GENDER DIFFERENCES IN BIOLOGICAL AND SOCIOLOGICAL PREDICTORS OF CRIME

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Good afternoon. My name is Deborah Denno. I am a law professor now, but I have a dark past. Before attending law school, I directed one of the largest longitudinal studies of biological and sociological predictors of crime in this country. One of the many goals of this Biosocial Study was determining whether there were gender differences among the numerous possible correlates of crime that the study examined.[1]

The purpose of my presentation today is to describe the study and its results, particularly as they relate to gender differences in crime. Another aim is to respond briefly to some of the potential political reactions to the study, despite its results.

I will begin with a quick account of historical attitudes toward gender differences in crime. I will then discuss the Biosocial Study and its major findings relevant to the prevalence and prediction of crime. Very generally, the study demonstrated that: (1) males commit substantially more crime overall, and violent crime in particular, than females; and (2) sociological and environmental factors are somewhat stronger predictors of crime among males, whereas biological factors are somewhat stronger predictors of crime among females. One of the most intriguing facets of this gender distinction is the especially strong link between lead poisoning and crime among males, an association that has current and increasing support in scientific research. Lastly, I would like to take issue, albeit briefly, with some of the criticism of

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1. *See generally* DEBORAH W. DENNO, BIOLOGY AND VIOLENCE: FROM BIRTH TO ADULTHOOD (1990) [hereinafter BIOLOGY AND VIOLENCE](discussing and analyzing the results of a study of numerous biological, sociological, and environmental predictors of crime within a sample of 987 male and female subjects born in Philadelphia between 1959 and 1962); Deborah W. Denno, *Gender, Crime, and the Criminal Law Defenses*, 85 J. CRIM. L. & CRIMINOLOGY 80 (1994) [hereinafter *Gender*] (examining the literature and research on gender differences in crime and how this research bears on gender differences in criminal law defenses). This presentation

> uses loose definitions of the terms "biological" and "environmental" or "sociological" because of their close association with related terms, and with one another. Generally, "biological" factors are "nonsocial, nonbehavioral measures of . . . constitution and functioning," such as neurological abnormalities. "Environmental" factors include measures without a biological base, such as family income. Factors comprising "behaviorally defined characteristics," like cognitive or intellectual ability and achievement, may have a partial biological base, which a certain environment could perpetuate or alter.

Id. at 83 (citations omitted) (No variables measuring genetic factors were collected in the Biosocial Study.).

biosocial research on criminality. Although I very much sympathize with arguments reminding us of the horrors of history, I think they mischaracterize the kind of research that I discuss here. In light of the findings I present, I ask, "What are we afraid of?" And in terms of future research I ask, "What more can we do?"

I. PRIOR RESEARCH ON GENDER DIFFERENCES IN CRIME

Men and boys commit substantially more crime than women and girls, particularly violent crime. For example, recent data show that males comprise 88% of those persons arrested for violent crime and 95% of new court commitments for violent offenses.[2] However, most theories and explanations of crime ignore these differences. They either disregard the gender issue entirely or question why females fail to follow the pattern of male criminality. Theories of crime also neglect to use gender disparities as a means of explaining the underlying correlates of all crime and deviance.

Historical accounts of gender differences in crime, however odd or bizarre they may seem today, still appear to influence indirectly how gender differences are perceived. The accounts are framed by two general perspectives. First, because crime and violence are associated with maleness, society deems women who engage in crime to be "doubly deviant," defying both the law and their gender role. At the same time, however, women's lesser involvement in crime has also been viewed as an "underachievement" attributable to women's biology or sexuality.

Near the turn of the century, for example, Cesare Lombroso, an Italian physician, attributed women's lower crime rate to their "piety, maternity, want of passion, sexual coldness, weakness, and undeveloped intelligence."[3] Women criminals, on the other hand, lacked such typical feminine features. They displayed "strong passions and intensely erotic tendencies," in addition to high intelligence and physical strength.[4] Regardless, society still adhered to the view that women criminals were capable only of lesser crimes than males because women did not possess the "combination of intellectual functions" required of more demanding crimes, such as highway murder, robbery, and assault.[5] Early sociological criminologists, who stressed the importance of economic conditions on crime, shared Lombroso's views, explaining that women have less "strength and courage" than men.[6] These

2. *See Gender*, *supra* note 1, at 80-81, 86.
3. *Id.* at 87 (citations omitted).
4. *Id.* (citations omitted).
5. *Id.* (citations omitted).
6. *Id.* (citations omitted).

criminologists explained that women's passive roles in their sexual lives were mirrored by their passive roles in their criminal lives. Postwar views of female crime similarly continued to pinpoint sexual and biological influences, focusing in particular on women's passivity during sexual intercourse and their ability to feign arousal, as well as social norms requiring women to hide menstruation and sexual information from children. Such deception enabled women to conceal their crimes which, if accurately detected, would compare in frequency to the numbers of crimes committed by males.[7]

With time, researchers increasingly began to pinpoint more sociological explanations of women's lesser criminality, most particularly in terms of society's efforts to curtail girls' delinquent and risk-taking behaviors and to encourage their adherence to gender norms. Recent research incorporates the study of a variety of possible sociobiological influences on female crime, including the following: (1) parental deprivation, such as a single-parent home, marital discord, and family stress; (2) an inability to adjust to feminine roles; (3) psychiatric and familial disorders and impaired physical health; (4) sexual corruption; (5) conduct disorders; and (6) premenstrual and menstrual syndromes.[8] Much of this early and later research has been severely critiqued, and with good reason. Over time, however, some of the more reliable research has revealed some trends. In general, research results on female criminality can be categorized two ways. First, with some exceptions, those factors shown to be correlated with crime among males are also correlated with crime among females. Second, those females who do engage in criminal or violent behavior appear to deviate substantially more from biological, psychological, and sociological norms than do their male counterparts. The greater normative deviance of female criminals appears to be attributable to the stricter social and cultural constraints that society places on female behavior. Those females who break normative behavior stand alone.

Relative to prior criminological research, the Biosocial Study allowed a more detailed examination of possible gender differences in criminality by incorporating biological, psychological, and sociological variables. The research emphasized two issues: (1) gender differences in the prevalence of crime; and (2) gender differences in the prediction of crime. This two-issue focus relied heavily on previous criminological theory and research, which has been discussed in depth elsewhere.[9]

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7. *See id.* at 88-89 (citations omitted).
8. *See id.* at 90-91 (citations omitted).
9. *See generally* BIOLOGY AND VIOLENCE, *supra* note 1; *Gender*, *supra* note 1.

II. THE BIOSOCIAL STUDY

The 987 subjects (500 females, 487 males) who participated in the study were born in Philadelphia's Pennsylvania Hospital between 1959 and 1962. The subjects and their families were originally part of the Collaborative Perinatal Project (Perinatal Project), one of the largest medical studies ever conducted in the United States. In total, nearly 60,000 pregnant women participated in the Perinatal Project between 1959 and 1966 in fifteen different medical centers across the country, including Philadelphia. In 1978, the National Institute of Justice awarded the first of a series of grants to the Sellin Center for Studies in Criminology and Criminal Law at the University of Pennsylvania to examine the crime records of those Perinatal Project children who were born in Philadelphia. For the next eight years I directed what was eventually termed the "Biosocial Study." I also continue to incorporate the results of the study in ongoing legal and sociological work.

For the following reasons, each one of the study's subjects was black: (1) there were too few white subjects who volunteered to participate in the Perinatal Project in Philadelphia (the subjects reflected the racial composition of the neighborhood surrounding Pennsylvania Hospital); (2) I had no interest in examining racial differences; (3) there was a need to control for the well-known racial differences in police arrest practices at the time, that is, the substantial data demonstrating a consistent tendency for police to arrest black youths more frequently than white youths irrespective of the type of alleged criminal activity; and (4) commentators had noted for some time that little research had been devoted to studying crime among black youths. For example, in 1980, William Raspberry, a highly regarded black journalist, criticized the Office of Juvenile Justice and Delinquency Prevention for spending eighty percent of its monies researching white youths.[10] Because of this and other such criticisms, many federal programs that currently offer funds to study crime urge grant applicants to include a broad representation of minority groups in their samples.[11]

Notably, all 987 subjects attended Philadelphia public schools, and remained in the same urban environment from the time of their birth to age twenty-two. These selection constraints controlled for factors that could influence criminal activity, such as leaving the city or attending a parochial school.

In order to test many different theories of crime, the study used, in addition to urban environment, three primary data sources that are listed in

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10. *See* William Raspberry, *Youth Crime Funds Go to the Whites*, PHILA. INQUIRER, Apr. 1, 1980, at 9A.

11. *See Gender*, *supra* note 1, at 96 n.96.

part in Table 1: (1) the Perinatal Project's data set of early biological and environmental factors; (2) public school records; and (3) official police records for juveniles and adults.[12]

A. Early Biological and Environmental Factors

The Perinatal Project provided an enormous amount of data on early biological and environmental factors. Upon registration for the Perinatal Project, each mother underwent a battery of interviews and physical examinations that provided data for each pregnancy, including the mother's reproductive history, recent and past medical history, and labor and delivery events. Data recorded for each child included information on neurological examinations conducted at birth, throughout the hospital stay, at four months, and at ages one and seven. The children also had speech, language, and hearing exams at ages three and eight.[13]

In addition to controlling or accounting for the effects of the urban environment, investigators also collected socioeconomic and family data during the mother's registration and the child's examination at age seven. These data included parents' occupation, education, and employment history; family income and size; religion; welfare status; child's residence in a foster home; and number of persons supported in the household.[14]

B. Public School Records

Public school records included a variety of data about each subject, most particularly academic achievement during ages thirteen and fourteen, and evidence of learning or disciplinary problems. Children with disciplinary problems were diagnosed as having normal intelligence but some record of asocial behavior in school, including a history of starting fires, physical aggression toward teachers, maladjustment to school, and conduct

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12. *See* BIOLOGY AND VIOLENCE, *supra* note 1, at 30-33.

13. There were six general types of indicators of biological, psychological, or developmental predictors of crime: (1) early central nervous system development (for example, prenatal, perinatal, and pregnancy complications; and the Apgar score, an accepted and validated scale of health and development immediately following birth); (2) intelligence and cerebral dominance or laterality (for example, measures of verbal and spatial ability, as well as indicators of cerebral dominance or laterality, such as the child's hand, eye, and foot preferences, which are indicative of learning disabilities); (3) physical growth and development (for example, measures of height and weight); (4) neurological factors (for example, "soft neurological signs" or lack of coordination); (5) attention deficit disorder and hyperactivity (for example, evidence of disciplinary problems in childhood and adolescence, as well as mixed indicators of cerebral dominance or laterality and difficulty with left-right identification); and (6) general physical health (for example, high blood pressure, lead poisoning, and anemia). *See id.* at 37-39.

14. *See id.* at 35-36.

disturbance. The Philadelphia School Board stated that any school's recommendation of a child to a special school program was made independently of any knowledge of that child's official delinquency status.[15]

C. Official Police Records for Juveniles and Adults

Police records were available for all subjects from ages seven to twenty-two. The Biosocial Study used three different measures of juvenile and adult crime: (1) number of offenses; (2) categorization of juvenile offenses according to levels of the most serious offense recorded (violent, property, and non-index); and (3) seriousness of offenses.[16]

In light of this brief account of the study's database, I next examine gender differences in the prevalence of crime. I first discuss gender differences in the prevalence of juvenile delinquency, and then gender differences in crime during young adulthood.

III. THE STUDY'S FINDINGS ON GENDER DIFFERENCES IN THE PREVALENCE OF CRIME

A. Juvenile Delinquency

The term juvenile delinquency refers to crimes committed by individuals under the age of eighteen. Altogether, 220 (22%) of the 987 study subjects experienced a police contact prior to age 18.[17] A police contact could include either an arrest or an official record short of an actual arrest. Consistent with prior research, there were substantial gender differences in the number of police contacts. Over twice as many males as females had a police contact.[18]

For both genders, the non-index, or less serious offenders dominated the offense distribution. In total, 64 (more than 40%) of the males, and 34 (nearly one-half) of the females, were non-index offenders.[19] However, more females (27, or 39%) were property offenders relative to males (51, or 34%).[20] Predictably, gender variations were greatest for crimes of violence. A total of 36 (nearly one-fourth) of the male offenders engaged in at least one offense that involved violence or injury to one or more persons, compared to 8 (12%)

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15. *See id.* at 31-32.
16. *See id.* at 32.
17. *See id.* at 40.
18. *See id.* at 40-41. Altogether, 151 males (31%) had a police contact, compared to 69 females (14%). *See id.* These percentages are created by using, as a denominator, the 487 males and 500 females who were part of the study's sample. *See id.*
19. *See id.* at 41-42.
20. *See id.*

of the female offenders. In general, then, although most male and female offenders engaged in nonviolent delinquent behavior, there still existed a sizable amount of violent behavior, particularly among males.[21]

1. Repeat and Chronic Delinquent Offenders

The number of offenses is critical to analyses of crime and violence because the most frequent offenders typically account for a grossly disproportionate amount of the crime. For example, past research has shown that chronic offenders (those who have five or more offenses) constitute less than one-fifth of all offenders; yet, chronic offenders are responsible for committing over one-half of all offenses.[22]

Altogether, the number of offenses committed by juveniles in the Biosocial Study ranged from a low of one to a maximum of 27 offenses across ages 7 to 17.[23] As would be expected, substantial gender differences appeared. In total, 45 (nearly two-thirds) of the female offenders, but 69 (less than one-half) of the male offenders, had only one offense.[24] Furthermore, 57 (38%) males and 17 (25%) females were non-chronic repeat offenders.[25]

Consistent with past research, chronic offenders dominated the amount of crime in the study, particularly serious crime. The 25 male chronic offenders represented 5% of the total sample of 487 males, and 17% of the total sample of 151 male delinquents.[26] However, these chronic offenders accounted for 51% of the delinquent offenses committed by all the males.[27] The 7 chronic female offenders represented only 1% of the total sample of 500 females and 10% of the total sample of 69 female delinquents.[28] Yet, these chronic females accounted for 41% of the delinquent offenses committed by all the females.[29]

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21. *See id.* at 41-42.
22. *See Gender*, *supra* note 1, at 103.
23. *See* BIOLOGY AND VIOLENCE, *supra* note 1, at 42-43.
24. *See id.*
25. *See id.*
26. *See id.* at 44.
27. *See id.*
28. *See id.*
29. *See id.*

2. Incidence and Seriousness of Delinquency

Predictably, there were substantial gender differences in the incidence and seriousness of delinquency. The sample of 987 males and females was responsible for 588 offenses committed between the ages of 7 and 17.[30] Males were responsible for 443, or three-fourths, of those offenses; females were responsible for 145, or one-fourth.[31]

Males committed relatively more violent offenses: 64 offenses (14%) involved violence or injury; 155 offenses (35%) involved property theft or damage; and 224 offenses (51%) were non-index.[32] In contrast, among females, 10 offenses (7%) involved violence; 51 offenses (35%) involved property theft or damage; and 84 offenses (58%) were non-index.[33]

Gender differences were even more significant for measures of offense seriousness that were reflected by a continuous seriousness score index. For male offenders, offense seriousness scores ranged from .3 to 158, with a mean score of 17.[34] For female offenders, offense seriousness scores ranged from .3 to 58, with a mean score of 7.[35] Thus, the mean level of offense seriousness for males was nearly 2.5 times greater than the mean level for females.[36]

Seriousness levels also differed according to groups of offenders. Among males, the mean seriousness score for one-time offenders was 3; for non-chronic repeat offenders, 15; and for chronic offenders, 58.[37] Among females, one-time offenders had a mean score of 2, non-chronic repeat offenders a score of 11, and chronic offenders a score of 30.[38] Clearly, chronic offenders deviated from the other groups in terms of the severity of their offenses. Moreover, substantial gender differences remained.[39]

3. Age

Overall, the earlier a juvenile commits an offense, the more offenses that juvenile will commit in the future. However, gender differences in the ages at which juveniles commit their first offense challenge this general

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30. *See id.* at 43.
31. *See id.*
32. *See id.*
33. *See id.*
34. *See id.*
35. *See id.*
36. *See id.*
37. *See id.*
38. *See id.*
39. *See id.*

proposition: females, who commit far fewer offenses than males, generally start to commit their offenses earlier than males.

In the Biosocial Study, the highest percentage of juveniles had a police contact by age 13 (17%) or by age 14 (19%).[40] The lowest percentages occurred at both ends of the distribution, ages 11 (6%) and 17 (7%).[41] Yet, some gender differences existed with these percentages. For example, the highest percentage of females became offenders at age 13 (23%), whereas the highest percentage of males became offenders at age 14 (20%).[42] Cumulatively, nearly one-half the juveniles (46%) became offenders before age 14.[43] More than three-fourths of both the males (79%) and the females (81%) became offenders before age 16.[44] Although the peak age of offending occurred one year earlier for females than for males, cumulative percentages are similar for both genders at ages 14 and 16, with females having a slightly higher representation at age 16. A more extended examination of the mean ages at the onset of delinquency for different offender groups confirmed that both non-chronic offenders, and chronic repeat offenders, start their offenses at a younger age. This finding held for both males and females.[45]

B. Young Adult Crime

Four categories of individuals were used to compare offense behavior between the juvenile and young adult years: (1) those who never experience either a juvenile or an adult police contact; (2) those who experience at least one juvenile contact but no adult contact; (3) those who experience at least one adult contact but no juvenile contact; and (4) those who experience at least one adult and one juvenile contact. The Biosocial Study mainly focused on the last two groups, which were combined in analyses of young adult crime.[46]

Distributions according to the four groups of possible juvenile or adult offense combinations showed the following for males: 280 (57%) had no juvenile contact or adult arrest; 98 (20%) had only a juvenile contact and no adult arrest; 56 (11%) had only an adult arrest and no juvenile contact; and 53 (11%) had both a juvenile contact and an adult arrest.[47] Combining these latter two groups, altogether 109 (22%) male offenders experienced an adult

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40. *See id.* at 44-45.
41. *See id.*
42. *See id.*
43. *See id.*
44. *See id.*
45. *See id.*
46. *See id.* at 46.
47. *See id.*

arrest irrespective of their juvenile contact history. Distributions according to the four groups of possible juvenile or adult offense combinations showed the following for females: 415 (83%) had no juvenile contact or adult arrest; 61 (12%) had only a juvenile contact and no adult arrest; 16 (3%) had only an adult arrest and no juvenile contact; and 8 (1.6%) had both a juvenile contact and an adult arrest.[48]

Of the 109 males who had an adult arrest, 55 had only one offense, and 15 were chronic offenders.[49] Of the 24 females who had an adult arrest, 15 had only one offense, and 2 were chronic offenders.[50] Altogether, then, the data show the following: males are considerably more likely than females to engage in crimes during adulthood, males are more likely to continue their crimes into adulthood if they have been juvenile delinquents, and males are more apt to commit more than one crime as an adult.[51]

Overall, these findings are consistent with prior research showing gender differences in the prevalence of crime. Males commit more violent crime, and more offenses, during both the juvenile and the adult years. The greater number of offenses for males is a reflection of both their greater participation in crime, and their more frequent offense commission once they do participate.

I next consider whether gender differences exist in the types of predictors of crime by examining three main theories: (1) the biological, psychological, and sociological factors predicting crime among males and females are similar and they interrelate; (2) biological factors are relatively stronger predictors of crime among females, given the greater social and familial constraints on female behavior; and (3) environmental factors are relatively stronger predictors of crime among males, in light of research suggesting that males are somewhat more vulnerable to environmental stressors throughout their lives.

IV. THE STUDY'S FINDINGS ON GENDER DIFFERENCES IN THE PREDICTION OF CRIME

The Biosocial Study examined numerous correlates of crime to assess biological and environmental predictors of gender differences. Statistical models tested direct and indirect relationships among variables across five different points in time: birth, age four, age seven, ages thirteen through

48. *See id.*
49. *See id.*
50. *See id.*
51. *See id.*

fourteen, and ages seven through twenty-two. This procedure required several statistical steps that have been discussed in depth elsewhere.[52]

After statistically screening several hundred variables (some of which are presented in Table 1), the Biosocial Study constructed structural equation models to assess the direct and indirect effects of the twenty-two independent variables across different time periods to determine their simultaneous impact on the eight dependent variables (Table 2). Table 3 lists the order of the significance of the effects of these twenty-two independent variables on four of the dependent variables: (1) number of adult offenses; (2) number of juvenile offenses; (3) presence of a disciplinary problem; and (4) language achievement. The Biosocial Study also examined these structural equation models in their reduced form, which combines the total impact of direct and indirect effects.

A. Effects on Male Offenders

Five factors showed significant effects on the number of adult offenses for males. The strongest factors were the number of delinquent offenses, mother's low educational level, and seriousness of delinquent offenses. The other two factors were father's high educational level and subject's low language achievement. The relationship between the number and seriousness of delinquent offenses and crime at adulthood was predictable, because past criminality is a strong predictor of future behavior. The finding of an expected negative effect of mother's educational level, but an unexpected positive effect of father's educational level, may simply be an artifact because father's educational level was highly related to mother's educational level.[53] These results indicate that parental characteristics have an important effect on adult male crime, perhaps suggesting that lesser-educated parents may not provide the kind of social control that is needed in early years to prevent crime in later years. The effect of low language achievement was also predictable in light of past research demonstrating associations between low verbal ability and crime.[54] Indeed, substantial research indicates greater evidence of reading or learning disabilities among delinquent and violent offenders.[55]

The effects on juvenile crime are important because of their indirect effects on adult crime, and because they may have a large influence on

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52. *See id.* at 70-72.

53. In the Biosocial Study, fathers were absent in over 40% of the households. *See id.* at 187. Therefore, the effect of the father's educational level may have been partially determined by whether the father was ever actually present.

54. *See id.* at 10-12.

55. *See id.* at 12.

initiating and perpetuating a youth's involvement in crime. Altogether, in decreasing order of significance, six factors showed significant effects on the number of juvenile offenses for males: (1) number of disciplinary problems in school; (2) amount of time the father was unemployed; (3) evidence of lead intoxication; (4) low language achievement; (5) number of household moves; and (6) abnormal speech.

Evidence of disciplinary problems in school showed the most highly significant association with juvenile offenses for males. This association demonstrates that, not unexpectedly, school-related aggression and behavioral disturbance are strong predictors of future behavioral disorders. The amount of time the father was unemployed, in addition to number of household moves, are indicators of familial and environmental instability. When combined with lead intoxication, a precursor of physiological and neurological instability,[56] these factors can create the kind of internal and external vulnerability that increases the likelihood of criminal behavior. Evidence of abnormal speech and low language achievement are additional factors that can lead to further instability in school. This evidence also supports research suggesting that delinquents have poor communication skills, and rely on physical aggression to compensate for what they lack verbally.

Five factors significantly predicted whether males demonstrated a disciplinary problem in school: (1) evidence of lead intoxication; (2) anemia; (3) number of household moves; (4) left hand preference; and (5) lack of foster parents. These findings suggest that behavioral problems reflect disorders of the central nervous system and an unstable environment, both of which are precursors of attention deficit disorder and hyperactivity. For example, number of household moves is one of a number of traditional indicators of family instability. In the study, a lack of foster parents also appeared to be a source of instability. Presumably, foster parents provided a relatively more intact, problem-free home.

Placement in a disciplinary program is strongly linked to three variables which, even though they are environmentally created, are typically associated with biological effects: lead intoxication, anemia (which allows for greater

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56. The key source of lead intoxication is lead-based paint, which children ingest by eating paint chips or by swallowing dust derived from the lead paint that settles on walls, windows, and floors. Other sources of lead toxicity are drinking water, soil, food, gasoline, and industry. *See* Deborah W. Denno, *Considering Lead Poisoning as a Criminal Defense*, 20 FORDHAM URB. L.J. 377, 392 (1993) [hereinafter *Considering Lead Poisoning*]. "Lead exposure can produce devastating physiological and neurobehavioral disorders among young children, . . . [including]: learning disabilities, delayed nervous system development, deficits in visual motor function, hyperactivity, hypoactivity, and abnormal social and aggressive behavior." *Id.* at 392-93 (citations omitted). Although children of all socioeconomic classes are vulnerable to the effects of lead, urban-dwelling black children appear to be most vulnerable. Furthermore, race appears to be a stronger risk factor for lead intoxication than poverty. *See id.* at 390-91.

lead absorption), and left-handedness. Previous research has shown that left-handedness is one indicator of dominance of the right cerebral hemisphere. It has been associated with a number of behavioral and intellectual disorders, including impulsiveness and lack of control.[57] Researchers have also found considerable evidence of high lead levels among hyperactive and behaviorally disordered children.[58]

Although lead intoxication has been ignored in crime research, the Biosocial Study showed that lead intoxication significantly impacted on the number of delinquent offenses among males. Similarly, researchers have ignored the effect of iron deficiency anemia on behavioral problems, although the Biosocial Study found that anemia was related to disciplinary problems. Moreover, iron deficiency anemia increases susceptibility to lead intoxication.[59]

Surprisingly, disciplinary problems in school were not highly correlated with school achievement in language; such problems, however, did show a significant, direct effect on delinquency. Thus, it appears that behavioral disturbance has a direct effect on delinquency, rather than an indirect, or impeding effect through school achievement.

Importantly, a physician's clinical assessment that a child had abnormal speech at age seven turned out to be a significant predictor of delinquency. The impact of speech is particularly telling in light of the finding that, of all the tests of adolescent achievement examined as predictors of delinquency at ages thirteen and fourteen, only language ability was significantly associated with delinquency.

Contrary to past research, the Biosocial Study did not find a direct link between delinquency and total family income either at the time of the child's birth, or at age seven. It appears, however, that the associations between socioeconomic status and delinquency found in prior research may have reflected an underlying relationship between factors that were tied to low income, but that have not been examined intensively in delinquency research (for example, lead intoxication or certain familial and parental characteristics). In the Biosocial Study, the number of times the family household moved between the child's birth and seventh birthday demonstrated a significant direct effect on delinquency. The length of time the father was unemployed showed the most highly significant impact, second only to disciplinary problems in school. Thus, patterns of familial instability and disorganization appear to be more important than the amount of money a family earns.

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57. *See* BIOLOGY AND VIOLENCE, *supra* note 1, at 12-14.
58. *See Considering Lead Poisoning*, *supra* note 56, at 392-93.
59. *See id.* at 392.

Overall, both biological and environmental factors predict crime and violence among males, although environmental factors, such as lead poisoning, appeared to be stronger predictors. Next, I consider the relatively stronger biological effects on crime and violence among females.

B. Effects on Female Offenders

Four factors showed direct effects on the number of adult offenses among females: (1) seriousness of delinquent offenses; (2) number of disciplinary problems in school; (3) low number of delinquent offenses; and (4) father's low educational level. As with males, the seriousness of delinquent offenses was significant. However, unlike males, those females most apt to continue to commit crime during adulthood were not always those who committed the most crime during their youth. This result is not surprising, however, because females commit a relatively larger number of petty or status offenses, like shoplifting. Therefore, unlike males, chronic female offenders were not always the most serious offenders, an association that has important distinguishing consequences in terms of social policy. Yet, disciplinary problems in school did show an effect on female crime, demonstrating that early problem behavior is predictive of problems in adulthood.[60]

Altogether, nine factors showed direct effects on the number of delinquent offenses among females: (1) disciplinary problems in school; (2) lack of foster parents; (3) abnormal movements; (4) neurological abnormalities; (5) left foot preference; (6) father's absence; (7) low language achievement; (8) normal intellectual status; and (9) right eye preference. The strong effect of disciplinary status is not surprising, given its importance in predicting a number of adult offenses. Moreover, the link between delinquency and low language achievement could be expected in light of a comparable link among males. However, the status of not being placed in foster care was a more surprising finding, because it suggested that keeping a child with her own family had a more negative effect on her behavior than foster care.[61]

Many of the children who were placed in foster care in the Biosocial Study came from disruptive and abusive homes where one or both parents were absent. Although the children were placed in foster care at any time between infancy and age seven, it appears that their early family experiences had a significant effect on their later delinquency. This conclusion is

60. *See* BIOLOGY AND VIOLENCE, *supra* note 1, at 86-87.
61. *See id.* at 87-88.

confirmed by the significant association found between father's absence and delinquency.

Other indicators of a number of delinquent offenses—abnormal movements, number of neurological abnormalities, right eye preference, and left foot preference—confirmed prior research indicating that female delinquents have a greater degree of neurological dysfunction than do male delinquents.[62] The study usually assessed abnormal movements during standard tests of coordination or while observing the child's spontaneous activity. For example, the researchers would ask a test child to "hold out both arms horizontally for thirty seconds to ease the detection of abnormal posture, chorea (rapid involuntary jerks), and athetosis (slow, spasmodic repetitions)."[63] They recorded many different types of abnormal movement, "including fasciculation, tremors, tics, and mirror movements."[64] Also, "medical examiners were asked to report as [neurological] abnormalities, 'conditions, which may not in themselves be neurological but are often related to CNS disorders, such as abnormalities of skull size and shape, spinal anomalies, and primary muscle disease.'"[65]

Two factors predicted the number of disciplinary problems in school: abnormal movements (which was highly significant) and abnormal vision. Physicians assessed whether a child's vision was abnormal by conducting a visual screening examination. Visual acuity was determined to be abnormal if any one of the following three conditions existed: (1) visual acuity less than 20:30 (with or without glasses); (2) hyperopia test failure; or (3) muscle balance test failure.

In general, predictors of female delinquency and violence were comprised of both biological and environmental factors. However, biological factors played a considerably greater role in the delinquency of females than in males. Although disciplinary problems were the most highly significant predictors of delinquency, neurological abnormalities and factors associated with attention deficit disorder were also important. Those factors—number of neurological abnormalities, mixed cerebral dominance as indicated by left-footedness and right-eyedness, and abnormal movements— influenced language achievement, which had a direct negative impact on delinquency.

Overall, there were two significant predictors of delinquency for both sexes: disciplinary problems in school—the strongest predictor for males and among the strongest predictors for females—and low language achievement.

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62. *See id.* at 87.
63. *Id.*
64. *Id.*
65. *Id.* at 88 (citation omitted).

This accords with prior research revealing that problems with conduct and academic achievement are among the principal predictors of delinquency.[66] Apart from academic achievement, however, other factors were highly significant predictors of delinquency for both sexes.

C. Total Impact of Effects on Number of Adult Offenses

Analyzing the total impact of independent and dependent variables through the summation of direct and indirect effects allows an alternative means of predicting juvenile and adult offenses. This method can answer questions pertaining to the combination of independent effects on intervening variables as they influence crime. For example, this approach can determine, first, the total effect of lead intoxication on adult male crime, given that lead has a direct effect on delinquency as well as an indirect effect through disciplinary problems; and second, the total effect of hand preference, given that it has only an indirect effect on delinquency through its impact on disciplinary problems.

For males, the number of adult offenses is most strongly influenced by four factors: (1) mother's low and father's high educational levels; (2) lead intoxication; (3) amount of time the father was unemployed; and (4) the number of household moves. The number of delinquent offenses is most strongly associated with three factors: (1) the amount of time the father was unemployed; (2) lead intoxication; and (3) number of household moves. For females, the number of adult offenses is most strongly influenced by five factors: (1) father's low educational level; (2) lower number of neurological abnormalities; (3) lack of foster parents; (4) number of abnormal movements; and (5) abnormal vision. The number of delinquent offenses is most strongly influenced by six factors: (1) lack of foster parents; (2) abnormal movements; (3) left foot preference; (4) father's absence; (5) number of neurological abnormalities; and (6) right eye preference.

In general, then, factors found to be important in the direct and indirect effects were also important in the reduced form models, although the relative strength of their impact shifted somewhat. Yet, the results of the reduced form equations still support the proposition that biological factors (such as abnormal movements, left foot and right eye preference, and neurological abnormalities) are more significant predictors of crime among females, whereas environmental factors (such as lead intoxication, father's employment status, and number of household moves) are more significant predictors of crime among males. Indicators of family stability were important for both

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66. *See id.* at 89.

males and females: the lack of foster parents and father's absence was important for females, and father's employment and household moves were important for males.

D. Summary of Results

Overall, the results of the Biosocial Study showed that direct, indirect, and total biological, psychological, and sociological influences on juvenile and adult crime were significant for both genders. Similar to past research, regression models demonstrated that some of the same factors that were influential on crime among males were also influential on crime among females. For example, seriousness of delinquent offenses was a key predictor of adult crime for both males and females, whereas the number of a child's disciplinary problems and low language achievement in school were key shared predictors of juvenile crime.

Most significant, however, were the numbers and kinds of predictors that the genders did not share. In general, the Biosocial Study confirmed past proposals suggesting that biological factors have relatively more impact among females, and environmental factors have relatively more impact among males. For example, among females, only two factors predicted disciplinary problems in school: abnormal movements and neurological abnormalities. These same two factors were also strong predictors of female offense behavior during the juvenile years and, in the reduced form equations, during the adult years. Among males, lead intoxication was the strongest predictor of disciplinary problems in school. Lead intoxication was also a strong predictor of male offense behavior during the juvenile years and, in the reduced form equation, during the adult years. Although lead intoxication results in neurological and physiological impairment, its origins are environmental. The fact that females appeared to be unaffected by lead, even though they were raised in the same or similar environment as males, suggests that males may be more vulnerable to certain kinds of environmental stressors. Similarly, abnormal movements or neurological abnormalities, which were associated with criminality among females, had no association with ability or criminality among males.

This conclusion warrants some qualification. First, as Table 3 illustrates, more factors appeared to influence crime and behavior among females than among males. Moreover, the interrelationships among these factors are more complex, suggesting that biological and environmental influences, and the interactions among them, weigh more heavily on female behavior. Second, certain biological factors, such as left-handedness, contributed indirectly to crime among males through an association with

disciplinary problems. Some environmental factors, such as lack of foster parents, or father absence, contributed directly to juvenile crime among females. Noticeably, the few biological predictors of disciplinary problems or crime for males (for example, left-handedness and perhaps abnormal speech) were not predictors for females. Moreover, only one family factor—lack of foster parents—that was significant in predicting juvenile crime for females was also significant for males in predicting disciplinary problems. Thus, more often than not, the genders do not share the same predictors of crime and behavior. This result suggests that researchers must assess different kinds of factors to determine the causes of gender differences in crime.

Results of the Biosocial Study did not confirm past findings of direct relationships between delinquency and early intelligence, mental retardation, socioeconomic status, or early central nervous system dysfunction as measured by the number of pregnancy complications. The lack of strong, significant associations among these variables may be due to a number of factors: the cultural and demographic characteristics and homogeneity of the sample; the infrequent occurrence of some of the independent variables (for example, particular types of pregnancy and delivery complications), which could mask true associations; or the simultaneous analyses of both biological and environmental variables, which could negate more traditional research findings. Because much of the research analyzing biological factors and crime has not adequately controlled for social, demographic, and environmental influences, some past findings of biological links to intelligence or to crime may be artifacts of environmental effects. Further, longstanding associations between environmental factors and crime may disguise the significance of biological effects, because researchers rarely incorporate them into delinquency research. Other variables, such as disciplinary problems, may be an outcome of both biological and environmental precursors, although most delinquency research offers only sociological explanations.

In sum, the Biosocial Study has pinpointed some potential correlates of crime that criminologists had previously not been able to examine. Moreover, a simultaneous focus on biological and environmental correlates throws doubt on some of the more traditional research findings that were limited to only a small range of variables. A study of gender differences in crime is particularly enlightened by a biosocial approach because of the wide range of disparity between genders in both the prevalence and types of predictors of crime. Ideally, the next goal will be to broaden this range of research even further. By answering some of the questions concerning gender differences, we may be well on the road to answering some of the questions concerning the causes of crime in general.

V. A PARTING COMMENT ON SOME CRITIQUES OF BIOSOCIAL RESEARCH ON CRIME

There are well known critiques of biosocial research on crime that are too numerous and detailed to recount in this presentation. I make no attempt here to debate the issue of whether biosocial research on crime should be conducted at all or whether these critiques are justified. I emphasize, only in parting, that the historical abuses of individuals in the name of science have never relied on, nor ever had, valid science to spur or justify their horrid goals. Discrimination, oppression, injustice, even genocide, have all been carried out with whatever "evidence" is conveniently at hand—evidence that bears no semblance to matters scientific or real. Those daunting issues aside, my purpose now is to examine briefly any possible concerns that individuals might voice regarding the results of the Biosocial Study in particular, because I confess I do not know what those concerns would be.

Before the Biosocial Study's findings were reported, some influential social scientists at the time thought that any studies involving biological data were oppressive or fascist. But, to this day, I cannot understand what these social scientists were afraid of. And when I go to conferences and present the Biosocial Study's results, I have received no open critique of the findings. This does not surprise me, because again, I don't know what the political critique would be.

When I started the study, I did know that I was examining a sample of children who, given their low socioeconomic background and limited resources, had every reason to be engaging in criminal activity. A number of the children were quite clearly impoverished. As I have reported, however, the study shed light in even more detail on how environmental deprivation was linked to crime. For example, one of the study's major results was the finding of a strong and consistent link between lead poisoning and crime. Commentators have cited lead poisoning as "the nation's No. 1 environmental threat to children."[67] In turn, they have conceded that although "[l]ead poisoning is entirely preventable . . . it is the most common and socially devastating environmental disease of young children."[68]

The question then becomes, how was I "oppressing" the subjects of the Biosocial Study by revealing even more thoroughly the unnecessary detriment that the environment can pose to a young person in ways that no criminologist had ever yet encountered? How was I "discriminating" when I explained that exposure to certain environmental toxins was correlated with aggressive and

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67. *Considering Lead Poisoning*, *supra* note 56, at 390.
68. *Id.*

hyperactive behavior among males, which seemed to be associated with their later criminality? The study's subjects had no personal responsibility for being exposed to lead—that responsibility fell on the landlords, the city, or the state. If the study had never been conducted, these results may never have been found, and the "entirely preventable" effect of lead poisoning would continue unnoticed.

The Biosocial Study also found a link between low language achievement and criminality among both males and females. But again, why should this result raise concerns of discrimination, inferiority, or oppression, particularly given the Biosocial Study's other findings? The Biosocial Study reported no direct link between measures of intelligence test scores and criminality, most likely because the study controlled for a number of socioeconomic factors that other studies did not have available. Moreover, detailed, uncoded data collected by social workers during each child's early life revealed other kinds of difficulties associated with language achievement that would never be detected had they not been unearthed in a study of this kind. I provide as an example a portion of my summary of the home observations of Frank X (a pseudonym), who had the most extensive offense record in the Biosocial Study's sample.

A striking feature of Frank X's record was his very severe speech problem at an early age, although the examiners made no mention of any medical attempts to help him. From all accounts, Frank appeared to be tongue-tied, an easily remedied condition that no one ever cured. Repeatedly, Frank was described by his mother, the home interviewers, and all psychological and medical examiners, as speech disordered and nearly unintelligible.

> At the four-year exam, for example, the examiner noted that [Frank's] mouth was "abnormal" and that he had a "severe articulation problem." [These difficulties supported the] examiner's assessment that the Stanford-Binet was "over the child's head" and that he was simply unable to verbalize his answers. At the seven-year exam [Frank] was described again as being "almost unintelligible," although he was cooperative with the examiner and "refuses to admit that he has difficulties with certain tasks." At age eight, [Frank] was completely unable to be tested for the speech exam because of a "severe articulation problem."[69]

69. BIOLOGY AND VIOLENCE, *supra* note 1, at 109.

Despite these conditions, Frank was consistently rated as friendly, cooperative, and pleasant during examination situations and at home interviews at an early age. What "discriminatory" or "oppressive" facts about Frank did the Biosocial Study reveal? The study revealed that economically deprived children do not receive sufficient medical care even when social workers are aware of their condition. Moreover, what looks to be lack of intelligence or underachievement in language on a standardized test is quite clearly linked to an easily treatable medical condition. The long-term consequences are life shattering.

What other "frightening facts" did the Biosocial Study uncover? The study did find that the amount of time the father is unemployed is related to crime among males. We all could have speculated that this association might exist, but the Biosocial Study provided scientific support for it. The most likely recommendation would be to help socioeconomically disadvantaged individuals gain or maintain their employment. The study also found that abnormal movements and neurological abnormalities were associated with delinquency among females. But again, these conditions have socioeconomic roots and interact with other stressors in the environment, such as father absence.

In response to the question, "What are we afraid of?," the only answer I can think of is this: We may be afraid that some key correlates of crime can be readily eliminated with relatively little money and a limited amount of time and we have yet to start doing anything about it. We may be afraid that a substantial amount of social pain that many individuals have experienced could have been avoided had we done more research a lot earlier. And, lastly, we may be afraid that the political resistance to certain kinds of biosocial research on crime has no social or scientific basis, regardless of the good intentions behind the anger.

TABLE 1[70]

SELECTED BIOLOGICAL AND ENVIRONMENTAL MEASURES

Measures at birth

1. Prenatal maternal conditions

Number of prenatal examinations

Number of prenatal conditions (a count of 8 items: mother's heavy cigarette smoking, use of sedatives, single marital status, presence of diabetes, hypertension, number of venereal conditions, number of neurological or psychiatric conditions, number of infectious diseases)

Poor obstetrical history (number of prior abortions, stillbirths, premature siblings, or neonatal death of siblings)

Mother's age

Number of prior pregnancies

2. *Pregnancy and delivery conditions*

Number of pregnancy and birth complications (a count of 17 items: placenta previa, abruptio placentae, marginal sinus rupture, uterine bleeding during the first, second, or third trimester, anesthetic shock, other anesthetic accident, cesarean or breech delivery, prolapsed cord, irregular fetal heart rate, meconium during labor, use of oxytocic during labor, loose cord around the neck, tight cord around the neck, forceps marks at delivery, multiple birth)

Duration of labor

Apgar at one and five minutes

Gestational age, birth weight

3. *Family and social structure*

Absence of the father

Amount of time the father is unemployed

Mother's employment status

Mother's marital status

Child's birth order

4. *Socioeconomic status*

Mother's education

Father's education

Total family income (adjusted to 1970 dollars)

Total family per capita income (adjusted to 1970 dollars)

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70. *Id.* at 34-36.

Measures at age 1

5. *Neurological factors*
   - Hand preference (right, left, or variable)
   - Abnormal behavioral control

Measures at age 4

6. *Intelligence*
   - Stanford-Binet Intelligence Scale
7. *Cerebral Dominance*
   - Hand, eye, foot preference (right, left, or variable)
   - Composite index of hand, eye, and foot preference

Measures at age 7

8. *Physical growth and development*
   - Height and weight
   - Ponderal index (height/weight^3)
9. *General physical health*
   - Pica
   - Lead intoxication
   - Iron deficiency anemia, 5 to 8 g.
   - Systolic and diastolic blood pressure
10. *Neurological factors*
   - Head shape, head circumference
   - Ear size, shape, and position
   - Otoscopic exam
   - Eye structure
   - Referral needed for glasses
   - Abnormal visual acuity
   - Mental status (clinical impression)
   - Speech (clinical impression)
   - Number of neurological abnormalities
11. *Soft neurological signs*
   - Nystagmus
   - Abnormal movements
   - Gait abnormality
   - Coordination, awkwardness
   - Right and left identification
   - Reflexes
   - Abnormal EEG
   - Mixed cerebral dominance
   - Position sense

Stereognosis

12. *Cerebral dominance*

Hand, eye, and foot preference (right, left, or variable)

Composite index of hand, eye, and foot preference

13. *Intelligence*

WISC Verbal IQ

WISC Verbal subscales (information, comprehension, vocabulary, digit span)

WISC Performance IQ

WISC Performance subscales (picture arrangement, block design, coding)

WISC Performance IQ Verbal IQ difference

Bender Gestalt Test, Koppitz scoring

Bender Gestalt, time in seconds

Goodenough-Harris drawing test

14. *Achievement*

Wide Range Achievement Test (WRAT) Spelling, Reading, Arithmetic

15. *Family and social structure*

Absence of the father

Absence of the father at birth and at age 7

Amount of time the father is unemployed

Mother's religion

Number of changes in mother's marital status (from birth to age 7)

Mother's marital stability

Number of adults, relatives in household

Total family size

Presence of grandparents in the household

Use of childcare

Foster or adoptive parents, guardian

Number of household moves (from birth to age 7)

16. *Socioeconomic status*

Education, occupation of household head (Census Bureau Index)

Additional schooling of the mother since child's birth

Number of persons supported

Total family income (adjusted to 1970 dollars)

Total per capita income (adjusted to 1970 dollars)

Measures at ages 13-14

17. *Achievement*

California Achievement Tests (CAT):

Total reading (vocabulary, comprehension)

Total math (computation, concepts and problems)
Total language (mechanics, usage, and structure)
Spelling

18. *Disciplinary status*

Enrollment in a school program for youths with disciplinary problems at any time during adolescence

19. *Mental retardation*

Enrollment in a school program for youths with tested evidence of retardation at any time during adolescence

Measures at ages 7-17

20. *Delinquency and violence*

Total number of officially recorded offenses (police contacts and arrests)
Seriousness of offenses (based on weights derived from a national survey of crime severity)
Classification of delinquency offenders (non-index, property, or violent)

Measures at ages 18-22

21. *Young adult crime and violence*

Total number of officially recorded offenses (police contacts and arrests)
Classification of criminal offenders (non-index, property, or violent)

TABLE 2[71]

INDEPENDENT AND DEPENDENT MEASURES

Ages	Dependent Variables
7	WISC Verbal IQ (45,155)
7	WISC Performance IQ (44,156)
13-14	Disciplinary problem (0 = absent; ≥ 1 = present)
13-14	Language achievement (199)
13-14	Mental retardation (0 = absent; ≥ 1 = present)
7-17	Number of delinquent offenses
7-17	Seriousness of delinquent offenses
18-2	Number of adult offenses
	Independent Variables
Birth	Pregnancy and delivery conditions (117 items)
Birth	Mother's education (number of years)
Birth	Father's education (number of years)
Birth	Family income (1970 dollars)
Birth	Time father unemployed (number of months)
1	Hand preference (0 = right; 1 = left or variable)
4	Stanford-Binet (25,175)
4	Hand preference (0 = right; 1 = left)
4	Eye preference (0 = right; 1 = left)
4	Foot preference (0 = right; 1 = left or variable)
7	Neurological abnormalities (total number)
7	Abnormal movements (0 = absent; 1 = present)
7	Abnormal vision (0 = absent; 1 = present)
7	Lead intoxication (0 = absent; 1 = present)
7	Anemia (0 = absent; 1 = present)
7	Intellectual status (0 = normal; 1 = abnormal)
7	Speech (0 = normal; 1 = abnormal)
7	Foster parents (0 = absent; 1 = present)
Birth-7	Father in household (0 = present; 1 = absent)
Birth-7	Household moves (total number)
7	Persons supported (total number)
7	Family income (1970 dollars)

71. *See id.* at 72-75.

TABLE 3[72]

GENDER DIFFERENCES IN PREDICTORS OF JUVENILE AND ADULT CRIME

(statistically significant predictors from Table 2, in decreasing order of significance)

Factors Predicting Number of Adult Offenses—Males
- Number of delinquent offenses**
- Mother's low education**
- Seriousness of delinquent offenses**
- Father's high education*
- Low language achievement*

Factors Predicting Number of Adult Offenses—Females
- Seriousness of delinquent offenses***
- Disciplinary problem***
- Low number of delinquent offenses**
- Father's low education**

Factors Predicting Number of Juvenile Offenses—Males
- Disciplinary problem in school***
- Time father unemployed***
- Lead intoxication***
- Low language achievement in school*
- Household moves*
- Abnormal speech*

Factors Predicting Number of Juvenile Offenses—Females
- Disciplinary problem***
- Lack of foster parents***
- Abnormal movements***
- Neurological abnormalities***
- Left foot preference***
- Father absence**
- Low language achievement*
- Normal intellectual status*
- Right eye preference*

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72. *See id.* at 77-89.

Factors Predicting Disciplinary Problem—Males

Lead intoxication**
Anemia**
Household moves*
Left hand preference*
Lack of foster parents*

Factors Predicting Disciplinary Problem—Females

Abnormal movements***
Abnormal vision**

Factors Predicting Language Achievement—Males

WISC Verbal IQ***
WISC Performance IQ***

Factors Predicting Language Achievement—Females

WISC Performance IQ***
WISC Verbal IQ***
Lesser number of persons supported***
Left foot preference**
Stanford-Binet**
Father presence**
Family income*
Mother's education*

* $p < .05$
** $p < .01$
*** $p < .001$.