

Genetic Factors and Criminal Behavior

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WHAT CAUSES AN individual to become a criminal? How does an individual who is raised in a stable adoptive home grow up to become Jeremy Strohmeier, the young man convicted of raping and murdering an eight-year-old girl in a Nevada casino? The response to this question varies according to several factors, including the political climate and the theoretical orientation of the respondent. Social factors have received the majority of the attention; environmental variables such as socioeconomic status, for example, are most commonly studied in relation to criminal behavior. But social variables may not be sufficient to account for the wide range of variance observed in criminal behavior. For example, based on all accounts, Jeremy Strohmeier was adopted into a loving and supportive environment. An investigation into Strohmeier's biological background, however, revealed a history of schizophrenia and criminality in his biological parents. Perhaps other factors, alone or in concert with previously identified environmental variables, may better explain why some individuals travel down a criminal path.

Brennan (1999), in a recent issue of *Federal Probation*, addresses the gap found in current sociological and criminological literature in relation to acknowledging the influence of "non-social" factors.

Genetic factors, an important source of influence implicated in a variety of mental disorders such as schizophrenia, depression, and anxiety disorders, may play a role in predisposing certain individuals to criminal behavior. A genetic background positive for criminal behavior or mental illness, however, does not mean that the individual will develop

the disorder later in life. In fact, most individuals who have a criminal biological parent do not become criminal. What we are stating is that certain individuals, due to genetic and/or environmental markers, may have an elevated risk of becoming criminal. Put another way, offspring of criminal biological parents may have a greater chance of engaging in criminal behavior than offspring of non-criminal biological parents.

The mention of genetic factors in relation to crime is sometimes met with resistance, a reaction which may be partially attributed to earlier efforts to identify observable physical characteristics associated with criminality. For example, in 1876, Cesare Lombroso proposed that criminals tended to have atavistic features, consisting of protruding jaws, receding foreheads and chins and asymmetrical facial features. Such theories have since been discounted. Genetic and biological research efforts today have largely moved away from this type of research. Nevertheless, there are still myths surrounding the role of genetics in relation to crime. To this end, several myths will be discussed, followed by evidence which links non-social or genetic factors to criminal behavior. These are by no means all of the myths, but may be the most commonly held inaccuracies regarding this type of research.

Myths

1. Identifying the Role of Genetics in Criminal Behavior Implies That There Is a "Crime Gene"

It is difficult to imagine that a single gene encodes for criminal activity; a more plausible

scenario is that multiple genes interact to create an increased risk for criminal behavior. Moreover, genetic factors are likely to be associated with other behavioral characteristics that are correlated with criminal behavior, such as impulsivity and sensation-seeking behaviors.

2. Attributing Crime to Genetic Factors is Deterministic

Genes alone do not cause individuals to become criminal. Moreover, a genetic predisposition towards a certain behavior does not mean that an individual is destined to become a criminal. The notion that humans are programmed for certain behaviors fails to acknowledge important environmental factors which are likely to mediate the relationship between genetics and crime. For example, the expression of a genetic liability towards a certain behavior may be minimized or neutralized by positive family rearing conditions. Negative family rearing conditions might trigger a genetic vulnerability. Such an occurrence suggests that genes and the environment interact to either elevate or reduce the risk for certain negative outcomes.

Genetic Epidemiological Studies

Family, twin, and adoption studies, three epidemiological designs which are employed to examine environmental and genetic sources of influence, suggest that criminal behavior may be genetically mediated. These three epidemiological designs, however, provide varying opportunities to test for genetic effects.

The limitation of family studies, for example, is that genetics and environmental sources of influence cannot be separated. Therefore, given the limited utility of family studies to separate issues of nature versus nurture, this section will focus on two other epidemiological research designs which are better equipped to test for genetic effects.

Twin Studies

Twin studies compare the rate of criminal behavior of twins who are genetically identical or monozygotic twins (MZ) with the rate of criminal behavior of dizygotic twins (DZ) in order to assess the role of genetic and environmental influences. To the extent that the similarity observed in MZ twins is greater than that in DZ twins, genetic influences may be implicated.

To date, over 10 twin studies, carried out in different countries, have tested for a genetic effect in crime. Taken together, these studies support the interpretation that criminal behavior may be a genetically mediated outcome. Specifically, a greater concordance rate for criminal behavior is observed for MZ twins than for DZ twins. Some researchers believe that the twin methodology may be flawed in that MZ twins, in addition to sharing more genetic information than DZ twins, are also more likely to be treated more similarly than DZ twins. Studies comparing the concordance rates in MZ twins reared apart can avoid this problem, but it is difficult to obtain such subjects. Christiansen (1977) has noted that several of the earlier twin studies had cases in which a set of monozygotic twins were raised in separate environments; these preliminary data suggest that studying MZ twins reared apart may be an important behavioral genetics tool to investigate the etiology of criminal behavior. To our knowledge, only one modern twin study has employed this type of research design to test whether criminal behavior may be genetically mediated.

Grove et al. (1990) investigated the concordance of antisocial behavior among a sample of 32 sets of monozygotic twins reared apart (MZA) who were adopted by non-relatives shortly after birth. Grove found substantial overlap between the genetic influences for both childhood conduct disorders (correlation of 0.41) and adult antisocial behaviors (correlation of 0.28). Although these findings are based on a small number of subjects, the Grove findings are congruent with the findings from other twin studies and extend the twin literature by evaluating MZ twins raised in separate environments.

Adoption Studies

Adoption studies provide a natural experiment to test the existence and strength of inherited predispositions. Adoptees are separated at birth from their biological parents. Thus, similarities between the adoptee and biological parents can be regarded as estimates of genetic influences, while similarities between the adoptee and the adoptive parents may be thought of as estimates of environmental influences. Adoption studies have been carried out in three different countries: the United States, Sweden and Denmark.

Iowa. The first adoption study to explore the genetic transmission of criminal behavior was carried out in Iowa by Crowe (1974). The sample consisted of 52 adoptees (including 27 males) born between 1925 and 1956 to a group of 41 incarcerated female offenders. A group of control adoptees were matched for age, sex, race and approximate age at the time of adoption. Seven of the 52 adoptees sustained a criminal conviction as an adult whereas only one of the control adoptees had a conviction. Since these adoptees were separated from their incarcerated mothers at birth, this tends to implicate a heritable component to antisocial behavior. A separate series of adoption studies carried out in Iowa by Cadoret and colleagues have supported Crowe's original findings. These independent replications lend support to the notion that criminal behavior may have important genetic influences.

Sweden. Bohman et al. (1978) examined the criminality and alcoholism rates among 2324 Swedish adoptees and their biological and adoptive parents, as determined by a check with national criminal and alcohol registries. The authors noted that a biological background positive for criminality contributed to an increased risk of criminality in the adopted-away children.

Denmark. Mednick, Gabrielli, and Hutchings (1984) carried out a study of the genetic influence on criminal behavior using an extensive data set consisting of 14,427 Danish adoptees (ranging in age from 29 to 52 years) and both sets of biological and adoptive parents. They found that adopted-away sons had an elevated risk of having a court conviction if their biological parent, rather than their adoptive parent, had one or more court convictions. If neither the biological nor adoptive parents were convicted, 13.5 percent of the sons were convicted. If the adoptive parents were convicted and the biological parents were not, this figure only increased to

14.7 percent. When examining sons whose biological parents were convicted and adoptive parents remained law-abiding, however, 20 percent of the adoptees had one or more criminal convictions. Moreover, as the number of biological parental convictions increased, the rate of adoptees with court convictions increased.

The finding that recidivism may be a genetically transmitted trait led us to investigate whether genetics play a role in persistent forms of criminal offending. Based on age of onset and duration of offending, Moffitt (1993) suggests the existence of two qualitatively different types of offenders; (1) individuals whose criminality is confined to adolescence, or adolescent-limited offenders, and (2) individuals whose criminality occurs during the adolescent period and extends into adulthood, or life-course persistent offenders. Genetic factors may play some role in explaining differences between the two groups. Moffitt suggests that life-course persistent antisocial behavior may have an underlying biological basis, whereas adolescent-limited antisocial behavior may be better explained by situational environmental factors. We tested this theory within the context of an adoption design. The results suggest that the biological parents with a criminal conviction were more likely to have an adopted-away son who evidenced life-course persistent offending than adolescent-limited offending (Tehrani and Mednick, in preparation). These data support the contention that genetics may play a role in persistent forms of offending.

These data, obtained from three different countries and in different laboratories, lend support to the notion that criminal behavior appears to have a strong genetic component. But what about serious forms of criminal behavior, such as violent offending? Our research group has investigated whether violent offending may be heritable.

Is There a Genetic Liability to Violence?

Twin and adoption studies have been employed to address this question, yielding mixed results. Cloninger and Gottesman (1987), for example, reanalyzed the twin data collected by Christiansen (1977) and grouped subjects as either violent offenders or property offenders. Heritability for property offenses was found to be 0.78 while heritability for violent offenses was .50. Although the genetic effect for property offenses was greater

than for violent offenses, the data suggest that violent offenses may also have a heritable underlying component. Two independent adoption studies, however, have failed to provide support for the hypothesis that violence is a heritable trait (Bohman et al., 1982; Mednick et al., 1984). The largest adoption study to date was carried out in Denmark by our research group (n=14,427). As stated earlier, Mednick, Gabrielli and Hutchings (1984) reported a significant relationship between the number of criminal convictions in the biological parent and the number of convictions in the adoptees. Subsequent statistical analyses revealed that this relationship held significantly for property offenses, but not significantly for violent offenses.

A study in Oregon provided an important clue that mental illness, particularly severe mental illness, may be genetically related to violence. In a classic study, Heston (1966) followed up a sample of 47 offspring born to schizophrenic mothers and compared them to a group of matched controls. These offspring were separated from their mothers shortly after birth and placed in foster care or orphanages. Heston was primarily interested in determining if adopted-away offspring of schizophrenic mothers were at increased risk of becoming schizophrenic themselves. The findings supported the original hypothesis, as 5 of the 47 offspring became schizophrenic. An interesting finding is that an even greater number of the adopted-away offspring of schizophrenic biological mothers actually had been incarcerated for violent offenses. Eleven (23.4 percent) of the adoptees had been incarcerated for violent offenses. Since these offspring were not raised by their schizophrenic mothers, this suggested the possibility that at least certain forms of mental illness and criminal violence may share a common genetic basis.

With the Heston study in mind, Moffit (1987) investigated the role of parental mental illness in the emergence of violent offending among the Danish adopted-away sons. When only the criminal behavior of the biological parents is considered, she found no increase in violent offending in the adoptees. A significant increase in the rate of violent offending is noted only among offspring whose biological parents were severely criminal (typically the biological father) and had been hospitalized one or more times for a psychiatric condition (typically the biological mother).

These findings suggest that a biological background positive for mental disorders may be associated with an increased risk of violent offending in the children. Other disorders in the biological parents may also increase the risk of violent offending in the adopted-away offspring. One such disorder which may elevate the risk of violent offending in children is the presence of alcoholism in the biological parents.

The Genetic Link Between Violence and Alcoholism

Recent molecular genetics studies report that a gene related to the serotonin system may be associated with increased risk for the co-occurrence of violence and alcoholism. These efforts have been fueled by the robust finding that alcoholism and violence, in humans and non-human primates, may be related to serotonergic dysregulation (Virkkunen et al., 1989; Higley et al., 1992). In a reanalysis of data from the Swedish Adoption Study, Carey (1993) noted that paternal violence is linked to alcoholism in adopted away males. We are currently investigating the possible genetic link between violence and alcoholism (Tehrani and Mednick, in preparation). Within the context of the Danish Adoption Cohort, we found that alcoholic biological parents were twice as likely to have a violent adopted-away son than non-alcoholic parents. In contrast, the risk for property offenses in adopted-away sons of biological parents with alcohol problems was not significantly elevated. The significant genetic effect was specific to violent offenders.

Moreover, violent offending (but not property offending) among the biological parents was related to severe alcohol-related problems in the adopted-away males. These findings from our adoption cohort are in agreement with data from the Swedish adoption study, and support the overall interpretations from recent molecular genetic studies.

Conclusions

Genetic factors represent one source of influence on criminal behavior. Until recently, their role had been ignored or discounted. The data that are emerging from research labs around the world indicate that excluding genetic factors from consideration may limit opportunities to advance the understanding of why some individuals become criminal. Apart from satisfying our scientific curiosity, this type of genetic research could potentially contribute to prevention efforts. Investiga-

tions into the etiological correlates of criminal behavior may lead to promising new directions for treatment and intervention. These etiological factors, either social or genetic, may help to identify individuals who are at elevated risk of certain negative outcomes. If, for example, we identify individuals who are at increased genetic risk for criminal offending, environmental buffers such as educational programs may be implemented to help reduce the risk that this genetic predisposition will be expressed. Put another way, the genetic vulnerability may be counterbalanced by positive environmental conditions. Two adoption studies have already noted this. For example, in the Danish and Swedish adoption studies, adopted-away children of criminal biological parents who were raised in higher socioeconomic adoptive homes evidenced a significantly reduced rate of criminal convictions, as compared to adoptees raised in low or middle class adoptive homes. Such an observation suggests that crime prevention efforts may be most effective when all risk factors, social and genetic, are evaluated.

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