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Violent Prisoners*

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Abstract. The article presents an interdisciplinary model for the study of violence and incorporates a hierarchy of levels of etiology: biological potential, personality structuring and social imprints. It also contains an updated review of the literature. The model synchronises electro-encephalographical data, endocrinological data, Shoham's personality theory, family dynamics and societal attitudes towards law enforcement. This model has been operationalised for actual research to be carried out in the Israeli prison system.

Introduction

Impulsiveness and violence are types of behaviour that may be linked to criminality, whereas aggression is recognized as a fundamental human drive or instinct [1]. A discharge of destructive energy transforms aggression into violence. The aetiology of violence is related to all levels of human functioning and may be traced to biology, personality and social norms.

We assume a rather strict determinism of human behaviour, which ranges within a configuration of somatic and environmental factors. We envisage three levels of interaction involved in the genesis of human behaviour: biological, psycho-personal and socio-cultural imprints.

The flow from one level to another is continuous and gradual, not discrete or divided by partitions. The hypothetical model suggests that impulses or stimuli are received by the nervous system through our senses and generate neuro-endocrinological responses. These are sifted through and processed by the psychological personality parameters of the specific individual and are finally structured by his or her sociocultural patterns of experience. The aetiological hierarchy envisages a

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complex configuration of factors inherent in human behaviour, so that at any given moment, the behaviour pattern of a given individual is unique and not reproducible. The probability that the configuration of factors within each level and between the three levels would be identical with the corresponding configuration of another person is so remote that it can be assumed to be non-existent.

The relationship between the various levels in the generation of behaviour is dynamic. Moreover, a multi-phasic relationship exists between each level and all the others, every level being linked simultaneously to all the others and receiving feed-back from them.

The idea of a behavioural hierarchy involves the idea that for each pattern of behaviour the relative contribution of any of the levels is not equal. Yet, the relative preponderance and intensity of each level in the generation of a given pattern of behaviour determines the nature and form of this behaviour. Consequently, if we are able to grade the relative contribution of each of these three levels to the resultant behaviour, we shall have the framework for understanding the content and form in a given case.

However, even if one level can contribute more than others to the genesis of a given type of behaviour, there is no instance where the contribution of the other levels is totally lacking.

In the case of violent behaviour, one person may be predisposed towards it more than another, owing to higher level of testosterone and cortisol. A predisposition to violence on the personality level might be related to the person's need for stimuli as measured by the Sensation Seeking Scale (SSS) [2], field dependency, as measured by the Rod and Frame Test [3], a high tendency to risk-taking as measured by an instrument developed by Shoham et al. [4], and other parameters indicating stimulus seeking activist behaviour [5].

Social and cultural factors may raise the probability of violent behaviour, e.g. the killing of an adulterous wife in Southern Italy, or the killing of a sister who is pregnant though unmarried in the Middle East. Faulty socialization may also raise the probability of the violating of both norms and laws that proscribe violent behaviour in a given context [6]. All these are predisposing factors, which interact with situational factors, i.e. the exchange of words and actions in the particular situation, which leads to the eruption of violence on a biological level [7].

The aetiological hierarchy relates to the predisposing factors in the following manner. Let us tke an actual case of a person allergic to alcohol who was given a glass of fruit juice laced with alcohol at a party. After consuming this beverage he took a jeep and drove it at full speed into a shop, killing two people. If his violence is taken as the dependent variable and we try to relate it to the independent variables in the aetiological hierarchy by multiple regression analysis, the conclusion will be that in his case the interaction of alcohol with his biological structure explains most of the variance. However, we still have to ascertain the role of the person's personality parameters in raising or lowering the chances of the eruption of violence. Furthermore, we have to consider how his socialization enchanced or impeded his ability to restrain himself, even in the extreme biochemical upheaval into which his allergy had pushed him.

In the case of the "crazy psychopath" who is always looking for trouble, most of his violence would be explained by stimulus-seeking low sensitivity to pain. Even in

this case, we would still need to measure the activity of the autonomic nervous system by determining the (low) GSR (galvanic skin response) rates, the levels of testosterone and cortisol in the blood, and the internalization of specific norms that impede or enhance the eruption of violence. However, the subject's stimulus-seeking personality would be the predominant factor in the aetiological hierarchy.

Finally, if an Arab kills his sister because she is pregnant out of wedlock, most of the explanation would lie in the sociocultural realm. Yet we should still have to answer the question of why this specific person, rather than another member of his family, undertook to carry out the ritualistic killing.

Our approach is synthetical and holistic, for we see the individual as an operational unit and not as a mere configuration of parts. The research therefore presents the inter-relationship of biological psychological and cultural factors in violent prisoners.

Theories of property crime and professional crime stress the socially learned component, following the approach advanced by Sutherland: this states that most criminality whose prime motive is profit is considered "normal" behaviour. This is a negative determination, because it does not stress the personality deficiencies amongst these criminals as opposed to the general population. Violence, inasmuch as it has no professional criminal correlates such as "settling scores" in the underworld or mercenary violence, is usually accompanied by a lack of internal conflicts. If we accept this assumption, then violence is related to structural dynamics entailing the lack of a preventive barrier against an uncontrolled outburst of behaviour. This lack of control is usually structural and is therefore related to the violent offender's personality. Thus, the measuring system presented here places more of an emphasis on personality analysis than on general criminological variables.

Personality and Violence

The most widespread explanations of violence indicate a significant connection between biological and personality components. Megargee designates the internal factors that motivate an individual to commit an aggressive violent act in a given situation as "instigation to aggression" [8].

One of the factors separating violent criminals from the rest of the population stems from the access of the latter to legitimate channels for the discharge of anger and hatred. Megargee [9] and Lane [10] have revealed that individuals whose personality structures do not allow for the release of aggression accumulate violence to the point where they must perform an extreme act of violence.

According to Eysenck [12], a dimension of the introvert-extrovert continuum can be found in the personality of the violent criminal. The introvertion is related to a high excitability level of the cortex and quick conditioning in the slow building up of inhibitions. Extroversion, on the other hand, relates to a low excitability level of the cortex, slow conditioning and a rapid rate of build-up of inhibitions. The quality of conditioning dictates the way in which social norms are acquired.

Many researchers equate psychopathy with the extrovert trait. Zuckerman [2] claims that psychopaths need a high level of stimulation in order to perform

optimally in their roles. Based on similar findings, Quay [13] suggests that the quest for stimulants that is characteristic of psychopaths is also one of the factors contributing to their criminal behaviour.

Allsop's findings regarding antisocial children indicate a linearity or at least an increase in antisocial behaviour parallel to an increase in psychopathy, extroversion and neuroticism [14]. The following hypothetical variables may be related to violent behaviour in the form of personality profiles which either raise or lower the probability of violence. The proposed typology dimensions and their corresponding traits can be summarized in chart form as follows:

Personality *Types, dimensions and traits*	
Separant	*Participant*
Interactive dimension	
Activist "Stimulus hunger" "Reducer"	*Quietist* "Stimulus aversion" "Augmentor"
Ontological dimension	
Object inclusion "Field dependence" "Sharpener"	*Self-exclusion* "Field independence" "Leveler"
Normative dimension	
Outwardly aggressive "Extrapunitive" Sanction orientation Outer control High risk taker	*Inner castigation* "Intrapunitive" Moral orientation Inner control Low risk taker

We propose to denote the high violence probability profile as "separant". Its dimensions appear on the left hand side of the chart, whereas the low violence probability profile we can denote as "participant", appears on the right hand side of the chart. The separant aims to contain or "swallow" the object whereas the participant wishes to be contained or merged with the object. The description and proposed measurements of each individual dimension in the profile are as follows:

In the interactive dimension the first parameter is "stimulus hunger", which characterizes the separant, whereas "stimulus aversion" is related to the participant. This conceptualization is based on Eysenck's research findings concerning his extrovert-introvert personality continuum. His extrovert is characterized by sociability, impulsiveness, activity, liveliness and excitability, whereas the introvert is marked by diametrically opposite traits [12]. Special importance should be given to Eysenck's findings concerning the "excitation" and "inhibition" of his polar types. An excited cortex will exert a restraining and inhibiting hold on behaviour, whereas an inhibited cortex will loosen the individual's self-restraint, with a resultant increase in behavioural excitation.

Eysenck has shown that his extrovert is hungry for stimuli, i.e. sensation-seeking, whereas his introvert displays stimulus aversion [11]. The more violence-prone separant would, therefore, be stimulus-hungry, whereas the more quietist participant, striving for inaction, i.e. a state of non-stimulation, would be less likely to resort to violence. This might be linked to Eysenck's findings that the introvert reacts favourably to sensory deprivation [12]. He also found that the extrovert

is relatively insensitive to pain but suffers acutely when in a state of sensory deprivation. This finding could be linked to the separant need for activity and the stimulation of the object, whereas the participant seems to suffer from stimuli which catapult him away from the coveted state of inaction. Stimulus hunger and stimulus aversion are readily measured by Eysenck's M. P. I. and other instruments [12].

Another character trait relating to the interactive dimension of the personality is revealed by Petrie's ingenious experiments on individuals who subjectively increase the size of the stimuli (augmenters) and others who decrease it (reducers) [15]. Petrie's instruments consist of a block of wood divided at meaured intervals and an elongated piece of wood that widens towards one end [15]. The subjects first rub the piece of wood while blindfolded, and then the block. They then have to point out the place on the widening piece of wood which seems to them to have the width of the block. Reducers point out the width at a point on the piece of wood which is narrower than the block, whereas the augmenters tend to have the opposite reaction [14]. This test is extremely simple, because the only necessary instruments are two pieces of wood and anyone can be trained to administer the tests.

Augmenter tend to be less violence-prone than reducers, who seek more excitement. The two interactive dimensions of separant would depict them as "aiming to devour" the object and incorporate it into themselves, whereas participants wish to exclude and isolate themselves from the object.

The second ontological dimension relates to the "object inclusion" of the separant and the "object exclusion" of the participant. The separant displays a higher "field dependence" than the participant, who tends to be "field independent". These two concepts, as well as Witkin's later study on "psychological differentiation", relate to the object, setting an environmental perception during performance of the task [3]. Field dependent persons display a low psychological differentiation because they are dependent for their performance on cues stemming from the overall *gestalt* and the background set of the situation. In other words, performance is dependent on the configuration of the surrounding object. On the other hand, field independent persons and those who display higher psychological differentiation rely on their own cognitive cues and not on the outward *gestalt* of the object [16]. Field dependence or independence is measured by the Rod and Frame Test [3]. A somewhat related test is that based on Klein's "Sharpener" and "Leveller" dichotomy [16]. Separants would tend more to be sharpeners, trying to pinpoint details of the object, thus displaying an intolerance of objective ambiguity, whereas levelers have more the characteristics of participants, displaying tolerance of objective ambiguity. The leveller/sharpener personality traits can be measured by instruments developed by Klein.

The third normative dimension deals with the self-object relationship. The "intropunitive type" is the guilt-ridden self-accuser, who rarely tends to solve disputes by violence, whereas the separant tends to be more outwardly aggressive, blaming others in an "extropunitive" manner. This trait could be measured by Rosenzweig's test [17].

Participants also tend to legitimize social norms, i.e. to be "morally oriented". They have deeply internalized social norms, so that external repressive sanctions are unnecessary to secure compliance. This trait is based on Rommetveit's theory

on the internalization of social norms [18]. We have developed a scale to measure the internalization of norms [4]. The hypothesis is that the sanction-oriented, i.e. those who comply with norms only through fear of sanctions, will tend to be more violent. Rotter imputes to his "internal controller" a belief in his ability to manipulate the external world [1].

Finally, we have the high risk taker and the low risk taker. The more violence-prone high risk takers can be detected both by the scale we have developed and by Rettig's moral risk-taking scale [20].

The final outcome would be seven dimensions which are continua rather than dichotomies and include the separant's high probability of violence profile and the participant's low violence probability profile. After testing this model we built a scale and instrument to measure violence-proneness at the personality level [21].

The psychological parameters of violence are naturally linked to personality formation, which is related to socialization within the family. Hence, our next section will deal with the family parameters of violent prisoners.

Family Parameters of Violence

The nuclear family is one of the major social institutions, so that many of the changes in the social structure are correlated with changes in that family. It is not therefore surprising, that a large number of theories have been formulated in attempts to explain delinquent and criminal behaviour as consequences of problems in the structure and processes of the offender's family. As Wilkinson [22] noted, the idea that a broken or malfunctioning family is the cause of criminal behaviour, has often been mingled with moralistic overtones [20]. Consequently, it is rather difficult to distinguish between those elements of the conclusions of various authors that are based upon well-grounded theory and those that are based largely upon ideological and ethical convictions.

All major theoretical orientations in the socio-psychological explanation of criminal behaviour are consistent with the idea that pathologies in the structure and functioning of the family are likely to be significant [23]. From the perspective of strain, or anomie orientation, problems within the family unit reduce the individual's opportunities to cope successfully with societal demands and hence operate as a strain-inducing mechanism.

The effect of problems in the family is clearer according to the subcultural approach. Delinquency, it is claimed, is essentially the outcome of a differential socialization process. Therefore, as the broken or malfunctioning family fails to socialize the child into the acceptance of social norms, it contributes to its socialization into alternative, deviant norms [24, 25]. According to another approach, suggested by control theory [26], delinquent behaviour emerges whenever the controls over the individual's behaviour are lowered. The family serves as a major control agent. Any process which reduces its ability to react consistently to transgressions, or which lowers the juvenile's attachment to the family, may be considered a delinquency- or deviance-inducing process.

These theoretical approaches do not necessarily contradict each other. Indeed, in many cases, they may be considered complementary [27], as they lead to the same

conclusions. A survey of research findings concerning the family and delinquency suggests that, despite a few arguments to the contrary [22, 28], the overwhelming majority of the findings are consistent with the hypothesis that broken, or conflict-ridden families have higher rates of delinquent children than those that are intact or free of conflict [29].

We propose the hypothesis, consequently, that violent and aggressive behaviour will be related directly to unstable, conflict-ridden relationships within the family of origin, and to weak or non-existent relationships with family members later on. More specifically, our hypothesis is that violent prisoners will have lived as children in tension-ridden families, in which at least one of the parents manifested role-inadequacy. Moreover, following Parson's masculine protest hypothesis [30], we expect that maternal dominance will be associated with violence. On the other hand, current attachment to both family and peers would be expected to be related inversely to violent behaviour [25].

Following the family parameters of violence, we devote our attention to some sociological manifestations among violent prisoners.

Societal Correlates of Violence as Related to Prisoners' Attitudes Towards Social Norms

After the pioneering work of Parsons and others in the 1940s on the social model of prisons, researchers have started to regard the behaviour of the prisoner as enmeshed in social norms. This approach envisages tht compliance or infringement of the norms within prison, the custodial staff, the structure of the prison and the prisoners' subculture determine the framework of the normative system in which the prisoner lives [31], Irwin and Cressey have shown that many prisoners bring an adherence to a criminal subculture into prison with them, which prepares them for life 'inside' [32]. Moreover, many prisoners identify with the criminal world and adjust their behaviour in prison accordingly. In this study, we intend to incorporate the link between the accepted and deviant perception of social norms of prisoners and their violence. There is evidence of a link between prisoners attitude to law enforcement agencies and their violence. Violent prisoners display a more negative attitude towards the police and towards lawyers than non violent prisoners [33]. The subculture of the prisoners has been found to be related to the violence of the prisoners as well as to overcrowding within the prison. Megargee [11] lodged groups of subjects in rooms of different sizes and studied their behaviour for three years. He found a significant link between room space and the number of normative infringements and their gravity. The link between discipline and overcrowding was found to be curvilinear, meaning that overcrowding is a sufficient but not a necessary correlate of normative infringement.

Having surveyed the psychological parameters, the family parameters and the societal attitudes of prisoners, we shall proceed to examine their biological correlates, which concern neural and endocrinological structures.

Impulsiveness seems to be linked to the high-probability-of-violence profile. It involves a mental state of excitement, with autonomic nervous system and bodily changes. Impulsiveness creates a favourable condition for the transformation of human aggressiveness into violence. The components of impulsiveness are four: provocative stimulus, a feeling response, visceral changes and nonrational outbursts [34]. The impulsive person "overreacts", since the impulsive outbreak (fourth step) is not logically or proportionately related to the provocative stimulus. Sometimes the provoking stimulus is lacking altogether. Then one faces a three step mechanism of impulsiveness manifested in anger, fury and rage. Impulsiveness may last for minutes, hours or weeks, during which period individuals are incapable of logical evaluation and interpretation of behaviours and actions. Impulsiveness may also be accompanied by cognitive incoherence. The "planned impulsive individual", in contrast to the "spontaneous impulsive individual", is characterized by mentally rational and programmed activity that is basically non-emotional. Psychologists and psychiatrists relate psychopathy to the spontaneous impulsive violence [35].

The main region of the brain mostly involved with emotions is the "limbic system", represented by cortical areas and subcortical nuclei (Fig. 1).

Because of its close connections to the areas involved in the function of smell, such as the paraolfactory area, the parahypocampal gyrus and the angulate gyrus, the limbic system was named "rhinencephalon". As the limbic system also controls autonomic functions through its subcortical nuclei, namely the amygdaloid complex, the septal region, the preoptic area, the hypothalamus, the anterior thalamus, the habenula and the central midbrain tegmentum, it was named the "visceral brain". Anatomical correlation of violent behaviour was mainly observed in animal studies. Aggressive-violent behaviour occurs in animals under natural conditions [36] but can also be elicited by electrical stimulation [37, 38]. It was found that when the hypothalamus and the brain stem were stimulated electrically, violent behaviour occurred [39]. An interesting effect was observed when the stimulation of the dorsal hippocampus suppressed attacks of violence caused by the stimulation of the ventral hippocampus, leading to the discovery of an arousing and an inhibiting area in the hippocampus [40]. In the macaque monkey, a normally aggressive animal, bilateral removal of the amygdaloid nuclei greatly reduced the reaction of fear and anger [38]. Despite these obvious relationships between anatomical regions of animals' brain and violence, animal functions and features cannot be automatically transposed to humans. We shall therefore review some of the relevant literature on the neurobiological bases of human violent behaviour. One of the earliest associations between impulsive violence in humans and the limbic system was the observation of co-existence of intranuclear inclusion bodies in the hippocampus cells of patients afflicted with rabies and violent behaviour towards their environment [42]. Teratoma of the third ventricle with damage to the hypothalamus resulted in non-rational behaviour after alcohol consumption [43], since the hypothalamic region has a function in controlling behaviour and its damage to it may result in irrational violence. In similar manner, tumours of the diencephalo-hypothalamus and hypophysis resulted in impulsive violence [44, 45].

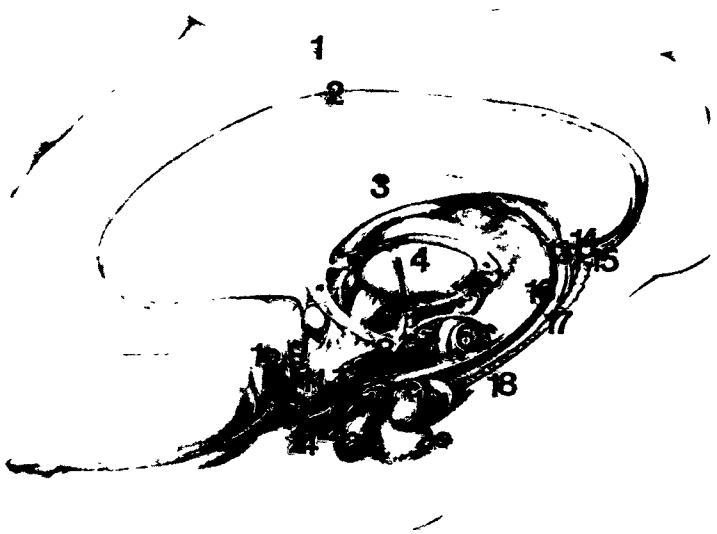

Fig. 1. Schematic presentation of the limbic system – (the emotional brain) (with author's permission). 1 Gyrus cinguli; 2 indusium griseum; 3 stria terminalis; 4 nucleus medialis thalami; 5 nuclei habenulae; 6 nucleus ruber; 7 fasciculus telencephalicus medialis; 8 corpus mamillare; 9 septum verum; 10 area subcallosa; 11 girus diagonalis; 12 fibrae amygdalofugales ventrales; 13 crus fornicis; 14 gyrus fasciolaris; 15 fasciola cinerea; 16 fissura choroidea; 17 gyrus dentatus; 18 subiculum; 19 cornu ammonis; 20 limbus Giacomini; 21 nucleus corticalis amygdalae; 22 nucleus anterior amygdalae; 23 nuclei basalis+lateralis amygdalae; 24 cortex praepiriformis

Defects in the septum pellucidum and temporal lobe tumours were associated with assaultive rape [44, 46]. This is because both the temporal lobe and the septum pellucidum regulate emotions and an injury of these regions of the brain is associated with violence. Temporal lesions due to haemorrhage, aneurysma or sclerosis were also found to be associated with impulsive violence [47, 51].

Temporal epilepsy of a psychomotor type was sometimes found to be associated with impulsiveness, aggression and violence, with epileptic fits manifesting themselves at times in uncontrolled violence [52, 53]. Episodic behaviour dyscontrol, an epileptoid type of brain activity detectable by electroencephalography, was also associated with violence [54–56]. Askenasy et al. found that episodic lack of behavioural control was associated with a confined environment for both violent and non-violent prisoners [57].

A link between temporal lobe lesions and violence should be related to brain-hemisphere dominance, i.e. violence is more likely if the temporal lobe lesions are located in the dominant hemisphere of the brain [58, 59].

In a number of patients, in whom aggressive actions were related to homicide, depth electrodes implanted in the amygdaloid nuclear complex recorded epileptic discharges during violent behaviour [60]. In experimental conditions the amygdaloid complex was stimulated electrically and violent behaviour occurred. When

the stimulation ceased the violence also subsided [60]. Moreover, when the amygdala was destroyed or removed, violence was no longer obtainable by excitation [60].

The idea that violent behaviour has an epileptic basis has resulted in several clinical experiments in which anticonvulsant drugs have been used to treat impulsive violence, with ambiguous results [61]. Narabayashi reported on 60 aggressive patients whose amygdala was removed, 29 of them were "greatly improved", i.e. became calm, obedient and socially adaptable, 22 were "moderately improved", 7 "slightly improved" and 2 showed no change [60]. Other results in partially amygdalectomized patients gave less grounds for hope [62, 63]. Neurosurgery on the posterior hypothalamus was performed in a series of 44 aggressive patients, with good results with reference to attenuation of their violence [64].

A review of the side effects of neurosurgery in violent patients showed that in cases where neurosurgery stopped violence, pseudocoma or an autism-like, "locked-in" syndrome appeared [34]. It was suggested that the section of associative pathways to the frontal brain is the cause of the placidity and apathy, that sometimes appear following neurosurgery for violence [65]. Bilateral temporal lobe excisions performed on violent patients resulted in the Kluver-Bucy syndrome, which consists in visual agnosia, orality, hypersexuality and bulimia [66–68]. Kleist suggests that the removal of orbital lobes enhances impulsivity and raises sexuality [69].

The following conclusions can be drawn from this short review of the literature on the neurobiology of violence. There is no aggression or violence centre, just as there is no anti-aggression or anti-violence centre in the brain. There are many centres and regions in the brain that are associated with violence [41, 69]. It is obvious that impulsive violence does not always reflect a disease or a pathology of the limbic system [70, 71]. Modern criminology has to disagree with the idea that medical causes determine violence. But it is evident that impulsive violent behaviour has a neurobiological potential.

The neurobiological potential of Shoham's separant violence-prone types involves a dynamic inter-relationship of many regions of the nervous system. Eysenck's hypothesis, adopted by Shoham, suggests the existence of a cortex hungry for stimuli in the separant, as opposed to the cortex averse to stimuli that is typical for the participant [12]. Separant types, owing to their sensation and impulse seeking, easily establish the circuitry needed to establish a violent behaviour pattern. Participants react favourably to sensory deprivation, which reflects their tendency to isolation, passivity and quietism. Hence their predisposition to violence is lower.

The Electrophysiological Correlates of Violence

The interest in the relationship between EEG and violence was initiated by a subject who had murdered his mother without apparent motive, and in whom the effect of hypoglycaemia on cerebral functioning was detected by electro-

encephalography (EEG) [72]. Later, many other studies substantiated the usefulness of EEG in detecting the potential for violent behaviour [58, 72]. Aggressive tendencies were found to be related to abundant theta activity [58, 74–77].

The use of EEG to differentiate between personality traits and other behavioural characteristics is controversial. With respect to violence, most authors who report positive results associate violent crime with EEG abnormalities that reflect minimal brain-damage. Since violent persons generally lead violent lives, and suffer more than their share of head trauma, these EEG changes have been dismissed as an acquired feature of a violent lifestyle. However, a close relationship between aggressiveness and theta rhythm is generally accepted [49, 73, 74–79]. Williams found up to 65% of violent subjects to have bilateral temporal theta rhythm [79, 80]. Other studies dedicated to this association found EEG abnormalities in 50% of psychopaths [81, 82]. Grossman described the appearance, during spontaneous sleep, of an abnormal finding i.e. 6–14 cps spikes in posterior regions of the brain in aggressive phychopaths [38]. Lairy underlines the importance of recording EEG in aggressive subjects during both wakefulness and sleep, because of the need to monitor theta waves in waking subjects and 6/14 cps, of the same subjects' sleep [81].

A group of 194 aggressive psychopaths underwent repeated EEG recordings and three distinct types of electrographic "immaturity" were described [83]. (1) Bilateral theta activity in the temporal and central area was found in 22% of these subjects, emphasized by hyperventilation; (2) in 32% there was no theta activity, but rather unstable alpha activity responding to photic stimulation with subharmonics was recorded; (3) in 14% there was slow theta activity 3–5 cps with a high amplitude in the posterior temporal regions, mostly with a right hemispheric lateralization. The slow activity was increased by hyperventilation and blocked by photic stimuli. All the above-mentioned EEG theta rhythm is considered to be of hippocampal in origin, and the hippocampus is related to violent behaviour [81]. This EEG pattern is explained by the continuous need for higher input of stimuli on the part of aggressive subjects maintained in a permanently alert state. All these studies confirm the biological basis of the personality hypothesis of Eysenck and Shoham [6, 7, 12].

Significant findings concerning the EEG correlates of violence were made in relation to temporal lobe epilepsy. Many cases of organic temporal epilepsy are associated with aggressive behaviour. Nuffield developed an aggression score applied to 322 children with temporal lobe epilepsy. Temporal lobe epileptics had aggressive scores nearly four times higher than those of the petit-mal patients [84]. In another study in 100 children with temporal lobe epilepsy, 36 exhibited outbursts of rage [85]. On the other hand, a study of 150 temporal lobe epileptics, did not reveal even one case of aggressive behaviour [86]. Moreover, among a school population, EEG signs of epilepsy were found without any features, of aggressive behaviour [87]. The generally accepted opinion today is that epileptic brain activity does not necessarily imply aggressive behaviour. There is a specific type of temporal lobe epilepsy originating in the amygdalohippocampic region which is intimately related to aggression and impulsive violence.

Permanently implanted stereotaxic electrodes in two subjects with epilepsy refractory to medication provided a unique opportunity of demonstrating the

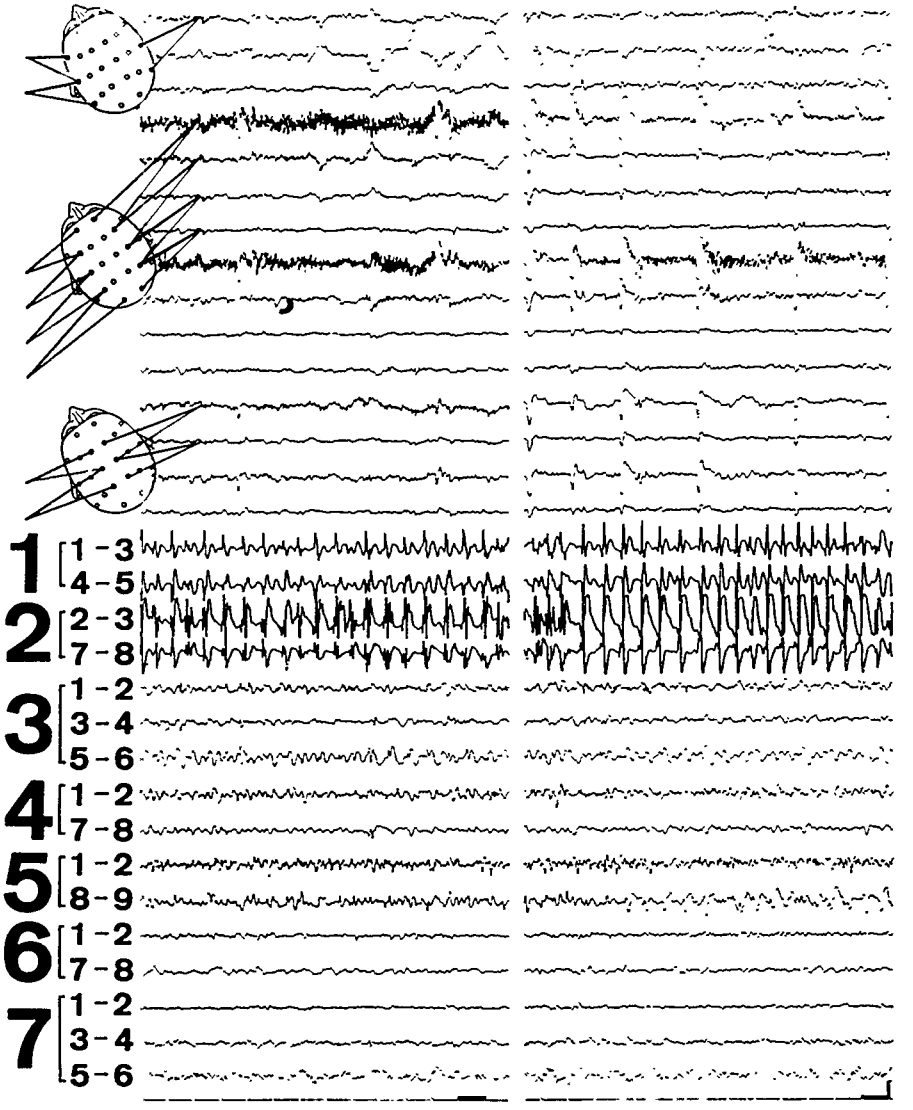

Fig. 2. Stereoelectroencephalogram of an amygdala seizure in a rage attack. Two sections at the beginning of the 2nd and 4th minute of this seizure are shown (with author's permission). Calibration: 1 s; 50 microvolt, TC=0,3; F=70

electrical correlates of amygdalohippocampic epilepsy and violence [88]. Negatively, this was demonstrated by the removal of the amygdala and hippocampus from each of these two patients and the subsequent cessation of the rage attacks (see Fig. 2).

These rare stereotaxic EEG observations show that such characteristics as impulsiveness and aggressive reactions can be attributed to ictal discharges in the limbic system [88]. In these young patients, their frequent rage attacks were due

to a hippocampal glial scars, connected with a periamygdalar hemangioma in each case. Following neurosurgical extraction of the peri-amygdalar hemangioma the rage attacks disappeared [88]. Wieser also observed a mentally retarded boy of 14 years of age displaying epileptic seizures with adversive movements of the head accompanied by fits of laughter and aggressive outbursts, due to a right mamillary body astrocytoma. This association of two emotional reactions, laughter and aggression, related to epilepsy in the para-amygdalar region and fronto-angulate cortex is a very convincing argument for the relationship between limbic imbalance and aggression [41, 88].

The electrical activity of the human cortex, particularly of the occipital cortex, can be aroused and to some extent controlled by photic stimulation [89]. Four types of reaction to photic drives have been described in the literature: synchronic, harmonic, nonsynchronic and indifferent. The synchronic photic drive is an imposition of a one to one frequency ratio on alpha waves with an energy above the mean electrical activity. The harmonic photic drive is an imposition of a one to two or one to half frequency ratio of photic stimuli on alpha waves with an energy above the mean electrical activity. The nonsynchronic photic drive is an imposition of a frequency ratio which is neither the photic stimulus rate nor the harmonic one. Electrical activity of the human cortex, which is indifferent to any photic stimulus, is called the indifferent photic drive. The effects of photic stimulation in impulsive aggressive subjects was found to block the slow theta activity, or to effect a synchronic drive with high amplitudes which is referred to as a photomyoclonic reaction [91]. The latter was found to be age related in aggressive psychopaths, and diminished with age [89, 90]. The photic drive in these studies was related to the occipital waves and not to the temporal ones [89, 90].

It should be stressed when reviewing the electrophysiological correlates of violence, that subjects in "total institutions" in a confined and disciplinary environment have a higher percentage of disturbed EEG recordings [91–93].

A survey of the EEG recordings of a group of confined aggressive subjects, when compared with the EEG recordings in a group of aggressive non-confined subjects, showed approximately 20% more disturbed EEG in the former group [92]. When EEGs were recorded in non-confined and in imprisoned aggressive psychopaths no differences were found between the two groups [93]. Eight percent more pathological EEG records were found among motiveless aggressive murderers [92, 93]. Thirty-four percent more abnormal EEGs were found in recidivists than in individuals with only one prison conviction each [94]. In contrast to all these studies, in a sample of 100 convicted prisoners, 30% displayed abnormal EEG records irrespective of their aggressive or non-aggressive behaviour profile [95]. The comparison of flying personnel with confined subjects showed that 5% had abnormal EEG in the former group, as against 25% in the latter [92]. A very large study revealed that 12% of the general population would be expected to display abnormal EEGs [79]. From the present review of electrographic correlates of confined subjects it can be concluded that a significantly high percentage of abnormal EEG recordings characterizes the population of total institution inmates. In a more detailed analysis of abnormalities in these subjects, temporal abnormalities were found in 74,6% of impulsive

aggressive subjects as against 59.1% in non-habitually aggressive prisoners. Frontal abnormalities were found in 57.1% of aggressive prisoners as against 19.3% in non-aggressive ones [79]. Gunn reported a higher incidence of epilepsy in a British prison population than recorded in the national figures for the general population [95]. Williams reported the widest difference between the percentage frequencies of EEG abnormalities in a normal population, (12%), and a confined population (65%) [98]. Lorne et al. [97] corroborated EEG abnormalities, analysed by means of spectral analysis in a delinquent versus a non-delinquent group, and found a highly significant correspondence between neuropsychological test profiles and EEG abnormalities in the delinquent group [41]. Additional support for the presence of EEG abnormalities in socially deviant subjects has been provided by various studies [97]. We can conclude that in a population completely confined in institutions, a higher percentage of EEG abnormalities will be found. Hence we shall have to take this into account when evaluating the results of other studies.

Another conclusion is that the slowing frequency of the cortical activity towards theta waves mainly located in the temporal lobes, characterizes violent prisoners. It is suggested that the slowing frequency of cortical activity is also related to a hunger for stimuli, which is also characteristic for impulsive violent subjects.

Because of a high percentage of abnormal EEG records among the relatives of aggressive subjects it was assumed that aggressivity is genetically predetermined [98, 99]. There is evidence of an association between human aggression and sex chromosome alterations, such as sex kariotype with supernumerary X or Y chromosomes, such as 47 XXY (Klinefelter's syndrome) or 47, XYY [100, 101]. An extra Y was considered to contribute to aggressive tendencies [102–107].

However, no clear cut conclusion can be drawn from the numerous studies about the relationship between chromosomal alterations and aggression. No evidence has been found that humans with supernumerary X or Y sex supernumerary chromosomes are prone to aggressiveness. Hence, is not worthwhile to carry out kariotype identification for the diagnosis and the prediction of violence. One or more genetic defects were related to violence in some studies [102]. However, the evidence was not conclusive and the results could also be explained by environmental factors.

The Endocrinologic Correlates of Violence

It is very difficult to define the neuroendocrine dimension of the violent prison population. The few studies of the function of the hypothalamopituitary gonadal axis in men in emotional situations emphasize the inhibition of testosterone and decreased sexual activity. The hormone most frequently studied with reference to violence is testosterone. Persky et al. studied 18 healthy young men and found that the production rate of testosterone was highly correlated with a measure of aggression derived from the Buss-Durkee Hostility Inventory [108]. A multivariate regression equation was obtained between the testosterone production rate and four psychological measures of aggression and hostility, which accounted for 82% of the variance in the production rate of testosterone in these young men.

Rose et al. in studies on rhesus monkeys, showed that dominant males, exposed to a sudden and decisive defeat by other males experienced a decrease in plasma testosterone levels [109]. Plasma testosterone in this primate species seems to be significantly influenced by the outcome of conflict attendant on alterations in status of these monkeys living in social groups. Kreuz and Rose studied plasma testosterone levels and indices of fighting and verbal aggression in 21 young prisoners [110]. While plasma testosterone levels did not differ between fighting and non-fighting individuals and did not correlate with psychological test scores, the 10 prisoners with histories of more violent and aggressive crimes in adolescence had a significantly higher level of testosterone than the 11 prisoners without such a history. These investigators postulated that in a population predisposed by social factors to the development of antisocial behaviour, levels of testosterone might be an important additional factor in putting individuals at risk of committing more aggressive crimes in adolescent life.

Meyer-Balburg et al. separated four low-aggression male undergraduate college students from six high-aggression students on the basis of the Buss-Durkee Hostility Inventory and found that while the two groups were reasonably differentiated on several aggression scales, they did not show any significant differences in the production rate, plasma levels, or urinary levels of testosterone [111]. Ehrenkranz et al. on the other hand, determined plasma testosterone levels in 36 male prisoners, 12 with chronic aggressive behaviour, 12 were socially dominant without physical aggressiveness and 12 who were neither physically aggressive nor socially dominant [112]. These groups were separated on the basis of a battery of psychological testing, and there was a significantly higher level of plasma testosterone in the aggressive group than the non-aggressive group or in the other two groups concerned. The socially dominant group also had a significantly higher level of testosterone than the non-aggressive group. Doering et al. performed a longitudinal study of the association between mood and plasma testosterone by sampling 20 normal young men every 2nd day for two months with a multiple affect adjective checklist and plasma testosterone concentrations [113]. Inter-subject correlation coefficients between hostility, anxiety, depression and plasma testosterone were all positive, but only the correlation between depression and testosterone was barely significant at the 0.10 level. Between the other two affects and testosterone the correlations were not significant.

Rada et al. classified 52 rapists and 12 child molesters, all of whom were hospitalized in an institution for male mentally disordered offenders, according to the degree of violence expressed during the attack [114]. One morning plasma testosterone level was measured for each subject. The most violent rapists had a higher mean plasma testosterone than normal subjects, child molesters, or other rapists. Mean Buss-Durkee Hostility inventory scores for all the rapists were significantly higher than the mean for normal subjects, but individual hostility scores did not correlate with plasma testosterone.

Monti et al. studied 101 healthy young adult male volunteers by the administration of questionnaires for anxiety, hostility, social desirability and sexual interest and practices, and two daily determinations of serum testosterone concentration [115]. Individual testosterone levels on the two days correlated significantly ($r=0.69$, $p<001$), but with only 48% shared variance, indicating a poor cor-

respondence between the two daily testosterone values. Testosterone levels correlated to a significant degree with some of the psychological measures, but only because of the large sample size, all correlations were quite low. Thus, in these normal subjects, no major relationship was found between the questionnaire items and testosterone levels.

Pesky et al. studied 40 male alcoholics during one week of abstinence and one week of unlimited alcohol intake [116]. Compared to levels during the week of abstinence, plasma testosterone was reduced significantly during the week of alcohol intake. Only low borderline significant correlations occurred between testosterone levels and hostility as measured by the Buss-Durkee Hostility Inventory and the Multiple Affect Adjective Check List.

Relationships between testosterone levels and the psychological dimensions of aggression, social dominance, hostility and depression, remain in some doubt [117–119]. There is some data in the literature suggesting how testosterone might affect mental functions. Zimmerman and Isaacs demonstrated decreased cerebral cortical cyclic AMP levels in male rats subsequent to the injection of testosterone, showing that at a cellular level testosterone can significantly affect brain chemistry [120]. Stumpf and Sar elucidated the distribution in the mammalian brain of neurons in which there is a nuclear concentration of steroid hormones and testosterone, selectively stimulating the somatomotor system [121]. Herrmann and Beach showed that testosterone is involved in sexuality, aggression, energizing system, psychomotor function, higher mental performance, mood and personality characteristics [122]. All the above mentioned data, despite the doubt about the relationship between testosterone and aggression, must be the object of further studies.

Testosterone is closely related to two hormones: the luteinizing hormone and prolactin. The pituitary gonadotrophin luteinizing hormone secreted by the anterior pituitary gland is essential for the secretion of testosterone. It is under the control of a hypothalamic factor for regulation the luteinizing hormone (LH) releasing hormone. Prolactin is secreted by the anterior pituitary gland, under the regulating control of thyrotrophic releasing factor and under the negative control of a specific prolactin-inhibitory factor (PIF). There is an inverse relationship between the rate of release of prolactin and the testosterone and LH. For all these reasons, a proper study of the testosterone secretion has to include LH and prolactin. Another methodological problem to be solved when determining testosterone is the fact that plasma testosterone levels vary from hour to hour and from day to day within the same subject and between subjects. Goldzieher et al. emphasized the large fluctuation properties of the plasma levels in three hormones: testosterone, pituitary gonadotrophine luteinizing hormone (LH) and follicle-stimulating hormone (FSH) [123]. For this reason Goldzieher et al. concluded that use of three equal samples of equal volume taken at 15 min intervals, is an accurate sampling method.

The principal glucocorticosteroid is cortisol or hydrocortisone. It acts on the intermediary metabolism of predominantly anti-insulin and on the regulation of protein, carbohydrate, lipid and nuclic acid metabolism. It is mainly catabolizing, but also increases glycogen content and promotes a hepatic storage of glucose. The integrity of the personality is enhanced by cortisol. Emotional disorders such as

impulsivity, aggression and violence are common with either excesses or deficits of cortisol.

As a general conclusion to our present survey of the bio-psycho-social correlates of violent prisoners, we may stress that violence cannot be regarded as a pathology *sui generis* but rather as a correlate of the behaviour of the whole human organism. Hence, we have pointed out the need first to study the bio-psycho-social behaviour of the human organism as a holistic totality and to regard violence as one deviant manifestation of it.

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