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Article in *American Journal on Addictions* · February 2010

DOI: 10.1111/j.1521-0391.1992.tb00357.x

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Personality, Mood, and Psychiatric Symptoms Among Anabolic Steroid Users

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The relationship between use of anabolic steroids (ASs) and specific personality dimensions was assessed in 50 male bodybuilders who were current or past users compared with a sample of 25 age-matched, "natural" male bodybuilders who never used ASs. No personality differences were found. The relationship between current AS use and the presence of variations in mood state, hostility, and psychiatric symptomatology was then evaluated. Current AS users scored higher than non-users only on psychometric scales measuring hostility, aggression, and somatization. Thus, reports that AS use was associated with significant psychopathology, other than aggression and somatization, could not be confirmed.

Anabolic steroids (ASs) are natural androgens or synthetic derivatives of the male hormone testosterone. These compounds are increasingly abused by both amateur and elite athletes via a growing black market distribution system. ASs are commonly self-administered in pharmacologic doses by bodybuilders, weight lifters, and other athletes for performance and physique enhancement. Besides evidence of an increasing prevalence of use of ASs,^{1,2} the few reports in the scientific literature pertaining to their psychiatric effects suggest that ASs may induce psychosis,^{3,4} organic affective disorder,^{5,6} violence,⁷ and suicidal⁸ and ho-

micidal behavior.⁹ Recently, Perry et al.,¹⁰ in a systematic study of psychiatric symptoms among current AS users, reported that AS-using weight lifters presented with more somatic, depressive, anxious, hostile, and paranoid complaints than did control, non-using weight lifters. However, this report did not evaluate personality differences between AS-using and nonusing athletes. Such a comparison is critical, since the impact of ASs on dispositional personality factors could account for the psychopathology reported among AS users.

We hypothesized that AS use would be primarily found among athletes who are ag-

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gressive and achievement-oriented, yet dysphoric. We anticipated that such individuals would be less traditional and less fearful of physical harm than "natural" athletes. Further, we hypothesized that AS use would augment aggression in a manner consistent with the literature on physiologic testosterone and aggression and that ASs would also augment the characterologic dysphoria of those who choose to use steroids.

To explore whether specific dispositional personality characteristics are associated with AS use, we previously had studied 50 male bodybuilders who were currently using or had used ASs in the past compared with a control group of 25 age-matched natural bodybuilders who had never used ASs. Following this determination, we evaluated mood state, psychiatric symptoms, and measures of aggression among 25 current users of ASs compared with control, nonusing bodybuilders. We did not include our past sample of AS users in this comparison because of the a priori confounding potential of pharmacologic carryover from prior steroid dosing on "state-sensitive" parameters such as mood or other psychiatric symptoms.

METHODS

Subjects

Male, amateur bodybuilding athletes ($N = 75$) were recruited from local gymnasiums. Recruitment was conducted by one of the authors (G.L.P.) and was made possible by his long-standing personal relationships with owners of gymnasiums, promoters of competitions, publishers of weight training and bodybuilding periodicals, and personal familiarity with amateur and professional athletes in this region.

The subjects were classified as either a current AS user, a past but not current AS user, or a natural athlete who never used steroids. These classifications were based on self-report followed by detailed interviews.

In the interviews, the subjects were questioned about their age at first AS use, their total number of years of use, and their best estimate of number of lifetime AS "cycles." The identity of the drugs and the weekly dosages of steroids used after achieving the dosing plateau were also obtained. All current AS users were required to bring in their ASs for positive identification and verification.

The vast majority of subjects in the natural bodybuilder's group were competitive athletes recruited from a selective bodybuilding club for drug-free bodybuilders. Any of these self-professed natural athletes who bore physical stigmata frequently associated with AS use (e.g., gynecomastia, marked hirsutism, severe acne) were excluded from participation to avoid potential confounds. Toxicologic confirmation of AS status was not available to confirm the self-reports of any of these subjects; however all natural subjects were administered polygraph examinations to confirm their lifetime steroid-free status prior to participation in bodybuilding competitions.

The subjects were not paid for their participation nor were any incentives provided. Each subject provided informed consent in accordance with the Institutional Review Board of the University of Pittsburgh School of Medicine.

Table 1 shows the ages and demographics of the members of each group; the patterns of AS use, described in terms of age at first use, lifetime number of AS "cycles," and years of AS use; and patterns for the noncurrent AS users, described in terms of the duration of abstinence since last AS use. Table 2 shows the types of ASs and other hormones used by current AS users.

Instrumentation

Personality characteristics. The Multi-dimensional Personality Questionnaire (MPQ; Tellegen, unpublished manuscript, 1982) was chosen as the most suitable assess-

TABLE 1. Characteristics of anabolic steroid users in a study of their personality, mood, and psychiatric symptoms

Characteristic	Current Users	Past Users	Nonusers
Age, years	25.00 ± 5.07	25.96 ± 5.09	27.84 ± 5.72
Education, years	13.84 ± 5.07	14.16 ± 1.65	14.52 ± 2.00
Currently employed	96%	100%	100%
Age at first steroid use	21.88 ± 3.87	21.68 ± 4.17	—
Duration of steroid use, years	3.40 ± 1.92	2.84 ± 1.74	—
Lifetime number of steroid "cycles"	7.40 ± 6.75	4.60 ± 3.71	—
Months of abstinence since last use of steroids	—	26.48 ± 22.66	—

Note: Study sample, $n = 25$. All values are means ± SD except currently employed.

TABLE 2. Anabolic steroids used by subjects in a study of their personality, mood, and psychiatric symptoms

Anabolic Steroids Used	Number of Subjects Using Drug
Oral Compounds	
Methandrostenolone	8
Oxymetholone	10
Oxandrolone	7
Fluoxymesterone	1
Injectables	
Nandrolone decanoate	30
Testosterone cypionate	19
Testosterone propionate	2
Testosterone enanthate	5
Testosterone suspension	2
Testosterone mixtures	5
Methenolone	1
Stanozolol	3
Veterinary Anabolic Steroids	
Boldenone	2
Trenbolone	6
Other Drugs	
Human chorionic gonadotropin (HCG)	1
Clomiphene citrate	1

Note: Study sample, $n = 50$.

ment tool for the determination of dispositional personality characteristics that could be modulated by ASs or mediate effects of AS administration. The reasons for use of the MPQ were fourfold: 1) it is an extensively researched inventory with excellent reliability and validity;¹¹ 2) it was developed to accommodate a psychology of individual differences;¹² 3) it contains six validity scales,

thereby enabling a determination of response set of the subjects taking the questionnaire; and 4) the personality trait dimensions measured are salient to the features that are theoretically implicated in AS use.

The empirically derived primary scales are 1) well-being, 2) social potency, 3) achievement, 4) social closeness, 5) stress reaction, 6) alienation, 7) aggression, 8) control, 9) harm avoidance, 10) traditionalism, and 11) absorption. The three higher-order scales, derived from the primary scale items are 1) positive affectivity, 2) negative affectivity, and 3) constraint. In addition, an index of invalid responding is obtained, which is a summary statistic derived from the other five validity scales of the MPQ.

Subjective mood state. Perceived current mood states were documented using the bipolar Profile of Mood States (POMS-BI).¹³ This self-report rating scale quantifies six bipolar subjective mood states. Each pole represents the positive or negative aspects of a given dimension. Each mood state is defined by a scale composed of 12 adjectives or phrases that are endorsed by the subject. The mood dimensions assessed are composed vs. anxious, agreeable vs. hostile, elated vs. depressed, confident vs. unsure, energetic vs. tired, and clear-headed vs. confused. Subjects were instructed to complete this instrument with the time set of feelings

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experienced "during the past week including today."

Psychiatric symptoms. Subjects' defined psychiatric symptoms were quantified using the revised version of the Symptom Checklist-90 (SCL-90-R).¹⁴ The SCL-90-R is a valid and reliable self-report measure of psychopathology. Endorsed symptoms aggregate into scores for 1) somatization, 2) depression, 3) phobic anxiety, 4) obsessive-compulsive, 5) anxiety, 6) paranoid ideation, 7) interpersonal sensitivity, 8) hostility, and 9) psychoticism. The three global indices of distress derived from SCL-90-R scores are Global Severity Index, an index of the overall depth of disorder; Positive Symptom Distress Index, a measure of symptom intensity; and Positive Symptom Total, a count of positively endorsed symptoms.

Hostility and aggression. The Buss-Durkee Hostility Inventory (BDHI) is a self-rating scale of 75 true and false items.¹⁵ The ques-

tionnaire quantitates seven empirically derived dimensions or types of hostility and has an additional scale to measure guilt. These are 1) assault, 2) indirect aggression, 3) irritability, 4) negativism, 5) resentment, 6) suspicion, 7) verbal aggression, and 8) guilt. A total summary score is also derived from these scales. This instrument has been demonstrated to discriminate between violent and nonviolent alcohol abusers.¹⁶

Statistical Analysis

After the generation of descriptive statistics and the determination of homogeneity of variance, between-group comparisons of individual test scale scores were conducted using a one-way analysis of variance (ANOVA). All reported probabilities were two-tailed. To confirm the between-group differences found on the various state-dependent instruments, a factor analysis was performed with a varimax rotation using the scale scores from the POMS-BI, the SCL-90-R,

TABLE 3. Scores on the multidimensional personality questionnaire for users of anabolic steroids and control subjects in a study of their personality, mood, and psychiatric symptoms

	Steroid Users	Nonusers	Between Group Differences
Primary Scales			
Well-being	18.20 ± 5.73	19.16 ± 5.14	NS
Social potency	15.30 ± 5.28	13.20 ± 6.06	NS
Achievement	12.86 ± 4.31	13.92 ± 3.52	NS
Social closeness	15.34 ± 4.38	15.28 ± 4.71	NS
Stress reaction	9.56 ± 6.22	8.68 ± 5.15	NS
Alienation	5.14 ± 4.33	3.92 ± 3.99	NS
Aggression	8.72 ± 4.77	6.60 ± 3.69	<i>P</i> < 0.06 ^c
Control	14.50 ± 5.02	15.84 ± 4.45	NS
Harm avoidance	15.72 ± 6.33	17.48 ± 5.98	NS
Traditionalism	16.38 ± 4.87	16.88 ± 4.10	NS
Absorption	14.74 ± 8.12	16.60 ± 9.12	NS
Higher-Order Scales			
Positive affectivity	157.15 ± 13.97	158.48 ± 14.06	NS
Negative affectivity	134.43 ± 17.16	131.18 ± 14.04	NS
Constraint	157.68 ± 15.37	162.45 ± 13.45	NS
Overall Validity Scale			
Index of invalid responding	21.60 ± 7.93	21.52 ± 6.57	NS

Note: Values are means ± SD. Steroid users, *n* = 50; nonusers, *n* = 25. NS = not significant.
^ctrend

and the BDHI. Individual factor scores were calculated for both current AS users and nonusers ($N = 50$) by the standard regression method. Again, past users were dropped because of our inability to toxicologically verify the absence of any pharmacologic carryover of previously administered ASs. Factor scores were then subjected to one-way ANOVA by AS use group. All statistical procedures were performed on a personal computer using SPSS/PC+.

RESULTS

Personality Differences Between Past and Present AS Users and Athletes Who Have Never Used Steroids

The MPQ scores are organized by group in Table 3. Past and present AS users were combined and contrasted with nonusing athletes to identify possible personality dif-

ferences between those athletes who currently or had used ASs and those who had abstained from AS use. No differences were noted between AS users and nonuser bodybuilders on any personality dimension with one possible exception. There was a trend for AS users to score higher on the aggression scale of the MPQ than control subjects ($F[1,73] = 3.80, P < 0.06$). It is also worthy of note that the index of invalid responding scores were well within the valid range (scores in the high 30s are probably invalid) and that these scores did not differ significantly between groups, which suggests that both groups provided valid responses to the questionnaire.

Mood Differences Between Current AS Users and Controls

Table 4 displays the POMS-BI mood ratings for current users of ASs compared with

TABLE 4. Scores for mood and psychiatric symptoms for current users of anabolic steroids and control subjects in a study of their personality, mood, and psychiatric symptoms

	Current Users	Nonusers	Between-Group Differences
Mean Scores (Bipolar POMS)			
Composed-anxious	23.04 ± 6.06	25.44 ± 6.12	NS
Agreeable-hostile	22.08 ± 6.65	26.24 ± 4.94	$P < 0.05$
Elated-depressed	23.00 ± 5.26	25.24 ± 5.55	NS
Confident-unsure	26.64 ± 4.43	25.72 ± 6.18	NS
Energetic-tired	22.32 ± 5.41	22.24 ± 4.38	NS
Clearheaded-confused	24.32 ± 5.79	25.52 ± 5.59	NS
Psychiatric Symptoms (SCL-90-R)			
Somatization	0.62 ± 0.57	0.35 ± 0.29	$P < 0.05$
Obsessive-compulsive	0.80 ± 0.63	0.70 ± 0.55	NS
Interpersonal sensitivity	0.62 ± 0.55	0.56 ± 0.52	NS
Depression	0.67 ± 0.53	0.54 ± 0.44	NS
Anxiety	0.48 ± 0.50	0.32 ± 0.36	NS
Hostility	0.90 ± 0.86	0.34 ± 0.35	$P < 0.005$
Phobic anxiety	0.21 ± 0.32	0.09 ± 0.14	NS
Paranoid ideation	0.79 ± 0.81	0.66 ± 0.52	NS
Psychoticism	0.38 ± 0.46	0.27 ± 0.41	NS
Global severity index	0.55 ± 0.42	0.40 ± 0.31	NS
Positive symptom distress index	1.36 ± 0.35	1.22 ± 0.29	NS
Positive symptom total	33.20 ± 20.50	27.36 ± 17.03	NS

Note: Values are means ± SD. Current users, $n = 25$; nonusers, $n = 25$. NS = not significant; POMS = Profile of Mood States.

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control subjects. Significant between-group mood differences were only found for the agreeable-hostile dimension ($F[1,48] = 6.30$, $P < 0.05$). Current AS users scored significantly lower than controls indicating greater hostility and less agreeability. Significant differences between AS users were not found on measures of anxiety, depression, tiredness, confusion, or insecurity.

Psychiatric Symptoms Among Current AS Users and Controls

The psychiatric symptom scores derived from the SCL-90-R for current AS users and control subjects are shown in Table 4. Interestingly, current AS users were found to have significantly higher somatization scores than nonusers ($F[1,48] = 4.48$, $P < 0.05$), suggesting greater somatic preoccupation. In addition, current AS users scored significantly higher on the hostility scale than controls ($F[1,48] = 9.06$, $P < 0.005$). No significant differences in psychiatric symptoms were found between AS users and controls on measures of obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, phobic anxiety, paranoid ideation, psychoticism, global severity, symptom distress, or total positive symptoms.

Aspects of Hostility and Aggression Among Current AS Users and Controls

Scores on the BDHI for current AS users and nonusing bodybuilders are shown in Table 5. Current AS-using athletes scored significantly higher than control subjects on the verbal aggression scale ($F[1,48] = 5.23$, $P < 0.05$). Two additional trends were noted. There was a trend for current AS users to score higher than controls on the irritability scale ($F[1,48] = 3.64$, $P < 0.07$), and there was a trend for current AS users to score higher on the guilt scale of the BDHI ($F[1,48] = 3.28$, $P < 0.08$). Between-group differences were not found on measures of assaultiveness, indirect aggression, negativism, resentment, suspicion, or for the total BDHI summary score.

Confirmatory Factor Analysis of Mood, Psychiatric Symptoms, and Hostility Variables

Four orthogonal factors were derived that accounted for 68.2% of the variance. The loading of each variable into the factors are displayed in Table 6. Factor I is loaded with depression/anxiety measures, Factor II is loaded by positive mood state variables,

TABLE 5. Scores on Buss-Durkee Hostility Inventory for current users of anabolic steroids and control subjects in a study of their personality, mood, and psychiatric symptoms

Scores	Current Users	Nonusers	Between-Group Differences
Assault	5.24 ± 2.30	4.80 ± 2.27	NS
Indirect aggression	4.64 ± 2.20	4.08 ± 2.31	NS
Irritability	5.68 ± 3.00	4.20 ± 2.47	$P < 0.07$
Negativism	2.16 ± 1.57	2.24 ± 1.42	NS
Resentment	2.52 ± 1.92	2.28 ± 2.30	NS
Suspicion	3.56 ± 2.62	3.16 ± 1.91	NS
Verbal aggression	7.60 ± 2.71	6.04 ± 2.07	$P < 0.05$
Guilt	4.04 ± 1.86	3.08 ± 1.98	$P < 0.08$
Total Buss-Durkee score	35.44 ± 13.46	29.88 ± 11.14	NS

Note: Values are means ± SD. Current users, $n = 25$; nonusers, $n = 25$. NS = not significant trends

Factor III is an anger factor, and Factor IV is a physical and verbal aggression factor. Individual subject factor scores were subjected to ANOVA grouped by AS-use status. As seen in Table 6, there were no significant differences found between current AS users and control subjects for Factor I (psychopathology), Factor II (positive mood scores), or Factor III (anger). However, for Factor IV (physical and verbal aggression), current AS users scored significantly higher than controls ($F[1,48] = 7.49, P < 0.01$).

Overall Summary of Results

With respect to personality traits, AS users differed little from nonusers. However, there was a trend toward increased aggres-

siveness among AS users. Further, responses on the SCL-90-R, the POMS-BI, and the BDHI suggest that users of ASs demonstrated greater somatic concerns, hostility, and aggression than did nonusers. The observation of greater aggression and hostility among AS users converged from these three separate instruments and was then confirmed by factor analysis. No between-group differences in other psychopathology were found.

DISCUSSION

Results of this investigation confirm anecdotal reports of ASs increasing aggression and hostility among users,^{7,9,10} and suggest that this affective state is the principal behav-

TABLE 6. Factor analysis of mood, psychiatric symptoms, and hostility ratings of current anabolic steroid users and nonusers

Rating Scale	Derived Orthogonal Factors and Variable Loading			
	Factor I Depression, Anxiety, and Psychosis	Factor II Enhanced Cognition and Moods	Factor III Anger	Factor IV Aggression
Bipolar Profile of Mood States ^a				
Composed-anxious		0.77		
Elated-depressed		0.79		
Confident-unsure		0.82		
Clearheaded-confused		0.82		
SCL-90-R ^a				
Obsessive-compulsive	0.79			
Depression	0.81			
Anxiety	0.79			
Phobic anxiety	0.79			
Psychoticism	0.72			
Buss-Durkee Hostility Inventory ^a				
Assault				0.72
Resentment			0.78	
Suspicion			0.74	
Verbal aggression				0.74
Factor Analysis Scores				
Current anabolic steroid users ($n = 25$)	0.25 ± 1.20	-0.09 ± 1.00	-0.07 ± 1.11	0.33 ± 1.10 ^b
Nonusers ($n = 25$)	-0.15 ± 0.80	-0.04 ± 1.01	0.10 ± 1.02	-0.44 ± 0.84 ^b

Note: Values for current AS users and nonusers are means ± SD. Current anabolic steroid users, $n = 25$; nonusers, $n = 25$.

^aOnly variables that load into factors at a level greater than 0.70 are listed.

^b $P < 0.01$

ioral phenomenon associated with AS use. This finding converges from results obtained on three separate instruments: the POMS-BI, the SCL-90-R, and the BDHI, as well as from the subsequent factor analysis. Despite reports to the contrary, we could not confirm the presence of other psychopathology secondary to AS use.^{3-6,10} AS use was not found to be associated with other specific psychiatric manifestations such as depression, anxiety, or psychosis. However, we did find elevated somatic preoccupation among AS-users, which corroborates the observation first reported by Perry et al.¹⁰

Our results suggest that bodybuilders who choose to use ASs to enhance their training do not differ significantly in a majority of personality traits from nonuser bodybuilders. Thus, hypotheses that intimate that AS users are more achievement oriented, less harm avoidant, less traditional, less socially potent, or more impulsive (i.e., less constraint) than their natural athletic counterparts cannot be supported by the data herein. AS users and control subjects only tended to differ with respect to scores on the MPQ aggression scale.

The issue of how aggression as a dispositional personality trait relates to either the propensity to use ASs or if it functions as the characterologic substrate for AS-induced aggressive behavior remains to be resolved. Little data exist on the effects of pharmacologic agents on scale scores of the MPQ. Thus, we cannot be sure whether the trend toward an elevated aggression score on the MPQ is a consequence of state-dependent aggression induced by ASs, a contributor to AS-induced aggressive behavior, or due to the selection of ASs as a preferred drug by those who are already dispositionally aggressive. In fact, several studies have noted that aggressiveness as a life-long characteristic is predictive of other types of substance abuse.¹⁷⁻¹⁹ The causal relationship between aggression and AS use may best be elucidated through the application of experimental methods in which ASs are administered

only under controlled conditions to well-characterized subjects. Quasi-experimental approaches such as reported herein provide only suggestive evidence.

Because ASs are either natural androgens or analogues, it is of interest that an extensive but inconclusive literature links physiologic testosterone concentrations and aggression.²⁰⁻²⁸ AS effects are both quantitatively and qualitatively different from those produced by physiologic androgens. AS administration produces circulating plasma concentrations that are 10-100 times that of physiologic androgens. Further, physiologic testosterone is secreted in a pulsatile fashion,²⁹ whereas AS concentrations are tonically elevated. Thus, the "signal" transmitted by physiologic androgens is obliterated by pharmacologic androgen doses. Autoradiographic studies of brain androgen receptors indicate that the diencephalon, the amygdala, and the hippocampus are rich in these receptor sites.³⁰ In rats, lesions of the olfactory bulb³¹ and the raphe nucleus,³² which reduce amygdaloid serotonin content, increase muricidal aggressive behavior. An extensive body of clinical³³⁻³⁷ and preclinical (reviewed by Valzelli)³⁸ investigations have linked decreased serotonergic neurotransmission with aggressive behavior. Interestingly, it has also been demonstrated that androgens may mediate a central serotonergic receptor subsensitivity.³⁹ Thus, androgen receptors in the amygdala may modulate serotonergic receptor sensitivity in that region. One could speculate that the chronic increase in occupancy of amygdala androgen receptors by pharmacologic doses of ASs (as opposed to the transient occupancy of physiologic testosterone) may produce a significant subsensitivity of amygdala serotonin receptors, with a net reduction in serotonergic neurotransmission and a resultant increase in aggressive behavior.

Previous investigations have documented that the strongest associations between physiologic androgens and aggression are found among the types of aggression classi-

fied as status-related. This association has been described in humans, nonhuman primates, and nonprimate mammals.⁴⁰ Other taxonomic descriptions of this type of aggression include intermale aggression, rank-related aggression, dominance-agonistic behavior, offensive aggressive behavior, or competitive aggression (reviewed in Valzelli⁴¹). In ethological terms, status-related aggression involves competition for social rank and dominance, for food and water, control of resources and territory, for the choice of mate, and for reproductive advantage. Status-related aggression usually involves intermale fighting. It is unclear whether participation in competitive sports is a human

variation of this theme, although the analogy is certainly appealing.

In conclusion, this investigation of the neuropsychiatric effects of AS use supports the hypothesis of androgen-induced aggression but does not support a broader psychopathogenic effect of ASs. Unfortunately, this study does not clarify the causal links between aggression as a predispositional trait and subsequent AS-related aggression. Well-controlled experimental studies are necessary to elucidate this relationship.

This research was supported in part by National Institute on Drug Abuse Grant P50 DA5605.

References

- Buckley WE, Yesalis CE, Friedl KE, et al: Estimated prevalence of anabolic steroid use among male high school seniors. *JAMA* 1988; 260:3441-3445
- Pope HG Jr, Katz DL, Champoux R: Anabolic steroid use among 1010 college undergraduates. *The Physician and Sportsmedicine* 1988; 16:75-81
- Pope HG Jr, Katz DL: Bodybuilders psychosis (letter). *Lancet* 1987; 1:863
- Annitto WJ, Layman WA: Anabolic steroids and acute schizophrenia episode. *J Clin Psychol* 1980; 41:143-144
- Freinhar JP, Alvarez W: Androgen-induced hypomania (letter). *J Clin Psychiatry* 1985; 46:354-355
- Pope HG Jr, Katz DL: Affective and psychotic symptoms associated with anabolic steroid use. *Am J Psychiatry* 1988; 145:487-490
- Conacher GM, Workman DG: Violent crime possibly associated with anabolic steroid use (letter). *Am J Psychiatry* 1989; 146:679
- Brower KJ, Blow FC, Eliopoulos GA, et al: Anabolic androgenic steroids and suicide (letter). *Am J Psychiatry* 1989; 146:1075
- Pope HG Jr, Katz DL: Homicide and near-homicide by anabolic steroid users. *J Clin Psychiatry* 1990; 51:28-31
- Perry PJ, Yates WR, Anderson KH: Psychiatric symptoms associated with anabolic steroids: a controlled, retrospective study. *Annals of Clinical Psychiatry* 1990; 2:11-17
- Tellegen A: Structure of mood and personality and their relevance to assessing anxiety with an emphasis on self-report, in *Anxiety and the Anxiety Disorders*, edited by Tuma AH, Maser JD. Hillsdale, NJ, Erlbaum, 1985, pp 681-706
- Tellegen A, Lykken DT, Bouchard TJ, et al: Personality similarity in twins reared apart and together. *J Pers Soc Psychol* 1988; 54:1031-1039
- McNair D, Lorr M, Droppleman L: *Manual for Profile of Mood States*. San Diego, CA, Education and Industrial Testing Service, 1971
- Derogatis LR: *SCL-90-R Administration, Scoring and Procedures Manual-II*. Towson, MD, Clinical Psychometric Research, 1983
- Buss AH, Durkee A: An inventory for assessing different kinds of hostility. *J Consult Clin Psychol* 1957; 21:343-349
- Renshaw GJ, Adams JE, Tinklenberg JR: Buss-Durkee assessment and validation with violent versus non-violent chronic alcohol abusers. *J Consult Clin Psychol* 1978; 46:360-361
- Lewis CE, Robins L, Rice J: Association of alcoholism with antisocial personality in urban men. *J Nerv Ment Dis* 1985; 173:166-174
- Nylander I: A 20-year prospective study of 2164 cases at the child guidance clinics in Stockholm. *Acta Paediatr Scand* 1979; 276:8-45
- Muntaner C, Nagoshi C, Jaffe JH, et al: Correlates of self-reported early childhood aggression in subjects volunteering for drug studies. *Am J Drug Alcohol Abuse* 1989; 15:383-402
- Persky H, Smith KD, Basu GK: Relation of psychologic measures of aggression and hostility to testosterone production in man. *Psychosom Med* 1971; 33:265-277
- Kreuz LE, Rose RM: Assessment of aggressive behavior and plasma testosterone in a young criminal population. *Psychosom Med* 1972; 34:321-332
- Ehrenkranz J, Bliss E, Sheard MH: Plasma testosterone: correlation with aggressive behavior and social dominance in man. *Psychosom Med* 1974; 36:469-475
- Rose RM: Testosterone and aggression in man (ed-

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- itorial). *Psychosom Med* 1974; 36:467-468
24. Rada RT, Laws DR, Kellner R: Plasma testosterone levels in the rapist. *Psychosom Med* 1976; 38:257-268
 25. Meyer-Bahlburg HFL, Nat R, Boon PA, et al: Aggressiveness and testosterone measures in man. *Psychosom Med* 1974; 36:269-274
 26. Scaramella TJ, Brown WA: Serum testosterone and aggressiveness in hockey players. *Psychosom Med* 1978; 40:262-265
 27. Dent RM: Endocrine correlates of aggression. *Prog Neuropsychopharmacol Biol Psychiatry* 1983; 7:525-528
 28. Rose RM, Bernstein IS, Gordon TP: Consequences of social conflict on plasma testosterone levels in rhesus monkeys. *Psychosom Med* 1975; 37:50-61
 29. Naftolin F, Judd HL, Yen SSC: Pulsatile patterns of gonadotropins and testosterone in man: the effects of clomiphene with and without testosterone. *J Clin Endocrinol Metab* 1973; 36:285-288
 30. Sheridan PJ: Androgen receptors in the brain: what are we measuring? *Endocr Rev* 1983; 4:171-178
 31. Karli P, Vergnes M, Eclancher F, et al: Role of the amygdala in the control of "mouse killing" behavior in the rat. *Adv Behav Biol* 1972; 2:553-580
 32. Vergnes M, Mack G, Kempf E: Controle inhibiteur du comportement d'agression interspecificque du rat: systeme serotoninergique du raphe et affrences ofactive. *Brain Res* 1974b; 70:481-491
 33. Brown GL, Goodwin FK, Ballenger JC, et al: Aggression in human correlates with cerebrospinal fluid amine metabolites. *Psychiatry Res* 1979; 1:131-139
 34. Brown GL, Ebert HJ, Goyer PF, et al: Aggression, suicide, and serotonin: relationships to CSF amine metabolites. *Am J Psychiatry* 1982; 139:741-746
 35. Linnoila M, Virkkunen M, Scheinin M, et al: Low cerebrospinal fluid 5-hydroxyindoleacetic acid concentration differentiates impulsive from nonimpulsive violent behavior. *Life Sci* 1983; 33:2609-2614
 36. Coccaro EF, Siever LJ, Klar HM, et al: Serotonergic studies in patients with affective and personality disorders. *Arch Gen Psychiatry* 1989; 46:587-599
 37. Moss HB, Yao JK, Panzak GL: Serotonergic responsivity and behavioral dimensions in antisocial personality disorder with substance abuse. *Biol Psychiatry* 1990; 28:325-338
 38. Valzelli L: Physiological basis of aggression, in *Psychobiology of Aggression and Violence*. New York, Raven, 1981, pp 97-121
 39. Fischette CT, Biegion A, McEwen BS: Sex steroid modulation of the serotonin behavioral syndrome. *Life Sci* 1984; 35:1197-1206
 40. Ellis L: Evidence of neuroandrogenic etiology of sex roles from a combined analysis of human, nonhuman primate and nonprimate mammalian studies. *Person Individ Diff* 1978; 7:519-552
 41. Valzelli L: Cerebral representation of aggression, in *Psychobiology of Aggression and Violence*. New York, Raven, 1981, pp 75-95