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TESTOSTERONE AND DOMINANCE IN MEN

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Abstract

In men, high levels of endogenous testosterone (T) seem to encourage behavior apparently intended to dominate -- to enhance one's status over -- other people. Sometimes dominant behavior is aggressive, its apparent intent being to inflict harm on another person, but often dominance is expressed nonaggressively. Sometimes dominant behavior takes the form of antisocial behavior, including rebellion against authority and law breaking. Measurement of T at a single point in time, presumably indicative of a man's basal T level, predicts many of these dominant or antisocial behaviors. T not only affects behavior but also responds to it. The act of competing for dominant status affects male T levels in two ways. First, T rises in the face of a challenge, as if it were an

anticipatory response to impending competition. Second, after the competition, T rises in winners and declines in losers. Thus, there is a reciprocity between T and dominance behavior, each affecting the other. We contrast a *reciprocal* model, in which T level is variable, acting as both a cause and effect of behavior, with a *basal* model, in which T level is assumed to be a persistent trait that influences behavior. An unusual data set on Air Force veterans, in which data were collected four times over a decade, enables us to compare the basal and reciprocal models as explanations for the relationship between T and divorce. We discuss sociological implications of these models.

1. DOMINANCE, AGGRESSION, AND ANTISOCIAL BEHAVIOR

Numerous animal experiments, especially on rodents, show that raising testosterone (abbreviated T) increases aggressiveness (Svare 1983; Monaghan and Glickman 1992). In interpreting this work, it is important to distinguish aggressive behavior from dominance behavior. An individual will be said to act *aggressively* if its apparent intent is to inflict physical injury on a member of its species. An individual will be said to act *dominantly* if its apparent intent is to achieve or maintain high status -- i.e., to obtain power, influence, or valued prerogatives -- over a conspecific. Rodents typically dominate aggressively, but that is not true among the higher primates (Mazur 1973).

Of course, it may be difficult to appraise the intentions of an animal in order to distinguish dominance from aggression. But when we study humans -- our focal species here -- it would be naively behavioristic to deny our ability to read people's intentions, a skill that is the very basis for human sociability (see Gopnik 1993). Much of interpersonal behavior is overtly or subtly concerned with managing dominance and subordination without causing physical harm. Sports, spelling bees, elections, criticism, competitions for promotion, and academic jousting all involve domination without aggression. It is harder to identify instances of aggression devoid of a dominating motive, but examples are infanticide; purely instrumental killings such as sometimes occur in the execution of felons, murder for hire, or religious sacrifice; circumcision and ritual mutilation; euthanasia, surgery and dentistry; suicide and self flagellation; and knowingly causing collateral casualties from military attack. We may distinguish actions, whether by ourselves or others, that are intended to dominate, or to injure, or to do both to a target person. We understand that there are different motivations for dominance and aggression, which sometimes work concurrently. We may refer to people as dominant, submissive, aggressive, or nonaggressive, so long as we are clear whether these descriptors refer to a particular context, or to a disposition toward such motivations and actions.

The distinction between aggression and dominance is particularly important for humans, because we often assert our dominance without any intent to cause physical injury. It may be the case that T is related primarily to dominance among men and not to aggression except in situations where dominance happens to be asserted aggressively. Ehrenkranz et al. (1974) showed that socially dominant but unaggressive prisoners had relatively high T, not significantly different from the T levels of aggressive prisoners (who may have

been dominant too). Nearly all primate studies that have been interpreted as linking T to aggression (Dixson 1980) may as easily be interpreted as liking T with dominance (Mazur 1976). Recent reviewers have questioned whether, among humans, T is related to aggressiveness *per se* (Archer 1991; Albert et al. 1994).

On theoretical grounds, it is clear that dominating mechanisms -- whether aggressive or nonaggressive in form -- would have evolutionary advantage in helping an individual acquire valued resources, especially in competition for mates. This is not simply a matter of a dominant man taking what he wants; women regard men who *look* dominant as attractive (Townsend 1993). Teenage men rated by naive judges as having "dominant looking" faces (often with prominent chins, heavy brow ridges, muscular rather than fleshy or skinny faces) report copulating earlier than their submissive-looking peers, presumably in part because they have an easier time finding willing partners (Mazur et al. 1994).

It is not obvious why there would be selective advantage in aggressiveness *per se*, apart from its dominating function. (Predation for food is a different matter, unrelated to T.) We therefore frame our inquiry around dominating (and deferential) behavior as being theoretically prior to aggressiveness, leaving as an important but subsidiary question why men sometimes dominate with intent to harm.

An important variant of dominant behavior occurs in settings like schools, prisons, the military, families or work groups, where authority figures require behavior to conform closely to rigid standards. In these circumstances, dominant acting individuals who hold subordinate roles are relatively likely to break restrictive norms and codes of conduct. Such actions, opposed or hostile to social institutions and laws, are conventionally defined by sociologists as *antisocial behavior*, and are labeled by those in authority as rebellious or even criminal. We believe antisocial actions are often attempts to dominate figures in authority (teachers, policemen) or, more abstractly, to prevail over a constraining environment. Therefore our inquiry focuses on the relationship of T not only to dominant and aggressive actions, but also to antisocial behavior.

2. A PRIMER ON TESTOSTERONE

T is the primary *androgen*, a class of steroid hormones that develop and maintain masculine features. Although T is made in the adrenal cortex and ovary of females, it is produced in far greater amounts by the Leydig cells of the testis. T in men is secreted into the bloodstream in spurts, so measured levels can change considerably within a few minutes. The hormone has a circadian rhythm in both sexes, highest and most variable in the morning, lower and more stable during the afternoon (Dabbs 1990).

Synthetic modifications of T are pharmacologically more useful than T itself because they are absorbed more easily when taken as pills or, in the case of esters such as T propionate, have longer lasting effects when injected. Beside its *androgenic* (masculinizing) effects, T also has *anabolic* (protein tissue building) qualities that have therapeutic value (Bhasin et al. 1996). The anabolic steroids used by athletes to build

muscle mass, reduce fat, and improve performance are synthetic derivatives of T, designed to maximize protein synthesis and minimize masculinizing effects, however virilization by anabolic steroids is never wholly eliminated (Kochakian 1993).

Many effects that we explain today by T deficiency were obtained since ancient times by castration of men and animals, which was practiced not only to prevent fertility but also to prevent the development of secondary sexual characteristics, produce docility, reduce sex drive, and -- in butchered animals -- to produce fatter, more tender meat. (Among men, testosterone is inversely correlated with body fat; Mazur 1995.) Castrating a male chick, for example, makes its adult flesh more edible, and the capon fails to develop the rooster's head furnishings (red comb and wattles -- markers of reproductive competence), does not crow or court hens, and does not fight other cocks. In Asia, eunuchs were presumed to be safe harem guards because of their lack of both interest and ability to copulate. Male sopranos and contraltos, emasculated to maintain their prepubescent voice range, were prominent in the opera and church music of 17th and 18th century Europe.

Our modern understanding began in the 1930s with the isolation and identification of T. Reminiscent of the Curies' heroic extraction of minute amounts of radium from a ton of pitchblende, Koch and his coworkers mashed tons of bull testicles to fractionate ounces of material sufficiently pure to make the combs of capons grow bright red (de Kruif 1945). (Butenandt distilled 25,000 liters of policemen's urine to obtain 15 mg of another androgen, androsterone. Kochakian 1993). Identification and synthesis followed quickly, enabling experimenters to replace or enhance T in animal subjects and human patients. An example is the classic study of hen peck-orders by Allee et al. (1939) who injected T propionate into low-ranking hens. These injected females became aggressive, and each rose in her status hierarchy, some to the top position. Furthermore, their comb size increased (a male characteristic), egg laying was suppressed, some began crowing (rare in hens), and a few began courting other hens.

Until the availability of radioimmunoassay in the 1960s, the measurement of endogenous T was elusive because it is produced by the body in tiny amounts (Nieschlag and Wickings 1981). A normal man has about one hundred-thousandth gram of hormone per liter of blood (i.e., ten nanograms/milliliter); women have roughly one-seventh as much. Soon it was practical to measure *free* T (i.e., T not bound to protein, which is assumed to be the physiologically active portion; Rada, et al. 1976) in saliva with a concentration of about one-hundredth that of total T in blood (Landman et al. 1976; Wang et al. 1981; Riad-Fahmy et al. 1982; Dabbs 1991; Dabbs et al. 1995). Collection of saliva rather than blood has made studies on humans more practical. These remarkable improvements in method, plus the recent availability of studies including thousands of men, have expanded our knowledge greatly.

3. TESTOSTERONE WORKS DIFFERENTLY PERINATALLY, AT PUBERTY, AND IN ADULTHOOD

It is now clear that T affects human males importantly but differently at three stages of life: perinatally (in utero and shortly after birth), during puberty, and in adulthood. This target article focuses on the adult stage, but a brief review of earlier effects is worthwhile.

The mammalian fetus of both XX and XY individuals begins with undifferentiated sexual parts. A gene on the Y chromosome has been identified which causes the asexual gonads to develop as testes; lacking this gene the gonads become ovaries. The sex chromosomes have little more to do with sex differentiation which hereafter is driven by hormones produced in the now sex-specific gonads. The testes produce T during gestation, and production peaks again a month or two after birth, then declines by six months of age to the low range seen in later childhood (Winter et al. 1976). T and other testicular secretions cause the external genitalia to form into penis and scrotum rather than clitoris and labia, and internal ducts take the male form. The central nervous system is masculinized in rats and probably in humans too. The general rule, somewhat simplified, is that early exposure to greater amounts of T will produce more male characteristics (masculinization) and fewer female characteristics (defeminization), while less exposure to T will produce the reverse. Perinatal manipulation of animal subjects, and developmental abnormalities among humans, show convincingly that even genetic females will show male forms if dosed early enough with T, and genetic males will show female forms if deprived of the hormone (Naftolin 1981; Wilson et al. 1981; Breedlove 1992).

Perinatal T exposure affects behavior in a number of animal species (Breedlove 1992). For example, young male rhesus monkeys normally engage in more threats and rough-and-tumble play than do females, but when T is administered to pregnant monkeys, their pseudohermaphroditic female offspring exhibit male-type play behavior. Furthermore, by limiting T administration to the later part of gestation, female offspring are produced who exhibit male-type play but retain female appearing genitals, showing that behavioral masculinization is independent of genital masculinization (Goy et al. 1988). Studies of human children exposed perinatally to abnormally high or low levels of T are hampered by methodological problems and not fully consistent but may be construed to support the primate results (Ehrhardt and Meyer-Bahlburg 1981; Collaer and Hines 1995).

Many perinatal hormone effects are regarded as *organizing* the architecture of the body and brain, and the distribution of hormone receptors, into a relatively male-like configuration. When male T increases later in life, it *activates* these preexisting structures. Thus, behaviors derive from the interaction of long-term organizational and shorter-term activational effects.

The testes greatly increase production of T at puberty, elevating prepubescent serum levels from under 100 ng/dl to adult levels ten or more times higher. This promotes growth of the penis, larynx (and deeper voice), muscles, beard and body hair, sex interest, and perhaps combativeness. Boys who are hypogonadal or castrated before puberty do not experience these changes, but they can be induced by T replacement therapy.

The best known research on T and aggression among adolescent boys is that of Olweus and his colleagues in Sweden (Olweus et al. 1980, 1988; Mattsson et al. 1980). Since reviewers sometimes interpret these results more strongly than do the original investigators, it is worth examining them closely. A group of 40 delinquent boys, ages 14 to 19 years (mean = 16 years), living in an institution for serious recidivist youth offenders, was compared with a group of 58 nondelinquent high school students, ages 15 to 17 years (mean = 16 years). The result: T of the delinquents was slightly but not significantly higher than that of the nondelinquents.

Attempts to relate T to aggressiveness *within* the delinquent sample produced marginal results. Boys who committed the most violent crimes had slightly but not significantly higher T than boys who committed only property crimes. Ratings of the boys' aggressiveness by institution staff were not related to T, nor were evaluations of aggressiveness by a psychiatrist. The boys completed several paper-and-pencil inventories of personality. Four scales measured forms of aggressiveness, and a fifth measured dominance/assertiveness. Only one of these five scales correlated significantly with T. By comparing the eight delinquents with highest T and the eight with lowest T, one additional scale reached significance with a t-test. For the delinquent sample overall, the investigators conclude, relationships between T and their behavioral and personality variables are small in degree (Mattsson et al. 1980).

Comparable attempts were made to relate T to aggressiveness within the nondelinquent sample of high school boys. Student peers rated the boys on three forms of aggressive behavior, none of which significantly related to T (by two-tail tests, although one scale did reach $p = .05$ with a one-tail test). The boys completed pencil-and-paper inventories, mostly the same ones given to the delinquents. Four scales measured forms of aggressiveness, and a fifth measured antisocial behavior. Only two of these scales correlated significantly with T. The investigators, summarizing their results for the nondelinquent boys, note that inventory items which most clearly correlate with T are those involving an aggressive *response to provocation* ("When a teacher criticizes me, I tend to answer back and protest") as opposed to expressions of unprovoked aggression ("I fight with other boys at school")(Olweus et al. 1980, 1988). This interpretation associates T with responses to challenge rather than with aggressiveness *per se*, but as we have seen, the empirical results are ambiguous. Acknowledging this uncertainty, the Swedish investigators suggest that the causal effects of T be evaluated further using a longitudinal design.

Udry and his colleagues have used just such a longitudinal method. In preliminary work, Udry examined the correlation of T with behavior in a cross-sectional study of boys 12- to 13-years old, the approximate age of puberty. He reported a correlation between T and sexual activity (sexual ideation, petting, and first coitus), and between T and norm-violating problem behavior (aggression, dominance, antisocial acts), even when level of pubertal development (pubic hair, genital growth) is controlled (Udry et al. 1985; Udry 1988, 1990). However, when Udry and his colleagues attempted to extend these results with a three-year panel study, following similar boys until ages 15 or 16 years, they found no correlation between T, measured in the later years of the study, and behavior

during those same years. Nor were changes in T related to behavior. They conclude that there was no direct hormone effect on the boys' behavior. Instead, they argue, T acts indirectly through pubertal development, which is a social stimulus explaining sexual and antisocial behavior among young adolescent boys (Drigotas and Udry 1993; Halpern et al. 1993).

Other researchers also report little or no relationship between level of serum T and problem behavior among young boys. A pair of studies of 86 normal boys, ages 9 to 14 years, showed no correlation between T and aggression as measured from videotapes and mother reports (Susman et al. 1987; Inoff-Germain et al. 1988). In a study of 18 highly aggressive prepubertal boys, ages 4 to 10, T levels were no higher than those of nonaggressive controls (Constantino et al. 1993).

Based on the work at hand, especially the methodologically strong studies by Udry's group, we believe that around puberty, the effect of T on behavior works primarily through long-term reorganization of the body, including increased size, muscle mass, and the appearance of secondary sexual characteristics. (This physical transition from boy to young man probably builds upon structures laid down perinatally.) Maturation produces profound social effects on the adolescent. His peers, parents, and other authorities all treat him differently because he has "suddenly" grown up. Thus, T affects adolescent behavior mostly through indirect social responses, elicited by maturation, rather than through direct activation of target receptors by T in the bloodstream. This is a provisional conclusion because much remains to be learned, but studies to date give little consistent indication that circulating T level *per se* affects behavior as much as the overall masculinization of the body during the teen years.

By the late teens, with puberty over, the physical shape and organization of the body and neurohormonal system are established (until the degradations of old age), so our concern during adulthood is solely with the behavioral effects of T circulating in the blood, available to receptors in the brain and other organs (Strumf and Sar 1978; McEwen 1981). T levels peak in the late teens and early 20s, and then usually decline slowly throughout adult life in men (Davidson et al. 1983; Dabbs 1990; Simon et al. 1992; but see Tsitouras et al. 1982 for a contrary result). There are similar age trends for male libido, aggressiveness, and antisocial deviance**,** all being highest among teenagers and men in their early 20s, then diminishing (Segall 1979; Wilson and Herrnstein 1985; Gagnon et al. 1994). However, the causal connection from hormones to behavior remains open to question.

Most evidence indicates that men require a minimum level of circulating T for normal sexual activity (e.g., Davidson et al. 1979; Bagatell et al. 1994). The literature does contain reports of castrated men who continue sexual relations in varying degrees -- sometimes approaching normality -- without T replacement (Carter 1992). Questions may be raised about the authenticity of some of these reports, but some appear reliable. Castrates are not totally devoid of T; they produce a small amount in the adrenal cortex (Nieschlag and Wickings 1981). The common occurrence of penile erection in prepubertal boys shows that vaginal penetration could be obtained with little circulating

T. However, most researchers agree that a full repertoire of male sexual behaviors, including libidinous feelings and ejaculation, is unlikely without a T level near normal.

Does high circulating T make a man more sexual than average in his behavior? Reviewing the limited literature, Kemper (1990) argues, partly on theoretical grounds, that a normal man's temporal fluctuations in T substantially affect his sexuality, with heightened T especially causing an increase in libidinous feelings and tendency to masturbate. We are dubious and tentatively accept at face value the usual finding that level of circulating T explains little -- at most modest -- variation in sexual behavior, as long as hormones are within the normal range (Brown et al. 1978; Tsitouras et al. 1982; Davidson et al. 1983; Yesavage et al. 1985; Sadowsky et al. 1993). Also, we know that causation can work in the opposite direction as when men's T rises after viewing erotic material (Hellhammer et al. 1985) or after coitus (Kraemer et al. 1976). The administration of exogenous T to 31 normal men in stable heterosexual relationships, nearly doubling circulating T for up to eight weeks, had no more effect than a placebo on overt sexual behavior, but it did increase some sexual attitudes (Anderson et al. 1992). The usual decline of T with age explains little of the decline in sexual activity with age (Tsitouras et al. 1982; Davidson et al. 1983). Overall, fluctuations in T (within the normal range) have little effect on men's sexual behavior as long as a minimum amount of hormone is present. May the same be said for T's effect on dominance and aggression?

4. DOMINANCE AND AGGRESSION IN ADULTHOOD

By the end of puberty, usually about age 16 years, the physical form of a boy has changed into that of a man so T can no longer influence behavior through major reorganization of the body. However, the level of T circulating in the bloodstream may affect dominating or aggressive behavior by activating receptors in organs or the nervous system.

Because of the practical and ethical difficulties in observing or even allowing high aggression in human subjects, researchers are often tempted to measure aggression, or aggressive or hostile *feelings*, by administering paper-and-pencil tests. A few positive correlations have been reported between T and such measures (Persky et al. 1971; Ehrenkranz et al. 1974; Olweus et al. 1980, 1988; Harris et al. 1996), but more typical are failures to find this relationship (Brown and Davis 1975; Doering et al. 1975; Kreuz and Rose 1972; Meyer-Bahlburg et al. 1973; Monti et al. 1977; Rada, Laws, and Kellner 1976; Huesmann et al. 1984; Dabbs et al. 1991; Anderson et al. 1992; Bagatell et al. 1994). It seems clear that T is not related in any consistent way with aggression as measured on common personality scales. Furthermore, performance on these paper-and-pencil tests is not always correlated with actual aggressive acts and there is little evidence of their relevance to violent or dominant behavior (Buss et al. 1968; Kreuz and Rose 1972; Brain 1994). We agree with Archer (1991) that studies based on self-assessment of aggressive traits or predispositions have limited relevance.

Focusing on more concrete indicators of behavior, and on males who have passed through puberty, there are several reports associating relatively high T with dominant, aggressive, or antisocial actors, including several studies of men in jail. Kreuz and Rose (1972), studying 21 prisoners aged 18 to 35 years, found no significant T difference between those who fought a lot while in prison and those who did not fight, however prisoners with a prior record of violent and aggressive crimes had significantly higher T than those without such a history. Ehrenkranz et al. (1974) studied 36 prisoners aged 18 to 45 years who were sorted into three groups: those with chronic aggressive behavior, those socially dominant without physical aggressiveness, and those who were neither aggressive nor dominant; T levels were not significantly different between the aggressive and dominant groups, but both had significantly higher T than the group that was neither aggressive nor dominant. Rada, Laws and Kellner (1976) report that rapists who were most violent in the act have higher T than less violent rapists or normal men; however, there were only five rapists in their "most violent" group, and they could not clearly replicate their finding in a subsequent study (Rada et al. 1983). Dabbs et al. (1987), studying 89 adult male inmates, found T related to violence of their crimes, and peer ratings of toughness. In another group of 113 male inmates, aged 17 to 18 years, Dabbs et al. (1991) found that those high in T committed more violent crimes, were judged more harshly by the parole board, and violated prison rules more often than those low in T. In yet another group of 490 prison inmates, their mean age 20 years, T was related to violence of the crime, and with violating rules in prison, especially rules involving overt confrontation, leading the investigators to characterize high T individuals as "dominant and confrontational" (Dabbs et al. 1995). On the other hand, Bain et al. (1987) found no significant difference in T between men charged with murder or assault, and those charged with property crimes.

Studies done outside prison walls show mostly corroborative results if we again focus on behavioral indicators rather than paper-and-pencil personality tests, and on males who have completed puberty. Scaramella and Brown (1978), studying 14 male college hockey players aged 18 to 23, found a significant correlation between T and coach ratings of players' aggressiveness in response to threat. Jeffcoate et al. (1986), studying four male physicians aged 28 to 38 who were confined on a boat for a two-week holiday cruise, report T to be correlated with the physicians' assertive and dominant behavior, as ranked by three women also on the boat. Lindman et al. (1987), studying 25 men aged 22 to 27, found significantly higher T among those judged by their peers to be most aggressive while drunk. Banks and Dabbs (1996) found higher mean T among 16 young men they classified as "delinquent," based on flamboyant dress, drug use, and violence, than among 15 college men. Using an unusually large sample of 4,462 male army veterans in their 30s and 40s, several investigators (Dabbs and Morris 1990; Booth and Osgood 1993; Booth and Dabbs 1993; Mazur 1995) show T to be significantly related to self-reports of diverse antisocial behaviors, including childhood truancy, trouble as an adult on the job and with the law, marital disruption, drug and alcohol abuse, violent behavior, and military AWOL -- mostly indicators of rebelliousness and assertive norm breaking.

Overall, there is considerable evidence from a variety of settings that in men, circulating T is correlated with dominant or aggressive behavior, and antisocial norm breaking. Of

course, correlation does not imply causation, and the questions remains: Is high T a *cause* of dominant and antisocial behavior? This question could be answered with a double-blind experiment comparing the behavior of normal men whose T levels had been altered to that of a control group. Recent interest in T as a male contraceptive has led to studies of this kind, primarily to assess the effect of altered T on sexual behavior (Anderson et al. 1992; Bagatell et al. 1994). Subjects in both studies were given paper-and-pencil measures of aggression, which showed no change in the hypothesized direction, but we have already seen that these tests are inadequate. The incorporation of established laboratory methods for measuring dominant behavior would improve such experiments as tests of the dominance hypothesis (e.g., Weisfeld and Beresford 1982; Gladue et al. 1989; Mazur and Cataldo 1989; Kalma 1991).

Kouri et al. (1995) have moved in this direction, but with only six subjects. These normal young men were given increasingly high doses of T cypionate (150 mg/week for two weeks, 300 mg/week for two weeks, and 600 mg/week for two weeks) or placebo using a double-blind, randomized, cross-over design. Each subject was tested for "aggressive" behavior by being placed in a lab setting and paired with another (fictitious) subject. The experimenter explained that each member of this pair could, by pushing an appropriate button, reduce the cash that would be paid to his opposite number. The subject was then made to believe that his fictitious opposite was indeed taking this punitive action against him. In this provocative situation, subjects made significantly more punitive button pushes while receiving T than placebo. (Non-punitive button pushes did not differ between T and placebo conditions.)

Further attempts have been made to evaluate the causal effect of T by looking at treatment of prisoners or patients with castration or chemical androgen suppressers to control aggression (Heim and Hursch 1979; Brain 1984, 1994). It is difficult to assess claims of reduced violence and recidivism because reports are often anecdotal, based on few cases, and when castration is involved there is no way to separate the effect of T reduction from the symbolic effect of mutilation. Some reports are so zealous in their advocacy of treatment that they lack credibility (Mazur 1983). Rates of violence and recidivism after treatment are not always compared with rates for similar men who were not treated. As a result, the record of these treatments tells us little more than is known from the long history of castration.

Attempts have also been made to evaluate the behavioral effect of T by analogy with the behavioral effects of anabolic steroids (Bahrke 1993). Illegal use of these drugs by young men (and some women) to improve their athletic performance, aggressiveness, or physical appearance is now widespread. Many different steroids are used, often "stacked" in diverse combinations and regimens. There have been numerous claims of violent outbursts or "roid rages", and of psychotic symptoms, as a result of doses that far exceed therapeutic levels (Taylor 1991; Pope and Katz 1990). These too are difficult to evaluate because of their anecdotal nature and our ignorance of the prevalence of morbid symptoms among athletes in the absence of steroid use. Methodological improvements were made in Pope and Katz's (1994) comparison of 88 athletes who were using steroids with 68 nonuser athletes. Nearly a quarter of the users reported major mood syndromes

(mania, hypomania, or major depression), a significantly higher rate than reported by these same men in the absence of steroid exposure, and significantly higher than the rate for nonuser athletes. Su et al. (1993) produced diverse mood changes -- positive and negative -- in 20 normal men, compared to a placebo condition, by administering an anabolic steroid (methyl T) at therapeutic doses (far below illicit dosage). The latter studies strengthen the claim that anabolic steroids can affect mood in a morbid way, but the association of such mood changes with aggressive, dominant, or antisocial behavior remains anecdotal. Also, recall that anabolic steroids are deliberately designed to minimize androgenic consequences, so their behavioral effects should differ from those of endogenous T. Furthermore, steroid abusers take amounts that far exceed normal physiological levels, which makes the relevance of their results to the normal situation dubious. Overall, available data on illicit experiences with anabolic steroid tell us little about the effect of T on dominance.

It seems likely that in the near future, properly controlled experiments will convincingly test whether or not T is a cause of dominant behavior in men. At present, however, this remains an unconfirmed hypothesis.

5. RECIPROCAL CAUSATION

If there is a link between T and dominance, primate studies suggest a reciprocity of effects. Not only does T affect dominance, but changes in dominance behavior or in social status cause changes in T level (Rose et al. 1975). We have stronger evidence on this *reverse* effect in humans because studies of it require no drug administration and can therefore be done by researchers other than physicians; also, T levels can be obtained from subjects' saliva, which is easily collected. By now there have been several reports of T changes in young men during athletic events, which are convenient research settings because they are stylized dominance contests involving face-to-face competition with a clear winner and loser.

Male T varies in predicable ways both before and after competitive matches. First, athletes' T rises shortly before their matches, as if in anticipation of the competition (Campbell et al. 1988; Booth et al. 1989). This pre-competition boost may make the individual more willing to take risks (Daltzman and Zuckerman 1980) and improve coordination, cognitive performance, and concentration (Herrmann et al. 1976; Klaiber et al. 1971; Kemper 1990).

Second, for one or two hours after the match, T levels of winners are high relative to those of losers (Mazur and Lamb 1980; Elias 1981; Campbell et al. 1988; Booth et al. 1989; also see Johnsen and Zuk 1995, for the same effect in male red jungle fowl). This rise in T following a win is associated with the subject's elated mood. If the mood elevation is lessened because the subject has won by luck rather than through his own efforts, or because he does not regard the win as important, then the rise in T is lessened or does not occur at all (Mazur and Lamb 1980; McCaul et al. 1992). When Salvadore et al. (1987) did not obtain the win-loss effect on T among amateur judo competitors, they explained that their subjects did not take the matches seriously.

The above results were obtained in physically taxing sports. However, as theorists we are more interested in the less vigorous competition of everyday social interaction and symbolic changes in social status (Kemper 1990; Mazur 1985). Additional studies show the same pattern of male T responses during nonphysical contests or ritual status manipulations. First, T rises shortly before chess matches (Mazur et al. 1992) or laboratory contests of reaction time (Gladue et al. 1989: Figure 1), and in subjects confronted with a symbolic challenge from an insult (Nisbett and Cohen 1996). Second, T levels of winners are high relative to those of losers following chess matches (Mazur et al. 1992) and contests of reaction time, especially if subjects' moods are appropriately positive or negative (Gladue et al. 1989; McCaul et al. 1992). Similar effects occur among sports fans who are not themselves participants in the physical competition. Following the 1994 World Cup soccer tournament in which Brazil beat Italy, T increased significantly in Brazilian fans who had watched the match on television, and decreased in Italian fans (Fielden et al. 1994).

The hormone-depressing effect of status loss is shown in a study by Kreuz et al. (1972), who found that the T of officer candidates was abnormally low during the early, most degrading weeks of Officer Candidate School, but their T returned to normal during the relaxed weeks just prior to graduation. Similarly, T among prisoners dropped after admission to an incarceration program modeled after military boot camp (Thompson et al. 1990). Mazur and Lamb (1980) found that T of medical students rose after their graduation ceremony when their mood was elated. During the first days of freedom for 52 Americans who had been held captive in Iran for 15 months, a period of elation over their improvement in status, the former hostages' T was highly elevated (Rahe et al. 1990). Thus, the T pattern appears in nonphysical as well as physical competition, and in response to symbolic challenges and status changes among men.

The function of the elevated T following a win and the drop in T following a loss is not known. One possibility is that winners are soon likely to face other challengers; the high T may prepare them for this eventuality. The drop in T among losers may encourage withdrawal from other challenges, thus preventing further injury.

6. T IN WOMEN

Despite considerable speculation that T is associated with aggression or status in women (Kemper 1990), the empirical literature is scant and disparate. Purifoy and Koopmans (1979) report that T in 55 women increased with the status of their occupations. Ehlers et al. (1980), studying women who were patients in a neurological clinic, found significantly higher T among relatively aggressive patients compared to less aggressive ones, but these groups also differed in diagnosis, making the comparison suspect. Dabbs et al. (1988) saw no difference in T between 84 women in prison and 15 college women, but women convicted of unprovoked violence had higher T than other prisoners. Dabbs and Hargrove (1996) found no significant relationship between T and extent of criminal violence among 87 female inmates, but T was significantly related to "aggressive dominant behavior" while the women were in prison. Banks and Dabbs (1996) found higher mean T in 13 delinquent young women than in 21 female college students. Gladue

(1991) found T to be negatively related to self reported aggression in 32 women. Cashdan (1995) found status (as judged by peer assessments) among 32 college women to be negatively correlated with T, although the women's self assessment of their own status was positively correlated with the hormone. Also among these college women, T was negatively correlated with frequency of smiling, the absence of which is sometimes regarded as an indicator of dominance. The lack of consistency among these correlational findings is a caution to await further research.

The issue of sex differences has been addressed by asking how men and women respond to an identical competitive situation. T was assayed from saliva given by young men and women before, during, and after competing with a same-sex partner in a video game (Mazur et al. 1995). The hormonal response to the competition was different in each sex. Males showed the usual pre-contest rise in T but females did not. Males did not show the usual result that T of winners is higher than that of losers, apparently because the video game produced no mood difference between male winners and losers. A mood difference was produced between female winners and losers, but even with this precondition met, female T showed no specific response to the competiton. Booth and Dabbs (1995) report a consistent finding from their study of 6 female basketball players, whose T was generally not responsive to the anticipation or outcome of their games. These results suggest that the effect of competition on T is specific to men.

7. DOMINANCE CONTESTS

Does T play a role in daily challenges to status, either from strangers or from people well known to us? Like all primates, humans in face-to-face groups form themselves into fairly consistent dominance/status hierarchies so that higher-ranked members have more power, influence, and valued prerogatives than lower-ranked ones (Mazur 1973). Ranks are allocated either *cooperatively*, by consensus of those involved, or *competitively*, when there is disagreement over who should outrank whom.

To appreciate a person's decision to compete or cooperate, visualize two individuals (Ego and Alter) meeting for the first time. If their interaction is very brief or casual, the notion of ranking may never arise. However, in more extended or serious meetings, each will size up the other and gain some sense of their relative standings. If Ego thinks that Alter's status does or should exceed his own, he may defer to Alter without any dispute. In human terms, Ego may believe that Alter belongs in the higher rank, that Alter deserves it, that Alter could easily take it if Ego resisted, or that Alter would be more competent in the duties of high rank. In any case, ranks are allocated quickly and cooperatively. If Ego and Alter do not agree on their relative standings, then they may either break off the interaction or vie for the contested rank.

Ego's decision to compete or to comply will also depend on his motivation to dominate, which we believe is related to his T level (among other factors). A man who has experienced a recent rise in T, perhaps from a victory or a symbolic elevation in status, will be unusually assertive and may challenge someone of relatively high status. If both

Ego and Alter decide to compete, their relative ranks are then determined by the outcome of one or more short dominance contests between them.

Nonhuman primates are commonly observed to establish and maintain their status hierarchies through a series of short face-to-face competitions between members of the group. Some competitions involve fierce combat; others are mild, as when one animal is obviously the more powerful and assertive or the other appears fearful. In such cases, a simple stare by the powerful animal, followed by the fearful animal's eye aversion or by its yielding something of value (perhaps food or a sitting place), may suffice. Sometimes a single contest is all that is needed to allocate ranks or to verify a preexisting rank relationship, but often the outcome is settled only after a series of contests.

According to our model of dominance contests (Mazur 1985, 1994; Brinkerhoff and Booth 1981), a psychophysiological mechanism operating across this range of competition is the manipulation of stress levels. An exchange of threats or attacks is seen as an attempt by each animal to "outstress" or intimidate the other by inducing fear, anxiety, or other discomfort. Stress is experienced as both a feeling of discomfort and a syndrome of neurological responses (Axelrod and Reisine 1984). The animal that outstresses his adversary is the winner.

The model becomes clearer if we consider a concrete example (Mazur et al. 1980). Consider two strangers, Ego and Alter, whose eyes meet, by chance, across a room. Let us say that one of the strangers, Ego, decides to hold the stare. The chance eye contact now becomes a dominance encounter. Ego's stare makes Alter uncomfortable. Alter may then avert his eyes, thus relieving his discomfort while, in effect, surrendering, or he may stare back, making Ego uncomfortable in return. In the latter case, the staredown would continue, with each individual attempting to outstress the other until finally one person succumbed to the discomfort (and the challenger) by averting his eyes. The matter thus settled, the yielder usually avoids further eye contact, though the winner may occasionally look at the loser as if to verify his victory.

In this example, Ego's stare is assumed to elicit feelings of stress in Alter. Alter's eye aversion is assumed to relieve his own felt stress. Staring -- the stress-inducing behavior -- is a dominant sign associated with high status. Eye aversion is a deferential sign associated with low status. In other words, a dominant act (staring) elicits stress in the recipient; a submissive act (eye aversion) relieves stress in the actor. It is a central assumption of this model that most dominant and deferential acts work this way, inducing or relieving stress, respectively. These acts are the means whereby the adversaries wage their stress contest, each aiming "darts" at the other. Finally, when the stress is too great for one, he switches from dominant to deferential actions, thereby relieving his stress and simultaneously signaling his acceptance of the lower rank.

Within hours of this outcome, we assume Ego (the loser) experiences a drop in T, reducing his assertiveness, diminishing his propensity to display the dominant actions associated with high status, and increasing his display of such submissive signs as stooped posture, smiling, or eye aversion (Mazur 1985). Faced with a new dominance

encounter, Ego is more likely than before to retreat or submit. On the other side Alter, the winner, experiences the opposite effects: rising T, increased assertiveness, and a display of dominant signs such as erect posture, sauntering or striding gait, and direct eye contact with others. Alter may seek out new dominance encounters and is bolstered to win them. This feedback between high (or low) T and dominant (or submissive) demeanor would help to explain the momentum often associated with strings of triumphs or defeats: success begets a high T response which begets more dominant behavior which begets more success.

8. HONOR SUBCULTURES

Nisbett (1993; Nisbett and Cohen 1996) has attributed the historically high violence in the American South, compared to the North, to its "culture of honor" whereby Southern men, when challenged by insults to themselves or their families, are required to defend themselves as virtuous warriors or else lose face. Apparently as a result, Southern men are unusually alert to possible insults, reacting dominantly -- sometimes violently -- to speech or actions that might not be perceived as injurious in other cultures.

Leaving aside the particular historic roots of the South, there may be a general hypersensitivity to insult in *any* subculture that is (or once was) organized around young men who are unconstrained by traditional community agents of social control, as often occurs in frontier communities, gangs, among vagabonds or bohemians, and after breakdowns in the social fabric following wars or natural disasters. When young men place special emphasis on protecting their reputations, and they are not restrained from doing so, dominance contests become ubiquitous, the hallmark of male-to-male interaction (Thrasher 1963, Sanchez-Jankowsky 1991).

The leading student of street behavior in America's inner cities, sociologist Elijah Anderson (1994), vividly portrays the importance of dominance contests and their constant presence for poor young black men:

(M)ost youths have...internalized the code of the streets..., which chiefly (has) to do with interpersonal communication..., (including) facial expressions, gait, and verbal expressions -- all of which are geared mainly to deterring aggression....

Even so, there are no guarantees against challenges, because there are always people looking for a fight to increase their share of respect -- of "juice," as it is sometimes called on the street. Moreover, if a person is assaulted, it is important, not only in the eyes of his opponent but also in the eyes of his "running buddies," for him to avenge himself. Otherwise he risks being "tried" (challenged) or "moved on" by any number of others. To maintain his honor he must show he is not someone to be "messed with" or "dissed."

...The craving for respect that results gives people thin skins. Shows of deference by others can be highly soothing, contributing to a sense of security, comfort, self-confidence, and self-respect.... Hence one must be ever vigilant against the transgressions of others or even appearing as if transgressions will be tolerated. Among

young people, whose sense of self-esteem is particularly vulnerable, there is an especially heightened concern with being disrespected. Many inner-city young men in particular crave respect to such a degree that they will risk their lives to attain and maintain it (Anderson 1994: 88-89).

The honor subculture, the defense of one's reputation from insult, has been amply demonstrated by social scientists to be a feature of life for young men in the inner city (Anderson 1978, 1991; Horowitz 1983; Katz 1988).

We know from laboratory and athletic studies that T rises in men awaiting a contest, regardless of the eventual outcome of that contest. Generalizing to the street, hormone levels should be elevated in young men who are constantly vigilant against assaults on their reputations. Of course, T is also affected by the outcome of the contest, so persistent losers might be hormonally depressed, but most men -- those with mixed outcomes or better -- should have elevated T.

A caveat: Stressors such as weight loss, surgery, or military training sometimes depress T (Kreuz et al. 1972; Strauss et al. 1985; Booth et al. 1993). If *all* stressors depressed T, then the stressful challenges of inner-city street life should lower the hormone, not elevate it. However, not all stressors are the same, and social challenges in particular evoke hormonal responses different from those due to surgery or weight loss. Indeed, we have already seen that T reliably *rises* in the face of competitive challenges, even while cortisol (the "stress hormone") goes up as well (Booth et al. 1989; Elias 1981; Salvador et al. 1987; Gladue et al. 1989). Thus, stress effects do not negate the hypothesis that street challenges elevate male T.

We may use this hypothesis to interpret reported racial differences in T. A comparison of black and white boys aged 6 to 18 years, mostly preteens, showed no significant race difference in T (Richards et al. 1992). By adulthood, black males do have significantly higher T levels than white males (Ross et al. 1986; Ellis and Nyborg 1992), possibly reflecting the higher defensive demands on black men during young adulthood.

The data set used by Ellis and Nyborg (1992) came from 4,462 army veterans, ranging in age from 30 to 47, and permits a finer grain analysis (Mazur 1995). Among veterans older than the median age of 37 years -- too old to be involved in inner-city honor cultures -- the T of blacks is no higher than that of whites. Furthermore, among younger veterans who have gone to college -- and thus are unlikely to be inner-city residents -- there is no significant race difference in T. Only among *younger veterans with little education* do we find T in blacks to be unusually high, significantly higher than in whites. These younger black men, poorly educated, most of them urban residents, are most likely to participate in the honor subculture, and that may be the reason for their elevated T.

The reciprocal linkage between hormones and behavior suggests that if T levels among young men in the inner city are heightened by their constant defensive posture against challenge, then these high hormone levels in turn encourage further dominance contests.

Feedback between challenge and T may create a vicious circle, sometimes with lethal effects.

9. BASAL VS. RECIPROCAL MODELS: DIVORCE AND MARRIAGE

A *basal model* is usually used in describing the causal effects of T on behavior, meaning that each man's T measurements represent short-term fluctuations around his characteristic basal level, which is genetically based, and that by adolescence or shortly afterward, this basal level is more or less consistent from year to year. Consistent with this model, reliabilities from r = .50 to .65 are reported for T measurements taken (at the same time of day to control for circadian variation) over periods ranging from days to six years (Booth and Dabbs 1993), showing that men with relatively high T at one time tend to be relatively high at other times too. On the assumption that basal hormone levels are consistent, they necessarily predate any post-adolescent behavior and so cannot be a consequence of that behavior. Furthermore, since basal levels are stable, it follows that they can be adequately measured at any time, whether before or after the behavior, and therefore can be adequately assessed in a cross-sectional study. Going further, basal hormone level is regarded as a *prima facie* cause of any post-adolescent behavior that it predicts, especially if the effect persists after controlling for alternate explanations.

We contrast the static basal model with a dynamic *reciprocal model* in which T and status competition influence one another, going up or down together. The observed reliability of a man's T measurements from year to year may reflect his stable social position rather than his genetically determined basal level. Current data are insufficient to choose one model over the other, so we regard both as viable and heuristically useful.

The power of the basal model is illustrated by its ability to predict behavior from T measured at a single point in time. It suggests, for example, that men with high basal T tend toward dominating or antisocial behavior which disrupts family functioning, leading eventually to divorce. Pursuing this reasoning, Julian and McKenry (1989) found in a small sample of men that T levels are negatively related to marital satisfaction. A more extensive analysis of data from 4,462 former military servicemen in their 30s and 40s showed that males with higher T (measured once) are less likely to marry and more likely to divorce (Booth and Dabbs 1993). The likelihood of never marrying is 50% higher for men whose T is one standard deviation above the mean compared to those one standard deviation below the mean. Similarly, among men who have married, those at the higher level of T are 43% more likely to divorce than those at the lower level. Once married, men with higher T are 31% more likely to leave home because of a troubled relationship with their wife, 38% more likely to have extramarital sex, and 13% more likely to report hitting or throwing things at their spouse. In addition, high T men are more likely to report a lower quality of marital interaction. The occurrence of these behaviors increases continuously with T; it is not limited to men with exceptionally high T.

Using the same sample of men, correlations between T and education, and between T and income, are significantly negative but small in magnitude. Dabbs (1992) coded the status of the occupations of these men, using U.S. Census categories, and showed a correlation with T of -.11 ($p = .001$). Professional and technical workers had lower levels of T than service and production workers. The unemployed had the highest level of T. There was no evidence of a threshold effect.

The men with higher levels of T are more likely to be arrested for offenses other than traffic violations, to buy and sell stolen property, incur bad debts, and use a weapon in fights (Booth and Osgood 1993). Those with a T level one standard deviation above the mean are 28% more likely to engage in criminal behavior than those one standard deviation below the mean. Again, no evidence of a threshold effect was observed. In addition, those who were delinquent as juveniles were more likely to commit crimes as adults if they had higher levels of T.

An analysis of factors that predict exposure to military combat reveals that T increases the likelihood of exposure (Gimbel and Booth 1994). It is unclear whether high T individuals take an active role in seeking out combat or if those in command recognize behaviors that make the individual a better combatant and assign him accordingly. It is also possible that high T individuals are antisocial enough to get combat assignments as punishment. In any case, the basal model shows impressive predictive ability.

Unfortunately these findings, based on data measured at a single point in time, cannot tell us whether the men with marital and other difficulties always had relatively high T, as assumed in the basal model, or if discord surrounding their problems produced elevated T, which in turn exacerbated the discord, as assumed in the reciprocal model.

An unusual opportunity to compare the two models is presented by a panel study of 2,100 male Air Force veterans who received four physical examinations, roughly three years apart, over a decade (Wolfe et al. 1990; Mazur and Michalek 1995). Correlations between T levels measured in any two exams range from $r = .47$ to .61, showing the expected consistency across years.

There was little behavioral measurement in this study, but marital status was determined at each examination. T, as measured four times during the decade, could accordingly be correlated with marital status at each exam. Among the 16 possible correlations, 10 were significantly positive, replicating Booth and Dabbs' (1993) association of high basal T with divorce. However, we find that T measured *right after* the divorce is the best predictor, giving a regression coefficient roughly twice as large as does T when measured five years away from the divorce. This higher T with proximity to divorce indicates that the reciprocal model is also at work.

Furthermore, men who divorced during the decade of the study had elevated T in the examinations just before and after their breakups, compared to examinations further removed in time. The T of men who married during the decade fell as they made the transition from bachelor to husband, and T remained low among stably married men.

Thus, T is highly responsive to changes in marital status, falling with marriage and rising with divorce.

These results have an easy interpretation in the reciprocal model. Normal marriages are secure and supportive, more free from stress than single life, consistent with the relatively low cortisol found in married Air Force veterans. Single men are more likely than married men to face confrontations and challenges and, lacking the social support of a spouse, they are more likely to face situations where they must watch out for themselves, acting defensively and adopting protective postures. These are precisely the kinds of situations in which T rises. The abrupt act of marriage is the culmination of a longer and more gradual period of courtship and engagement, in which a man accepts the support of his partner, removing himself from the competitive area in which he has operated with his fellows. It is for this reason, we suggest, that T declines with marriage.

Similarly, a divorce is discreet in time but the breakup of a marriage is a process usually spanning years both before and after the legal announcement (Booth and Amato 1991). Typically it is accompanied by arguments and confrontations, the kinds of events associated with high T, both as cause and effect (Booth et al. 1985). We suggest that most men undergoing this level of challenge, unless persistently defeated, will experience rising T, which in turn encourages further confrontation with their estranged wives. Reciprocity is thus an appealing model here, but we also need the basal model to explain why men initially high in T have more propensity to divorce.

10. SUMMARY AND CONCLUSIONS

Perinatally and during puberty, the effects of T on behavior appear to work primarily through long-term reorganizations of the body and neurohormonal system, and only secondarily through short-term activation. By the end of puberty, usually around age 16 years, the body is nearly at its adult form so behavior is affected primarily by the level of T circulating in the bloodstream which can activate steroid receptors.

We share doubts expressed by Archer (1991) and Albert et al. (1994) that circulating T directly affects human aggression -- the intentional infliction of physical injury. We favor instead the hypothesis that high or rising T encourages dominant behavior intended to achieve or maintain high status (implying power, influence, and valued prerogatives). Usually humans express dominance nonaggressively. We leave as an important but subsidiary question why men sometimes dominate with intent to harm.

When military, school, or legal authorities require the behavior of subordinates to conform to rigid norms or laws, those people in subordinate roles who are motivated to act dominantly are likely to do so by breaking these norms or laws. In such settings, high or rising T encourages actions conventionally regarded as rebellious, antisocial, or even criminal.

Studies using various paper-and-pencil self reports of aggressive/hostile moods or personalities have not been generally successful in demonstrating relationships to T, nor

have we found such instruments reliable in our own research. Using more direct indicators or inventories of behavior, studies in both prisons and free settings fairly consistently show significant correlations between T and dominating behaviors (with or without aggressiveness), and between T and diverse antisocial or rebellious actions. Although we regard the *correlation* between T and dominant or antisocial behavior as well supported, heightened T has not been established as a *cause* of these behaviors. Attempts to appraise hormonal causation by evaluating the use of castration or chemical androgen suppressers on prisoners or patients, or the illicit use of anabolic steroids, have not been helpful because of methodological difficulties. We are just beginning to see proper double-blind experiments testing the effect of T on dominant behavior as measured with established laboratory procedures.

There is strong correlational and experimental evidence that T responds in predictable ways both before and after competitions for status. First, T rises shortly before a competitive event, as if anticipating the challenge. Second, after the conclusion of competition, T in winners rises relative to that of losers. T also rises after status elevations, and it falls after status demotions. These effects require the presence of appropriate mood changes -- elation or dejection -- accompanying the status changes. Limited evidence suggests that this pattern of T responses is specific to men.

People in face-to-face groups form themselves into fairly consistent status hierarchies. Usually ranks are allocated cooperatively, but sometimes people compete for high rank in dominance contests where each contestant tries to outstress the other until one concedes, accepting the lower rank. We propose that high or rising T, by encouraging dominant behavior, induces men to compete for high status. The experience of winning or successfully defending high rank boosts T, which in turn encourages more dominant behavior. The experience of losing depresses T, encouraging a switch from dominant to deferential behavior. This mechanism explains the momentum associated with winning or losing streaks.

"Honor subcultures" are communities in which young men are hypersensitive to insult, rushing to defend their reputations in dominance contests. Challenges are pervasive and have the effect of elevating T among those who participate in them (unless they are persistently defeated). Heightened T may in turn encourage more challenge behavior, producing a vicious circle.

This *reciprocal model* implies feedback between T and dominance, each reinforcing the other. It contrasts with the customary *basal model* in which an individual's basal level of T is presumed to be a fairly stable trait that predicts his behavior. Most studies cannot distinguish between the basal and reciprocal models because their data are collected at one point in time. An exception is a study of marital status among 2,100 male Air Force veterans who received four medical examinations over a ten year period. Among these men, T levels fall and remain low with marriage, and rise with divorce, rather than remaining constant. These results, although limited in scope, favor the reciprocal model over the basal model. The basal model, on the other hand, better explains the propensity for divorce among men who were initially high in T. We tentatively regard both models

as viable. The basal model has the pragmatic advantage of predicting behavior when T is measured at a single point in time.

The reliable association of high T with antisocial behaviors, including marital disruption and violent criminality, raises an interesting puzzle. These negative behaviors foster downward social mobility. Under the basal model, which assumes T level to be a persistent trait, we should expect an accumulation of *high T* men in the lower ranks of society. Indeed, as we have noted, correlations between T and various measures of socioeconomic status (occupation, income, education) are significantly negative. But they are slight in magnitude. Thus, leaving aside honor subcultures, we find little concentration of men with high T in the lower classes. Why not? One possibility is that the downward flow of high T men who are antisocial is nearly balanced by an upward flow of high T men who are prosocial. This hypothetical stream of prosocial high-T men remains invisible to us, so far, perhaps because past studies have used as subjects mostly working class men or convicts, who have limited opportunities for legitimate advancement.

The nearly uniform distribution of T across social classes is less puzzling under the reciprocal model, which regards T as malleable rather than a stable personality trait. Again excepting honor subcultures, where challenges are exceptionally common, dominance contests probably occur nearly as frequently among elites as in the working class, as often in the boardroom as on the shop floor. Therefore, T responses to challenge, and to winning and losing, should be distributed fairly evenly across classes. Under this reciprocal model, we would expect little accumulation of T at the bottom levels of society.

The applicability of one model or the other would be elucidated by studying the relationship of T to behavior among upper class men who have favorable social opportunities and strong incentives for prosocial behavior.

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