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Table

Inheritance of Isolation-Induced Aggression in Inbred Mouse Strains

Parental Strains	Generations Studied	Apparent Mode of Inheritance	Minimum Gene Loci	Reference
A/J, CFW	F <sub>1</sub>	autosomal(?)	?	(10)
C57Br, CBA	F <sub>1</sub>	dominant	?	(11)
C57BL/6By, Balb/cBy	F <sub>1</sub> , RI*	dominant	2	(2)
Balb/cJ, Balb/cN	F <sub>1</sub> , F <sub>2</sub>	recessive	1	(1)
DBA/1, C57BL/10	F <sub>1</sub>	x-linked	1	(?)
		dominant		
A/J, Balb/cJ	F <sub>1</sub> , F <sub>2</sub> , BC	recessive	1	(3)

\* RI = Recombinant Inbred

association between genetic transmission of high concentrations of brain cyclic AMP and high levels of aggression. Naturally, such studies provide no proof of a causal relationship between the activity and the related biochemistry. Still they may provide valuable clues about those areas which merit closer inspection. If investigators can characterize the regulatory mechanisms of genetically self-contained segments of aggressive behavior, it may be possible to use them as blocks for building a better understanding of the entire phenomenon of aggression.

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Genetics of Human Aggression

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The concepts of evil, aggression, and criminality are intimately intertwined and are often confused by laymen and scientists alike. Thus, although hereditary influences on aggression have been demonstrated in animal studies (1), investigations of similar contributions to human aggressivity are frequently confounded by value judgments, culture-bound morality, and subjective attitudes regarding right and wrong.

Attempts have been made to show that aggressivity in man, as exhibited in criminal or antisocial

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behavior, is inherited. When examined, criminality appears to follow the characteristics of genetically determined traits. Thus, criminality runs in families. In addition, studies of twins generally show a higher rate of concordance for criminality among monozygotic pairs than among dizygotic pairs. In the studies published prior to 1963, none showed a monozygotic concordance rate below 60 percent (2). However, in the two most recent twin studies in which more systematic and representative sampling procedures were used, the monozygotic concordance rates did not exceed 33.3 percent (3,4). Because siblings have both an environment and a proportion of their genes in common, it is not possible to distinguish between psychosocial influences on behavior and biological ones through family and twin studies. Thus, the evidence derived from family and twin studies is equivocal with respect to demonstrating a genetic influence on criminal behavior.

With the development of karyotyping procedures in the late 1950's, attempts were made to show an association between antisocial behavior and such chromosomal abnormalities as the 47,XXY and 47,XYY constitutions. In both instances, a greater number of individuals with these karyotypes appear to be detected in special security institutions than might be expected on the basis of current incidences at birth. So far, with the exception of a tendency toward increased stature among 47,XYY men, no behavioral, psychological, or marked physiological differences have emerged that distinguish males with chromosomal disorders from matched, chromosomally normal fellow inmates. Like the latter, institutionalized men with the 47,XYY karyotype appear to come disproportionately from families of lower socioeconomic classes and to have a history of various combinations of criminality, alcoholism, child abuse, illegitimacy, parental separation or death early in the inmate's life, pregnancy and birth complications, and psychiatric disorders (5).

The reasons for the apparently high rate of 47,XYY males in certain institutions is unknown. Some investigators believe that these men may have a neural defect as a consequence of their genetic make-up; but, as yet, no convincing evidence for a specific defect has been advanced. Other workers believe that the findings might be artifactual, reflecting sampling and methodological anomalies. Perhaps the truth lies somewhere in between.

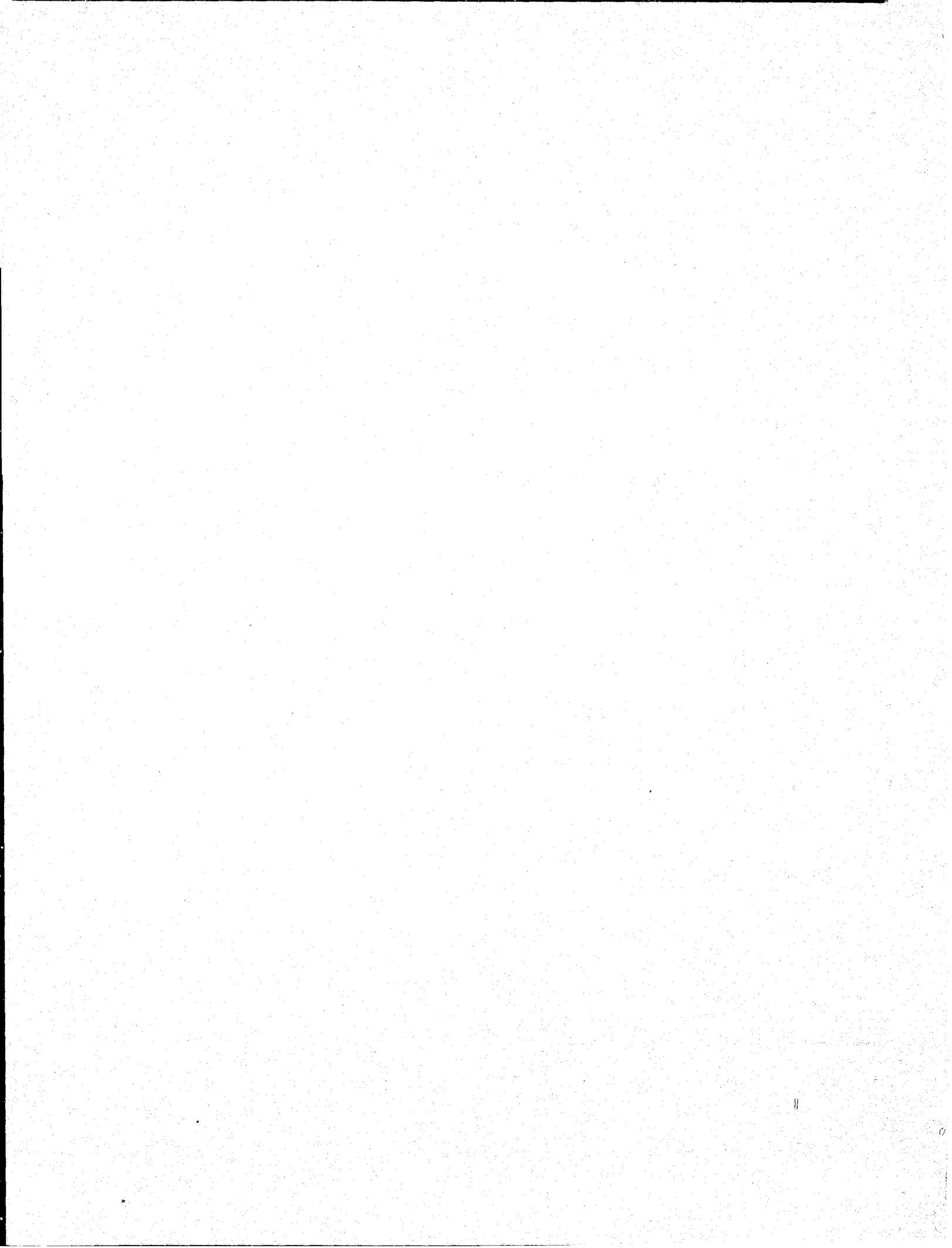
In recent years, several investigators have reported a higher rate of criminality among individuals born to a criminal parent and given up for adoption at an early age than among similarly adopted persons born to noncriminal parents. In a study carried out

in Denmark, Hutchings and Mednick (6) found that the rate of criminality among the biological fathers of criminal adoptees was higher than that among their adoptive fathers. These investigators also found that when the biological father was a noncriminal the rates of criminality among the adoptees were lower than when the biological father was a criminal. The highest rates of criminality among the adoptees occurred when both the biological and adoptive fathers were criminals. The latter findings suggest that both genetic and environmental factors may contribute to the liability of criminality.

As suggested by the above review, most genetic studies have focused upon criminality as an index of aggression. Yet criminality is only one aspect of human aggression—probably a tangential one. As previously noted, aggression and criminality are essentially separate concepts, linked by social definitions. Furthermore, even if one could unequivocally demonstrate that some individuals are genetically predisposed either to criminality or to aggression, heredity is not destiny. Environmental influences unquestionably play a major role in shaping and eliciting final behavior. The larger task, then, will be to determine how genetic predispositions interact with environmental factors during the course of development to promote or to inhibit aggressivity or criminality.

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