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Research Report

TESTOSTERONE, SOCIAL CLASS, AND ANTISOCIAL BEHAVIOR IN A SAMPLE OF 4,462 MEN

James M. Dabbs, Jr. and Robin Morris

Department of Psychology, Georgia State University

Abstract—Two hypotheses have been offered to explain the relation between testosterone and antisocial behavior in delinquent and criminal populations. One is that testosterone leads directly to antisocial behavior. The other is that a constellation of dominance, competitiveness, and sensation seeking associated with testosterone leads to either antisocial or prosocial behavior, depending upon an individual's resources and background. Analysis of archival data from 4,462 U.S. military veterans supported the first hypothesis: Testosterone was correlated with a variety of antisocial behaviors among all individuals. However, socioeconomic status (SES) proved to be a moderating variable, with weaker testosterone-behavior relationships among high SES subjects.

Testosterone has been related to human antisocial behavior, but primarily in delinquent and criminal populations. It has been found that prison inmates high in testosterone are more likely to have committed violent crimes (Dabbs, Frady, Carr, & Besch, 1987; Dabbs, Ruback, Frady, Hopper, & Sgoutas, 1988; Ehrenkranz, Bliss, & Sheard, 1974), engaged in criminal activity at an early age (Kreuz & Rose, 1972), been more dominant in prison and violated prison rules more often (Dabbs et al., 1987; Ehrenkranz et al., 1974), and been judged more severely by parole boards (Dabbs et al., 1988; Kreuz & Rose, 1972). Testosterone in adolescent males has been associated with dominance, leading especially to delinquency when they feel unfairly restricted (Olweus, 1983) or prematurely try to engage in activities (especially involving sex, drugs, alcohol, and tobacco) usually reserved for older persons (Udry, 1989).

Focussing on criminals and delin-

quents, however, may obscure more positive relationships. Daitzman and Zuckerman (1980) suggest that testosterone is related to a general sensation-seeking tendency. Sensation seeking can have positive or negative effects, depending on one's social background and resources. Individuals low in socioeconomic status (SES) often find the most exciting things to do are illegal, while high SES individuals can do things that are both exciting and socially acceptable—driving fast cars instead of stealing them, arguing instead of fighting, playing college football instead of assaulting. Data from a large sample of normal adults could help clarify the relationship between testosterone and behavior.

We obtained such data from a study of 4,462 male U.S. military veterans. These men, half of whom had served in Vietnam during 1965–1971, were studied beginning in 1985 to assess long-term effects of the Vietnam military experience (Centers for Disease Control, 1988). Their mean age was 37 years, and they were representative of the U.S. population in race, education, income, and occupation. All had been enlisted men. They were interviewed by telephone and underwent extensive medical, psychological, neuropsychological, and laboratory examinations at the Lovelace Medical Foundation (Albuquerque, NM). Laboratory examinations included assays of testosterone in serum samples collected in the morning before eating; the coefficient of variation (CV) among quality control samples was less than 10%. Subjects completed the Minnesota Multiphasic Personality Inventory and were interviewed using the Diagnostic Interview Schedule (DIS), which provides information on DSM-III psychiatric diagnoses (American Psychiatric Association, 1980). The DIS was modified to include additional items on antisocial behavior. The present paper examines relationships between subjects' testosterone levels and reports of their own behavior.

Following the epidemiological approach used by the Centers for Disease Control (CDC) in the original study, we treated testosterone as a risk factor that might increase the likelihood of antisocial behavior. This approach dichotomizes continuous variables and thus loses some information, but it has the advantage of focussing attention directly on the behavior of extreme groups. We classified subjects as high in testosterone if they were in the upper 10% of the distribution and as normal if they were in the remainder of the distribution. We then computed ratios to contrast the risk (or likelihood) of various behaviors in the high testosterone group with the risk of these behaviors in the normal testosterone group. For example, a risk ratio of 2.0 would indicate a given behavior was twice as probable in the high as in the normal testosterone group. A risk ratio is considered statistically significant ($p < .05$) when its 95% confidence interval excludes 1.0. Risk ratios were adjusted (SAS Institute, 1985) for subjects' age, race (white or nonwhite), and place of service (Vietnam or other), variables that might plausibly affect the testosterone-behavior relationship.

The findings are summarized in Table 1. The behaviors in Table 1 are described in footnotes to the table; they are as defined in the original CDC data set. These behaviors occurred at times ranging from childhood to the recent past. Individuals higher in testosterone more often reported having trouble with parents, teachers, and classmates; being assaultive toward other adults; going AWOL in the military; and using hard drugs, marijuana, and alcohol. They also reported having more sexual partners. The overall picture is one of delinquency, substance abuse, and a general tendency toward excessive behavior.

We then examined SES, to see if it moderated the testosterone-behavior relationship. There was relatively little social class information in the data set, and we used subjects' education and current

Correspondence and reprint requests to James M. Dabbs, Jr., Department of Psychology, Georgia State University, Atlanta, GA 30303.

Testosterone and antisocial behavior

Table 1. Percentage of normal and high testosterone subjects reporting high levels of various behaviors

Behavior	Group		Risk Ratio	95% Confidence Interval
	Normal Testosterone (n = 4,016)	High Testosterone (n = 446)		
Childhood delinquency ^a	11.5	17.9	1.4	1.1-1.8
Adult delinquency ^b	10.0	22.6	1.9	1.6-2.3
Hard drug use	9.7	24.7	2.1	1.8-2.6
Marijuana use	22.5	47.6	1.8	1.6-2.0
Alcohol abuse ^c	11.5	16.4	1.4	1.1-1.7
Military AWOL ^d	5.9	13.4	1.8	1.3-2.3
Many sex partners ^e	23.1	32.1	1.3	1.1-1.5

* Mantel-Haenszel relative risk ratios, adjusted for age at time of hormone assay, race (white vs. nonwhite), and place of military service (Vietnam vs. other).

^a In upper 10% of sample in number of DSM-III conduct disorder problem areas before age 15, including poor grades, trouble in school, truancy, being expelled or suspended, running away from home, starting fights, lying, stealing, vandalism, being drunk or using drugs, and being arrested.

^b In upper 10% of sample in number of DSM-III antisocial personality symptoms since age 18, including assaultive marital or relationship problems, negligence toward children, job trouble, trouble with debts, traffic offenses, non-traffic arrests, lying, violence, and vagrancy.

^c Alcohol abuse/dependency in year preceding interview.

^d Lost service time for absence without leave or other misbehavior.

^e Had 10 or more sex partners in one year.

household income to determine their SES. Education and income weigh heavily in measures of SES (Miller, 1983). We classified subjects as low or high in SES if they were, respectively, below or above the 1985 U.S. population median in both income and education. This dual criterion excluded 39% of the subjects, who were high in income and low in education, or vice versa, but it produced a relatively clear distinction between low and high SES groups.

More of the low than the high SES subjects were in the upper 10% range in testosterone (14% vs. 6%, $p < .001$ by chi-square test). We computed testosterone risk ratios separately for low and high SES groups, again adjusting for age, race, and place of service (Table 2). Marijuana use was significantly related to testosterone in both SES groups, but the other behaviors were significantly related to testosterone only in the low group. Risk ratios for adult delinquency

and hard drug use were twice as great in the low as in the high SES group.

We conclude that testosterone is related to antisocial behavior, is lower among subjects who are higher in SES, and is less strongly related to antisocial behavior among subjects who are higher in SES. Testosterone is thus directly associated with many negative effects. While high testosterone theoretically might lead to prosocial behavior, the present data provide no indication of

Table 2. Socioeconomic status (SES) differences in percentage of normal and high testosterone subjects reporting high levels of various behaviors

Behavior	Low SES			High SES		
	Normal Testosterone (n = 1,294)	High Testosterone (n = 202)	Risk Ratio ^a	Normal Testosterone (n = 1,167)	High Testosterone (n = 73)	Risk Ratio ^a
Childhood delinquency	14.2	21.8	1.5*	8.6	11.0	1.1
Adult delinquency	14.7	30.7	1.9*	4.5	4.1	0.9
Hard drug use	10.0	29.2	2.5*	7.5	12.5	1.3
Marijuana use	23.6	51.0	1.8*	18.4	37.5	1.8*
Alcohol abuse	18.1	27.7	1.4*	11.8	11.1	1.0
Military AWOL	9.8	19.1	1.5*	2.2	4.1	1.7
Many sex partners	23.6	33.3	1.4*	21.4	28.8	1.3

NOTE: Of the original 4462 subjects, 39% were excluded because they were not clearly high or low in SES.

^a Mantel-Haenszel relative risk ratios, adjusted for age at time of hormone assay, race (white vs. nonwhite), and place of service (Vietnam vs. other).

* 95% confidence interval excludes 1.0.

such redeeming social value. Prior findings emphasize the importance of testosterone in individual confrontations (Bernstein, Rose, & Gordon, 1974; Mazur, 1985). Individuals high in SES tend to avoid individual confrontations, especially physical ones, and to submit to years of schooling. Perhaps the antisocial behavior associated with high testosterone interferes with education, but those individuals who do become highly educated are better equipped to control their antisocial tendencies. We do not yet know whether the relationship of testosterone to education and SES involves only motivational factors, or whether cognitive factors are also involved (Christiansen & Knusmann, 1987).

The statistical power provided by the present sample of 4,462 subjects is extraordinarily high. With a sample this large, for example, Pearson $r = .05$ is significant at $p < .001$. The effects reported in the present paper are relatively small in size and account for appreciable variance only at extreme levels of testosterone. This fact may help us understand why the results of previous studies have not always been consistent. Previous

studies have generally employed small samples, and only with large samples can one see clearly the relationship of testosterone to antisocial behavior.

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