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Sociological and Human Developmental Explanations of Crime: Conflict or Consensus

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SOCIOLOGICAL AND HUMAN DEVELOPMENTAL EXPLANATIONS OF CRIME: CONFLICT OR CONSENSUS?*

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This paper examines multidisciplinary correlates of delinquency in an attempt to integrate sociological and environmental theories of crime with human developmental and biological explanations of crime. Structural equation models are applied to assess links among biological, psychological, and environmental variables collected prospectively from birth through age 17 on a sample of 800 black children at high risk for learning and behavioral disorders. Results show that for both males and females, aggression and disciplinary problems in school during adolescence are the strongest predictors of repeat offense behavior. Whereas school achievement and family income and stability are also significant predictors of delinquency for males, early physical development is the next strongest predictor for females. Results indicate that some effects on delinquency also vary during different ages. It is suggested that behavioral and learning disorders have both sociological and developmental correlates and that adequate educational resources are necessary to ensure channels of "legitimate opportunities" for high-risk youths.

The theoretical development of multidisciplinary explanations of crime seems to be one of the most praised concepts in criminology and, at the same time, one of the most ignored in actual research. For example, recent growth in the biological and neurological sciences has greatly increased knowledge about the complexities of human behavior. However, such influences are not reflected in most studies of crime which emphasize predominantly the role of environmental factors.

The seeming indifference in criminology to contributions in the biological sciences is not accidental; in part, it reflects a concern that the acceptance of biological theories of crime reduces the importance of environmental effects (Shah and Roth, 1974: 102). It also demonstrates the tendency for the different social and biological sciences to work in isolation, with each using its own language and technique, each unintentionally discouraging interdisciplinary

convergence and exchange (Denno and Schwarz, 1985). This disciplinary split pits one research bias against the other, with neither approach singly able to investigate thoroughly the more complex components of behavior. Previous attempts to develop criminological theories have often failed in particular to acknowledge variations in the physiological and psychological capabilities of individuals for internalizing socially approved behavior. In turn, many efforts to study biological factors in crime have ignored even the most obvious environmental and sociological influences.

In their recent book, *Crime and Human Nature*, Wilson and Herrnstein (1985: 512-513) point out the lack of information available in the social sciences on the complex interactions between biological and environmental variables and criminal behavior. They suggest the need for a prospective study of individuals followed from birth through adolescence in order to unravel the ties between such "traits and circumstances" as constitution and social factors. They also emphasize the importance of longitudinal research on black children to determine the contributions of select social and environmental effects, including family structure and economic status (1985: 478).

The purpose of the present study is to examine links among multidisciplinary correlates of delinquency in an attempt to integrate sociological and environmental theories of crime with human developmental and biological explanations. Models are applied to assess biological, psychological, and environmental variables collected prospectively from birth through adolescence on a sample of black children at high risk for learning and behavioral disorders. Thus, this study presents an opportunity to weigh simultaneously the importance of social and nonsocial factors in a developmental framework. Overall, the results suggest that sociological and developmental approaches can be complementary, not conflicting, and that both are necessary for a comprehensive explanation of behavior.

THEORY INTEGRATION

Sociological and social-structural theories suggest in general that delinquency is an adaptation to conditions and social influences in lower-class environments (for reviews of these theories, see Hirschi, 1969; Kornhauser, 1978). Some of these environments may be part of a "subculture of violence" which maintains norms of violence separate from the dominant culture and which may vary among different ethnic groups (Wolfgang and Ferracuti, 1982).

Recognizing that behavior has both psychological and social bases, differential association and social learning theories propose that delinquency is imitated, facilitated, and internalized with social reinforcements and modeling (Sutherland and Cressey, 1978). Hirschi's (1969) social bond theory links

delinquent behavior to the strength of an individual's ties with society through attachments, commitments, involvements, and beliefs.

The successful maintenance of these ties is perhaps most in jeopardy during adolescence. Although human development is continuous, some authors suggest that adolescence is a time of "moral turbulence," when a strong sense of self or behavioral control is not yet established (Zellermayer, 1976: 99). Adolescence is also the most significant period of value formation (Konopka, 1973) and when, presumably, behavior is most open to change (McMahon, 1970). School, family, and peer experiences are all influential. Given opportunities, a youth will commit a delinquent act because he or she is not yet deterred by a strong attachment to conforming values in society. Consistent with some bonding theory, those adolescents who avoid deviant influences may have greater self-esteem and self-control (Jensen, 1973). By later adolescence and early adulthood, the increased understanding of social organization that develops with age allows the individual to realize the "social and legal relations that bind him to society and constrain his behavior" (Simpson, 1976: 101). Thus, individuals "outgrow" those ages most susceptible to environmental influence (Schur, 1973).

Although considerable research supports the premise that social bonding and environment influence adolescent behavior, it is difficult to determine which constraints have the most impact. Moreover, bonding theories fail to explain adequately the persistence of criminal behavior among those who have reached maturity—or the start of criminal behavior among adolescents who have a favorable environment. The extent to which children and adolescents are relatively more susceptible to peer and social influences has also not been clearly gauged.

The strength of social bonding and the likelihood of a delinquent status may be dependent, in part, on early developmental, biological, and environmental factors whose cumulative and interactive influences vary over time. Considerable evidence indicates that many biological and developmental disorders associated with delinquency (for example, learning and reading disabilities) may be attributable, in part, to minor central nervous system (CNS) dysfunction which is linked, most predominantly, to complications occurring before and after birth (for reviews, see Denno, 1982, 1984).

The cumulative effects of indicators of CNS trauma and subsequent bonding and behavior may be analogous theoretically to the combined effects of different variables used in risk research (Garmezy, 1977; Slone, Shapiro, Heinonen, Monson, Hartz, Siskind, Rosenberg, and Mitchell, 1976). Infants "at risk"—those born prematurely, with low birth weight, and so on—seem to have somewhat more difficulty adjusting to poor environments than healthy, full-term infants. It appears that the relatively more immature or stressed central nervous systems of these infants are less able to become integrated in deprived circumstances (Eagle and Brazelton, 1977: 37).

At-risk infants are not only more vulnerable to their immediate environment, however, they are also more prone to later CNS-related disorders associated with delinquency. These disorders include reduced intelligence or achievement, minimal brain dysfunction (MBD) and hyperactivity, problems associated with cerebral dominance, and learning and reading disabilities (Denno, 1982). Unfavorable environmental circumstances during childhood may compound these disorders (Denhoff, Hainsworth, and Hainsworth, 1972: 164-165). Likewise, CNS-related deficits which are accompanied by subcultural or familial deprivation may impair social bonds.

The nature and extent of relationships among "at risk" factors and delinquent behavior are complex and, in many ways, difficult to detect. The opportunity to identify sequential or ordering effects is an advantage of longitudinal research because biological and environmental interactions with delinquency are not always clear or consistent. Overall, specification of interrelationships among various kinds and occurrences of developmental variables may pinpoint those factors which initiate and perpetuate offense behavior.

Analyses of sex differences in behavior provide an additional method for deciphering sociological and developmental effects. Previous research has shown that developmental and biological factors are more strongly associated with delinquency among females for two reasons: females are physically less vulnerable to environmental influences than males; and female delinquents deviate more widely from biological norms in light of the greater sociological and cultural constraints on female behavior (Climent, Rollins, Ervin, and Plutchik, 1973; Cowie, Cowie, and Slater, 1968).

In the present study, sex differences in the direct and indirect interrelationships among sociological and human developmental variables and delinquency are specified in a longitudinal model. It is expected that factors associated with aggression, as well as with the economic and social stability of the family, should be the dominant predictors of delinquency for both males and females. Aggressive behavior has been shown to be fairly consistent across different ages; however, it is far less likely to appear outside of a cultural or social context (Elliott, in press). Individuals also vary to the extent that they can internalize socially approved, or nondelinquent, bonds and behaviors. Throughout their lives, males are at a greater risk than females for CNS-related disorders which are often linked indirectly to difficulties associated with impulse control and poor bonding during early childhood and adolescence. These difficulties include behavioral, academic, and learning problems, particularly verbal ability. CNS-related disorders occur most frequently in socioeconomically deprived environments. However, if a susceptibility to problematic behavior exists among some individuals exclusive of the environment, it is expected that CNS and developmental factors should also be contributing predictors of delinquency.

METHOD

SUBJECTS

Subjects were selected from a total sample of nearly 10,000 children whose mothers participated in the Philadelphia Collaborative Perinatal Project (CPP) at Pennsylvania Hospital between 1959 and 1966. Pennsylvania Hospital was one of 12 medical centers included by the National Institute of Neurological Diseases and Stroke (NINDS) in a nationwide study of genetic, biological, and environmental influences upon child development (Niswander and Gordon, 1972). Thus, the total sample reflects, in part, the characteristics of children born to a self-selected group of women who were interested in receiving inexpensive maternity care.

Data collection for the CPP was prospective. Upon registration, each mother was administered a battery of interviews and physical examinations, and extensive data were recorded for each pregnancy. Data recorded for each child from birth through age seven included neurological, medical, psychological, and behavioral test results. Socioeconomic and family data were collected during the mother's registration and at the child's seven-year examination. The forms used for collecting data and assessing coder reliability have been described in detail (U.S. Department of Health, Education, and Welfare, 1966, 1970). School and police records collected on the Philadelphia CPP youths by the Center for Studies in Criminology and Criminal Law provide educational achievement and arrest data during ages 10 through 17.

The final sample of 800 subjects analyzed in the present study was selected from the first four cohorts (1959-1962) of 2,958 black mothers who participated in the Collaborative Perinatal Project. Data collection is ongoing for the latter four cohorts of subjects. A sample of white subjects was too limited in size to be included in analyses of delinquency.

The sample of 800 subjects consisted of 410 males and 390 females. These subjects were selected according to the following criteria: (1) located in a Philadelphia public school, (2) stayed in Philadelphia from ages 10 through 17, (3) received selected intelligence tests at ages 4 and 7 (+/–six months) and achievement tests at ages 14 and 15, (4) were not among sibling members excluded from the sample to prevent possible biases in multiple family membership. Comparisons between the final sample of 800 subjects and the excluded sample of 2,158 black subjects show no significant differences in total and per capita family income, the number of prenatal examinations the mother attended, and mother's age. In general, the final sample appeared to be representative of the sample from which it was drawn (Denno, 1982).

Table 1. Independent and Dependent Variables: Theoretical
Model

Independent Variables (ξ)

ξ_1 Prenatal Maternal Conditions

—Number of Prenatal Examinations
—Number of Prenatal Conditions (a count of 8 items including
presence of heavy smoking, sedative use, infectious diseases)
—Poor Obstetrical History (number of prior stillbirths, abortions,
premature siblings, or neonatal death of siblings)
—Mother's Age
—Number of Prior Pregnancies

ξ_2 Pregnancy and Delivery Complications

—Number of Birth Complications (a count of 17 items including
presence of placenta previa, bleeding during pregnancy, Caesarean
or breech delivery)
—Duration of Labor
—Apgar at One and Five Minutes (a widely used scaled scoring
system to evaluate an infant's physical condition one and five
minutes after birth)
—Birth Weight, Gestational Age (indicators of infant health and
premature birth)

ξ_3 Socioeconomic Status—Registration

—Family Income
—Mother's Education
—Husband or Father Present in the Household

ξ_4 Intelligence—Age 4

—Stanford-Binet Intelligence Scale

ξ_5 Nursery School Attendance—Age 4

—Enrollment in a Publicly Funded Nursery School Program

ξ_6 Physcial Development—Age 7

—Height, Weight
—Blood Pressure (systolic and diastolic)

ξ_7 Cerebral Dominance (Laterality)—Age 7

—Hand, Eye, Foot Preference

ξ_8 Socioeconomic Status—Age 7

—Family Income
—Education, Occupation of Household Head (Census Bureau Index)

Table 1 (continued)

—Husband or Father Present in the Household

ξ_9 Disciplinary Code in School—Age 15

—Enrollment in a Program for Youths with Disciplinary Problems at Any Time during High School

ξ_{10} Retardation Code in School—Age 15

—Enrollment in a Program for Youths with Tested Evidence of Retardation at Any Time during High School

Dependent Variables (η)

η_1 Verbal Intelligence—Age 7

—Verbal Subscales of the WISC[a]
—Spelling, Reading, Subscales of the WRAT[b]

η_2 Spatial Intelligence—Age 7

—Spatial Subscales of the WISC
—Arithmetic WRAT
—Bender Gestalt Test, Goodenough-Harris Drawing Test

η_3 Achievement—Age 15

—All Subscales of the CAT[c]

η_4 Number of Offenses—Ages 10-17

—Total Number of Officially Recorded Offenses (both police contacts and arrests) during ages 10 through 17

[a]Wechsler Intelligence Scale for Children
[b]Wide Range Achievement Test
[c]California Achievement Test

MEASURES

Measures in this study, presented in Table 1, were selected according to social-structural, social bonding, and human developmental theories of delinquent behavior.

SOCIAL STRUCTURE

The selection and characteristics of the Philadelphia CPP sample control for a number of potentially social-structural variations. All subjects were born and raised (until young adulthood) in the same urban area and received very similar medical treatment early in life. A sizable number of subjects lived in the same neighborhoods. All subjects selected in the present study attended Philadelphia public schools and most shared a predominantly lower to lower-middle socioeconomic status. Only black subjects were included in

this study's sample. Thus, the sample represents a fairly homogenous group with social-structural characteristics found in some past research to associate strongly with delinquency.

Aside from such homogeneity, however, previous research has also demonstrated the importance of a wide range of other social-structural factors in predicting crime. For example, various maternal and family variables have been linked to delinquency, such as broken homes (Andrew, 1981; Gabrielli, 1981) and absence of the father (Virkkunen, 1976), with differential effects according to the sex and race of the delinquent (Austin, 1978; Datesman and Scarpitti, 1980). In the present study, family indicators of social structure emphasized in the criminological literature included measures of socioeconomic status (income, occupation, and education) and presence of the husband or the father in the household.

An additional indicator of social structure in this study is whether or not a subject attended a publicly funded nursery school at age 4 (similar to Head Start), which was made available to some participants in the CPP. Head Start and related programs were instituted originally during the 1960s to provide disadvantaged preschool children with "legitimate opportunities" for academic success. There is evidence that some preschool programs have had a positive effect on the later school competence of children from low socioeconomic families, contradicting several past findings of no effect (Darlington, Royce, Snipper, Murray, and Lazar, 1980).

SOCIAL BONDING

The extent to which youths are committed to normative values in society can be assessed through their degree of socially conforming ambitions and aspirations (Hirschi, 1969) as well as through their actual behavior. Academic achievement in school is often considered an indicator of commitment to conformity in terms of both current peer acceptance and the recognition of future prospects (Paternoster, Saltzman, Waldo, and Chiricos, 1983). Undisciplined or deviant school behavior is more of a direct indicator of lack of normative commitment and involvement in unconventional activity.

In the present study, school achievement was measured by subjects' California Achievement Test scores for ages 14 and 15 (grades 7 and 8). Seriously problematic or undisciplined school behavior was measured in terms of whether a subject participated in a program for the remedial disciplined at any time during high school ("Disciplinary Code at Age 15"). These children were diagnosed as having normal intellectual ability but some record of asocial behavior in school, such as physical aggression toward teachers, firestarting, inability to adjust to school, and conduct disturbance. According to the Philadelphia School Board, recommendation of a child to this program was based solely on in-school performance and was made independently of any knowledge of a child's official (delinquent) status.

Associations among delinquency, behavior disturbance, and low school achievement have been frequently linked to subtle health disorders such as minimal brain dysfunction and hyperactivity. The term "hyperactivity" in particular describes the heterogeneous behaviors of children who may evidence overactivity, attentional deficits, perceptual-motor impairments, and antisocial responses. By definition, children with below-normal intelligence or very severe neurological problems are excluded. Etiological explanations of minimal brain dysfunction include prenatal or birth trauma, neurodevelopmental lag, and poor living environment (Nichols and Chen, 1981; Rie and Rie, 1980).

Problem behaviors among minimal brain dysfunction children appear to correspond with age. For example, young children (2 to 6 years) may show lack of discipline and hyperactivity; older children (during elementary school and adolescence) may demonstrate reading and learning disorders, academic underachievement, and delinquent or aggressive behaviors (Wender, 1971). Longitudinal follow-up studies indicate that children who do not outgrow such behavioral disorders may retain antisocial conduct into adulthood (Shah and Roth, 1974).

HUMAN DEVELOPMENT

Human developmental theories of delinquency emphasize the physiological and psychological capacities of individuals to adjust to their social and physical environments and to internalize normative conduct. Individuals who experience disorders of the central nervous system, who have delayed maturation, or who have low scores on intelligence tests may be particularly more vulnerable to negative or stressful environments, or exhibit less control over their behavior. In the present study, indicators of human development are generally of three types: (1) early CNS dysfunction or development, (2) intelligence and cerebral dominance, and (3) physical health and growth.

Early CNS Dysfunction or Development. Early CNS dysfunction or development is measured by a variety of prenatal and pregnancy complications found to relate to later disorders, including the mother's obstetrical history, her age, and her health conditions during pregnancy and delivery. Measures of the child's health include birth weight, evidence of premature birth (indicated by age at gestation), and Apgar score, an accepted and validated scale of health and development immediately after birth. (For a review of the literature, see Denno, 1982.)

Intelligence and Cerebral Dominance. Evidence of anatomical and functional differences between the two (left and right) hemispheres of the brain provides one possible explanation for both intellectual and behavioral variations in the general population and, perhaps, between the sexes. In most (right-handed)

individuals, the left crebral hemisphere specializes in processing verbal stimuli, whereas the right cerebral hemisphere specializes in processing spatial stimuli (Bogen, 1969; Dimond and Beaumont, 1974). WISC Verbal IQ and other verbal measures are widely used indicators of left hemispheric abilities; WISC Performance IQ and other spatial measures are indicators of right hemispheric abilities. Both verbal and spatial tests specify "cerebral dominance"—that is, a condition in which one of the hemispheres plays a relatively more active role in certain kinds of cognition than the other (Reitan and Davison, 1974). (Further discussion of these differences and the controversies surrounding this area of research may be found in Gevins, Doyle, Cutillo, Schaffer, Tannehill, Ghannam, Gilcrease, and Yeager, 1981; and McGlone, 1980.) In the present study, measures of intellectual and behavioral development and cerebral dominance included the Stanford-Binet at age 4 and the WISC (and other psychological tests) at age 7.

Additional factors have been found to be associated with cerebral dominance, most notably hand preference and, to a lesser extent, eye and foot preference (Nachshon, Denno, and Aurand, 1983). Findings that some left-handers tend to rely on the "less analytical, more emotional, more impulsive response modes" associated with the right cerebral hemisphere have been used to explain their greater involvement in delinquency and violence (Gabrielli and Mednick, 1980; for a review, see Denno, 1984). In the present study, hand, eye, and foot preferences at age 7 are analyzed as indicators of cerebral dominance.

Evidence of mental retardation in high school ("Retardation Code at Age 15") was determined by the results of a full battery of psychological tests in addition to personal assessments by school psychologists.

Physical Health and Growth. Physical growth, even at an early age, is one of several predictors of subsequent health and development (Prahl-Andersen, Kowalski, and Heydendael, 1979) and, in some studies, of physical maturation (Frisch and Revelle, 1971). Measures of height and weight, selected for the present study, have been found to be excellent indicators of physical growth (Davie, Butler, and Goldstein, 1972). Although blood pressure is a less stable measure of growth, it is highly related to height and weight in childhood and, as in adulthood, is an accepted correlate of general health (Katz, Hediger, Schall, Bowers, Barker, Aurand, Eveleth, Gruskin, and Parks, 1980).

GENDER

Males and females are examined separately in the present study in light of gender differences in human development and in response to variations in social structure and environments. For example, males appear to be relatively more vulnerable to environmental stress and developmental difficulty.

In general, they experience a higher incidence of prenatal and perinatal mortality and complications, reading and learning disorders, mental retardation (Reinisch, Gandelman, and Spiegel, 1979), as well as left-handedness and left hemisphere deficits (Carter-Saltzman, 1979). The higher incidence of (particularly violent) delinquent and criminal behavior among males is well-documented (Wolfgang and Ferracuti, 1982).

DELINQUENCY

In the present study, delinquency was measured in terms of the number of official police contacts (offenses) a subject experienced from ages 10 through 17. Previous analyses of this data set have found "number of offenses" to be associated with total offense seriousness and to be the single best indicator of offense behavior (Denno, 1982). A detailed description of arrest data coding and reliability can be found in Center for Studies in Criminology and Criminal Law (1981).

THEORETICAL MODEL

Longitudinal relationships among selected variables were examined using structural equation models which combine features of both factor analysis and regression analysis. The models are especially appropriate for analyzing longitudinal panel data because each equation represents a "causal link," in contrast to other techniques such as ordinary least squares regression, where each equation represents an empirical association (Goldberger, 1973: 2).

Jöreskog (1973) has developed a general linear model for the analysis of covariance structures which allows for both error in the equations and error in the variables. The general model is a system of equations relating both unobservable and observable independent and dependent variables with an underlying causal structure (Jöreskog and Sörbom, 1978: 4).

Variables selected for the initial structural equation model, which was used as a theoretical framework for the present study, are shown in Table 1. The model consisted of 10 latent independent variables (identified by ξ) with 28 indicators and 4 latent dependent variables (identified by η) with 20 indicators. Direct and indirect relationships among social-structural, social bonding, and human developmental variables and delinquency were specified for males and females across four different time points.

The cumulative effects of indicators of early CNS trauma may be viewed longitudinally as risk factors. Children with prenatal and perinatal complications are at a greater risk for CNS-related difficulties such as impaired physical growth, intellectual and academic problems, minimal brain dysfunction, and pathological or mixed cerebral dominance associated with left hand, foot, or eye preference. These CNS disorders are also interrelated. For example, children with pathological and mixed cerebral dominance are significantly

Table 2. Means and Standard Deviations of Independent and Dependent Variables by Sex: Final Model

Variable	Males		Females		t
	Mean	SD	Mean	SD	df = 798
ξ₁ Mother's Age	24.42	6.66	24.79	6.34	-.81
ξ₂ Birth Weight (lbs.)c	7.10	1.16	6.66	1.08	5.54
ξ₃ Income at Registration (1970 dollars)	4,070.83	1,897.31	4,016.59	1,919.66	.40
ξ₄ Husband in Household, Registration (0 = present, 1 = absent)	.32	.47	.26	.44	1.65
ξ₅ Stanford-Binet–Age 4[a]	89.83	12.23	92.06	13.46	-2.45
ξ₆ Nursery School Attendance–Age 4 (0 = attendance, 1 = no attendance)	.90	.30	.89	.31	.35
ξ₇ Physical Development–Age 7					
—Blood Pressure, Systolic	101.87	9.85	100.63	9.81	1.78
—Blood Pressure, Diastolic[a]	62.01	7.65	60.89	8.06	2.01
—Weight (lbs.)c	55.06	10.31	51.94	9.07	4.56
—Height (cms.)c	124.40	5.68	122.37	5.61	5.10
ξ₈ Cerebral Dominance–Age 7					
—Hand Preference	.12	.32	.09	.29	1.14
—Foot Preference (0 = right, 1 = left or variable)	.16	.37	.21	.41	-1.79
ξ₉ Income at 7 Years	6,575.84	3,492.98	6,663.80	3,257.17	-.37
ξ₁₀ Husband in Household, 7 Years (0 = present, 1 = absent)	.38	.49	.41	.49	-.86
ξ₁₁ Disciplinary Code in School–Age 15[a] (0 = absent, 1 = present)	.05	.21	.01	.11	2.12
ξ₁₂ Retardation Code in School–Age 15[b] (0 = absent, 1 = present)	.05	.22	.02	.15	2.83

Table 2 (continued)

Variable	Males		Females		t
	Mean	SD	Mean	SD	df = 798
η_1 Verbal Intelligence–Age 7					
—WISC Information	9.24	2.37	9.24	2.43	-.07
—WISC Comprehension[b]	8.65	2.49	8.20	2.27	2.67
—WISC Vocabulary[b]	8.27	2.39	7.77	2.35	2.98
—WISC Digit Span	9.16	2.87	9.56	3.06	-1.94
—WRAT Spelling[a]	22.80	4.73	23.65	4.71	-2.53
—WRAT Reading[a]	31.16	7.64	32.91	8.32	-3.11
—WRAT Arithmetic	20.03	3.48	20.49	3.19	-1.91
η_2 Spatial Intelligence–Age 7					
—WISC Block Design[a]	9.10	2.27	8.77	2.14	2.08
—WISC Coding[c]	9.71	2.86	10.63	2.76	-4.66
—WISC Picture Arrangement[b]	8.88	2.69	8.33	2.59	2.96
—Bender-Gestalt[c]	7.78	3.33	8.68	3.62	3.66
—Goodenough-Harris Drawing Test[c]	96.53	13.17	93.59	11.88	3.32
η_3 Achievement					
—CAT Vocabulary[a]	32.41	26.27	37.43	29.81	-2.52
—CAT Comprehension[b]	29.03	23.71	33.77	24.69	-2.77
—CAT Mechanics[c]	27.89	24.06	39.81	26.64	-6.63
—CAT Usage and Structure[c]	29.21	20.76	35.40	23.34	-3.96
—CAT Spelling[c]	26.08	23.70	40.30	27.91	-7.75
—CAT Computation[c]	23.14	22.07	29.05	23.64	-3.66
—CAT Concepts and Problems	24.76	22.35	28.51	22.36	-2.37
η_4 Number of Offenses[c]	.82	2.17	.18	.71	5.61
(N)	(119)		(47)		
N	410		390		

[a] p < .05   [b] p < .01   [c] p < .001

more apt to experience minimal brain dysfunction and to have learning and reading disorders. Likewise, positive correlations between physical development, intelligence, and achievement have been demonstrated.

Regardless of the presence of birth-related CNS injury, however, CNS difficulties developed during childhood increase the likelihood of intellectual and behavioral problems. These difficulties may be compounded, or dominated, by negative social-structural factors such as absence of the father and low socioeconomic status. Notably, such individuals are at a greater risk for behavioral disorders and delinquency as well as persistent violent behavior. The considerably greater incidence of males in delinquency and violence may be attributable, in part, to their more frequent incidences of CNS-related disorders as well as cultural pressures to be aggressive. (Evidence for the links among these variables may be found in Denno, 1982.)

The extent to which the interrelationships among these variables predicts delinquency has not been thoroughly investigated, particularly among black, lower SES subjects. Longitudinally, it is expected that the strength of associations would become more pronounced during adolescence when physiological and, to some extent, environmental influences are strongest.

MODEL TESTING

Testing of the theoretical model involved examining each of the 14 factors or variables separately by confirmatory factor analysis. The procedure for determining the appropriate fit of each model is described in Jöreskog and Sörbom (1978). In general, independent factors for the final structural equation model were considerably different from those outlined initially. The final model comprised 12 independent and 4 dependent factors, as shown with means and standard deviations in Table 2.

Independent factors changed considerably and for interesting reasons. Aside from Mother's Age (ξ_1) and Birth Weight (ξ_2), most prenatal and perinatal indicators of birth stress showed very low correlations with dependent factors and thus could not be retained in the model. Mother's Age (ξ_1) remained as a single indicator of prenatal and perinatal conditions because it correlated with birth-related events and dependent factors; Birth Weight (ξ_2) remained as a single indicator of perinatal condition. SES at Registration and at Age 7 were best represented by two single indicators, Family Income (ξ_3, ξ_9) and Husband or Father Presence in the Household (ξ_4, ξ_{10}). Although family income and father presence are correlated, they demonstrate both theoretically and statistically somewhat separate effects on dependent measures. In turn, only the two strongest correlates of Cerebral Dominance (ξ_8), hand and foot preference, were retained. The factor of Physical Development (ξ_7) was confirmed, however, along with the three dependent factors: Verbal Intelligence (ξ_1), Spatial Intelligence (ξ_2), and Achievement (ξ_3).

Table 3. Final Structural Equation (Comparison) Model: Standardized Solution - Males and Females

		Males				Females		
	Verbal IQ	Spatial IQ	Achievement	Offenses	Verbal IQ	Spatial IQ	Achievement	Offenses
β_1 Verbal IQ	—	—	.734*** (4.35)	—	—	—	.314* (2.43)	—
β_2 Spatial IQ	—	—	.026 (0.16)	—	—	—	.458*** (3.13)	—
β_3 Achievement	—	—	—	-.158* (-2.46)	—	—	—	-.026 (-1.27)
Υ_1 Mother's Age	.097* (2.28)	.049 (1.20)	-.040 (-1.31)	.005 (.28)	-.020 (-.45)	.049 (1.20)	-.040 (-1.31)	.005 (.28)
Υ_2 Birth Weight	-.007 (-.20)	.069 (1.63)	.007 (.22)	.041* (2.17)	-.007 (-.20)	.069 (1.63)	.007 (.22)	.041* (2.17)
Υ_3 Income at Registration	.050 (1.46)	.014 (.35)	.030 (.98)	-.265*** (-2.67)	.050 (1.46)	.014 (.35)	.030 (.98)	.014 (.88)
Υ_4 Husband in Household, Registration	.079* (2.20)	.035 (.81)	.003 (.10)	-.138* (-2.00)	.079* (2.20)	.035 (.81)	.003 (.10)	.029 (1.40)
Υ_4 Stanford-Binet	.473*** (9.55)	.560*** (12.28)	-.077 (-1.87)	.012 (.62)	.588*** (12.06)	.600*** (12.28)	-.077 (-1.87)	.012 (.62)
Υ_6 Nursery School Attendance	.064* (1.93)	.039 (.96)	-.049 (-1.66)	-.003 (-.14)	.064* (1.93)	.039 (.96)	-.049 (-1.66)	-.003 (-.14)
Υ_7 Physical Development	.099* (2.52)	-.012 (-.25)	-.012 (-.34)	-.058** (-2.63)	.099* (2.52)	-.012 (-.25)	-.012 (-.34)	-.058** (-2.63)
Υ_8 Cerebral Dominance	-.057 (-1.27)	-.019 (-.34)	.019 (.48)	-.020 (-.59)	-.057 (-1.27)	-.019 (-.34)	.019 (.48)	-.020 (-.59)
Υ_9 Income at 7 Years	.056 (1.44)	-.018 (-.37)	-.008 (-.23)	-.011 (-.51)	.056 (1.44)	-.018 (-.37)	-.008 (-.23)	-.011 (-.51)

Dependent Variables

Table 3 (continued)

	Males				Females			
	Verbal IQ	Spatial IQ	Achievement	Offenses	Verbal IQ	Spatial IQ	Achievement	Offenses
Υ_{10} Husband in Household, 7 Years	.010 (.21)	-.079 (-1.60)	-.011 (-.31)	.122 (1.82)	-.146** (-.288)	-.079 (-1.60)	-.011 (-.31)	.038 (1.65)
Υ_{11} Disciplinary Code in School	-.017 (-.53)	-.016 (-.40)	-.089** (-3.04)	.256*** (5.66)	-.017 (-.53)	-.016 (-.40)	-.089** (-3.04)	.925*** (11.58)
Υ_{12} Retardation Code in School	-.158*** (-4.71)	-.111** (-2.75)	.031 (.99)	-.023 (-.86)	-.158*** (-4.71)	-.111** (-2.75)	.031 (.99)	-.023 (-.86)
R^2	.37	.37	.47	.13	.42	.37	.49	.29

Dependent Variables

The t-statistic is reported in parentheses (2-tailed test)   N = 410 (males); 390 (females)

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

Sex Comparison Model X^2 (1,035) = 1,081.82; p = .152
Initial Male Model X^2 (554) = 1,450.53; p < .001
Initial Female Model X^2 (554) = 1,673.59; p < .001

RESULTS AND DISCUSSION

SAMPLE CHARACTERISTICS

Values of independent and dependent variables in Table 2 show that, on the average, CPP subjects were from families in the lower-middle to lower income ranges. They scored in the lower-average or average ranges in intelligence tests at ages 4 and 7 and fell in the bottom one third in achievement test scores at age 15. About 25% of the total sample evidenced an official police contact of some kind. In general, then, the CPP sample was skewed toward the lower income and achievement levels.

Results of t-tests indicate significant sex differences in some independent variables: males are significantly heavier at birth; and they are heavier, taller, and have higher blood pressure at age 7. They score somewhat lower on the Stanford-Binet at age 4 and have higher enrollments in programs for the retarded and remedial disciplined. Significant sex differences exist on most dependent variables, although the directions of the differences are inconsistent for intelligence tests at age 7. For example, males score higher on some tests (for example, WISC comprehension and vocabulary) and lower on others (for example, WISC coding and WRAT reading). In contrast, males score consistently lower on achievement tests at age 15 and, expectedly, are more apt to have an offense record; 29% of the males and 12% of the females experienced an officially recorded police contact. Male offenders also evidence 4.5 times more mean number of offenses than female offenders.

Overall, the results in Table 2 support earlier research indicating generally greater weight and height for males at birth and at age 7 (Nichols and Chen, 1981), as well as research indicating inconsistent sex differences in intelligence at young ages (McGlone, 1980). The finding of significantly higher achievement levels among females at adolescence has some empirical support, particularly among samples experiencing environmental stress. However, studies of sex differences in achievement are limited and their results are variable (Wittig and Petersen, 1979). The greater tendency for males to engage in delinquency was expected.

The longitudinal interrelationships among independent and dependent variables are shown in the standardized solution for the male and female final structural equation (comparison) model in Table 3. Parameter estimates and model fitting were conducted first for separate male and female models until chi-square results reached a level of nonsignificance. The initial, highly significant chi-square results for these separate models are shown along with the nonsignificant chi-square results of the final model comparing parameter estimates of the male and female samples. The "good fit" of the final sex comparison model is reflected in its nonsignificant chi-square. It is to be emphasized, however, that the variables selected as correlates of delinquency

do not represent the full range of potentially relevant effects; the final model is only one possible explanation of the interrelationships.

Coefficient effects in Table 3 can be interpreted in the same way as ordinary least squares regression. The effects of independent variables upon dependent variables are represented by γ; the effects of dependent variables upon other dependent variables are represented by β.

Interrelationships among the significant ($p < .05$) direct and indirect effects from Table 3 comparing males and females are illustrated in Figure 1. A single coefficient on an arrow indicates that the relationship from one variable to another is identical for both sexes; two coefficients on an arrow, identified by exponents "M" and "F," indicate different relationships for males and females, respectively. The significance of a direct effect is shown by the t-value in parentheses (a t-value > 1.96 is significant at the .05 level). The following discussion will emphasize primarily the direct and intervening effects of selected variables on the final dependent variable, delinquency (Number of Offenses).

DELINQUENCY PREDICTORS

Direct and indirect effects on delinquency in Figure 1 indicate some sex differences. Evidence of disciplinary problems in school, represented in the model as the number of times an individual was enrolled in a disciplinary program, shows the most highly significant association with delinquency for both males and females (.256 and .925, respectively). Most likely, the striking effect for females reflects the fact that very few girls have a disciplinary problem. These results demonstrate that, not unexpectedly, school-related aggression and behavioral disturbance are strong predictors of an official delinquency status. Moreover, it appears that delinquents evidence fewer attachments and commitments to conforming and normative behavior, at least in the school setting.

Evidence of disciplinary problems is not only linked with delinquency, however; it has the same magnitude of negative effect for both sexes on achievement ($-.089$), which, in turn, is negatively associated with delinquency for males ($-.158$) but not for females ($-.026$). It appears, therefore, that behavioral disturbance among males extends to their abilities to achieve in school, which may further inhibit normative bonds and legitimate opportunities. The negative effect of disciplinary problems on achievement among females, however, does not indirectly lead to an official delinquency status. These results are consistent with past research indicating strong links between school achievement and delinquency among males (Kirkegaard-Sørenson and Mednick, 1977; Wolfgang, Figlio, and Sellin, 1972) but no such links among females (Climent et al., 1973; Offord and Poushinsky, 1982).

What other factors may affect the association between male delinquency
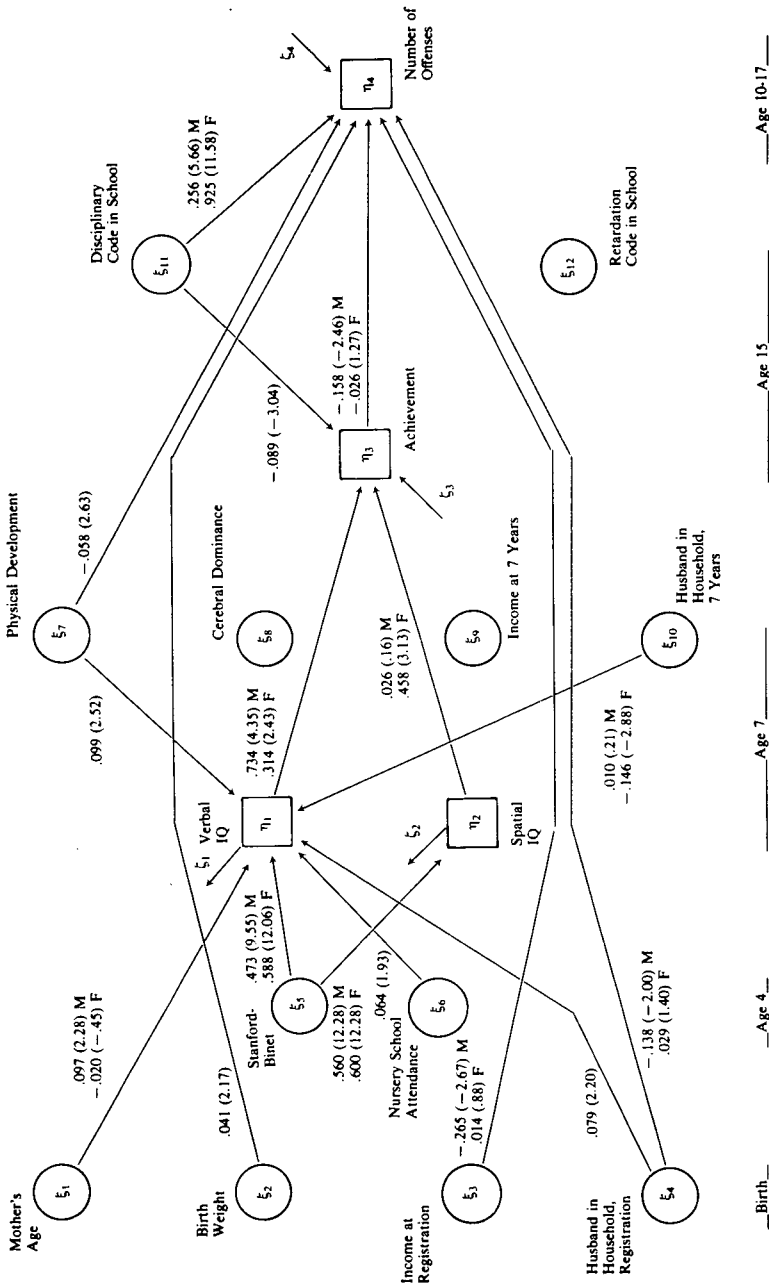
Figure 1: Final Structural Equation (Comparison) Model, Standardized Solution, Significant Effects Only

M = Males   F = Females

and achievement? The only significant direct effect on achievement for males is Verbal IQ at age 7 (.734), whereas both Verbal and Spatial IQ are significantly associated with delinquency for females (.314 and .458, respectively). Contrary to some past research (Moffitt, Gabrielli, Mednick, and Schulsinger, 1981; West and Farrington, 1973), early intelligence scores show no direct effect on delinquency for either sex, although scores do show an indirect effect on delinquency through achievement for males. The link between achievement and intelligence is expected. In addition, the dominant effect of Verbal IQ on achievement among males confirms past evidence that poor verbal ability (one indicator of left hemisphere deficit) may be an important factor in academic underachievement (Reitan and Davison, 1974).

Other sex differences also exist. For example, income at registration and presence of a husband in the household are significantly negatively related to male offense behavior ($-.265$ and $-.138$, respectively), although these variables show no significant effect on the offense behavior of females (.014 and .029, respectively). These results are consistent with past research, indicating strong links between delinquency and low income among males (Elliott and Ageton, 1980; Wolfgang et al., 1972). Notably, such associations run counter to evidence linking delinquency and father absence among males (Virkkunen, 1976) as well as studies showing broken home to be one of the strongest predictors of delinquency among females (Cowie et al., 1968; Datesman and Scarpitti, 1980). As Datesman and Scarpitti (1980) note, however, no major research on broken homes distinguishes between types of male and female offenders or a possible sex-by-race interaction, although such distinctions may be important. For example, broken homes may be associated with the generally minor delinquency characteristic of white females because most of their offenses (for example, runaway, truancy) reflect escape from a poor environment.

In turn, results in the present study associating male delinquency with presence of a husband at registration may be an artifact of several situations: a tendency for single women to lie about their marital status when they are pregnant (particularly during the time this study took place), a practice of some of the women to live with parents and relatives (and thus potential father figures) at the time of their pregnancy, a possibility that a number of women were married soon after the birth of their child. As Table 2 shows, a higher proportion of women are living with a husband or father figure when their child is age 7, although for some women this discrepancy may reflect a number of changes in marital status during the seven-year period between exams.

Evidence of a negative association between income at registration and delinquency for males, but not for females, may be attributed to a variety of factors particular to the present study. For example, this study incorporated

social-structural and bonding indicators at different points during development with the assumption that the timing of certain events is an important contributing factor to later behavior. This assumption has some support. It appears that negative environmental effects in infancy may have more serious ramifications for males than environmental effects during early childhood. Such time-related associations are consistent with research indicating a mental and physiological transformation in a child's development. Around age 7, for example, children become less physically and emotionally dependent on the family. They develop strategies to control their environment and to assert their autonomy (Shapiro and Perry, 1976: 97).

Indeed, there is evidence in Figure 1 that developmental types of variables at age 7 are predictors of delinquency. Physical development at age 7 is significantly negatively related to delinquency for both sexes ($-.058$), although the relative effect is small. The few previous studies which have examined associations between growth factors and crime, however, report conflicting results. One review of the literature, for example, concludes that both delinquent girls and boys "are usually found to be on average better grown than control series, and to be above population averages for height and weight" (Cowie et al., 1968). In contrast, other research indicates that correlates of delayed growth, such as minimal brain dysfunction and poor nutrition, have been linked to delinquency and other behavioral disorders (Denno, 1982).

Evidence in Figure 1 that birth weight is positively associated with delinquency but physical development at age 7 is negatively associated points to contradictory results in developmental factors with the same sample. However, as the following discussion demonstrates, the significance of the birth weight variable disappears when indirect and direct effects are merged.

Standardized reduced form equations presented in Table 4 represent the total impact of independent upon dependent variables through the summation of indirect and direct effects. In the present structural equation model, all independent variables and the two Verbal and Spatial IQ dependent variables determine the ultimate dependent variables, delinquency and achievement. The reduced form equations for Verbal and Spatial IQ are identical to their structural form equations.

The strength of coefficients for reduced form equations is determined by comparisons with other coefficients in the equations. With regard to delinquency, sex differences are clear. For males, delinquency is most strongly associated with evidence of disciplinary problems in school and low income at registration. However, delinquency is negatively related to husband's presence at registration but positively related to husband's presence at 7 years. In other words, mothers who report not having a husband at birth are more likely not to have delinquent children. However, when direct and indirect effects are combined, the reverse situation exists at age 7 and a husband's

Table 4. Standardized Reduced Form Equations for Achievement and Number of Offenses

		Males		Females	
		Achievement	Offenses	Achievement	Offenses
γ_1	Mother's Age	.032	.000	−.024	.006
γ_2	Birth Weight	.003	.041	.036	.040
γ_3	Income at Registration	.067	−.276	.052	.012
γ_4	Household in Household, Registration	.062	−.148	.044	.028
γ_5	Stanford-Binet	.285	−.033	.364	.003
γ_6	Nursery School Attendance	−.001	−.002	−.011	−.002
γ_7	Physical Development	.060	−.067	.013	−.058
γ_8	Cerebral Dominance	−.023	−.017	−.007	−.020
γ_9	Income at 7 Years	.033	−.016	.001	−.011
γ_{10}	Husband in Household, 7 Years	−.006	.123	−.093	.040
γ_{11}	Disciplinary Code in School	−.102	.272	−.102	.927
γ_{12}	Retardation in School	−.088	−.009	−.070	−.021
	N	410		390	

presence appears to inhibit delinquency. Most likely, differences in the direction of these effects reflect the high incidence of marital instability occurring during the time mothers participated in this study. Measures of husband presence at two time points may not fully characterize the potential complexity of associations in those households where living arrangements change frequently.

The major total effects on achievement are not surprising. In decreasing order of magnitude, achievement is positively predicted by scores on the Stanford-Binet at age four and negatively predicted by evidence of disciplinary misconduct and mental retardation at adolescence. Notably, evidence of misconduct has more impact on achievement than evidence of retardation.

The order of magnitude of these total effects on achievement is the same for females. However, evidence of disciplinary misconduct has a clear dominating effect on predicting delinquency. A negative association with physical development follows in importance; remaining effects are weak in comparison.

SUMMARY AND CONCLUSIONS

Overall, consideration of the direct, indirect, and total effects on delinquency and achievement demonstrate differences between the sexes and across time. For both males and females, the dominant effect on delinquency and achievement is evidence of disciplinary misconduct in school. The next strongest effects on delinquency among males are achievement, income at registration, and the presence of a husband or father in the household, with conflicting effects between birth and age 7 measures. Physical development was the next strongest effect on delinquency among females. For both sexes achievement was most strongly predicted, in decreasing magnitudes, by the Stanford-Binet at age 4, and by the presence of disciplinary misconduct and mental retardation at age 15.

These results partially confirm for males initial expectation in the present study that factors associated with aggressive behavior and the economic and social stability of the family (family income and presence of a husband) would be the dominant predictors of delinquency. However, family income and husband presence had no impact on delinquency among females. Female delinquency was predicted predominantly by school aggression and, to a considerably lesser extent, by physical development. These sex differences suggest that female delinquency may be less strongly influenced by environmental factors, although further evidence is needed for more definite conclusions.

Results of the present study did not confirm past findings of direct relationships between delinquency and intelligence, retardation, cerebral dominance (for example, left-handedness), or early central nervous system dysfunction as measured by number of pregnancy complications. The lack of strong, significant associations among these variables and delinquency may be due to several factors: the cultural and demographic characteristics of the sample, the infrequent occurrence of some of the independent variables (for example, early CNS dysfunction) which could underestimate true associations, or the simultaneous analyses of both sociological and human developmental variables which could negate more "traditional" findings. For example, much of the research analyzing developmental factors and crime has not controlled adequately for social, demographic, and environmental influences. Consequently, some past findings of biological links to intelligence or to crime may be artifacts of environmental effects. Current adoption studies may contribute more information on the association between social and nonsocial variables and behavior (Mednick, Gabrielli, and Hutchings, 1984).

Results of the present study do suggest, however, that both sociological and developmental variables contribute independent effects on delinquency. School behavior and achievement appear to be significant mediating factors, particularly for males. The importance of school variables in delinquency is

not new, of course. What may be informative, however, is the possible chain of events that contribute to making school factors consequential in a sample of subjects who are at high risk for both learning and behavioral problems.

In examining this chain, considerable support exists for Hirschi's (1969) theory of social bonding, but with some modification. This modification incorporates human developmental and age-related factors which may influence bonding ability. In the present study, typical bonding impediments such as low achievement and unstable social structure predicted delinquency among males. Behavioral misconduct among both males and females was stronger and more direct evidence of lack of social commitment.

Other factors are possible antecedents of weak bonding. In the present study, intelligence scores demonstrated no direct effect on delinquency for either sex; however, for males, verbal ability had an indirect effect on delinquency through school achievement. This association supports Hirschi and Hindelang's (1977) emphasis on the school experience as a crucial factor in crime. However, previous analyses of the sample in the present study have found no mean differences in intelligence test scores between nondelinquents and even the most violent and chronic categories of delinquents on a variety of measures administered at age 7 (Denno, 1982). The inconsistency of this finding relative to other reports of significantly lower intelligence levels among delinquent groups (see Wilson and Herrnstein, 1985, for a review) may be attributed to a number of factors relevant to sampling characteristics. It is to be emphasized, however, that the intelligence measures in this study were administered prospectively—that is, before any involvement in delinquency. Considering the large impact of behavioral misconduct on achievement, it appears likely that test scores are strongly influenced by both behavioral and environmental circumstances. This conclusion is not to suggest, as other researchers have, that intelligence test scores are indicative only of social-structural influences or even of middle-class thinking (see Hirschi and Hindelang, 1977, for a review of these arguments); it points out only that timing may be critical in assessing intellectual and behavioral variations among individuals, particularly in environmentally deprived populations.

Overall, however, results of the present study indicate that delinquency is not related to intelligence, but that it is related to lack of behavioral control. Other research supports this conclusion. For example, studies have shown links among low school achievement, behavioral disturbance, and delinquency in intellectually normal children who evidence minimal brain dysfunction and hyperactivity (Rie and Rie, 1980). Correlates of minimal brain dysfunction and hyperactivity include early CNS trauma, neurodevelopmental delay, and poor environment (Nichols and Chen, 1981). In the present study, early CNS trauma was not associated with delinquency; however, early income did show a relatively strong negative effect on delinquency even among males from low socioeconomic environments.

It appears that minimal brain dysfunction and hyperactivity could be associated with the learning and behavioral problems evidenced in this study's sample. In turn, such behavioral problems would inhibit considerably the ability of young children to learn normative conduct or to create social bonds with conforming peers even before the school experience. Academic failure would perpetuate misconduct and further impede bonding. Indeed, a sizable amount of research shows that children who evidence minimal brain dysfunction and hyperactivity are significantly more likely to retain antisocial conduct during adulthood, a time when negative social or subcultural influences on behavior subside (Shah and Roth, 1974). Studies demonstrating that a relatively higher proportion of males have minimal brain dysfunction and hyperactivity (Rie and Rie, 1980) may also explain in part sex differences in crime.

If children demonstrate hyperactivity before school age, it seems likely that preschool programs may prevent later academic and behavioral disorders. In the present study, early nursery school attendance did show a positive effect on verbal ability at age 7, which was in turn positively associated with achievement during adolescence. However, nursery school attendance had no significant direct effect on delinquency. The lack of a direct effect may be due, in part, to the timing and the length of the program which was analyzed. Recent studies of preschool intervention indicate that those programs which start earliest in childhood and last longest generally have the most positive impact on both ability (Darlington et al., 1980; Schweinhart and Weikart, 1980) and behavior (Schweinhart and Weikart, 1980). In one of the most extensive studies of a preschool program yet conducted, Schweinhart and Weikart (1980) use a social bonding explanation for their finding that preschool education decreased the later delinquent behavior of impoverished teenagers. They suggest that early education strengthens bonds to school which in turn inhibit misconduct.

As yet, no longitudinal research has been conducted on the effects of early school programs on adult bonding ability, which is perhaps best indicated by employment status. However, an extensive research supports the relationship between school achievement and employment success (Jencks, Bartlett, Corcoran, Crouse, Eaglesfield, Jackson, McClelland, Mueser, Olneck, Schwartz, Ward, and Williams, 1979).

Most public schools do not have adequate facilities for treating children with learning or behavioral disorders; consequently, these children's prospects for future "legitimate opportunities," such as employment, may be hindered (Zinkus, Gottlieb, and Zinkus, 1979). For example, there is no strong evidence to suggest that employment programs for delinquent adolescents or adults may deter crime or enhance marketability, particularly among high-risk populations (Vera Institute of Justice, 1979: 3). Recent results of the Young Black Men Employment Survey, on the other hand, did show that

enrollment in schooling, in addition to other factors, had a significant deterrent effect on criminal behavior (Viscusi, 1983). The importance of education is highlighted in most studies on employment and crime (Thompson, Sviridoff, and McElroy, 1981).

It appears that expenditures in maintaining youth enrollment in school, as well as in promoting programs for the learning disabled, may provide more successful alternatives to potential labor market problems than employment per se. Early intervention for the learning disabled, in particular, may be one of the most effective factors in the prevention of juvenile delinquency (Zinkus et al., 1979). This conclusion does not imply that intervention programs should be substitutes for employment training or job services. However, it is recommended that training in fundamental skills and basic education be given priority in order to enhance legitimate opportunities, particularly for high-risk youth. From both theoretical and policy standpoints, attention to school bonding early in life, along with its developmental and sociological correlates, may prove to be more feasible socially and economically than attempts to deter well-established patterns of offending.

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