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The Double Helix Takes the Witness Stand: Behavioral and Neuropsychiatric Genetics in Court

Paul S. Appelbaum[1,*]
[1]NY State Psychiatric Institute, 1051 Riverside Drive, Unit 122, New York, NY 10032, USA
*Correspondence: psa21@columbia.edu
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Data on neuropsychiatric and behavioral genetics have attracted legal interest, as attorneys explore their use in criminal and civil cases. These developments may assist judges and juries in making difficult judgments—but they bring substantial risk of misinterpretation and misuse.

Advances in understanding genetic predispositions to behavioral and neuropsychiatric syndromes are squarely in the sights of the legal profession. With data suggesting substantial genetic contributions to the risk for criminal behavior (Tuvblad et al., 2011), attorneys have begun to explore the potential uses of genetic evidence in their clients' defense (Denno, 2011). In addition, the first signs that genetic data may be of interest to the civil justice system have begun to appear. As is true whenever scientific data are introduced in court, these developments hold potential for assisting judges and juries with some of the difficult judgments that they face—but they also bring a substantial risk of misinterpretation and misuse.

In considering current and future uses of behavioral and neuropsychiatric genetic evidence, the unhappy history of genetics in the courtroom cannot be ignored. Even before the structure of DNA was identified and the transmission of genetic information elucidated, courts recognized that behavioral traits could be handed down in families. However, judges' understanding of genetics typically reflected the science of the day, and the consequences of their reliance on contemporary knowledge were not always salutary. For example, in the U.S. Supreme Court's decision in *Buck v. Bell* (274 U.S. 200, 1927), which upheld Virginia's involuntary sterilization statute, Justice Oliver Wendell Holmes, appealing to the popular view that intellectual disability was passed from parent to child and was associated with promiscuity and crime, notoriously declared, "It is better for all the world, if instead of waiting to execute degenerate offspring for crime, or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind."

Presumptions about the relationship between crime and hereditary intellectual deficiencies appear to have influenced the lower courts as well, with defendants who were viewed as "defective delinquents" often sent to state institutions where they could be confined indefinitely, rather than being sentenced to a fixed term in a correctional facility (Willrich, 1998). But the first use of genetic tests in the courts for their presumed relationship to criminal behavior did not arrive until the late 1960s and was based on data purporting to show that the XYY karyotype was linked to violent crime (Denno, 1996). Derived from a number of studies demonstrating overrepresentation of XYY men in correctional populations, the data were recruited by enterprising defense attorneys to argue that their clients' violence was driven by genetic factors beyond their control, and thus that they could not be held criminally responsible for their behavior. Courts, however, were skeptical about the validity of data suggesting a causal link between the XYY karyotype and violent behavior and generally declined to admit karyotyping of defendants into evidence. As it turned out, the courts' skepticism was fully justified—the purported link between XYY and violence has never been generally accepted (Stochholm et al., 2012).

Genetic Evidence in Criminal Court

Since the mid-1990s, a more sophisticated set of claims based on genetic predispositions to criminal behavior and neuropsychiatric syndromes has made its way into the criminal courts. These arguments have taken two forms. As suggested by the attempts to introduce testimony about a defendant's XYY karyotype, one potential use for genetic data is to support a claim that the defendant has a neuropsychiatric or behavioral condition that negates criminal liability. Anglo-American law traditionally has excused from criminal responsibility a defendant whose actions were driven by a distorted understanding of the nature or wrongfulness of her behavior (e.g., a delusional belief that she was being threatened by another person) or, in some jurisdictions, an inability to control her behavior. This approach forms the basis for the insanity defense, which all but a handful of American jurisdictions embrace in one form or another. In principle, a defendant could claim that a genetic predisposition to impulsive or criminal behavior rendered her incapable of understanding or controlling her actions, and some legal writers have argued for consideration of this approach (Jones, 2003).

However, being predisposed to certain kinds of behavior does not necessarily indicate that one is unaware of its wrongfulness or is unable to behave otherwise. Since the threshold for establishing claims of nonresponsibility is quite high, most expert commentators believe that genetic predisposition evidence cannot meet the legal standard for nonculpability (Morse, 2011). Hence, rather than introducing genetic evidence during the guilt phase of their trial, defendants who have been convicted may prefer instead to employ genetic evidence to argue for mitigation of their sentences. The usual basis for a claim for mercy in sentencing is that a genetic predisposition makes it

harder for the defendant to control his behavior compared with other people, and thus he is not deserving of the most severe punishment for his offense. Such arguments might have particular traction in capital cases, since the death penalty is generally reserved only for the most culpable murderers. Although parties seeking to introduce scientific evidence in court bear the burden of demonstrating its validity, judges tend to be fairly permissive at death penalty hearings—yet another reason that one might expect genetic evidence to appear more commonly in such cases.

The best look at the current role of behavioral and neuropsychiatric genetic evidence in the criminal courts confirms this view. Denno (2011), surveying reported cases from 2007–2011, found 33 instances in which the defense sought to admit genetic information in a criminal trial. (Because most criminal cases do not result in written opinions, the reported cases on which she drew were largely cases that reached the appellate stage. Hence, the actual number of cases involving genetic evidence may well be larger.) Her previous survey of cases from 1994–2007 had identified 44 cases in which an attempt was made to introduce genetic evidence, suggesting modest but growing interest in utilizing such data.

Denno found genetic evidence was almost always limited to death penalty cases and almost invariably for mitigation. Most cases involved an effort to demonstrate that the defendant had a serious condition that may have created inherent difficulties in controlling behavior and thus did not deserve the death penalty. For the most common of these conditions—substance dependence—genetic evidence had the additional value of suggesting that the behavior was not the defendant's fault. Other conditions that genetic evidence was introduced to support included a range of serious mental illnesses (including schizophrenia and depression) and intellectual disability, as well as hereditary propensities to engage in violence or other criminal behavior. Additional findings included an increasing willingness on the part of courts to admit genetic arguments, the absence of attempts by the prosecution to turn genetic evidence against defendants (e.g., by suggesting that a genetic predisposition indicates enhanced dangerousness), and uncertainty as to the impact of genetic evidence. Of note, almost all cases involved genetic arguments made on the basis of family history data; use of actual genetic tests in this series was rare.

It is clear from other sources, however, that genetic tests for traits presumed to be associated with criminal behavior are also being presented to the courts, although the frequency of attempts to introduce such evidence is unclear. Published reports indicate that such testimony is most often based on findings linking a number of gene variants to criminal behavior (Bernet et al., 2007; Rigoni et al., 2010). The most discussed example is monoamine oxidase A (MAOA), probably the best-studied gene linked to antisocial behavior. In a study of a Dutch kindred, complete absence of MAOA activity was associated with impulsive, criminal behavior among men (MAOA is carried on the X chromosome) (Brunner et al., 1993). A subsequent, influential study by Caspi and colleagues (2002) of an epidemiologic cohort in New Zealand demonstrated a gene × environment interaction (GxE) between lower activity alleles of MAOA and childhood maltreatment. With multiple confirmatory studies (and some failures to confirm), this finding has generally withstood scrutiny (Baum, 2013) and may be among the better-supported GxE findings in behavioral genetics (Duncan et al., 2014).

As with other genetic evidence, MAOA findings have generally been used in murder trials, sometimes to suggest diminished capacity of the defendant to premeditate his criminal behavior, but most often for purposes of mitigation at sentencing. Courts' responses to attempts to introduce these data have been mixed, with some excluding it on the basis that the science has not been developed sufficiently to establish the validity of the relationship between the genetic findings and the defendant's behavior. Even when introduced, though, the impact of the evidence has often been less than striking. However, there are three reported cases—one from the U.S. and two from Italy—in which courts appear to have relied on evidence from MAOA and other genes (including DRD4, COMT, and SLC6A4), along with neuroimaging data suggesting impaired brain function, as grounds for mitigation of sentences (Greely, 2011; Walker, 2013).

Indeed, some experimental data support the likely efficacy of genetic evidence in influencing sentencing decisions. Aspinwall and colleagues (2012), surveying a sample of state trial court judges, found that those judges who read a vignette in which a genetic basis was suggested for the defendant's psychopathy were inclined to give significantly lower sentences than judges who were not told about a genetic basis for the defendant's condition. However, the absolute differences were modest: a mean sentence of approximately 13 years in the genetic evidence condition compared with nearly 14 years in the control condition. Members of the general public, however, may be less likely to see genetic evidence as mitigating. In a vignette study from our group that was modeled on the MAOA × childhood maltreatment interaction, a representative sample of the U.S. population did not assign lower levels of responsibility or shorter sentences when told that the defendant had a genetic propensity for violence compared with a control group not exposed to genetic evidence (Appelbaum and Scurich, 2014). Respondents in the genetic evidence group, though, manifested greater fear of the defendant, suggesting some broader cost to defense strategies based on genetic arguments.

Use of behavioral genetic data in criminal trials has been subject to criticism from both scientific and legal perspectives. Studies of the relationship of gene variants to criminal behavior have often failed to replicate, calling into question the validity or at least the robustness of the original findings (Duncan et al., 2014). Even the MAOA × childhood maltreatment interaction is neither a highly sensitive nor specific marker for criminal behavior, making it difficult to apply group data on the impact of genes on behavior to individual cases (Buckholtz and Meyer-Lindenberg, 2013). A limited number of populations (generally white and of European descent) have been studied, and interactions with other genes and other environmental stimuli are largely unexplored. Hence, expert witnesses who offer testimony regarding

a defendant's genetic makeup and its influence on his behavior may be overstating the certainty of their conclusions.

From the legal side have come questions regarding the probative value of genetic evidence for issues of concern to the law. As Morse (2011) has noted, "A genetic predisposition to criminal conduct does not per se mitigate or excuse. Causation is only relevant if it tends to show the presence of a genuine excusing condition, but it is the latter that does the legal work." Many defendants experience pressures to commit criminal acts—from peer encouragement to the disinhibiting effect of intoxicating substances—but in general we expect them to resist the urge to act illegally or suffer the consequences. Unless a defendant's genetic endowment substantially impairs her ability to appreciate the wrongfulness of her conduct or to obey the requirements of the law, genetic influences may simply be one more pressure that she is expected to resist. Finally, from a policy perspective, since there are currently no proven treatments for the genetic conditions that are posited as mitigating in these cases, facilitating an earlier return to society for (noncapital) offenders who are at higher risk of future criminal acts may be a self-defeating approach.

Genetic Evidence in Civil Court

Much less attention has been given to possible uses of behavioral and neuropsychiatric evidence in civil proceedings, although one instance was recently reported. In a case involving a claim against a landlord for injuries suffered in a fire, an Alberta court compelled a plaintiff with a family history of Huntington's disease (HD) to undergo genetic testing for the disorder to determine whether her impairment was related to the fire or to HD (*Adacsi v. Amin*, 2013 ABCA 315, Ct. App. Alberta). Compelled genetic testing has not previously been reported, but courts can require plaintiffs who place their medical conditions in contention to undergo medical examinations or tests, unless such procedures could endanger their lives or health. That most people with family histories of HD elect not to know whether they carry the mutation for the disorder makes the choice faced by the plaintiff in *Adacsi*, i.e., have the testing or forego compensation for injuries that may have resulted from the fire, particularly poignant.

In addition to helping courts determine the cause of conditions allegedly due to negligence of a defendant in a tort claim, behavioral and neuropsychiatric genetic evidence could be relevant in a number of other circumstances. Employers contesting work-related mental disability claims might, like the defendants in *Adacsi*, want to compel claimants to undergo genetic testing to prove that an underlying disorder was not responsible for their impairment. Divorcing couples in child-custody disputes, in which court-ordered psychological evaluations are routine, may want to add genetic testing for behavioral traits or neuropsychiatric disorders to the list of procedures that their estranged spouses must undergo to assess their fitness to parent a child. Plaintiffs seeking to establish that a defendant acted recklessly (e.g., in precipitating an auto accident) might attempt to seek data regarding the defendant's genetic predisposition to impulsive behavior. With increasing utilization of next-generation sequencing in medical settings, and arguments being made for sequencing newborns at birth, adverse parties in civil litigation may not need to compel genetic testing but merely to seek access to existing data.

Utilization of genetic tests in civil cases, for the foreseeable future, will be constrained by the limited predictive capacity of most current genetic findings related to behavioral traits and neuropsychiatric disorders. The situation in *Adacsi*, after all, involving a gene with complete penetrance (albeit variable age of onset), is vanishingly rare. But as predictive algorithms are developed for disorders that involve the interaction of multiple genes, and as more alleles of moderate effect are identified (e.g., ApoE4), we can expect to see more efforts made to introduce genetic evidence in civil cases as well.

Conclusion

The courts are in a period of exploration regarding the uses of behavioral and neuropsychiatric genetic evidence, an effort that is likely to continue so long as there are advances in understanding genetic influences on behavior and behavioral disorders. As genetics becomes a more frequent visitor to the courtroom, however, the risk that genetic information will be misinterpreted will be real. At the extreme, we may see judges presuming genetic bases for criminal behavior in the absence of any reliable evidence to that effect (*U.S. v. Cossey*, 632 F.3d 82, 2d Cir. 2011). More subtly, legal finders of fact, whether judges or juries, may overestimate (or sometimes, underestimate) the conclusions that can be drawn from genetic evidence, thus unfairly distorting the legal process. It will be an ongoing challenge for both legal and genetic experts to monitor the use of genetic data in the courts to ensure that the conclusions drawn validly reflect the science.

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