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Schizotypy and leadership: a contrasting model for deficit symptoms, and a possible therapeutic role for sex hormones

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Summary Associational loosening, slow and faulty information processing, poor gating of irrelevant stimuli, poor ability to shift attention, poor working memory, passivity, ambivalence, anhedonia, and impaired motor coordination are cardinal features of schizophrenia but, unlike delusions and hallucinations, they are related more to negative/deficit symptoms. As summarized by Bass, numerous studies have correlated leadership with 'ambition, initiative and persistence' (opposite of passivity), 'speed and accuracy of thought', 'finality of decision,' or decisiveness (the opposite of ambivalence), 'mood control, optimism and sense of humor' (opposite of anhedonia), etc. Andreasen et al postulate that a disruption in the circuitry among nodes located in the prefrontal regions, the thalamic nuclei, and the cerebellum produces 'cognitive dysmetria', meaning difficulty in prioritizing, coordinating, and responding to information, and that it can account for the broad diversity of symptoms of schizophrenia. A relationship between cognitive processes and cerebellar and basal ganglia functions, and a role of neocerebellum in rapidly shifting attention, have been demonstrated. The cognitive styles, including a proficiency to quickly shift attention, of several famous leaders are used as examples of this contrasting model. Julius Caesar and Napoleon, for instance, could dictate to up to six secretaries simultaneously, using their exceptional working memories, and proficiency in quickly and effortlessly shifting attention while flawlessly gating irrelevant external and internal stimuli. It is suggested that specific brain imaging studies could illustrate this contrast. Gray et al noted positive correlations between 'dominance', an important leadership trait, and serum levels of dehydroepiandrosterone (DHEA) and testosterone (T), but not of more potent dihydrotestosterone (DHT), in over 1700 older men. Though not scientifically rigorous, the author noted positive correlations ($P = 0.0162$) between the self-rated ratings of voice depth (promoted by T) and of leadership, but none between those of body hair (DHT dependent) and of leadership in 47 male US National Academy of Sciences members. And 43 male US Senators had deeper voices than 36 male House members ($P < 0.01$) who, in turn, had deeper voices than either of two groups (numbers 102 and 72) of male scientists ($P < 0.01$). Therapeutically, before chlorpromazine, DHEA had been used in young schizophrenics with modest success in improving deficit symptoms. DHEA, or other sex hormones, or some of their natural and synthetic derivatives may prove to be valuable to treat deficit symptoms of schizophrenia in both sexes. © 2000 Harcourt Publishers Ltd

INTRODUCTION

Manfred Bleuler suggested that nearly all schizophrenic mechanisms can be found in normal people (1), and the basic nature of schizophrenic psychopathology (*see* 2), such as associational loosening, ambivalence, avolition, anhedonia, and poor ability to shift attention at will (*see* 3), has been conceived rather as a quantitative variation from a normal mean (3). This basic nature is also largely the deficit symptom cluster of schizophrenia. Some cardinal features of schizophrenia that have more direct experimental evidence are slow and faulty information processing, from poor gating of irrelevant stimuli (4–7), and poor working memory (8–10).

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The author has observed a vivid contrast between the cognitive style of a typical, ectomorphic, male schizophrenic, evolving from a schizoid personality, with only minimal positive symptoms, and that of a very rare, highly dominant, charismatic and persuasive leader (3,11), notwithstanding the paranoia of some. In other words, the average psyche is somewhere between that of a natural leader and of a schizophrenic with prominent deficit symptoms, or schizotypy. Schizotypy can be considered largely as a miniature form of schizophrenia (12, 13, 14.)

Curiously, such charismatic (male) leaders also often have 'enormous sexual appetite' (15–20) which has little relevance to their leadership skills but may yet be a)physiological reflection – as 'supermasculinity', alpha maleness – of leadership. This heightened masculinity is more striking when physical hardiness is also noted, not (always) together with the enormous sexual appetite, in many, e.g. Alexander the Great (21), Julius Caesar (21), Akbar (22), Abraham Lincoln (23), Theodore Roosevelt (24) and Fidel Castro (25). According to press reports, even in his seventies, Ronald Reagan was a great arm-wrestler. An unarmed Akbar, as a teenager, once disabled a fleeing assassin 'with a single knock-out punch' (22). Akbar's physical strength and stamina were legendary (although women leaders have been few and rare, both Indira Gandhi, who was quite feminine, and Margaret Thatcher, with no outstanding constitutional characteristics, had been extraordinarily persuasive, dominant, and charismatic).

On the contrary, diminished sex drive, or 'sexual apathy', even at the premorbid state of the illness (26), and frail or ectomorphic body build are commonly seen in schizophrenics. Rees (27) writes, 'there is some evidence to suggest that paranoid schizophrenics tend to be different in body build from [other types] ... The work of [several authors, six cited] suggests that schizophrenics with [an ectomorphic] body build tend to have an early age of onset, show a greater degree of withdrawal, apathy and scattered thinking, whereas schizophrenics of [endomorphic/pyknic] body build tend to have a later age of onset and to show a better preservation of personality and better affective relations with the environment'.

The author hypothesized that some sort of a disorder in androgen effects, rather than diminished effects, in the brain – an 'androgen dysgenesis' hypothesis (3, 11) – could be one of the pertinent predisposing factors for developing schizophrenia: 'If the CNS regions are mapped to determine the uptake and/or influence of various androgen-like steroids, some of them, by virtue of their stereochemical affinity to the receptor or effector macromolecules, may be found to have much greater affinity to (or influence at) some regions ...' (11). Slight conformational differences of steroid molecules can profoundly alter their physiological effects.

Substantial data from the literature, since the publication of the 'androgen dysgenesis' hypothesis, as well as some less sophisticated data from many years of the author's work (3,28) reasonably support a broad concept of 'androgen dysgenesis' effects on the origins of psychological parameters and disorders.

A prima facie flaw in this concept is that quite a few leaders have also been paranoid. This is a contradiction to the prevailing dopamine theory, which fits well with the type I schizophrenia (29) model, but inadequate to account for the deficit or the negative symptoms. The biological substrates for the development of paranoia and of the deficit symptoms could well be different, as Rees' (27) review suggests. And the androgen dysgenesis concept could be viewed as a complementary hypothesis (besides, sex hormones do critically influence the dopaminergic and GABA-ergic systems in the brain, and vice versa (*see* 30–33).

Although sex-hormonal abnormalities as a cause for schizophrenia are by no means a new concept, others have not considered the hypothesized contrast between schizotypy and leadership (3,11) which is a useful concept, both phenomenologically, and also from a therapeutic perspective, as argued in this paper.

LEADERSHIP

Leadership is considered to be a universal human phenomenon, regardless of culture and ethnicity, or time in history (34). Burns (35) describes leadership as 'one of the most observed and least understood phenomena on earth', probably because there is a certain mystical quality to it (see the mystical nature of the 'boss' among cats, below). According to President Truman (36), 'you can't breed or teach leadership, it comes naturally'. Torre (16) perhaps put it best when he said, 'political leaders have certain personality characteristics not [seen in ordinary people, and that such] traits enable them both to seek out and be cast in a leadership role'.

Stark (37) writes, 'in times of crisis, a highly dominant figure, a hero with charisma, makes enormous feats of leadership happen' (charisma is defined as 'an overwhelming charm or allure a leader casts over his followers instilling devotion' [38]). He quotes from Joseph Goebels' personal diary from 1925–26, admiring the 36-year-old Adolph Hitler: 'I am finishing Hitler's book. Thrilled to bits! Who is this man? Half-plebeian, half God! Really Christ, or only John? ... That man has got everything to be a king ... We ask. He gives brilliant replies ... He has thought it all out ... I bow to his greatness' (37). In a less dramatic way, the American public was mesmerized by Ronald Reagan in the 1980s when they collectively

perceived the immense contrast between him and Jimmy Carter. Reagan, like Franklin Roosevelt, offered simple solutions to complex problems, and articulated them forcefully, and both displayed a total absence of ambiguity. These two titans could steer the middle-of-the-road American public decidedly to the left in the 1930s, and 50 years later, decidedly to the right.

Bowden (39), equating leadership with the strength of personality, says that the latter can even be 'estimated by the degree of influence [one] can exert on others'. This 'strength of personality' could be roughly equated with 'ego strength', with reference to eight 'ego-strengthening' factors listed below. Goodwin and Jamison (40) have correlated leadership with hypomania. However, it is argued that a leader is much more than a hypomanic, in that he also possesses superior ego strength. As for intellectual giftedness, though most studies show that leaders are as a rule more gifted, too high an IQ could even be a handicap (34) 'an IQ of around 119 [may be] the prescription for leader success' (17).

SELECTIVE 'EGO-STRENGTHENING' FACTORS

The term 'ego' has been used in non-psychoanalytic literature also (*see* 41,42). In this paper, 'ego' and 'ego strength' are used merely to describe cognitive functions and personality characteristics (*see* 3). Ego may be viewed as the central 'magnetic sphere' of the psyche that integrates and coordinates the autonomous cognitive fragments consisted of 'percept units' and (reactive and non-reactive) 'thought units' (3), and ego strength as the centripetal, cohesive force with which the integration and coordination of the cognitive fragments are prosecuted. Kaplan and Sadock (43) write, 'first described by Herman Nunberg in 1931, the synthetic function refers to the ego's capacity to integrate diverse elements into an overall unity ... [It] involves organizing, coordinating, and generalizing or simplifying large amounts of data'.

Freeman (44) envisaged, 'it is conceivable that damage to the perceptual system of ego leads to a failure of its screening function. As a result the individual can no longer insulate a train of thought from extraneous sensory stimulation [i.e. deficient sensorimotor gating – *see* 5–7]. Percepts and images now compete for attention with the already existing thoughts'.

Andreasen et al (2) have coined a term, 'cognitive dysmetria', meaning 'difficulty in prioritizing ... coordinating, and responding to information'. They postulate that a disruption in the circuitry among nodes located in the prefrontal regions, the thalamic nuclei, and the cerebellum produces cognitive dysmetria. 'This poor "mental coordination" is a fundamental cognitive deficit in schizophrenia and can account for its broad diversity of symptoms' (2). It is suggested that cognitive dysmetria could also be viewed as an end-result of 'ego weakening'.

Further, at the neuroanatomical level, Nasrallah (45) envisaged that 'defective interhemispheric integration ... may lead to disinhibition of the awareness by the left hemisphere [in most cases] that is being "influenced" by an unknown "external force" which is in fact the right hemisphere'. Crow (46) also argues that schizophrenia is a disorder of the interaction between the hemispheres, and that 'there is a failure to establish unequivocal dominance' by either the left or the right hemisphere. Woods (47) writes, 'in schizophrenia, the lack of asymmetry appears to result from a *reduction* in volume of the side that is normally larger, while in dyslexia there is an expansion of the side that is normally smaller'. It is suggested that a strong ego (partially) reflects an optimum inhibition of non-dominant hemispheric signals by the dominant one. Hopefully, sometime in the not-too-distant future, the neurophysiological circuits that potentiate ego-strength, and even the genes for the development of them will be discovered.

It was hypothesized (3) that 'a train of thought is an orderly linked chain made up of different autonomous units like amino acids in a protein molecule; the correct position of any unit, as well as the pace with which these units enter into consciousness for the organization of a stream of thought, is directed by the "ego"; this operation is largely automatic, instantaneous and without subjective awareness. If the ego is weak, as in schizophrenia, this arrangement becomes impaired and the "thought units" will "express" [themselves] their independent existence ... often in a disordered fashion (loose associations) either individually, or more collectively, to a highly variable extent depending upon the degree of ego-weakening, anxiety [level], learning (by conditioning), and the state of arousal'.

For the purpose of this discussion, the following eight ego-strengthening factors are delineated (3), although they do not encompass the entire range of ego functions (adapted and modified from a description of ego and ego strength in an older 1963 edition [not noted in many later editions] of Encyclopaedia Britannica, and 44):

1. rational self-confidence and courage;
2. dominant and influential disposition in company;
3. ambition and initiative but with restraining power over impulses;
4. selective attention;
5. ability to organize a number of facts within a limited time without the feeling of overcrowding or confusion;
6. ability to choose decisively among alternatives;
7. effortless systematization in instantaneous reactions when facing a crisis, and;
8. adaptability to changing environment.

It is again plausible that these ego-strengthening factors reflect an optimum inhibition of non-dominant hemispheric signals by the dominant one.

Conceivably, all eight of these factors are unusually weak in (dementia praecox-like) schizophrenics, and to a lesser extent, in schizotypy, compared with the average normal person. It is argued that all eight are unusually strong in great or strong natural leaders (see below). The first three ego-strengthening factors could reflect certain 'masculine traits' (see 'Androgens and dominance'). And ego-strengthening factors 5, 6, and 7 could be a reflection of the speed and accuracy of information processing. A main argument of this paper, as said before (3), is that the first three ego-strengthening factors are 'much more important than mere intelligence to potentiate [the other five]' (3), though the argument may appear strange, or too much of a jump. An indirect support to this argument, nevertheless, is given below, as exemplified by a gender difference in certain cognitive abilities.

Swerdlow et al (48) have noted that 'prepulse inhibition [PPI, which is the normal reduction of startle reflex when the startling stimulus is preceded by a weak prepulse], of the acoustic startle reflex is reduced in women compared to men'. PPI provides an operational measure of sensorimotor gating (7). PPI is impaired in schizophrenia (5–7), obsessive compulsive disorder (OCD) (49), and Huntington's disease (50). 'Although PPI is clearly impaired in OCD, ... female controls and male OCD patients exhibit comparable amounts of PPI' (49). Chen et al (51) administered the Continuous Performance test (CPT), in different forms, to a large sample of Taiwanese population – 115 adolescents and 345 adults. CPT, especially the higher load versions, has been widely administered to assess vulnerability to schizophrenia (51,52). Poorer CPT performance has also been associated with older age, lower level of education, and female gender (51). However, 'the sex difference in sustained attention manifested itself only for adults [not for adolescents], especially in the higher processing load version of CPT', using a 'successive vigilance task' (51). Nevertheless, female schizophrenics deteriorate less with less intense negative symptoms, and less neuropsychological, and brain structural abnormalities (46, 53–55). For instance, left temporal lobe volume was smaller in male, but not female, schizophrenics (55). The apparent reversal of gender differences in PPI, and CPT, between normals and schizophrenics, could indirectly support the 'androgen-dysgenesis hypothesis' of schizophrenia (11), if the incongruity is based substantially on sex-hormonal influences. Though all gender differences, whether physical or psychological, are not the results of sex-hormonal effects (54), in (complete) androgen insensitivity syndrome, due to androgen receptor defects, the affected 46 XY subjects grow up to be, physically and psychosexually, female, though the testosterone levels are in the normal male range (56). And in occasional cases of andrenogenital syndrome, due to 21-hydroxylase deficiency, the female genotype (46 XX), are born, raised, look and behave, psychosexually also, as just male with long enough penises but without testicles (56). Further, in female-to-male transsexuals, testosterone (T) treatment had 'a pronounced effect', to boost their performance in visuo-spatial tasks when compared with untreated subjects (57).

ANDROGENS AND DOMINANCE

As said above, 'dominant and influential disposition in company' is an ego-strengthening factor. Gray et al (58) reported positive correlations between dominance and serum levels of T and dehydroepiandrosterone (DHEA), an adrenal androgen, but not of androstenedione, a weak androgen as DHEA, or of dihydrotestosterone (DHT), a far more potent androgen than T, in a group of 1709 men, aged 39–70 years. The authors noted, 'these results partially support previous findings in animals, adolescents and criminal populations [59] that dominance is related to T'. Dominance and aggression do not covary, even in certain animal models (60).

DHEA has recently come into prominence in the public eye (61). Before chlorpromazine gained recognition as a breakthrough in the treatment of psychoses, the same DHEA was used on a small scale in young schizophrenics (62). Unlike chlorpromazine, DHEA apparently improved the deficit symptoms, such as 'timidity, lack of social confidence, feelings of inferiority, apathy, vagueness, mixing uneasily with others, ... [It was also] useful in improving rapport and accessibility to psychotherapy' (62 – *see* case histories). Higher plasma levels of DHEA sulfate and of androstenedione, but not of T, were noted in 15 boys with conduct disorder and aggression (63). Higher doses of DHEA caused aggression such as bullying by previously meek schizophrenics (62). Though the dose was too high (200–300 mg per day, as compared with the 10–20 mg per day Sands [62] used), DHEA induced clear-cut manic symptoms in a 65-year-old man (61).

DHEA is a versatile neurosteroid, a GABA antagonist (30,31), with clear antidepressant properties (64). DHEA sulfate is the most abundant steroid in humans, and both steroids steadily decline with age in both men and women (65), and they may have a role 'in brain development' (66). Steroid sulfatase, which catalyzes the conversion of DHEA sulfate to DHEA, is widely distributed in varying concentrations in the brain tissue in animal models (67).

Erb et al (68), and Brophy et al (69) have noted somewhat lower blood levels of DHEA, but not of other androgens studied, in schizophrenics; this finding has not been established with sufficient replications. Moreover, this is

too complex an area to study satisfactorily when the differences are small and may be in obscure androgens or androgen metabolites, and the androgen metabolites are too numerous (70), and only very few have been studied.

Further, DHEA stimulates interleukin (IL) 2 production, and 'counteracts the inhibition of [IL2] by glucocorticoids' (71). DHT, on the other hand, suppresses immune functions (72).

Though the blood levels of DHEA are slightly higher in men (65), its concentration is probably higher in the brain tissue of women (30). The gender differences of schizophrenia (46, 53–55, 73), later onset and slower deterioration in women, could have been influenced by this higher brain concentration of DHEA in women, and/or by some beneficial effects of intermediate metabolites between androgens and estrogens, or mostly by the beneficial effects of estrogens (54). It is worth exploring the physiological roles of such metabolites. Though 19-hydroxy-T and 19-hydroxyandrostenedione, from which estradiol and estrone respectively are formed, are unstable, 19-hydroxy-DHEA and 19-hydroxy-DHT are stable, as they are not aromatizable. The literature cited in this section reasonably support a broad concept of 'androgen-dysgenesis' effects on psychological parameters.

It may be possible to synthesize DHEA derivatives, or those of other sex hormones, that could have possible 'ego-strengthening properties', with reference to the eight ego-strengthening factors (above), or correcting 'cognitive dysmetria', to varying degrees. Further, various known and unknown sex hormones and their derivatives (70), including synthesized ones, could be tested for their possible potentiating effects on PPI in animal models, and CPT and PPI in human volunteers also. If effective (and safe) ones are found, they must be valuable to treat deficit symptoms.

Leadership correlates with voice depth but not with body hair growth

Although T and DHT bind to the same receptor, some of their physiological actions are different and not all are clear (74). DHT is needed for the development of external genitalia of the male fetus, and later, for body-hair growth (74). Both T and DHT can promote muscle growth (75). However, 5α-reductase, which converts T to DHT, is too low to produce sufficient DHT in skeletal muscles (75), unlike in the skin (74) or the brain (76). DHT formation, as compared with T output and level, is also negligible.

Curiously, the author noted a *statistical* correlation between body-hair growth and educational level in several samples of men, and that homosexual men, while they are much less muscular, are much more hirsute (28). These findings are well supported by a number of published studies (77–84) done with different objectives over a span of about 80 years (28), and also support a broad concept of 'androgen dysgenesis' effects on psychological parameters.

T to DHT ratio is extremely high in 5αR-2 deficiency 46 XY subjects (74, 83), who are known to be very low in body-hair growth and are generally high in mesomorphism. These subjects tend to be, but not exclusively, sexually attracted to females (74, 83), even when raised unambiguously as female (83). And T to DHT ratio could be lower than normal in homosexual men, as Doerr et al (80) noted, and also in intellectuals. In a follow-up study, to determine the difference in body-hair growth, and T metabolites, between Caucasian and Chinese men, Lookingbill et al (82) chose first year white medical students. Not less than 45% (24/53) of those white medical students scored a body-hair rating of '4', on a scale of '0–4', compared with probably 8–12% ~~they~~ could have scored comparably in Danforth and Trotter's (79) sample of several thousand white men. Physical examination results of Henry's (78) 40 homosexual men included descriptions of their body-hair growth also. Twelve of the hairiest ones, all white, were described 'excess [hair] on chest, abdomen, upper and lower back, thighs and legs', (p. 37), 'a wide band of hair extending down from his hairy chest', (p. 59), 'marked hypertrichosis with hair on upper and lower back', (p. 84), 'hypertrichotic; feminine arm angle and large phallus and testicles' (p. 531). Further, both male and female homosexuals are known to be more educated. In a sample of medical students answering an anonymous questionnaire, "[63 and 69% of the] students ... reported that around the age of puberty they were aware ... of sexual attraction to members of the same sex; 45% of the male and 48% of the female students were currently aware of such feelings' (81). And the 5αR deficiency subjects may be around the dull–normal range in intelligence (83).

Of 46 male US National Academy of Sciences members who responded, out of a random sample of 187 questioned, there was a significant ($P = 0.0162$) correlation between their (self-rated) aptitude for leadership and their (self-rated) voice depth while their (self-rated) body-hair ratings were evenly distributed at all levels of leadership (Figure 1). Though the method lacks scientific rigor, the results neatly reflect what Gray et al (58) have demonstrated – a negligible effect of DHT on dominance, and consequently, leadership, as DHT is needed for body-hair growth, and a positive effect of T on dominance/leadership, as T causes thickening of the vocal cords and deepening of the voice (85).

This apparent correlation between voice depth and aptitude for leadership was supported by another series of observations, though still less rigorous: voice depth of four groups of Caucasian men was arbitrarily rated on a scale of 1–5, the higher the number the deeper the voice,

in pages 37, 59, 84, 180, 203, 217, 339, 348, 380, 411, 519, and 531, e.g.,

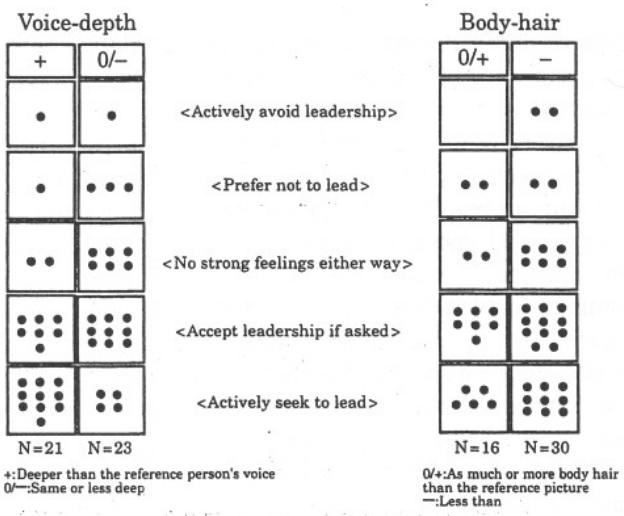

Fig. 1 A random sample of 187 male US National Academy of Sciences members were asked to compare their body-hair with the picture of a half-naked Caucasian male. They were asked whether they had as much or more body-hair on their chest, or forearms, and to answer with 'yes' or 'no'. They were also asked whether or not their voices were significantly deeper than that of a well-known US television anchorman of the time whose voice was slightly higher-pitched than average. Using this questionnaire their aptitude for leadership was assessed. Only 46 members responded. A significant ($P = 0.0162$) correlation was noted between the members' aptitude for leadership and their voice-depth (promoted by testosterone), while their body-hair (dihydrotestosterone-dependent) ratings were evenly distributed at all levels of leadership. Gray et al (58) have correlated leadership with T, but not with DHT in over 1700 older men.

with 3 being average. *Group 1:* A fairly random sample of 102 scientists who spoke, including those of the audience who asked questions, at an annual meeting of the Society for Neuroscience, were individually rated. *Group 2:* All 72 scientists who spoke, including those of the audience who asked questions, (at the same year's annual meeting as Group 1), of the Society of Biological Psychiatry, was individually rated. *Group 3:* All 36 male US House Judiciary Committee members was individually rated after repeatedly hearing them on television. *Group 4:* A fairly random sample of 43 male US Senators who were heard during the same 6-month period as Group 3, many of them repeatedly, on the same television set as Group 3, was individually rated. (All voice-depth ratings were done [only] by the author. However, the ratings of up to 33 US Senators' voices were cross-checked, and statistically validated by the ratings of three judges. The judges were asked to rate the voice-depth of as many Senators as they felt comfortable to rate confidently on a scale of 1–5. Then the names of 43 Senators were gradually read to them. All three could not rate all 33. Correlation coefficients of 0.54 ($P < 0.01$), 0.54 ($P < 0.01$) and 0.38 ($P < 0.02$) were obtained between the author's voice-depth ratings and the corresponding ratings of each of the judges. Moreover, the mean voice-depth ratings of the three judges were 3.77, 3.82, and 3.87, all well above the average of 3, clearly pointing to a plausible correlation between voice-depth and leadership.)

The 36 male US House Judiciary Committee members had deeper voices, and the 43 male US Senators had still deeper voices, than both groups of scientists. (It is a reasonable assumption that the US Senators as a group have higher leadership caliber than the members of the US House of Representatives.) Both differences, between the scientists and House members and between the House members and Senators, were statistically significant ($P < 0.01$). The voice-depth ratings of both groups of scientists were nearly identical.

Hippocampal, and/or amygdalar, lesions and dominance in animal models

Stress-induced hypercortisolemia leads to hippocampal shrinkage (86–88). DHEA reverses some effects of cortisol (71). Sapolsky (89) studied wild olive baboons, living freely in stable dominance hierarchies in their natural habitat in East Africa, annually for 6 consecutive years. The subordinate males, compared with dominant males, were consistently found to be hypercortisolemic (89).

Sapolsky (88) writes, commenting on hypercortisolemia and hippocampal atrophy in post-traumatic stress disorder, 'some rare, inexplicable supermen may come out of [extremely stressful situations] unfazed or even strengthened ...'. It is argued that strong natural leaders are such 'rare, inexplicable supermen'.

Fonberg's (60) studies in cats have revealed some fascinating findings especially regarding predatory dominance: 'The features of the "boss," detectable by [another] cat, escaped our observations. Changes in dominance following brain damage were equally mysterious ... Changes in dominance were observed in cats [with lesions to several structures including] dorsomedial amygdala (DMA) ... DMA cats [for instance] fully preserved their predatory behavior if tested alone with mice. In the presence of other cats, they ... permitted other [submissive] cats to catch, kill and eat the prey ... A spectacular observation was that the smallest cat, always submissive to all [other] cats, played with the mouse in front of the nose of the DMA cat, the overall dominant [prior to the lesions]' (60). male rats causes the larger 'posterodorsal nucleus of medial amygdala' (MePD) to shrink rapidly to adult female size, and administration of T to adult females causes MePD to rapidly swell to adult male size (90). T levels correlate with dominance in men (58, 59).

Further, chronic treatment of submissive cats with imipramine raised their dominance; cats that became submissive as the result of DMA damage regained some dominance under imipramine (60). Mirtazapine, a newer

and somewhat atypical antidepressant, suppresses corisol in normal men (91). Imipramine and other antidepressants are known to induce or exacerbate mania, and the amygdala could be enlarged in (some) bipolar disorder patients (92).

Goodwin and Jamison (40), having correlated leadership with hypomania, cite Theodore Roosevelt, Churchill, and Mussolini as examples of recent hypomanic leaders: '[Mussolini's] behavior and mood were characterized by euphoria, ideas of grandeur, pressure of activity, irritability and intolerance, and paranoia' (40). Again, a natural leader also has superior 'ego-strength' with reference to the eight ego-strengthening factors. Nevertheless, subclinical hypomania, by raising the arousal level (*see* 3), probably enhances leadership, and also ego strength, and probably working memory, and sensorimotor gating, as well. Many great leaders may have secured their status with the help of their hypomanic disposition.

Kling et al (93) have noted that monkeys that had surgical damage to amygdala were not accepted by the group. In the field and forest, the operated monkey stayed apart from the group, and sometimes even starved to death because other monkeys drove them from the source of food.

Drevets et al (94), based on their regional cerebral blood flow studies, suggest that, 'the abnormality involving the left amygdala may represent a trait marker for familial pure depressive disease'. In Alzheimer's disease, the extent of impairment in emotional event memory, 'is related to intensity of amygdalar damage' (95).

An average reduction of about 19% in the volume of gray matter in the left anterior hippocampus-amygdala was noted in chronic schizophrenics (96). Reduction in hippocampal volumes has been noted even in first episode cases of both schizophrenia and affective disorders (97). Weinberger and Lipska (98) suggest 'a developmental "disconnection" of temporolimbic-prefrontal cortices', in schizophrenia.

Cognitive styles of a leader, an average person, and a 'latent' schizophrenic

As summarized by Bass (99, pp. 53–59), numerous studies have repeatedly correlated leadership with 'ambition, initiative and persistence' (contrasting avolition/passivity), 'speed and accuracy of thought,' 'finality of decision' (contrasting ambivalence), 'strengths of integrity, convictions, responsibility, self-assurance, mood control, optimism, and sense of humor' (unlike anhedonia, or exaggerated, or 'dysregulated' and incongruous affective responses), etc. This capsule summary supports the middle position of the average normal person's psyche while schizotypy and leadership tend to position themselves at opposite ends. Further, Bass (99, p. 68) writes, 'the average person who occupies a position of leadership exceeds the average member of the group in the following respects: sociability; initiative; persistence; knowing how to get things done; self-confidence; alertness to, and insight into, situations; cooperativeness; popularity; adaptability, and; verbal facility'. Typical (early) male schizophrenics, with minimal positive symptoms, substantially fall behind in almost all of these ten items, as compared with the 'average member of the group'. These ten items and the above stated 'capsule summary' fairly reflect the eight ego-strengthening factors.

Torre (15, 16), who extensively studied the mental health of world leaders, and stressed the negative side as a consequence of physical and mental health problems in their decision-making proficiency, listed five characteristics of leaders (16): 'The first of [them] is high energy … [They] appear to attack their job with extreme vigor and vitality [Goodwin and Jamison (40) correlated leadership with hypomania.] … A second … is that they are … able to process large quantities of information quickly [not entirely a function of pure intelligence (17, p. 234)] … A fifth characteristic is that these leaders also have enormous sexual appetite [17, p. 38–39] … extramarital activity seems to be the rule rather than the exception'.

Schoenbrun (100) writes, 'I never met a great man or woman [leader] who did not possess that fine quick wit. No one could think more quickly on his feet, with spontaneous wit, than John Kennedy'. Kennedy had an IQ of only 119, however (101). According to the *Guinness Book of World Records*, Kennedy was the 'fastest talker' in public life, referring to a 327-words-per-minute burst in a speech he made in 1961. When the schizophrenic attempts to talk rapidly, it tends to become a 'word salad,' a reflection of weak ego, and of breaking down of sensorimotor gating.

To illustrate the contrast between schizotypy and leadership using more examples, it has been said of Napoleon (e.g. 102, p. 385), 'courage he had, and self-confidence and imagination and amazing energy and vast ambition … (*see* 40) Napoleon had, like Akbar, an extraordinary memory and a perfectly ordered mind. He said of himself, 'when I wish to put away any matter out of my mind, I close its drawer and open the drawer belonging to another. The contents of the drawers never get mixed up [conceivably, the opposite extreme of associational loosening, with flawless gating] … He had the magnetism of the great and he won devoted friendship from many. His glance, like Akbar's, was magnetic'. (Napoleon and Akbar, a 16th Century South Asian leader, were among the 100 most influential people of the past 1000 years listed by *Time* magazine.)

Another description (103), 'Napoleon was the most formidable military commander since Alexander the Great … His personality in school was described as granite heated

by a volcano ... In battle he seemed almost fearless, often leading the charges himself. His physical and intellectual stamina were amazing ... Often he dictated to as many as six secretaries at a time, jumping from subject to subject and never losing its place', requiring flawless gating of irrelevant external and internal stimuli, and exceptional working memory, and not entirely a function of his superior intelligence. Smith (104) writes, 'Julius Caesar's working memory ... was so disciplined that he could dictate four letters to his secretaries simultaneously, says Pliny the Elder. On days when he didn't have more pressing matters on his mind, the emperor could step up the pace to seven'.

There must be others who could do these sort of cognitive feats. Indeed, a ruggedly built neighbor of the author, who concurrently kept three wives – about 50 years ago – could dictate legal documents to his three assistants (sometimes even more) simultaneously. Such exceptional examples may only be better models of ego-integrity with excellent working memory, and flawless sensorimotor gating, found in (a certain kind of) 'hyper-androgenic' men coupled with superior intelligence. As said above, this is reflected in the reduced PPI in women compared with men (48), and also in the weaker CPT performance in women (51).

By contrast, for example, a senior scientist, half-jokingly responded to a member in the audience who simultaneously asked more than one question, by saying, 'one question at a time please [gracefully accepting the limitations of his normal working memory], chewing gum is an effective contraceptive for me', (an American joke started in the late 1980s based on a derisive remark on then US House member Gerald Ford by President Johnson who reportedly said, 'He [Ford] can't walk and chew gum at the same time'). Bob Woodward, a highly respected journalist author on US politics, forgot the first question, despite having been visibly 'lit-up' by its implication, by the time he finished answering the second question, and the female moderator had to remind him, on a 90-minute call-in program on *C-SPAN* on June 20, 1999. Such examples are not at all rare. For instance, during a 7-month period (between December 1997 and July 1998), two prominent scientists from the same university department displayed similar cognitive weaknesses: one forgot the second of two simple questions, after answering the first question, and the other lost his train of thought with a slight distraction while speaking. He then joked, 'now you know why I study memory'. Whereas most political leaders do not encounter difficulty in answering more than one question at a time from reporters.

True, over-inclusiveness is a characteristic positive symptom of schizophrenia, and also a sign of ego weakness, but in such instances the subject with a weak ego becomes perplexed and his cognition becomes disorganized to varying degrees. By virtue of the leader's greater ego strength, sensorimotor gating ability, and working memory, he is very resilient to such perplexity. The unperplexed successful over-inclusion could be conceived as a sign of a stronger-than-average ego. The number of items handled with ease simultaneously, like dictating to more than one person at a time, could be a measure of ego strength, working memory, and sensorimotor gating ability. Timothy Crow suggested, 'the highest levels of success [in leadership may be] related to the ability to sustain syntax against any type of disturbing influence' (personal communication, 1997).

Ego strength and ease in rapid attention shifting of leaders

It was suggested that 'in a "latent" schizophrenic, the perceptual confusion is felt only in the beginning of attention, and attention can later be fixed by excluding all other stimuli and by narrowing [the subject's] 'vision'; the insulation of the perception from other [interfering external and internal] stimuli could paradoxically be more complete [e.g. a schizoid 'book-worm'] than that in a person with a stronger ego. But it is difficult for the latent schizophrenic to transfer his attention from one object to another, [due to gating impairment], with the same facility a person with a better ego-strength can, [without fumbling]. In order to transfer the attention quickly ... the ego has to suppress a host of unwanted stimuli simultaneously; ... the earlier this suppression is achieved the quicker will be the transfer of the (selective) attention and the less the initial feeling of overcrowding' (3). A person with superior ego-strength, as an inherently strong leader, does this rather effortlessly, as illustrated above with the cognitive styles of Caesar and Napoleon, and below with that of Kennedy.

During the Cuban Missile Crisis, John Kennedy displayed his remarkable ability to maintain composure under extreme pressure, and also his ability to switch his attention from a heated confrontation with some elder Senators who argued for an invasion of Cuba, to addressing the nation announcing the historic Naval Blockade of the island (105). Robert McNamara, Kennedy's Secretary of Defense, said, '... he was – very good at that. He could carry on an intense dialogue, a controversial dialogue, right up to the point of a public appearance ... and still perform admirably, which he did that night' (105). At the neuroanatomical level, the 'neocerebellum plays a role in the ability to rapidly shift attention' (106).

High energy level, physical hardiness, and high sex drive of leaders

A description of the 33-year-old Fidel Castro soon after his coming to power is a good example for both

hypomania and hardiness. Mathews (25) writes, 'watching him so closely all afternoon made nonsense of a rumor [that he was on some stimulant] ... Apparently it is hard for some to understand how otherwise he can work so feverishly for 20 or 21 hours a day, everyday without a break. But the answer is simple; he has the build of a professional football player and the strength of a bull ... [And] he eats like a horse'.

Donald (23) writes, 'after [Lincoln] shook hands with patients for several hours, a surgeon expressed fear that his arm must ache from the exertion ... [He said] he had 'strong muscles,' [and] picked up a heavy ax ... [and] chopped away vigorously for a few minutes and then, taking the ax in his right hand, extended it horizontally, holding it steady without even a quiver. After he left, some strong soldiers attempted to duplicate his feat but failed'.

'[Theodore Roosevelt had] turned the white house years into a bully spectacle of romps ... [with] presidential judo battles with imported Japanese wrestlers, [and] boxing matches with his aides' (24). With a serious bullet wound to his chest, Roosevelt insisted on delivering a campaign speech, and after finishing the speech, he showed off the blood-soaked clothes he was wearing to a stunned audience.

While profusely bleeding, and close to death, from a bullet wound to his chest in 1981, Ronald Reagan cracked two memorable jokes, as widely reported in the press: 'Honey, I forgot to duck', to his wife, and to the doctors, 'I hope all of you are Republicans'. This is another example of a natural leader's extraordinary ability to gate (overloaded) sensory inputs.

One news commentator, during the 1984 US Presidential election season, ridiculed the promotional video of Walter Mondale, who lost to Reagan, which displayed him frying fish wearing an apron, while in a similar piece, the rugged-looking Reagan was splitting firewood with 'wood chips flying all over the place'.

By contrast, a Newton, a Voltaire, a Darwin, a Bernard Shaw, or a James Watson did not have to look physically impressive, nor poised and coordinated (see below), to prove their worth. However, pure intellectuals can be physically hardy also, as Leonardo da Vinci was known to be. Conversely, as many political and military leaders have been, Theodore Roosevelt was also a 'pure intellectual'. 'He identified 64 different bird species while strolling through England's New Forest' (24).

Life histories of great, charismatic (male) leaders frequently include folklore-like stories of their sexual escapades. These sexual adventures may well be a physiological reflection of leadership (*see* 16) though they cheapen and handicap them. And yet, from time immemorial, the public opted to condone them, and in effect provided leaders with recreational sex as a 'perk' in the form of harems and the like. As recently as 1960s, Kennedy's escapades (17,20) were condoned, and implicitly covered up, by the press, but Clinton had no such luck; a function of the difference in charisma of these two US Presidents? Hagood (20, p. 138) writes (assuming the account is not fabrication), 'that inaugural night, Jack [John Kennedy] had his choice of young party girls ... One European ambassador offered his niece ... Six attractive young starlets ... volunteered to sleep with the new President of the US. Peter lined them up, and after inspection Jack took one or two to bed ... Jack once told *several* reporters, 'I'm never through with a girl until I have had her three ways." (Although society is far more permissive now, imagine the intensity and reach of reverberations from a similar remark made by Bill Clinton to just one reporter.) Some prominent recent examples are Mustapha Kemal, Mussolini, Sukarno, and Mao Zedong. Hagood (20) has cataloged the sexual escapades of various US presidents, from Jefferson to Clinton.

Simonton (17) writes, 'One study ... [noted that] charisma was associated with (a) the leader's getting a reputation for sexual prowess, and (b) women making sacrifices for the leader'. Mussolini's mistress, Claretta Petacci, chose to be executed with him. She took the first bullet by stepping in front of him (107). As the American media frequently report, Charles Manson's women blindly committed brutal murders at his command.

According to Sachar (18), whose crisp, scholarly analysis of twentieth century leaders captivated US public television audience in the early 1970s, 'Mustapha Kemal [who is still revered by most in Turkey] was a complex character, strong, decisive ... He was defiantly dissolute and scarcely selective. He could sleep with a duchess or waitress with equal satisfaction ... 'availability' [for sex was what] he admired most in a woman' (p. 126).

On Mussolini, Sachar (18, p. 51) writes, '... above all, he was proud of his sexual prowess and boasted that he was ready at any hour of the day or night ... One of his mistresses complained that he did not even bother to take off his boots'.

On Sukarno, Sachar (18, p. 594) writes of, 'a compulsion that drove him to bring endless processions of women into his private life – wives, mistresses and affairs of the moment ... He thrived on crises; they deepened the dependence on him and when they did not come he created them'. While Kennedy shone during the Cuban missile crisis, the gravest since World War II, Jimmy Carter's presidency was crippled by the US hostage crisis of 1979–80, which eventually felled him. Unlike Kennedy, Carter lusted only 'in his heart', as widely reported in the press.

According to Li (19), Mao Zedong's personal physician and close confidant for 22 years until his death at age 83, Mao had an enormous sexual appetite, and sex was his

only recreation even, or especially, in his seventies. Mao's fourth wife said, 'in the matter of political struggle, none of the Chinese and Soviet leaders can beat him. In the matter of his personal conduct [i.e., sexual indiscretion], nobody can keep him in check either' (19).

The two clearly paranoid American cult leaders, Jim Jones and David Koresh, who had been exceptionally charismatic to persuade many of their followers to commit mass-suicide along with them, also had enormous sexual appetites, as widely reported in the press.

However, all leaders who may have had 'enormous sexual appetite' may not have displayed their lust with corresponding behaviors. For example, Greenblatt (108) writes, 'Gladstone was a complex, guilt-ridden man driven by relentless sexual urges ... Despite his lust, he remained a virgin until his marriage at age 29 ... His ethics and iron will prevented him from hurting his beloved wife, his image as a champion of people's rights, or his position of public trust'.

Awkward movements with neurological 'soft signs' in schizophrenics and superior motor coordination in leaders

Minor disturbances in motor functions are seen in many cases of schizophrenia with neurological 'soft signs' that may be enhanced by medication effects (2). This phenomenon is compatible with the 'attention-deficit' hypothesis of schizophrenia, and the co-existence of motor and thinking disturbances (111). Poor motor coordination in childhood can even predict vulnerability to, or future development of, schizophrenia (112). 'Increased cerebellar blood volume with tissue loss in the cerebellum, particularly the vermis', has been noted in schizophrenics, but bipolar patients showed a trend in the opposite direction (113).

Henrietta Leiner developed a theory on human brain evolution (114) linking dexterity to mental agility – anxiety episodes impair both in many normal people. While the dentate nucleus of the cerebellum is slightly enlarged in monkeys, it is much larger in humans (114, 115). Subcortical neuronal projections from the dentate nucleus and the globus pallidus via the thalamus to area 46 of the primate prefrontal cortex have been identified, and, 'these connections provide part of the anatomical substrate for the involvement of cerebellar and basal ganglia nuclei in cognitive processing'(116, *see also* 117).

The famous photographer, Alfred Eisenstaedt, was quite impressed by Mustapha Kemal's unusually good motor coordination, as he wrote in the caption of a picture he took of him, 'manag[ing] to sip coffee [from a cup in a saucer], smoke, hold a liquor glass, and look at pictures – all at the same time' (the physical/motor equivalent of dictating several documents simultaneously). Trained jugglers do much more difficult things, but they are achieved by people of above average dexterity by prolonged practice on specific acts. By contrast, some years ago, Solomon Snyder, a Lasker award recipient, and also very articulate, announced, 'I am a klutz', without any self-consciousness, in an interview with a news reporter.

President Bush was especially impressed by the proficiency with which Mikhail Gorbachev, with no previous experience, played horseshoe throwing. Gorbachev also displayed unusual skill in learning to use chopsticks during his visit to Beijing, as it may have impressed the television camera crew or the film editors to show it on national television in the US (Gorbachev was chosen as the 'Man of the Decade' by *Time* magazine although the Russians later trashed him). As shown in television news clips, and repeated in 1996, Senator Gary Hart, once the leading US Presidential candidate, displayed his unusual skill in 'ax-throwing' during the 1988 election season.

As examples of slightly impaired motor coordination seen in less than great leaders, *Time* magazine (February 27, 1995, p. 77) humorously wrote in the caption of a picture of three left-handed US Presidents playing golf: 'Bush and Ford did their customary best – driving balls into the gallery. Bush set a new record, striking two onlookers. Ford hit only one ... Clinton managed to avoid [that]'. And as for the 'ability to organize a number of facts within a limited time without confusion', ego-strengthening factor 5, both Ford and Bush had displayed their inadequacy. In a 1976 US presidential election debate, Ford unwittingly enumerated almost all the East European countries, as examples of countries *not* dominated by the Soviet Union (when the general feeling was that quite a few of them were indeed controlled by the Soviet Union), which he probably would not have done had he been making a prepared speech. Commenting on a 1988 Presidential election debate, conservative columnist, George Will condescendingly wrote (Syndicated Column, September 1988), 'tracing a Bush thought back from its manifestation in speech to origin in his thinking is like seeking the source of the Blue Nile ... Bush sentences that reel drunkenly around a topic ... [are] a sign of a chaotic mind'. Bush's mind is by no means chaotic, as he has proved it through his actions all his life including his eventful presidency. However, in press conferences, for instance, he was often very deliberate, sometimes struggling to keep his thought processes and communication 'in line'. (By contrast, his right-handed son, George Bush (Jr), speaks effortlessly with a natural sense of humor, and he is charismatic enough to apparently weed out all his republican challengers by June, 1999 and to command extraordinary respect from a broad spectrum including journalists who yearn to like him. And he could effortlessly flip pancakes with a spatula nearly a meter up in

the air into the plate of a woman standing some two meters away.)

Unlike Ford and Bush (Sr), Clinton usually, but not always, performs very well in press conferences, often answering two or more questions at a time, as he did in a 90-minute press conference in December 1997, probably his best, when he displayed his phenomenal skill in effortlessly laying out well-fitting bits of information on both national and international topics, as if from a powerful computer, from his vast reservoir of knowledge. During the next 13 months, although he was besieged by a sex scandal, Clinton managed to 'compartmentalize', (reporters' favorite phraseology) while handling different stressful matters one at a time, while successfully gating others. Napoleon said of himself, 'when I wish to put away any matter out of my mind, I close its drawer and open the drawer belonging to another. The contents of the drawers never get mixed up' (102). However, Clinton has only minimal charisma, it is suggested, and he thrives with his brute intellectual force coupled with an amazing tenacity, and a certain sense of mission, and an empathy which is too profound to feign. Roger Rosenblatt (*Time*, February 3 1997, p. 78) writes, '[Clinton] is sweet and graceful ... He works like a horse. He can weep on demand. He has spasms of inspiration. He blows up at the right people at the right times ... Yet ... he evokes less warmth than [even] much stiffer predecessors.'

The author noted that, 'boys compared to girls, as well as constitutionally more masculine boys and less feminine girls compared to less masculine boys and more feminine girls, respectively, learn driving faster and [can] do it better in the opinion of 34 driving instructors' (3). One of the 34 instructors added a telling comment that though boys definitely learned driving faster, they might not do it better as they were less cautious than girls. This survey indicates that gross motor coordination could be a function of tissue effects of androgens.

Driving ability is very sensitive to alcohol consumption. High tolerance is a cardinal feature of alcohol addiction, which is noted even in (non-alcoholic) sons of alcoholics (118). The author noted in several samples, of over 40 each, of male alcoholics that over 75% had strikingly deep voices, with voice-depth ratings of '4' or higher on a scale of 1–5 (unpublished). Marc Schuckit attributes this deep voice of alcoholics to their chronic bronchitis as they are heavy smokers (personal communication, 1985). John Ewing concurred with this and he added that female alcoholics also had deep voices (personal communication, 1981). There is anecdotal evidence for excessive use of alcohol by many celebrated leaders. Under the influence of alcohol, during a divided attention task, individual differences in performance, a reflection of individual differences in tolerance to alcohol, have been noted to be related to individual differences in glucose metabolic rates change in parietal cortex, as well as in several subcortical matters (119). Although the incidence of alcoholism is low in women, alcoholism, and heavy drinking are unusually high in homosexual women (120, 121). Correlating high tolerance to alcohol not only with deep voice but plausibly with muscle strength also, in a hand-strength task, and in a throw-to-target task, homosexual women and heterosexual men outperformed heterosexual women and homosexual men respectively, but in a fine motor coordination task, the reverse was the cae (84). Perkins (122) has convincingly demonstrated that homosexual women are much more mesomorphic than heterosexual women. However, these impressive constitutional differences demonstrated have not been convincingly translated into blood hormonal abnormalities.

Though general or gross motor coordination could be correlated with constitutional masculine traits, as shown above by the difference in driving proficiency, as well as the correlation between hand-strength and accuracy in aiming (84), in a fine motor coordination task, heterosexual women and homosexual men outperformed homosexual women and heterosexual men (84). Greg Louganis' physical movements have some feminine quality, he happens to be homosexual, and he is considered the greatest diver in history (123); his entire diving motion was almost always carried out with exquisite grace and perfect motor coordination. About half of male dancers are estimated to be gay (124). Sheldon (125) believed that the masculine and feminine components of the physique are two of the 'most important constitutional factors in determining personality'.

A neuroanatomical model for leadership in contrast with schizophrenia?

Dorsolateral prefrontal cortex appears to be 'crucial for gating of distracting information during delay tasks' (126). Prefrontal cortex, along with other crucial cortical and sub-cortical brain regions, such as the thalamus, hippocampus-amygdala and the cerebellum, might be well developed, and better 'organized' and 'integrated' in leaders than in most of their followers. Frontal lobe dysfunction and/or unusual anatomic asymmetries in the schizophrenic brain are well documented (45–47, 127–132). A disharmony in hemispheric functions may underlie the pathophysiology of schizophrenia (45, 46). Crow (46) writes, 'That asymmetry might be relevant to psychosis was first suggested by Crichton-Browne ... [who in 1879] wrote, "It seemed not improbable that the cortical centres which are last organised, which are the most highly evolved and voluntary, and which are supposed to be located on the left side of the brain, might

suffer first in insanity"'. Brain imaging studies of the past 20 years, set in motion by the landmark study of Johnstone et al (133), have apparently proved this hypothesis (*see* (3, *96*, 132, 134, 135)). Shenton et al (*96*) noted reduced volume of gray matter in the left anterior hippocampus-amygdala in chronic schizophrenics, and that the volume of the left superior temporal gyrus was negatively correlated with the thought-disorder index. Buchsbaum et al (134) noted decreased left hemispheric volume in frontal and temporal regions in schizophrenics, and to a lesser degree, in schizotypal personality disorder patients as well. And schizophrenics, 'have reduced left planum temporale gray matter and a reversal of planum temporale asymmetry ... ' (135, *see* 46 *also*). Further, *N*-methyl-*D*-aspartate (NMDA) receptor-1 mRNA was found to be reduced by up to 30% in the superior temporal cortex (side was not noted) in cognitively impaired, but not in non-deteriorated, schizophrenics (136). Hypoactivity of NMDA receptors is thought to play a role in the pathogenesis of schizophrenia (137). A recent study (130), however, demonstrated some of the complexities of brain imaging studies in schizophrenics showing volumetric reductions in, 'the right [not left] fronto-orbital cortex', bilateral reductions in the middle frontal gyrus and frontomedial cortex, but, 'the middle frontal gyrus showed greater reduction on the left'.

Crichton-Browne (cited in 46) wrote, 'the tendency to symmetry in the two halves of the cerebrum is stronger in women than in men'. Women's brains are less lateralized, less asymmetric, though dyslexia and related problems are more common in boys and men (46). Geschwind and Galabarda (138) have theorized that, 'testosterone influences the development of brain asymmetry (*see also* 139–141). Wisniewski (141) also showed that sex steroids were important in influencing cortical asymmetry, and that testosterone is the most likely candidate to influence cortical dominance, although a mechanism has not yet been identified. In (gonadectomized) animal models, T and DHT in males, and progesterone and estradiol in females, reestablished interparietal asymmetry' (142).

According to Kochakian (70), a pioneer in the field, 'testosterone is metabolized by practically every tissue to a large variety of related steroids. The metabolites vary with each tissue and appear to be formed to meet the specific needs of the particular tissue and animal ... Many of the metabolites show interesting differences in their relative biologic effects'.

There could be specific T (or DHEA) metabolites that influence, or even determine, brain asymmetry. Further, certain as yet unknown T metabolites may facilitate the asymmetric development of certain brain regions, whereas others may do the same in other regions, or indirectly suppress the development of some other regions. Although this may be stretching a little too much, differences in brain tissue effects of certain T metabolites may substantially influence the development of subtle differences in brain anatomy to determine personality profiles, as well as leadership potential.

CONCLUSION

(i) Leadership correlates with speed and accuracy of information processing, and a leader ought to be faster in processing information without mistakes than the followers, average normal people. Contrariwise, schizophrenics are much slower and defective in processing information than the average normal people. (ii) Leaders appear to have better than average working memory, and sensorimotor gating ability, whereas schizophrenics have poor working memory, and impaired sensorimotor gating. (iii) Various studies have also correlated leadership negatively with avolition, ambivalence, and anhedonia, whereas schizophrenics have these symptoms. (iv) At least some leaders appear to have superior motor coordination, whereas poor motor coordination is a good predictor of future development of schizophrenia. (v) All eight ego-strengthening factors listed are unusually strong in leaders and weak in schizophrenics. (vi) A disorder in androgen effects in the brain, an 'androgen dysgenesis', could be a pertinent predisposing factor towards the development of schizophrenia.

Suggestions for future research

1. Neuroanatomical and functional brain imaging studies may illustrate the contrast between leadership and schizotypy. Possible sites could be (left) prefrontal cortex, (left) planum temporale/superior temporal gyrus, the thalamus, hippocampus-amygdala, and the cerebellum. The study may use a group of accomplished leaders, a group of intellectually comparable academicians who have very little inclination or interest to be leaders, two groups of subjects – one who score high, and the other low in schizotypy – and schizophrenic patients with prominent negative symptoms, or type II schizophrenics (29).
2. The above groups may be administered working memory tests (10), Wisconsin card sorting test (143), PPI tests (48), different versions of CPT (51, 52), and Stroop's test (143).
3. The above groups' blood androgen profiles – T, DHT, androstanediol, DHEA, DHEA sulfate, androstenedione, and perhaps other possible steroid levels – may be obtained.

4. The above groups' anthropometric measurements (144), plus their body-hair ratings, using reference sketches, and the fundamental frequencies of their voices may be obtained.
5. Carefully selected (for negative symptoms) younger, preferably male schizophrenics who have predominantly ectomorphic (144) body type, and who have had schizoid premorbid personalities, may be given DHEA, as an adjuvant, after obtaining well-informed written consent from both the patients and responsible relatives or guardians, in double-blind, cross-over, longitudinal study. Each patient could be served as his own control during DHEA-free placebo period.
6. Various DHEA and other androgen derivatives, as well as other neurosteroids (30, 31) could be isolated and synthesized, and their pharmacological effects could be tested in animal models, as well as in human volunteers, to appraise their potential for therapeutic uses in schizophrenia, as an adjuvant to improve deficit symptoms.

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Addendum on the reprint:

The main theme of this paper - a striking contrast between schizotypy and leadership - occurred to me over 30 years ago. Unfortunately, I was not able to write it up cogently, because of my limited writing skills as well as of the comlexity of the related ideas, most of which were supported only by indirect or equivocal evidence. Part of the evidence itself, especially during the early years, was hypothetical constructs based on my empirical observations that looked too remote, though they made "perfect sense" to me.

I kept on writing it up awkwardly over and over again which brought forth not only derisive but also some unusually complimentary comments. After rejecting some five times, *the Lancet* agreed to publish it as a rather lengthy Letter to the Editor in 1972. Dr James Hedlund of University of Missouri spent a lot of time and thoroughly revised it, and the late Dr Joseph Wortis (bless his soul) of *Biological Psychiatry*, without the usual peer review, accepted it as a lengthier paper in 1974.

To cite one of the earlier comments, Dr Eliot Slater, of *the British J Psychiatry*, wrote on Aug 25, 1969, while rejecting a version, "I have had a shot myself at trying to reduce [your article] into concise and straightforward English but found that I was unable to do so. Not only have you padded out your paragraphs with a lot of unnecessary remarks, but very often it is exceedingly difficult to see just exactly what you do mean to say."

As recently as 1995, reviewers complained of the discursive display of the ideas in my compositions when journal after journal rejected previous versions. Dr Tim Crow sympathized and suggested to submit it to Medical Hypotheses. Although Dr Horrobin, the editor, was not impressed first, he was still willing to accept it. He wanted me to revise it, but I overdid it by sending him too many revised versions again and again to the point of annoying him.

I should like to say that the present paper, nevertheless, is largely cogent and readable, and many who have read it appeared to have liked it. For example, Prof George Ulett of Univ of Missouri wrote (Nov 3, 1999), "I found your excellent paper to be most interesting.... Your hypothesis has importance not only for schizophrenia but also for greater understanding of mental processes," and Prof John Money of Johns Hopkins Univ wrote (Dec 21, 1999), "Metaphorically it reminds me of a gold mine with many veins yet to be discovered - excellent hypotheses for further research. I am not sure where sex hormones are going to lead us in the [21st] century of research, but probably on a different road than the one we are presently following, and much influenced by the Human Genome Project."

I have mixed feelings about my findings (briefly referred to on p. 541) correlating body hair growth, a reflection of testosterone to dihydrotestosterone ratio, with intelligence/educational level (there are numerous male intellectuals in all races with little body hair, as there are numerous retarded men who are quite hirsute), as well as with male homosexuality. The former evoked embarrassing interests in the lay press, but the academic community turned a blind eye to the whole thing so far. Unfortunately, these findings (which can be readily replicated as I have in numerous samples in different races), could create too much controversy, and even prejudice, if and when the academic community chooses to take a serious and critical look at them.