Lockett,100 Daubert,101 and Strickland102 standards for admissibility of mitigating evidence will require courts to allow such evidence at the sentencing phase, as well as recognize the validity of ineffective counsel claims where such evidence is not offered.

IV. AGGRESSION GENES AND THE THEORIES OF PUNISHMENT

A. Retribution

Retributive theories of punishment have long been used to justify imposition of the death penalty. In Furman v. Georgia,103 the Supreme Court addressed the purpose and efficacy of retributive punishment when it stated,

The instinct for retribution is part of the nature of man, and channeling that instinct in the administration of criminal justice serves an important purpose . . . . When people begin to believe that organized society is unwilling or unable to impose upon criminal offenders the punishment they ‘deserve,’ then there are sown the seeds of anarchy . . . .104

While the death penalty was rejected by the Court in Furman, this language was later used by the Court in Gregg v. Georgia105 to justify the reinstatement of capital punishment in Georgia.106

The idea of retribution, or “just deserts,” is based on a strong presumption that the offender deserves to be punished in order to restore a balance to the scales of justice. “Deserve” is defined as “to be worthy, fit, or suitable for some reward or requital.”107 Thus, in the criminal sentencing context, a defendant must consciously direct his conduct in such a way that punishment commensurate to the crime committed is the most suitable way to ensure restoration of the balance of justice. Resort to such dictionary definitions emphasizes personal responsibility and culpability.

99. Id.
100. See supra notes 75-78 and accompanying text.
101. See supra notes 80-82 and accompanying text.
102. See supra note 91.
103. 408 U.S. 238 (1972).
104. Id. at 308 (Stewart, J., concurring).
106. The Gregg Court distinguished between the 1972 death penalty statute applied in the Furman case and Georgia’s revised death penalty statute by showing that the arbitrary “untrammeled discretion” that violated the Fourteenth Amendment’s proscriptions against cruel and unusual punishment in the earlier statute was ameliorated by a system that “provides for a bifurcated proceeding at which the sentencing authority is apprised of the information relevant to the imposition of sentence and provided with standards to guide its use of the information.” Id. at 195.
107. MERRIAM WEBSTER’S COLLEGIATE DICTIONARY 313 (10th ed. 1993).
Culpability plays a key role in the elucidation of two important assertions set forth by retributionists. First, the primary object of criminal sanctions is to punish culpable behavior. Although punishment may result in certain utilitarian benefits, notably the reduction of criminal behavior, the justification of punishment does not require such a showing; for it is moral and just that culpable behavior be punished. Second, the severity of the sanctions visited on the offender should be proportioned to the degree of his culpability.\textsuperscript{108}

Thus, for retributive punishment to be validly utilized, culpable behavior must be shown. Criminal “culpability” is defined as requiring “a showing that [the criminal] acted purposely, knowingly, recklessly or negligently, as the law may require, with respect to each material element of the offense.”\textsuperscript{109} When the presence of a possible aggression-causing gene enters the calculation of a criminal defendant’s behavior, the issue of culpability becomes less clear because such genetic evidence may show that the alleged criminal was acting in accordance with a genetic code and thus did not have complete control over his behavior.

Evidence of a genetic predisposition may nullify the retributive theory of punishment for aggressive, violent criminal behavior since such behavior in certain individuals may be the result of biological determinism as opposed to conscious, choice-based decision making. Scientists, however, warn against viewing behavior-causing factors in isolation. Defending his theory of how genetic factors influence violent behavior, Jonathan Glover contends that the combined effect of genes, neurodevelopmental, and environmental factors account for behavioral determinism.\textsuperscript{110} This theory of determinism dictates that retributive punishment should be restricted to those who have consciously “chosen to break the law.”\textsuperscript{111} Arguably, those who are not to blame for their actions due to genetic causes should not suffer commensurably for the crimes they have committed because retributive punishment would not achieve its social purpose.

**B. Rehabilitation**

It is not likely that rehabilitation will be successful with genetically predisposed criminals. This is because rehabilitative theories rest on the presumption that the cause of criminal behavior can be corrected. The rehabilitation theory holds that “human behavior is the product of antecedent causes, that these causes can be identified, and that on this basis therapeutic measures can be employed to effect changes in the behavior

\textsuperscript{109} BLACK’S LAW DICTIONARY 379 (6th ed. 1990).
\textsuperscript{110} Jonathan Glover, The Implications for Responsibility of Possible Genetic Factors in the Explanation of Violence, in GENETICS OF CRIMINAL AND ANTSOCIAL BEHAVIOUR, supra note 4, at 237.
\textsuperscript{111} Id. at 243.
of the person treated." Because this theory relies so heavily on behavior modification, it is not likely that a "genetically hard-wired" criminal would benefit from the rehabilitative measures that are currently available.

Unfortunately, it seems that if and when proof of a genetic predisposition toward criminal or violent behavior becomes scientifically accepted, it will likely have negative implications for "genetically programmed" violent individuals. According to Deborah Denno, lawyers may argue that rehabilitative efforts for a genetically predisposed criminal defendant would be futile since the basis for rehabilitation is the assumption that the offender's behavior can be modified. This argument could ultimately lead to the adoption of a hypothesis that such defendants should be penalized more, not less, because they are inherently dangerous and incurable.

While the potential of negating rehabilitative efforts for aggression gene carriers exists, conversely there are also potential sentencing alternatives that could allow society to deal with carriers in a positive, humane way. This could be accomplished by thinking of and treating violent behavior in terms of a public health model, thus dealing with the genetic predisposition in its earliest stages of behavior manifestation or preventing manifestation altogether. Dr. C. Ray Jeffery, a criminologist at Florida State University, compared this public health-based approach to the prevention of cancer or heart disease, when he stated, "Science [can replace] punishment and revenge with prevention and treatment."

Potential sentencing alternatives under rehabilitative theories could include such alternatives as developing and prescribing drug therapies to reverse or restore a chemical balance where a genetic deficiency has caused an imbalance. While research on MAOA deficiency, lowered nitric oxide levels, and Chromosome 11 abnormalities is still in the infancy stage, there is evidence that MAOA and Chromosome 11 abnormalities are linked to heightened serotonin levels. Serotonin-boosting drugs, such as Prozac, have proven very successful in the treatment of chemically based conditions like bipolar depression, which suggests that serotonin-reducing drugs could also be developed to ameliorate the violence-causing effects of these genetic abnormalities. Depressed nitric oxide levels, on the other hand, are not closely associated with serotonin levels. Scientists are hopeful, however, that drugs can be developed to replace the missing nitric oxide. Although the use of these hypothet-

113. See Denno, supra note 62, at 254.
114. Id.
115. Id.
116. Angier, supra note 9, at C1, C6.
117. Id. at C6.
118. See Nelkin, supra note 1, at 2123-24.
119. See Cases et al., supra note 34, at 1763.
120. See Birch, supra note 26, at 1A.
cal drug therapies is promising in the rehabilitative context, the development of such treatments is even farther off than the scientific acceptance of the existence of aggression genes in the first place.

Chemical castration, through the use of drugs like Depo-Provera, as a condition of parole for sex offenders has opened the door to the use of drugs in the criminal rehabilitative context. If and when the chemical treatment of aggression genes becomes a feasible sentencing alternative, such treatment may pose constitutional questions regarding the liberty interest of criminal defendants in maintaining their bodily integrity. While biological approaches to fighting violent propensities promise to remain controversial, some criminologists believe that medical therapies should not only be incorporated in the treatment of violent criminals, but that such therapy should be mandatory when it becomes available.

C. Deterrence

Deterrence is an example-based sentencing theory that relies on a presumption that "would-be" criminals will steer away from criminal behavior when they see the punishment received by convicted criminals. Thus, in order to be effective, the punishment must outweigh the benefit of committing the crime. An inherent problem with deterrence is that many criminal offenders do not think rationally about their criminal behavior. This problem may be even more acutely realized among those whose behavior is explained in whole or in part by genetic factors. The utilitarian goal of reducing crime through the example of convicted offenders, therefore, may not be best achieved by deterrence among those genetically predisposed to violence and aggression.

D. Incapacitation

As previously discussed, there is a fear that genetic evidence may lead juries to deliver harsher, longer sentences based on the conclusion that an offender with a genetic disorder cannot be cured or rehabilitated and, thus, should be incapacitated for a longer period of time. In light of the difficulties such genetic predisposition evidence poses to the efficient application or justification of the retribution, rehabilitation, and deterrence punishment theories, at the present time incapacitation seems the most logical choice.

Incapacitation is justified by the belief that society must protect itself from dangerous criminal offenders by completely eliminating the offender's ability to commit crime in the future. Critics of incapacitation

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123. Angier, supra note 9, at C1, C6 (citing Dr. Diana Fishbein, a criminologist with the U.S. Department of Justice).
124. LAFAVE & SCOTT, supra note 112, at 24-25.
125. See Denno, supra note 62, at 254.
126. LAFAVE & SCOTT, supra note 112, at 23-24.
denounce this theory because of the inherent difficulty in accurately predicting who will pose a danger of continuing criminality.\footnote{Id. at 24.} Genetically identifiable causation of violent behavior may, however, substantiate incapacitation theorists' claims that execution or life imprisonment is justified. Arguably the only way society can protect itself from persons who lack culpability for their actions due to a genetic predisposition to violent, impulsive behavior is through total isolation or elimination. Thus, the presence of a genetic abnormality may ultimately end up weighing against the criminal defendant as a risk assessment factor in sentencing decisions since "genetics appear as a way to predict the future, helping to anticipate . . . the likelihood of recidivism."\footnote{Id. at 24.}

Trying to prove Stephen Mobley's genetic predisposition to violence in \textit{Mobley}\footnote{Mobley v. State, 455 S.E.2d 61, 65-66 (Ga.), cert. denied, 116 S. Ct. 377 (1995); see supra notes 59-74 and accompanying text.} was an unsuccessful attempt by the defense to mitigate punishment and avoid the death penalty. While this tactic will likely be tried again, it is at least foreseeable that juries will respond to genetic predisposition information, absent effective drug therapies, by imposing longer, harsher sentences. In turn, juries may view themselves as on a crusade to remove the "bad apples" from the societal bushel.\footnote{One possible check against such reactionary determinism is the Supreme Court's decision in Robinson v. California, 370 U.S. 660 (1962). The Court held that chemical addiction, which in many cases can be tied to hereditary factors, may not be considered as a criminal offense. \textit{Id.} at 667. In a concurring opinion, Justice Douglas said, "We would forget the teachings of the Eighth Amendment if we allowed sickness to be made a crime and permitted sick people to be punished for being sick. This age of enlightenment cannot tolerate such barbarous action." \textit{Id.} at 678. It is certainly plausible that this line of reasoning could be extended to biologically linked aggression.} Because incapacitation raises the potential for eugenic justification of permanent incarceration, some commentators wonder if this theory will ultimately lead to the preventative isolation of children who are suspected of being genetically prone to criminal behavior—just as defective cars are recalled.\footnote{See Lawrence Taylor, \textit{The Genetic Defense}, 90 Sci. Dig. 44 (1982).}

\section*{V. ANALOGOUS GENETIC PREDISPOSITION DEFENSES}

When anticipating the future use of aggression gene information by criminal defendants, it is helpful to survey how other biological information has been used by criminal defendants in the past, and how it is viewed by courts today.

\subsection*{A. Alcoholism}

Research has long shown that those with alcoholic parents are more likely to develop alcoholism than those without alcoholic parents.\footnote{See ROBERT FLOMIN ET AL., \textit{BEHAVIORAL GENETICS: A PRIMER} 352 (1980).} In fact, a number of scientific studies have shown that alcoholism runs in biological families with severe alcoholism affecting twenty-two percent of...
the male relatives of alcoholics. Adoption and twin studies have shown that genetics play an important role in determining a person's vulnerability to alcoholism and that a distinction exists between crimes associated with alcoholism and those not associated with alcoholism. Although scientists have yet to identify the specific gene or genes which may predispose a person to alcoholism, twin and adoption studies help explain why showing a genetic predisposition should mitigate criminal punishment in some cases.

Courts that have heard cases in which defendants have been allowed to admit evidence of a genetic predisposition to alcoholism have demonstrated a judicial willingness to view genetic evidence as a mitigating factor, thus, lowering a defendant's culpability. Such recognition is starkly demonstrated by comparing two similar California state disbarment proceedings that involved attorneys with substance abuse problems who were accused of misappropriating client funds. In In re Ewaniszyk, the attorney was disbarred for his unethical conduct, while the defendant-attorney in Baker v. State Bar of California was able to offer evidence of a genetic predisposition to alcoholism and as a result was only placed on probation. It is important to note, however, that in the Baker case, the court did not view the defendant's genetic predisposition as a mitigating factor, but rather the fact that he was not aware of his condition and thus could not adjust his behavior accordingly.

The rationale of the Baker decision suggests that courts will still hold a person with lowered culpability, due to a genetic predisposition to violence, responsible for his actions if he is aware of the condition but fails to take appropriate steps to curb his violent, antisocial, or otherwise criminal behavior. Although there is currently no scientifically reliable way to demonstrate that the existence of a nitric oxide or MAOA abnormality in humans causes violent behavior, such evidence, once available, will likely only be allowed as a mitigating factor if a criminal defendant can show: (1) that he did not know he carried the genetic defect; or (2) that he knew of his condition and took all reasonable steps to eliminate any effects it might have on his behavior.

In Powell v. Texas, the Supreme Court considered whether alcoholism was in fact a disease that should be recognized as a constitutional

133. Id.
135. ENCYCLOPEDIA OF BIOETHICS, supra note 16, at 952.
137. See Denno, supra note 62, at 253-54.
139. Denno, supra note 62, at 254.
141. See Baker, 781 P.2d at 1352 n.6.
biological defense for excusing certain behavioral propensities. The Court in *Powell* argued that "a constitutional biological defense would be both difficult to administer from an evidentiary standpoint and would pose a serious policy dilemma by opening the floodgates for excusing compulsive behavior." The majority stated,

If Leroy Powell cannot be convicted of public intoxication, it is difficult to see how a State can convict an individual for murder, if that individual, while exhibiting normal behavior in all other respects, suffers from a 'compulsion' to kill, which is an 'exceedingly strong influence,' but 'not completely overpowering.'

The Court, however, did recognize a state's inherent authority to adopt new criminal defenses as it sees fit in accordance with an evolving understanding of human behavior.

The reluctance of the Court to extend a constitutional biological defense to alcoholism does not bode well for those who may attempt to gain such status for an aggression gene. There is hope, however, that the argument against punishing those whose criminal behavior is caused by a hereditary condition they cannot change, as put forth in Justice Fortas's dissent in the *Powell* case, will be adopted. Justice Fortas stated: "Its core meaning, as agreed by authorities, is that alcoholism is caused and maintained by something other than the moral fault of the alcoholic, something that, to a greater or lesser extent depending upon the physiological or psychological makeup and history of the individual, cannot be controlled by him."

**B. Positron Emission Tomography**

Positron emission tomography (PET) scans allow trained technicians to determine the existence of arachnoid cysts and metabolic imbalances in the scanned brain, which assist in making a diagnosis of insanity. The evidentiary allure of PET scans that show abnormal brain activity has caused many courts to allow such information to be considered in sentencing decisions. It was not until 1992, however, that a New York court allowed a criminal defendant to use PET scan results to try to establish an insanity defense. Although the court in *People v. Weinstein* allowed the defendant to enter PET scan evidence, the court limited its use. The PET scan results were allowed as diagnostic evidence of abnormal brain function; however, the court refused to allow the defense to

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143. *Id.* at 522.
144. Coffey, supra note 140, at 369.
145. *Powell*, 392 U.S. at 534; see also Coffey, supra note 140, at 369.
146. Coffey, supra note 140, at 370.
147. *Id.* at 371 (citing *Powell*, 392 U.S. at 561 (Fortas, J., dissenting)).
149. See Nelkin, supra note 1, at 2121.
link the findings with the defendant's actual violent behavior since the scientific community had yet to substantiate the association between the biological abnormality and the claimed predisposition theory.\textsuperscript{151}

The evidentiary acceptance of PET scans tracks the likely evolution that aggression genes will face in a courtroom: from consideration as a mitigating factor at the sentencing stage to admitting evidence of a biological excuse at the trial stage, accompanied by the usual relevant scientific knowledge hurdles.

C. XYY Defense

In 1968, scientists discovered what they then believed was a genetic explanation for criminal behavior when they found an extra Y chromosome trait shared by three percent of the male inmates at one hospital housing the criminally insane.\textsuperscript{152} Although this information has been used by a small number of criminal defendants in attempts to displace culpability, courts have generally rejected this genetic defense.\textsuperscript{153} Currently, the theory that XYY men are predisposed to aggression or violence is not recognized either as a valid defense or as a mitigating factor by either the medical or legal communities.\textsuperscript{154} In one of the most celebrated cases in which the XYY defense was attempted, the court refused to allow the evidence to reach the jury because "presently available medical evidence [was] unable to establish a reasonably certain causal connection between the XYY defect and [the] criminal conduct."\textsuperscript{155} It seems that any possible nitric oxide or MAOA defense is currently in the XYY stage because the findings are not yet substantive enough to prove a causal connection between the genetic abnormalities and violent behavior. In order for these new theories of genetic predisposition to criminality to gain more acceptance than the XYY defense, there must be more research with duplicative findings that will substantiate the initial findings of causation.

VI. CONCLUSION

The scientific and legal communities are on the edge of a new frontier with the discovery of genetic explanations for aggressive, violent behavior. Although research into nitric oxide and MAOA deficiency is still quite new, it is certain that this information will have an impact on the way the criminal justice system looks at, and treats, criminals carrying a violence-causing genetic abnormality. The Mobley case is just the tip of the iceberg, and it certainly foreshadows future attempts to admit evidence of genetic defects to reduce criminal culpability. A weakness of the current research, however, is that it does not address how the pres-

\textsuperscript{151} Anderson, supra note 150, at 2; see Weinstein, 591 N.Y.S.2d at 724-25.
\textsuperscript{152} Connor, supra note 56, at 19; see also Denno, supra note 62, at 249.
\textsuperscript{153} Denno, supra note 62, at 249.
\textsuperscript{154} Id. at 249-50.
\textsuperscript{155} Id. at 250 (citing State v. Roberts, 544 P.2d 754 (Wash. Ct. App. 1976)).
ence of a nitric oxide or MAOA deficiency acts when coupled with environmental or psychosocial stressors. Therefore, it is most likely that when this evidence achieves the necessary scientific status under the Daubert guidelines to be deemed admissible, it will be admitted for the limited purpose of showing a mitigating factor at the sentencing phase of punishment. This is the current trend among courts in using evidence of analogous genetic or hereditary factors.

Because it is likely that evidence of genetic predispositions to violent, antisocial behavior will ultimately be used in the courtroom, it is important that this information be used wisely and cautiously. Unfortunately, there is the possibility that those who favor the retribution and incapacitation theories of punishment will attempt to exploit the current climate of fear to validate “quick fix” solutions for punishing criminal offenders by claiming that the genetic die is cast and that the only way to protect society is either to lock affected individuals away for life or to eliminate them from society altogether. Such an approach would be detrimental not only to the individual offender but to society at large. It seems that the best that can be hoped for at this point is that advancements in drug therapies or treatments for genetically violence-prone individuals will either parallel, or quickly follow, the scientific validation of genetic predisposition evidence so that courts will have the option to use such information in a proactive rehabilitative context.