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Implications regarding the use of behavioral genetics in the criminal courtroom

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Boston University
IMPLICATIONS REGARDING THE USE OF BEHAVIORAL GENETICS IN THE CRIMINAL COURTROOM

by

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DEDICATION

I would like to dedicate this work to my loving parents Manju and Jamuna, and my first best friend, Ashwini.
ACKNOWLEDGMENTS

I want to thank all of my mentors and supporters along the way who helped me achieve my goals these past few years. My parents, for their undying support, love, and care packages. My sister, for always motivating me to keep going and for Facetiming with me for hours when I needed some real talk. Kyle, thank you for keeping me sane and never giving up on me through the most stressful of times. You all provided a listening ear with unwavering support, even when I didn’t believe I could do it myself.
Throughout history, humans have sought to find the mechanisms that drive human behavior. The field of behavioral genetics has grown to fill this desire, as modern techniques for research are being used to find a link between genetics and human behavior. One of the most primal and historical human traits is our propensity for violence and antisocial behaviors. Over the years, adoption studies and twin method studies have shown us that these traits are heritable to a certain degree, but advances in scientific research have allowed researchers to identify specific genetic polymorphisms and genetic factors that are associated with certain behaviors. In courtrooms across America, these genetic claims are becoming a bigger part of the defense’s arguments, and it has become important to further explore the consequences and implications of using behavioral genetics in the courtroom. First, the validity of these claims was assessed by looking at two of the most common genetic defenses, XYY syndrome and Brunner’s syndrome (associated with a genetic abnormality in the MAOA gene). Since the first claims were made in court, it was found that the XYY claim simply does not hold its ground in the courtroom any longer. The Brunner’s syndrome claim is found to be valid for use in court, however careful review of the circumstances is still required. Changes in the interpretation of MAOA effects, its
gene-environment interactions, and the inconsistencies in its use were examined to provide examples for why discretion is highly important. Upon establishing guidelines for validity, ethical issues were also considered, to identify the social implications of using these behavioral genetics data in the courtroom. Issues regarding determinism, labeling theory, racial tension, privacy, and discrimination are areas of daily life that are relevant to this increasing usage. Finally, a discussion is introduced on ways this data can be used outside the realm of criminal law, as it has also started to be used in civil law as well. The future of behavioral genetics research and the possibility of bringing neuroscience to the courtrooms are areas of discussion that show the need for the courts to understand the changing nature of defenses. In the end, this paper concluded that some key points must be achieved before use of behavioral genetics is as fair and ethical as possible. Unbiased education of judges and jury members is crucial before allowing the defense to present their interpretation of any genetic findings. More standards need to be in place to prevent the ethical dilemmas that arise. Courts must work towards standardizing approval for genetic claims to be made in court such that all defendants get a fair trial. In the end, an outright ban on the use of behavioral genetics in the courtroom would be irresponsible given the validity and importance of the claims. However its use must be carefully scrutinized, and the researchers, courts, and policy makers must work towards eliminating bias and the ethical concerns that arise, as well as carefully moving forward with research in the future.
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LIST OF ABBREVIATIONS

BU .................................................................................................................. Boston University
DNA.............................................................................................................. deoxyribonucleic acid
DZ twins ....................................................................................................... dizygotic twins
GINA................................................................. Genetic Information Nondiscrimination Act of 2008
GWAS ........................................................................................................... genome-wide association studies
HD ................................................................................................................ Huntington’s Disease
MAOA........................................................................................................ Monoamine Oxidase A
MZ twins .................................................................................................... monozygotic twins
INTRODUCTION

Throughout history, many theories have emerged as to explain what causes criminals to act in the way they do. This study of criminology dates far back to long before the modern methods of twin and adoption studies. In the 1800’s, Cesare Lombroso claimed that physical features of the face and body could drive individuals to crime. He asserted that the “characteristics presented by savage races are very often found among born criminals”, describing traits such as a “retreating forehead”, “pigmentation of the skin”, and “anomalies of the ear (41).” Charles Davenport, an important figure in the American eugenics movement, described criminal traits as remnants of our “animal ancestry [that] have never been got rid of (41).” Today these views are seen as completely invalid, however the question of whether an individuals’ DNA can manifest itself as criminal behavior is a highly researched and discussed topic. Over the years, there have been many established, contemporary psychological studies of human behavior describing what drives individuals to crime, and these conclusions have been shaping the criminal justice system ever since.

Behavioral Genetics

Behavioral genetics is the field of research that uses genetic methods to explore the nature and origin of individual differences in behavior. The goal of behavioral genetics research is to distinguish which parts of human behavior are influenced
innately by our DNA versus what comes from our environment (25). While today behavioral genetics is on the forefront of genetic research, it was almost completely discredited in its early years. In 1869, Francis Galton was the first to publish ideas regarding the heritability of human behavior (51). He believed that some type of inherited factor was having significant influences on differences in individual human behavior. Alongside other scientists of the day, Galton coined the term ‘eugenics’, meaning well-born in Greek, and an entire concept of selective mating and childbearing was born to help combat some of the major social issues of the day like poverty and lack of education. Regardless of his original goals with the ideas, eugenics soon evolved into a repressive movement, most notably adopted by the Nazis, and used as evidence to support the Holocaust. Because of this negative connotation with eugenics, the field of behavioral genetics was unpopular for many years. Near the end of the 20th century, researchers began to open the books on behavioral genetics again, and started smaller studies to see if there really could be a link between genetics and behavior (51). They created new methods and techniques for data analysis, namely the twin and adoption studies that are widely used today (81). Study of these individuals provides an amount of genetic control when looking at behavioral variables when the individuals were raised in similar and differing environments.
Research on Criminal Tendency

Twin and adoption studies are the primary way to start looking for a connection between genetics and criminal behavior, before starting to look at specific genes. These are the hallmark methods of behavioral genetics research, and the conclusions drawn from these studies provide a basis for continuing ethical and legal discussions on the matter. Because causality is difficult to definitively determine when looking at heritability and behavior, these methods allow researchers to get the first look at the possibilities for further research down the line.

Adoption Studies

Adoption studies are a unique spin-off from classic family studies in that they capitalize on the natural experiment of nature versus nurture. The main logic with adoption studies is that regardless of the environment that a child is raised in, if genetic factors are important for behavior, an adopted away child will maintain characteristics held by their biologic parents (51). Many behavioral traits have been shown to have some sort of genetic influence over the years.

Throughout the late 1900's, researchers have shown links between genetic factors and traits including intellectual ability and alcoholism (80, 17). They have also found links between genes and mood disorders and mental illnesses such as schizophrenia (56, 32). These studies all consistently show that having parents exhibiting these behaviors is associated with an increase in prevalence
of the same behaviors in biological children, regardless of by whom or where they were raised.

In adoption studies looking specifically at heritability of criminal behavior, if biological parents have been involved in criminal activity, it is thought that their biological children raised by adoptive parents (55) will also partake in criminal activity at higher rates than control populations. In 1972, an Iowa study looked at 52 adopted children of 41 women who were imprisoned (20). Crowe compared the arrest rates of the adopted children with criminal mothers to the arrest rates of a matched sample of adopted children. He found that there were significantly more adopted children with criminal mothers who had an arrest record than the control group. He concluded that there was an increased “prevalence of psychopathy among the relatives of criminals”. Another study done in 1978 by Bohman in Sweden reported similar results (10). In this large study, Bohman looked at fathers who had been involved in violent crimes and alcoholism, and found there was no association between violent criminality in the biological parent and their adopted-away children. They did however find a genetic component to petty criminal offenses. While the adoption studies do not specifically provide the strongest evidence for heritability of specifically violent criminal behavior, they still support a behavioral genetics claim that there is a genetic link to criminal behavior in general.
**Twin Method Studies**

The classic twin method of study for behavioral genetics is one of the most common research designs used. In these studies, researchers aim to compare the correlations of reared-together monozygotic twins (MZ) versus reared-together dizygotic twins (DZ). Reared together twins share the same environment, and depending on the type of twin, they share either 100% or 50% of their genetic material. Specifically, MZ twins shared 100% genetic similarity, as opposed to DZ who share 50% genetic similarity. Often in these studies, greater similarity is seen amongst MZ twins versus DZ twins, and this is used as evidence that there is a genetic basis for the trait being studied. Again, many studies have been done, similar to the adoption studies in the areas of intellectual ability (52), psychopathology (31), and things like social attitude (48).

In criminal twin studies, if a higher similarity is found in MZ twins for criminal activity versus DZ twins, then it can be concluded that there must be some sort of genetic influence (54). The first criminal twin study was done in Germany in the 1930’s, and was actually one of the earliest twin studies to ever be conducted (41). Johannes Lange located 13 MZ twins and 17 DZ twins, in which one of the pair had been in prison. Upon further review, he found that 10 of the MZ individuals had a twin who was also imprisoned, compared to only 2 of the DZ individuals. He concluded that there was significant importance to genetics playing a role in criminal behavior. Over the years, many additional studies have been conducted, with similar conclusions. In the 1970’s, a
Scandinavian study with 85 MZ twin pairs and 147 DZ twin pairs concluded that there was a higher concordance rate for the MZ twins (16). These twins had been selected from an open national registry and were not specifically selected for criminality or pulled from prison logs or police logs, increasing the reliability of the study by eliminating confounding variables. A 1995 study of twins from the Vietnam War era concluded that many antisocial traits associated with criminal behavior were “significantly heritable” (47). Because data for this study were pulled from self-reports of criminal behavior, underreporting is likely. However even with this caveat, the evidence still supported the conclusion that there is likely a genetic component to criminal behavior.

**Specific Genes and the Law**

In order to advance in the field of behavioral genetics, the next step for researchers is to identify the specific genetic polymorphisms and factors that correspond with certain behaviors. While research has been done looking at the general heritability of behavior criminal behavior with the twin and adoption studies, recent advances in the field have begun to suggest links between specific gene variants and propensity for criminal behavior (38). While there is no “crime gene” per say as of yet, these specific links cannot be ignored and have already begun to enter the courtroom. The ability to screen for specific genes has raised many questions, including whether or not genetic screening can be used as reliable evidence. The use of behavioral genetics in the justice system creates
many questions in the fields of ethics, policy, and law. This new insight has the power to profoundly alter the way we interpret and react to criminal behavior.

Criminal Law Process

In the realm of the criminal law process, behavioral genetics can come into play in two major ways: determining responsibility for actions and during the sentencing process.

In terms of determining responsibility, proving that a defendant is guilty of their charge requires that two foundational elements are established concurrently: actus reus and mens rea (2, 57). These two key terms come from the phrase “Actus non facit reum nisi mens sit rea” which literally means “an act does not make a person guilty unless mind is also guilty.” The rationale behind this rule is that it is morally wrong to punish an individual for causing harm that they did not intend. To constitute true criminal behavior, a person must commit actus reus, a guilty act, simultaneously with mens rea, a guilty mind (with guilty intent). A caveat to this rule is that true actus reus requires a voluntary act in order for the individual to be responsible for their actions (2). Behavioral genetics could be used in this setting as evidence to disprove actus reus, saying that the act committed by the defendant was not guilty due to some sort of genetic variant causing the person to act in an involuntary way (i.e. a gene correlated with increased violent behavior) (8). Alternatively, genetics could be used to disprove mens rea, stating that the defendant’s intent in the situation was not guilty due to
some sort of genetic variant causing the person to believe their actions would not
be harmful (i.e. a gene correlated with lack of capacity or insanity). If by the end
of the trial the defendant is still found guilty, behavioral genetics can also be
brought into play to impact the sentencing process. If unable to completely
negate criminal responsibility, lawyers can use behavioral genetics to at least
lessen the criminal responsibility of the defendant in the ways described above
with the goal of lessening the amount or type of punishment given. In this way,
the data could be used as a mitigating factor in a criminal defense to lessen
responsibility by the defendant.
SPECIFIC AIM

U.S. courts allow “any aspect of character or record” to be used as a mitigating factor during sentencing (44). In recent years, the increase in behavioral genetics making its way into courtrooms has been met with a level of intrigue and skepticism by jury members and the scientific community alike. Data show that there is an increasing trend in the use of behavioral genetics in criminal cases, increasing from around 100 judicial cases in 2005 to around 300 opinions in 2012 (26). As more and more research is done in these areas, and more and more lawyers are coming on board, comfortable with presenting these data in court, it is necessary to take a hard look at the ethics and implications of allowing these data to be presented. This paper aims to take a direct look at the results of some key court cases that presented behavioral genetic information as evidence in different ways to see if the conclusions drawn in court are in line with the scientific literature today. Additionally this paper will take a look at some of the ethical, social, and psychological considerations that must be taken into account when dealing with behavioral genetics to determine at what cost this evidence is being used at. Finally, this paper will attempt to draw a conclusion on the implications of using behavioral genetics in the courtroom with the intention of determining under what circumstances behavioral genetics should be used in court.
The XYY Claim in the Courtroom

Genetics was first brought to the courts in the 1960’s, regarding the XYY syndrome. Normal individuals have 46 chromosomes in each cell, 2 of which are referred to as sex chromosomes X and Y. Females generally have two X chromosomes, while males have one X chromosome and one Y chromosome. Individuals with XYY syndrome are males who have an extra Y chromosome due to an error during cell division involving nondisjunction. This will result in a sperm cell carrying two Y chromosomes instead of the usual one. If this sperm cell is used in the genetic makeup of a child, then the child will be born with the genotype YY (from the father) and X from the mother. This condition affects approximately 1 in 1000 male births, and is a random event, meaning that it is not heritable (1). The syndrome manifests in both physical and mental symptoms. Physically, XYY individuals grow faster and bigger than their XY counterparts and are generally much taller than the average man. Mentally, the syndrome is associated with lower IQ and increased risk of learning disabilities, along with delayed motor skills, weak muscle tone, and other movement disorders. Most important to defense attorneys however is the link between the syndrome and increased antisocial, aggressive, and criminal behavior (28).
**XXY and Criminal Behavior**

The first instance of criminal behavior being associated with the XYY syndrome was documented in 1962 (27). In a letter to the Lancet journal, Dr. William Court Brown described that the chromosomally abnormal males displayed a tendency towards criminal behavior including fire-starting, larceny, and indecent exposure (18). He questioned whether these individuals could be held accountable by the law for their actions given this predisposition. This idea was further investigated in 1965 by Dr. Patricia Jacobs, who looked at populations of incarcerated individuals at a maximum security prison in Scotland (37, 68). The study looked at a group of individuals who were being held for especially heinous crimes and were held under special surveillance. Jacobs hoped to find evidence that within this group of individuals, there was a higher incidence of the XYY chromosomal abnormality, supporting the idea that XYY individuals are prone to more aggressive behavior than the general population. Her study showed that 3% of the individuals incarcerated were of the XYY genotype (37). The next step was to compare this figure to the prevalence of the XYY genotype in a general population, to see if the numbers were similar, or significantly different. In 1966, a combined study looking at individuals in Canada, the United States, and Scotland, predicted an overall figure of 1.5 XYY individuals born for every 1000 births (12). This puts the percentage of XYY individuals in the general population at about 0.15%. This finding made Jacobs’ study findings statistically significant, as the XYY population numbers she found
in the prisons represented a 20-fold increase over the general newborn incidence.

**XYY in Court**

At the time of release of these studies, lawyers began to immediately use these data to support a claim that their client was acting involuntarily when committing the crimes he was accused of.

The first attempt to bring this matter to court was in 1968, during the trial for the murder of Mrs. Margaret Burke (73). Sean Farley was convicted of rape and murder in Queens, New York. Sean had the XYY genotype, coupled with a past history of anti-social behavior. For the first time, lawyers argued that a genetic anomaly in their defendant coupled with his past psychiatric history made him unable to formulate the mens rea (guilty mind) to commit murder. While this initial attempt failed to sway the jury, the courts acceptance of the evidence opened the door for many future XYY cases. In the 1970 case People v. Tanner, the defendant was convicted of assault, rape and murder, but used a similar XYY claim stating that due to the chromosomal abnormality, the defendant was exposed to higher levels of aggressiveness (65). The defendant was able to call in expert testimony as well and held the position that he was legally insane at the time of committing the crime, and argued that he not be held responsible for his actions. Again, the court denied this claim and the defendant was convicted, proving that even an expert testimony was not enough to prove that without a
doubt the genetic abnormality caused the individuals behavior. They stated that the evidence collected did not suggest that all XYY individuals are by nature involuntarily aggressive, and could therefore not conclude that the XYY genotype was to blame (65). Though unable to really make a difference in sentencing, these XYY cases, and many more, demonstrated the fact that the courts have not completely shut out the use of behavioral genetics as evidence in the courtroom. Rather they hold it to a very high bar for determining a causal relationship.

**The Brunner Syndrome Claim in the Courtroom**

Brunner Syndrome is a recessive genetic disorder that is characterized by an increase in impulsiveness, aggression, and violence (53). It is most closely associated with a deficiency in the enzyme Monamine Oxidase A (MAOA). Around 40% of the population has the MAOA gene variant causing a deficiency in the amount of MAOA enzyme, however the associated symptoms described as Brunner’s syndrome are relatively rare (35). MAOA is an enzyme that catalyzes the oxidative deamination of amines in the brain and peripheral tissues, specifically serotonin (5-HT) (76).
MAOA and Criminal Behavior

For many years, it has been shown that low levels of 5-HT are associated with a predisposition to impulsive and aggressive behavior (43). Any genetic defects to the enzymes that metabolize 5-HT are a candidate for psychiatric and behavioral study, as it can directly affect the amount of the neurotransmitter in the brain. In 1993, Brunner studied a group of men from a single family in the Netherlands who all exhibited similar traits of borderline mental retardation and violent aggressive tendency (11). He noticed that five of the males in the group contained a DNA base change in the region that codes for MAOA. He discovered that this mutation resulted in lack of the MAOA enzyme for these individuals. As stated above, MAOA is an enzyme that is directly responsible for the metabolism of 5-HT, so the lack of MAOA resulted in a cascade effect causing overall low concentrations of 5-HT in the brains of these men as compared to the general population. Brunner concluded that the MAOA genetic defect was the underlying cause for the abnormally aggressive behavior patterns he noticed in the group of men. This was the first time that an association had been made specifically between the MAOA gene variant and aggressive behaviors, and the term ‘Brunner’s Syndrome’ was coined.

MAOA in Court

Within a few years of Brunner’s original 1993 findings being published, defendants were bringing this evidence to court to lessen their charges for violent
criminal acts (82). In the 1998 case Turpin v. Mobley, Mobley was being charged with the death sentence for murder. His defense team introduced Brunner’s paper to the court, and explained that like the family in the Netherlands that was studied, Mobley’s family also contained a history of generations of individuals who had all been involved in acts of violence and aggression. Armed with the newly published article describing the MAOA genetic variant, they requested that Mobley be tested for the genetic polymorphism with the intention that if he had the variant, he should not be charged as harshly as it would act as a mitigating factor in his case. At the time, the courts denied this request due to the lack of evidence supporting the causality of the variant and the criminal behavior, but also because they believe it was unlikely Mobley had the same genetic variant as the family in the Netherlands. Additionally court funds were low. While not actually tested for in this case, this Brunner’s syndrome claim opened the doors for the genetic variant to gain some momentum in the courts.

One of the more publicized and media driven stories in recent years was that of the State v. Waldroup in 2011 (77). Waldroup was accused and convicted of two counts of first degree murder and two counts of aggravated kidnapping. The crime was especially heinous and made headlines in the news (38). Being years after the initial description of the MAOA genetic variant, defense lawyers immediately screened for the MAOA gene defect. When Waldroup tested positive, they successfully used the Brunner’s syndrome claim to reduce his charges and sentences (77). Over the years the MAOA claim has gained
backing, and the courts initial apprehension about accepting the data has changed. In the Mobley case, the decision to not test for the MAOA variant was likely due to concern for the validity of the recently published paper at the time.

The courts continue to prove that they are open to hearing behavioral genetics in the courtroom, however they are also careful not to accept new research too soon before allowing the claims to be confirmed. In the cases describe above, it took almost ten years for the courts to allow behavioral genetics research to influence their decisions.

**Debunking the XYY Myth**

Over the years however, the use of an XYY defense has been largely discredited due to lack of evidence for causality and errors in research methods resulting in heavily biased data. One of the biggest issues with the research that was done early on has to do with sampling. Many studies were done by screening individuals for XYY who actively presented with violent and criminal behavior and also matched the trait of increased height (27). Studies were done first screening for criminality (usually individuals in prisons or mental institutions), and a second screening was done for those over the height of 6 feet. Though the data collected supported the claim that there were higher rates of XYY individuals in these settings, variables like small sample size and heterogeneity of sample locations may have biased the data and overstated the predictability of criminal behavior based on having the XYY genotype (68). Today, research is
being done to try to correct many of the pitfalls of past experimental data. Most studies maintain that the incidence of XYY males in the prison system is significantly higher than the incidence found in the general population (27), however the interpretation of this finding has changed. Each incidence of XYY syndrome must be individually studied in the courtroom to determine what aspects of the syndrome and its symptoms are present and influencing the accused individual. More recently, socioeconomic measures are also being accounted for in XYY studies. A 2012 study showed that XYY individuals had a moderately increased overall risk of conviction over the controls, however this difference disappeared when adjusting for socioeconomic parameters (78, 79). It is evident from the data that there are more XYY individuals to be found in incarcerated populations than in the general population, but it is becoming more and more clear that one cannot make conclusions regarding criminal propensity based on this genotype. By jumping to accept the XYY claims made in the earlier days, the XYY defense crept into the courtrooms for years, allowing for unsubstantiated information to be brought to court. Defendants using the XYY defense presented data that while valid and supported, was being interpreted incorrectly. Genetic fallacies were rampant in the criminal law system for years as a result, with juries and judges jumping to dangerous conclusions simply based on an individual’s genes. Today, at best, lawyers will be able to construct a model for how the XYY genotype can be associated with criminal behavior, but
due to the lack of consistent causal data, they cannot responsibly assert that the cause for a defendant’s actions is the genetic variant.

**MAOA Research Over the Years**

Over the years, the Brunner’s syndrome claim has become one of the most documented traits to be brought up in court successfully. Today, it is even referred to as the ‘warrior gene’ in media and the general population (23). The association between the gene variant and behavioral and aggressive criminal action has been largely upheld by researchers (50), so the specific claims of the early court cases can be validated to a certain extent. Following Brunner’s initial research, many studies have been done to further support these conclusions, as well as add to them in new ways. While the associations are valid, it is still hard to fully accept these associations with the large amount of variability in the trait in the population. The MAOA gene variant discussed can be seen in as much as 40% of the population (35). However it is obvious that 40% of the population does not act out in aggressive and antisocial ways. This suggests that there must be something else influencing this behavior. In fact, there is new evidence that has been introduced suggesting that there may be a link between the environment that an individual was raised in and the presence of MAOA-linked aggression. Growing up, children who face trauma and abuse can display large amounts of variability in their eventual mental health outcomes as adults (86). While many children will grow to develop behavioral and emotional problems,
many other children express high levels of resiliency and are able to function at much higher levels than would be predicted due to their history of facing adversity. This variability has been the subject of studies for many years as researchers aim to determine the factors responsible for this wide range of outcomes (86).

**Gene-Interaction Research on MAOA**

Gene-environment interaction describes a phenomenon in which genetic effects are activated or amplified due to exposure to a certain environment (75). In 2002, Caspi et. al did a study to see if the aggression and antisocial behavioral effects of the MAOA gene variant were in any way related to the experiences an adult had during childhood involving trauma, violence, and/or abuse (13). Instead of starting with a violent and aggressive population as Brunner did with the incarcerated populations, Caspi started by looking at a large group of male adults who had the genetic MAOA variant that is associated with aggression and antisocial behavior. He then took detailed history on the childhood of these adults to determine the amount of trauma and abuse they had experienced. He also took personal histories to quantify and qualify the presence of aggressive and violent behavior in the adults. He found that when adults had low MAOA levels (Brunner’s variant) and had been mistreated as a child, they were more likely to be aggressive and develop antisocial personalities in adulthood than individuals with higher levels of MAOA (normal variant) and similar negative childhood
experiences. This study suggested and provided support for the conclusion that there was a gene-environment interaction that changed the effects of the MAOA gene variant in individuals. He concluded that having the MAOA gene variant that results in Brunner’s syndrome was a significant risk factor for displaying aggressive and antisocial behavior when looking at individuals who report and describe abuse and maltreatment as children. In 2006, Cohen did another study to further replicate and validate these results (40) and confirm that the MAOA gene variant influences an individual’s ability to maintain resiliency in childhood which affects adult behavior and decision making. These conclusions, while strongly supported in the data, must also be carefully understood and interpreted as the associations between genetics and complex behaviors and emotions will always be difficult to confirm (60).

**Inconsistencies Using MAOA Defense in Court**

The understanding of the gene-environment interaction above, along with continued studies on the topic create a problem when using the MAOA defense, and similar new findings in court. New information and new studies that are done can change the acceptance of the MAOA warrior gene claims and illustrates that courts must be very careful in how they choose to accept behavioral genetic data. In the Mobley case, the courts were not as open to the new science that was being presented to them and as a result, the defendant was not given the chance to lessen his sentence. Yet on the same grounds, years later, the court
fully accepted the MAOA defense and went so far as to reduce Waldroup’s sentencing. A lack of consistency in how behavioral genetics evidence is handled in different courts makes it difficult to say how fair using these defenses truly is. This is an especially important area to tackle and clarify for the justice system and defendants moving forward as more and more genetic links to behavior are discovered. In the years to come, it will be dangerous to jump to conclusions regarding certain genetic claims (as evidenced by the XYY claims), yet it can be just as unjust to disregard them (as evidenced by the MAOA claims).
DISCUSSION

Issues Regarding Stigma: Genetic Determinism

As public understanding of genetics increases over the years through media and formal school, behavioral genetics research, similar to conventional genetic research, is falling prey to fallacies regarding genetic determinism (70). This concept is the idea that holds that all events, including human action, are ultimately determined by causes external to random choice (14). It is the idea that our DNA “hardwires” us to behave in a certain way that free will cannot control (61). When the power of genetics to control human behavior is overstated, there is an increasing misconception regarding what it actually means to have, for example, a genetic polymorphism associated with increased criminality (9). Choosing to use behavioral genetic information in the courtroom as evidence becomes a double-edged sword. While the evidence can be successfully used to reduce a sentence, it can also promote stigmatization of the individuals and his family, and others with the genetic variant as well.

Issues Regarding Stigma: Labeling Theory in Individuals, Families, and Others

By establishing that a person is more likely to be involved in criminal behavior, either through testing of the MAOA warrior gene or through knowledge
of XYY DNA, an ethical dilemma arises regarding labeling theory and can create a self-fulfilling prophecy. Labeling theory is a theory describing how the behavior of an individual may be determined or influenced by the terms or categories used to define him or her (83). In other words, it is the idea that an individual will become what he or she is labeled or what others expect him or her to become, particularly in negative or stigmatizing labels. In regards to behavioral genetics, telling an individual that he or she is more likely to commit criminal acts due to their genetics can be damaging to their psychological well-being, and can create a self-fulfilling prophecy. In one way, an individual who believes that he is more prone to violence may try to take steps to minimize their interaction with triggering and highly emotional situations. However in another way, a person who has completely shifted the blame to their genes and away from their choices may believe that he has no choice but to behave in a violent manner, and may actually partake in violent and antisocial behavior more than he normally would otherwise (59).

Bringing up behavioral genetic links to aggressive behavior in court can also have an impact on the families of the accused. Many people assume that there is a one-to-one association between genes and behavior (6) and this genetic fallacy can prove to be very concerning for individuals who believe that they are inheriting antisocial behavior from, for example, a criminal parent. The idea of inheriting personality traits has been evident throughout history as seen in the hierarchical social and political structures that have maintained for years
where the royalty and riches were passed down based on family name (85). Today, much work has been done to eradicate these ideas and opinions as social mobility is such a deep rooted part of the American society (8), but the issues persist today creating problems for family members of the accused.

Similarly, individuals who carry the genetic variants described in court may stigmatize others, who have not been involved with the law, in negative ways. Following the research released on the XYY gene in the 1960’s, while criminal defendants were shifting the blame and responsibility for their actions onto their genetic variant, thousands of innocent individuals with the XYY variant were being stigmatized as criminals (66). Hospitals were even screening newborns for XYY as a possible reason for selective abortion (66). A curious dilemma arises where using behavioral genetics in courts. It can in one way declare guilty criminals more innocent, and declare innocent non-criminals as potentially guilty.

**Issues Regarding Race**

In behavior genetics research, the genetic variants associated with aggressive and criminal behavior is not something that is readily visible to others, as it is imbedded in our DNA. When a gene begins to be associated in higher rates to a certain ethnic or racial group, the potential for stigma becomes apparent. The physical features of the implicated individuals is what soon becomes associated with certain behavioral traits, as opposed to the actual genetic variant (70). If the implicated individuals are of similar background and
ethnicity or race, then it is the differentiating physical features of those specific ethnic and racial groups that becomes associated with certain behavior traits.

XYY syndrome is a chromosomal disorder that affects all races and ethnicities in similar proportions (58). The MAOA warrior gene variant however appears to have different prevalence in different parts of the world. Up until 2002, all studies done on the MAOA gene were done in Caucasian individuals (13). In 2006, researchers in New Zealand started investigating the prevalence of the gene in Maori culture, a culture with historic and traditional fundamental values of warfare and aggressive behavior (64). Today, the Maori are mostly integrated with the modern New Zealand society, yet in many socioeconomic ways, they lag behind the general Caucasian population. The Maori population in New Zealand is also cited as having high levels of criminal activity and imprisonment over the European and Pacific Island populations (62). 51% of individuals in New Zealand prisons are of Maori descent as compared to 33% and 12% of Europeans and Pacific Islanders, respectively. The Maori were chosen initially to see if their historical values of aggression and warfare may have been selected for genetically via the MAOA variant. In the end, the behavioral genetics study showed that Maori males living in New Zealand did have a higher prevalence of the MAOA warrior gene than white Caucasians (42). With the variant associated with aggressive behaviors, violence, and criminal activity, it is easy to see how this information can quickly take on racial connotations (84).
Furthermore, it has since been found that Maori were not the only ethnic group with a higher prevalence of the variant gene. While the gene occurred in 56% of Maori males, it was also present in 58% of African American males, 61% of Taiwanese males, 56% of Chinese males, and 34% of European males (45, 46). Information like this, when presented in court, can be easily misinterpreted by the general public and media to create a narrative as to why certain racial groups appear to have increased rates of criminal activity. The idea that entire populations of individuals identifying as certain races are predisposed to aggressive behaviors as opposed to individuals being predisposed to aggressive behaviors is a conclusion that can be irresponsibly made if the results of the study are misinterpreted by the general public.

Upon recognizing this difference in prevalence of the MAOA gene among racial lines, a study was done to determine whether Caucasians with a MAOA gene variant and African Americans with a MAOA gene variant are affected similarly by the polymorphism (15). In an attempt to see if there were any other factors affecting this association, the study concluded that given the MAOA variant, both Caucasians and African Americans had an equally increased risk for antisocial behavior in adulthood. This helps the case that individuals of different race are no more or less dangerous than others when it comes to having the MAOA variant, however on the scale of populations, the ethnic differences can cause misunderstanding and bias. Allowing behavioral genetics to take the next step from linking genes and individual behavior to linking genes
and a population’s behavior can be dangerous to society and can validate the irresponsible claims of genetics supporting racial inequality.

In the courtroom, these data could be used in a few different ways to propagate racism. It is possible that a defense would try to claim race as a mitigating factor in criminal trial. Alternatively a prosecutor could try to sway a jury with data stating that a certain race is more predisposed to aggressive behavior. In any case, the evidence being raised in court would be skewed by racial bias leading to unfair trials. With more and more genetics being introduced to court cases as a way to explain behavior, it is important to go back to the basics of the justice system and remember what we are putting on trial – individuals. Because of our genetic fallacies, it is sometimes hard to separate an individual’s genetics versus and individual’s self. Though more and more links are being found over the years, an individual’s genetics cannot define every part of their being.

Issues Regarding Privacy and Discrimination

When bringing genetics into the court room, an individual’s privacy is put on the line in an attempt to sway the jury one way or another. Yet after the trial, this information is still documented as free knowledge, and there becomes an issue regarding privacy. Courts have to balance the opposing ideas of public need and privacy when handling any sort of medical information released in court, and genetic information is no different (49). A new fear facing Americans is
evolving regarding genetic testing. Individuals are becoming more and more concerned that undergoing genetic testing may lead to discrimination in various aspects of their lives (30). The Genetic Information Nondiscrimination Act of 2008 (GINA) was enacted to protect Americans from this discrimination in the workplace as well as in dealings with insurance companies. The law protects medical genetic testing information from being used against an individual. However this same protection has not been made available for individuals undergoing behavioral genetic testing. In the past years, the implications of being genetically tested for behavioral associations has proven to be more than just a courtroom issue. In 2012, a study was done to see if the MAOA gene variation associated with risk taking and aggressive behaviors could be associated with increased credit card debt (22). Upon looking at populations of individuals with low MAOA levels (Brunner’s variant), the study shows an overall 8% increase in the amount of credit card debt between MAOA variant individuals and the control group that was studied. The study immediately sparks the question of whether credit card companies could use genetic information to discriminate against a person who is trying to obtain credit. If it is on the medical record that an individual has the MAOA variant, creditors could use this information to deny loans or credit applications. It could spill into the housing market as well, with individuals unable to get clearance to sign leases and rental agreements. While GINA protects against employment and insurance discrimination with regards to medical genetics and pre-existing conditions, there is nothing to say that credit
lenders could not also use this information with negative consequences for the individual in question. As more and more people are getting genetically screened for behavioral traits in the courtroom, this is just another unforeseen consequence of having this information readily available. The results of this study would suggest that more needs to be done in the policy arena to prevent genetic discrimination is all different aspects. As more and more genes are discovered to be associated with behavioral traits, there are many different aspects of people’s lives that will be affected by this information being brought up in court, apart from just using it as criminal evidence.

**Behavioral Genetics Use Outside of Criminal Law**

The massive ethics debate surrounding the use of behavioral genetics in the criminal courtroom has been described in detail above, but it is really just the tip of the iceberg when one considers the future implications of this research in other aspects of the law. There are a number of minor legal proceeding in which evaluations of aggressive tendency and antisocial behavior are used. This issue is commonly raised in bail and parole hearings, sex offender registrations, and instances of character assessment such as those in domestic abuse cases. Many of the same ethical concerns regarding bringing genetic behavioral information to court are similar for these instances. The major difference in these cases however is determining if this scientific evidence is really appropriate or relevant in a predictive manner, as opposed to a criminal manner where the
defendant has already been convicted of wrongdoing. Jumping to conclusions preemptively can cause misunderstanding in the lay community, leading judges and jury members to believe that the scientific data holds more certainty in regards to predicting behavior than in reality (7). This is a problem that we see in criminal law proceedings as well, and the ethical dilemmas that come out of this are very similar to those coming out of criminal law cases.

Another implication of using behavioral genetics in criminal law proceedings is the possibility for this evidence to begin being used in civil law, family law, and perhaps social welfare eligibility cases as well. Again the major difference in these cases is allowing the scientific data to be used in a predictive manner. The following examples introduce the idea of a court compelling an individual to obtain genetic testing to be used as evidence preemptively (4). For example, in 2013, a woman was suing her landlord for injuries she sustained in a fire in her apartment (3). During the trial, the court insisted that the woman undergo genetic testing for Huntington’s Disease (HD), a disease that runs in her family, to ensure that her disabilities were due to the fire injuries and not due to the genetic disease. Because more individuals with a family history of HD choose not to undergo genetic testing in early adulthood, this request was met with resistance. This was one of the first times that a judge has requested that genetic testing be done in this way to provide further evidence in a civil case (4). In family law cases involving child custody and divorce, many states allow routine psychological evaluations. With the introduction of behavioral genetics, lawyers
and judges may see fit to include court-ordered genetic testing as evidence to
decide which parent is more fit to obtain custody of the children. And in welfare
services situations, while many states have already implemented mandatory drug
screening in order to receive payments (63), the increasing research into
addiction and genetic risk factors for addiction (24) make it easy to see a
potential for court-ordered genetic testing down the line to test for potential drug
use of welfare recipients in the future.

Because civil cases are not a matter of life and death in most instances,
the standard for scientific analysis is much lower (8, 9) than they would be in
criminal trial. While criminal law focuses on the behavioral genetics of aggression
and violent behaviors, there are a number of new links being discovered for a
range of personality and behavioral traits that can be used in various aspects of
the law. It is hard to say if these associations should be allowed in courts due to
the amount of misinformation and overgeneralization of the results.

Future of Behavioral Genetics Research

The future of research in the area of behavioral genetics faces many of
the same limitations and challenges as in the area of medical genetics. Studies
must be replicated over and over again with consistent findings before it will
become safe to draw strong conclusions between genetic polymorphisms and
behavior. The current methods of looking at genome-wide association studies
(GWAS) as a means of discovering novel gene variants has been especially
successful in the medical realm (36). However it is still very hard to draw these strong conclusions for behavioral traits (19). The variables involved in the studies are so difficult to control for, which is one of the main reasons for a lack of replication of many of the landmark studies described above that associate a genetic marker with a behavioral trait. In order to successfully push forward with the GWASs, massive studies need to be conducted on a scale that has not yet been tackled. Collaboration among groups of scientists in different countries and labs is required to effectively come to stronger conclusions.

**Neuroscience in the Courtroom**

A growing direction for the future of genetics and biology in the courtroom is the introduction of neuroscience to the scientific evidence. In the past 10 years, over 1585 judicial opinions have been cited as using neurobiological data in some capacity during the criminal defense (26). Around 5% of all murder trials and 25% of all death penalty trials have included some mentions of neuroscientific data in an attempt to lessen the charges or sentencing. Neurobiologic data are different than behavioral genetic data in that it often includes things like medical history (such as history of brain injury or damage), neuropsychological testing results (such as interviews and therapy notes), and also brain scanning (providing imaging).

Brain imaging has been involved in the court system for many years, beginning in the late 80’s with the trial of John Hinckley Jr., the man who was
accused of the attempted assassination of President Ronald Reagan (34).

Lawyers showed a computed tomography x-ray scan of Hinckley’s head which showed shrinkage of the brain and abnormally large ventricles. These findings are often associated with mental deficiency, and thus this defense was brought to court. While it hasn’t been investigated further, in the end, the charges against Hinckley were ultimately dropped due to a plea of insanity, a claim that may have been influenced by the neurobiologic evidence. Over the years, lawyers have introduced many other types of brain scans into the courtroom, including PET scans, structural MRI, and fMRI scans. After scanning the brains of dozens of mental illness patients along with hundreds of healthy controls, researchers were able to predict the presence of certain diseases based on how the brain scans looked. For example, structural MRI scans can predict associations with schizophrenia disease with 80% accuracy (21). The research into associating imaging with mental illness and behavioral traits is a new venture into examining the human condition, and is becoming an important area for much growth in understanding.

Objective data are crucial to an unbiased evidence pool. The major issue in using neurobiologic data in court is brain scans are usually the only objective portion of the scientific data being brought to court, and they only are present in 15% of the neuroscience evidence cases (26). The rest of the cases have been relying on subjective evidence from neurologic testing, and even in some cases, just anecdotal stories of previous head injury. This is a problem because the
validity of the neuroscientific claims diminished when the data presented are only
sometimes subjective with no unbiased data to corroborate it. Additionally, in
cases where brain scanning is actually discussed, MRI or CT scans are the most
common studies that are presented (26). This is to say that the more
sophisticated and functional neuroimaging such as EEG and fMRI are only used
in 2% of cases, imaging that may be more beneficial to the case at hand. It is
much harder to associate neurobiologic findings with aggressive behavior than
when using behavioral genetics. One of the unique aspects of using
neurobiologic data in court is that it can add evidence to support claims of
incompetency, unlike behavioral genetics. In this way, it is much more
successfully used in the pretrial stages and also to delay trials once they have
already begun (26). The big issue with this that has emerged however is that the
neuroscience data are being used in situations that have not yet even been
studied by researchers. While researchers have discussed the use of this data
for mitigation of punishment, they have not discussed its use in determining
competency to stand trial. Yet as described, one of the most common reasons for
bringing neuroscience data to trial is to challenge competency. Again, it is going
to be important for those in the legal system and neuroscientists to work together
to ensure understanding both ways. Because the use of neuroscience is growing
and only going to increase, efforts must be pushed towards minimizing
differences between the public’s perception of the data and what the actual
results of research are.
CONCLUSION

The way we look at behavior and the human condition has changed so much since the origins of this study, due in large part to the findings of behavioral genetics research. What started as an effort to examine if behavior could be heritable through basic methods of twin and adoption studies has since expanded and grown as the importance of these original findings were published. Over the years, as more polymorphisms were identified as associated with disease and pathology, the search was on to find specific genes that may also influence behavior. As more and more of these genetic variants were identified, it became crucial to validate and further support these findings, and along the way, gene-interaction studies grew and began to shed light on some of the phenomena that were observed in these genetic studies.

In the end, the discussion about using behavioral genetics in the courtroom comes down to efficacy. If using this evidence is really making a difference in the courtrooms, then some argue that it is worth pursuing despite the ethical issues surrounding the topic that arise. Does using this evidence really make an impact on the rulings? A 2012 study looked at just this. A case was presented to 181 trial judges where genetic evidence was reported as the cause for the criminal’s actions. Results from the study showed that when hearing the violent case, judges significantly increased the number of mitigating factors and significantly decreased the sentencing of individuals when genetic data were provided as evidence in court (5). Knowing how pervasive and
significant genetic data can be to a court ruling, the question now is to determine whether the ethical dilemmas that arise are reason enough to avoid the situation all together, or if they can be overlooked. Additionally, one must also consider the expansive possibilities and ways in which these data are being used, not only in criminal law, but in other parts of the justice system as well.

The courts are still in an exploratory phase with the introduction of behavioral genetics being used as evidence in the courtroom. However this effort is one that will definitely continue as long as scientists stay on the forefront of genetic discovery. Because of this forecast, it will be more important than ever to properly educate the public about what genes are and what they can and cannot tell us about individual people. It is likely that this process will occur naturally and over time, as more and more genetic testing becomes a part of our society, however it should be a priority of scientists and those who know better to not propagate genetic fallacies and misinformation. It will be crucial to highlight that personal behavior is complex and that the behavioral traits that individuals have are created by more than just a genetic marker. In educating the public and presenting data and evidence in court to judges and jury members, extra care must be taken to ensure that the weight of the evidence is in proportion to what the scientific claims state. When data are being used as predictive evidence of behaviors or actions that have not yet occurred, extra care must be given in these situations. Additionally as evidenced by cases in the past, regulation and consistency should be maintained in the courts in regards to hearing behavioral
genetic information as evidence. There must be a high level of scientific scrutiny for all the claims being brought forward, and all claims should be handled in similar manner to ensure fairness and equality in legal proceedings. Finally, we need to avoid an outright ban on the use of behavioral genetics in court. This would hinder research and development that could impact many other aspects of society that expand beyond just criminal law.

For now however, we have to keep in mind how delicate the situation has been and will be for the foreseeable future. The road blocks involving the ethics of this research that have been raised must be considered as well, as the concerns are well documented and reviewed. The negative consequences the research has on stigma, racial tensions, privacy and discrimination have been predicted and studied for years, but the actual implementation of behavioral genetics in the courtroom has made these concerns a reality. These concerns make it clear how careful the court system must be when introducing these defenses. It is evident that the validity of these tests is always changing, as more and more research is being done. The justice system must be informed and educated of the ongoing changes. Looking forward, the possibilities are endless. The research to come and its relationship to court proceedings will be an area that we must continue to tackle for years.

The next steps for researchers are significant, starting with growing the database of known polymorphisms and genetic variants to explain all sorts of human behavioral traits. As more and more associations are found, researchers
will be able to start to understand how the human body is pieced together and how the human mind is molded.

In the lab, data come in neat, discrete packages with controlled variables and sterile methods and procedure. But in the court rooms, the data and evidence are being collected from the real world, where things get muddled and the evidence is imperfect. At these times, when lives are on the line, science takes a back seat for a moment, and individual judgement and decision come into play. It is during these times that understanding and knowledge of the implications of behavioral genetics is crucial. Behavioral genetics is being used as evidence more and more, and its implications cannot be understated in deciding the law.

This paper aimed to conclude whether or not using behavioral genetics in the courtroom was justified given the concerns regarding ethics and justice. Through examining the validity of the behavioral genetic claims alongside the issues that arise, it has become clear that a blanket statement regarding this issue cannot be made. Courtrooms and lawyers along with their witness scientists will have to make individual judgement calls regarding each case and the specific data that are being presented. In an effort to be most fair, when a genetic marker is found to be associated with a specific behavior, the first order of business will be to examine the validity of the claims, repeating the study and verifying across multiple variables. Only at this point, once cleared of all bias, should this association be allowed in court. Once established that a behavioral
genetics claim is allowed as a defense, all courts should be educated on the matter in a uniform and concise way so as to inform the judges and the juries on the issue prior to its mention in court. This creates uniformity in how the judge and jury hears the case, as they have already been briefed on the facts prior to hearing the defense’s interpretation of the data. And finally, more protocols need to be put into place to prevent the negative consequences of the ethical dilemmas that arise. Individuals being tested for behavioral genetic traits need to be better protected. Their families, and those not accused of crime, must also be protected, by implementing policies that help negate stigma and racial tensions. Now that more is known about how this information is being used and it is being addressed, steps must be taken so that these defenses can be better used in the criminal justice system.
REFERENCES


CURRICULUM VITAE