Criminality and Moral Dysfunctions: Neurological, Biochemical, and Genetic Dimensions

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Abstract: *In this article, the author attempts to demonstrate a relationship between neurobiological dysfunctions and/or genetically determined deviant behavior and personality traits as well as moral abnormalities. Data from neuroscience show that a number of neurological dysfunctions are linked to cognitive and emotional disturbances. Cognitive and emotional abnormalities, in turn, are frequently related to moral dysfunctions. Moreover, neurological disorders can produce dramatic psychological and social problems, personality changes, and behavioral problems in patients. Those mental, emotional, and psychosocial problems and related moral dysfunctions are frequently linked to violence and/or criminal behavior. Genetic research found evidence of inheritability of antisocial traits, which interfere with moral development and activities. This information has consequences for any assessment and disposition within the legal system. More research on the interrelationship between neuro(bio)logical, genetic, emotional, and mental aspects of moral dysfunctions is needed for the development of adequate treatment, prevention, and intervention programs.*

Moral development is usually the result of interactions of psychological, social, and biological (neurological, biochemical, and hereditary) influences. Psychologists, psychiatrists, neurologists, and philosophers have defined the moralf significance of such distinctive mental functions as cognition, rational information processing, and judgment abilities. But a general agreement on the moral significance of emotions is missing. Nevertheless, in contrast with the opinions of philosophers such as Kant (1870) and Bond (1990) and a number of other scientists, it seems evident that emotions also play a crucial and necessary role in the moral process (Ben-Ze'ev, 1997; Martens, in press-b; Oakley, 1991). Kant and Bond believed that our moral agency—our ability to articulate, justify, and act on moral principles—must be defined in terms of our rational nature, understood as being logically independent of our emotional nature.

MORAL SIGNIFICANCE OF EMOTIONS

From the evolutionary perspective first proposed by Darwin, emotions evolved to enhance survival by providing more adaptive solutions to problems that ani-

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mals encounter, such as finding food and defending against danger (Darwin, 1872; Pinker, 1997). In animals and humans, emotions organize sustained responses to rewarding and aversive stimuli, coordinate the mind-body system, and regulate perception through memory, physiology, behaviour and social interactions, and coping with particular situations (Pally, 1998; Pinker, 1997). Morality can be seen as a transformation of primitive forms of problem solving, judgment, and social awareness into a higher level. These capacities became gradually more differentiated and developed into a higher degree of rational (also reasoning and judgment skills), emotional, consciousness and conscience development, and related moral abilities.

There is some empirical evidence that emotions are strictly associated with cognitive aspects (DeLancey, 1997; Drevets & Raichle, 1998; Izard & Ackerman, 1998; Kolacyk, 1997; Lewis & Michelson, 1980). As a consequence, emotions can play a constructive role in the moral process because all cognitive activities are directed to the growth of insight and knowledge. All gathered insight and knowledge can be useful and valuable in moral development and activities. It can be posited that at least some emotions, such as empathy, guilt, and compassion, are morally significant because of their obvious relationship to cognitive and rational thinking and behavior.

A number of neuro(bio)logical abnormalities are related to emotional and/or cognitive dysfunctions (Yudofsky & Hales, 1997). As a consequence, those emotional and cognitive dysfunctions will be frequently linked to moral disturbances. Damasio (1994) found, however, that rational decision making is not so rational after all. Evidence from neuroscience shows that emotions play an important role in judgment and reason (Damasio, 1994).

NEUROLOGICAL, BIOCHEMICAL, AND GENETIC DIMENSIONS OF MORAL DYSFUNCTIONS

NEUROLOGICAL ABNORMALITIES

Emotional abnormalities are often linked to judgment and reasoning dysfunctions and manifest themselves through emotional and mental instability, impulsivity, delusions, psychosis, restlessness, sleep disorders, depression, and personality changes. Emotional disorders can disturb each area of our inner and social lives. Individuals with such disorders can become unadapted, weird, and isolated, and all of these abnormal conditions can have a negative impact on their moral functions (American Psychiatric Association, 1994; Hales & Yudofsky, 1997; Martens, 1999, in press-a, 2000). Thus, emotions often play, directly and indirectly, a crucial role in our social as well as introspective and contemplative activities (Martens, in press-b).

Various kinds of brain injuries and cerebrospinal disorders can be related to severe personality changes and emotional problems, which, in their turn, can be

paired with maladaptive behavior (Robinson & Starkstein, 1997; Silver, Hales, & Yudofsky, 1997) and moral confusion (Martens, 2000). But also, viral infections such as the Borna disease virus are often linked to neurobehavioral and "emotional" disturbances (Dietrich, Schedlowski, Bode, Ludwig, & Emrich, 1998) and related moral problems.

The orbitofrontal cortex, a region of the prefrontal cortex, is able to use previous emotionally significant experiences in such a way that it can flexibly apply that information to current functioning. In a situation, the orbitofrontal cortex has access to representations of body responses and influences how an individual will respond to the situation. As a consequence, orbitofrontal cortex damage or dysfunction, which can be termed *internal feedback disorder*, will be frequently linked to maladjusted and inappropriate behavior, emotions, and (indirectly) mental activities (also cognitive and moral). Damasio (1994) uncovered that patients with orbitofrontal cortex damage demonstrate poor judgment (which is a morally significant function) and abnormalities of autonomic response to emotion. But more recent findings suggest that the orbitofrontal cortex appears to be crucially involved in adaptive behavior, the motivational control of and learning that underlies goal-directed behavior (Schoenbaum, Chiba, & Gallagher, 1998, 1999; Tremblay & Schultz, 1999). Patients with lesions of orbitofrontal cortex show impairments in making decisions about the expected outcome of actions. In my opinion, such impairments are also closely linked to moral dysfunctions because the patients' inability to foresee the consequence of their actions will easily result in moral assessment and planning failures. Moreover, they show an incapacity to learn goal direction, and this cognitive function is very important in the evaluation of their own moral processes, their development, and the maturation of their moral capacities. Tsujimoto Ogawa, Tsukada, Kakiuchi, and Sasaki (1998) revealed that the orbitofrontal and mesial frontal cortices play an important role in the neural processes involved in self-initiation of movement and self-regulation of inner drives. Impairment of self-regulation of inner drives can result in impulsivity and unrestrained, undisciplined behavior and mental activities, which can have negative consequences for necessary moral activities because a calm, contemplative mental condition is usually a requirement for optimal moral functioning.

Devinski, Morrell, and Vogt (1995) analyzed the data of 247 studies of the anterior cingulate cortex and discovered that this part in the brain plays a major role in the (a) emotional learning process, (b) screening of and motivation as a result of, and (c) attribution of emotional values to external and internal stimuli. It can be opined that anterior cingulate cortex damage can induce severe emotional learning difficulties and problematic emotional assessments and processing of external and internal emotional stimuli. Many patients with anterior cingulate cortex lesions will also show an increased risk for disturbed emotional development, lack of empathy, emotional immaturity, emotional confusion, and poor emotional misunderstanding, which can easily interfere with adequate moral functioning.

Gorenstein (1982) found that frontal lobe lesions are associated with psychopathy and cognitive disorders. Cognitive disorders can be linked to moral abnormalities, too, because cognitive functions are essential in the moral judgment process. Levin, Goldstein, and Williams (1989) found that patients with frontal lobe lesions demonstrate severe changes in their emotional condition, bad impulse control, and misinterpretation of moods or feelings of other people. Misinterpretation of moods or feelings of others can lead to (a) inadequate judgment of the emotions of other people, which will often form a limited and incorrect basis for moral activities; (b) lack of involvement with others' emotions because a misinterpretation of others' emotions will give an erroneous value and priority to those emotions and the related needs or interests of others. Such inability to adequately empathize, it was noted earlier, is a morally significant emotion–it will frequently impair moral activities because relevant emotional information is missing.

Recent studies suggest that a fundamental mechanism of moral and social behavior disturbed by acquired cerebral damage is empathy. Empathic changes are particularly evident after focal prefrontal cortex damage and closed head injury in adults, although early frontal lobe damage is also associated with poor empathic and social development (Eslinger, 1998). Although empathy is a very important emotional dimension of morality, social development, in its turn, is the foundation of empathy and all moral capacities. A lack of social development and education will frequently produce an extremely selfish, hostile, unreliable, indifferent, and immoral attitude (Martens, 1997, 2000).

Patients with amygdala lesions are also unable to empathize with the emotions of others. They suffer from emotional underarousal, disturbed emotional memories, and an emotional learning and processing disorder (Adolphs, Tranel, Damasio, & Damasio, 1995; Cahill, Rabinsky, Markowitsch, & McGaugh, 1995; Clark, 1995; Davidson & Sutton, 1995). Martens (1997, in press-a) observed that emotional underarousal is directly linked to empathic apathy and indirectly linked to moral dysfunction because empathy is a crucial moral emotion. A disrupted emotional memory in patients with lesions of the amygdala can also be related to moral abnormalities. Many of those patients do not have the capacity to store morally significant emotions in their memories, and as a consequence, they cannot make free associations with former, relevant emotional experiences. Disorders in the areas of emotional processing and learning are therefore also linked to ethical and moral dysfunctions. Furthermore, emotional learning disorders due to lesions of the amygdala will be associated with an emotional development disorder and emotional immaturity (also of morally significant emotions), and this will have negative effects on moral functioning. Emotional processing disorders in patients with amygdala damage can cause emotional disorganization and confusion and a poor integration of morally significant emotions in the moral process. As a result, these patients show rather confused, unclear, and less powerful moral emotions such as empathy, compassion, and guilt. As a consequence, these emotions have too little constructive effects and too great an impact on the coherence of the moral process.

Raine, Lencz, Bihrle, LaCasse, and Colletti (2000) showed a relationship between 11.0% reduction in the prefrontal gray matter volume in the absence of ostensible brain lesions and a reduced autonomic activity in men with antisocial personality disorder (Costin & Draguns, 1989; Raine, 1996; Raine, Venables, & Mednick; 1997; Raine, Venables, & Williams, 1996; Raine et al., 2000). They also found a reduced cortical arousal in antisocial persons. As a consequence of their low cortical arousal, antisocial individuals feel a stronger need for stimulation, which can explain their excessive sensation-seeking behavior. The neurophysiological reactions of antisocial personalities as a result of provocation or frustration were investigated in diverse laboratory settings. Magnusson (1996) presented results indicating that low autonomic activity-reactivity (i.e., low adrenaline excretion) was strongly associated with persistent antisocial behavior but not with adolescence-restricted antisocial behavior. Findings of studies on resting skin conductance and heart rate indicate that antisocial individuals are characterized by a low autonomic activity-reactivity or underarousal (Raine et al., 1997). Evidence was found for specificity of low heart rate to aggressive forms of antisocial behavior. It is concluded that low resting heart rate, a partly heritable trait, and low resting skin conductance, reflecting fearlessness and stimulation and sensation seeking, is an important, diagnostically specific, and well-replicated early biological marker for later aggressive behavior and/or Antisocial Personality Disorder (Raine et al., 1997). Sensation seeking, in its turn, is strongly related to other antisocial traits such as impulsiveness, recklessness, irresponsibility, criminality (Martens, 2000), and, as discussed previously, aggressiveness (Raine et al., 1997). Impulsive, aggressive, reckless, irresponsible, and criminal behavior will interfere with moral development and activities because adequate and optimal moral functioning and development usually require a prosocial, calm, contemplative, and empathic attitude and mental condition.

Lykken (1995) found that antisocial persons showed low fearfulness, poor fear conditioning, and poor avoidance learning. These individuals showed fewer physiological disturbances than controls, as seen from electrical conduction of the skin in anticipation of an imminent painful electric shock. They were also less concerned about the shock (punishment). Lykken concluded that antisocial persons suffered from an inborn defect of the central nervous system. As a result of a biologically low anxiety level, these individuals are not able to learn from experiences and cannot avoid negative life events. This inability to learn from experiences, however, will have a long-lasting negative effect on moral development and moral activities, because moral development and activities will gradually improve and become more and more mature as a result of the ability to learn from experiences.

McGuigan (1997) demonstrated that when the striated musculature is totally inactive, cognitions are absent. The conclusion is that muscular components of the circuits are necessary for cognitions and cognitive-based ethical and moral activities. An explication of the human mind emerges as the selective interaction of bodily systems to (a) generate contents of mind (cognitions) and (b) to program

covert and overt behavior. Kutas and Federmeier (1998) suggested that the brain is but one component of the complex system that is the body. Humans take in information and interact with the world through their bodies, and their bodies change with—and in some cases change—cognitive and emotional processing. Therefore, it can be posited that all mental events (also ethics and morality) are embodied in, but not identical to, brain events.

BIOCHEMICAL ASPECTS

There is an association between low serotonin (5-hydroxytryptamine, 5-HT) function and aggressive behavior (Dolan, 1994). Various studies uncovered an inverse relationship between 5-hydroxy indoleacetic (CSF 5-HIAA) on one hand and impulsivity, irritability, hostility, and aggression on the other (Linnoila et al., 1994; Virkkunen, Kallio, et al., 1994; Virkkunen, Rawlings, et al., 1994). Low monoamine oxidase activity is linked to impulsivity (Dolan, 1994; Martens, 2000).

Elevated triiodothyroine (T3) levels (Stålenheim, Eriksson, von Knorring, & Wide, 1998) and high concentrations of total testosterone and sex hormone–binding globulin (Stålenheim, von Knorring, & Wide, 1998) were related to a diagnosis of a *DSM-IV* (American Psychiatric Association, 1994) antisocial disorder. T3 and free-thyroxine (T4) were also associated with criminality and an ICD-10 dyssocial disorder (World Health Organization, 1992). Serum levels of T4 were negatively related to the same disorders and personality traits. Results indicate an intimate relationship between T3 and T4 and abuse and antisocial behavior (Stålenheim, Eriksson, et al., 1998). There is a possibility that T3 and T4 constitute the same neurobiological basis for antisocial personality disorder. Alm and colleagues (1996), however, showed that increased T3 activity was correlated exclusively with more persistent criminality, compared with former delinquents who demonstrated lower T3 values.

In boys, a relationship was observed between low cortisol and aggressive behavior but not covert antisocial behavior (McBurnett, Pfiffner, Capasso, Lahey, & Loeber, 1997). Low cortisol findings have also been found in conduct disorder (McBurnett et al., 1997; Susman & Ponirakis, 1997; Van Goozen, Matthys, Cohen-Kettenis, Thijsen, & van England, 1998; Zuckerman, 1994), and one would expect the same low findings in antisocial personality disorder (Virkkunen, 1985) together with low CSF adrenocorticotropic hormone (Virkkunen, Rawlings, et al., 1994). Susman and Ponirakis (1997) presented findings linking hormones of the hypothalamic-pituitary-adrenal and hypothalamic-pituitary-gonadal axes to antisocial behavior in youth. The results of the study of Van Goozen and colleagues (1998) also supported an important role for hypothalamic-pituitary-adrenal axis sympathetic autonomic functioning in persistent antisocial behavior in young boys.

Zuckerman (1994) found that sensation seeking, one psychopathic trait, was related to low levels of monoamine oxidase, cortisol, and high concentrations of gonadal hormones.

As discussed earlier, impulsive, aggressive, and criminal behavior (including when these acts are biochemically determined) will have negative effects on moral development and activities.

GENETIC IMPACT

Adoption and twin studies show genetic and environmental influences on antisocial personality disorder (Martens, 1997, 2000). However, there are a lot of investigations that found mainly or only genetic impact and hardly, if any, environmental influences on the etiology of specific antisocial personality traits. The investigation by Krueger and colleagues (1994) revealed that rejection of conventional values (a highly morally significant feature), sensation seeking, and reckless behavior were genetically ascertained in a population of antisocial individuals (n = 862). Gottesman and Goldsmith (1994) found that antisocial anger, impulsivity, and thrill seeking were determined by heredity.

INHERITABILITY OF IMPULSIVITY, IRRITABILITY, AND AGGRESSION

The studies of Coccaro, Bergeman, and MacClearn (1993) and Coccaro, Bergeman, Kavoussi, and Seroczynski (1997) demonstrated substantial genetic influence but little or no shared environmental impact on the etiology of impulsivity and aggression. But shared environmental aspects also seem to have influence on the development of these traits. The results of the investigations of Nielsen and colleagues (1994) and Virkkunen, Goldman, Linnoila (1996) confirmed the assumption of Coccaro and colleagues (1997) that the serotonin function, which is linked to aggression, is genetically ascertained.

The relationship between genetic liability for antisocial behavior and CSF 5-HIAA in newborns was explored by Constantino, Morris, and Murphy (1997). The authors assayed 5-HIAA in "leftover" CSF from 193 neurologically normal newborns and obtained family psychiatric histories of the newborns' first-degree and second-degree relatives. Levels of 5-HIAA were significantly lower in the infants with family histories of antisocial personality disorder than in the newborns without such family histories. Decreased CSF 5-HIAA concentrations are associated with impulsivity, aggression, and hostility (Virkkunen, Kallio, et al., 1994; Virkkunen, Rawlings, et al., 1994), all traits of antisocial personality disorders. The findings of Constantino and colleagues support the possibility that serotonin mediates one component of genetic liability to an antisocial outcome. This is a pure form of a genetically determined neurobiological dysfunction, which results in an antisocial and psychopathic personality characteristic.

SENSATION SEEKING

The studies of Benjamin, Ebstein, and Belmaker (1997); Benjamin, Patterson, Greenberg, Murphy, and Hamer (1996); Ebstein and Belmaker (1997); Ebstein, Nemanov, Klotz, Gritsenko, and Belmaker (1997); and Ebstein and colleagues (1996) described significant associations between a dopamine D4 receptor (DRD4) exon III 48-base pair insertion-deletion polymorphism and the personality traits of sensation seeking and positive emotional experience. In a sample of 119 boys, Noble and colleagues (1998) uncovered that dopamine receptor DRD2 and DRD4 polymorphisms were individually associated with sensation-seeking behavior. Boys with the DRD4 7 repeat (7R) allele also had a significantly higher sensation-seeking score than those without this allele. However, the greatest difference in novelty-seeking score was found when boys having all three minor DRD2 alleles and the DRD4 7R allele were contrasted with those without any of these alleles. However, the combined DRD2 and DRD4 polymorphisms contribute more markedly to this behavior than when these two gene polymorphisms are individually considered. The findings of Sander and colleagues (1998) in dissocial (World Health Organization, 1992) alcoholics (n = 39) suggest that the S allele of the 5' regulatory SLC6A4 (serotonin transporter gene) polymorphism confers susceptibility to a temperamental profile of high sensation seeking and low harm avoidance.

This evidence of the inheritability of morally significant personality traits is of major interest (it was noted previously that antisocial features such as sensation seeking, impulsivity, and aggressiveness will interfere with moral development and functioning) because this knowledge may influence legal and judicial decisions.

DISCUSSION

Further understanding of the interrelationships between neurological, genetic, emotional, and mental dimensions of morality will be necessary for the construction of more adequate treatment and prevention programs and appropriate defense and legal decisions for some categories of immoral criminals. The interrelationships between those dimensions, however, are rather complex and circuitous. Neurological functions interact on many levels with mental and emotional functions and influence rational abilities, conscience, motivational behavior, social skills, and coping behavior, which, in turn, can affect moral activities. Despite the fact that various brain areas are linked to particular emotional, cognitive, and other mental functions, until now, there has been no evidence that these specific brain areas have more than a supportive role in morality.

It is unlikely that with the exclusion of genetic determination, the central nervous system is responsible for the complete foundation of moral capacity. All the

functions of our body can contribute to the moral system to facilitate useful information (processing). For example, some individuals develop their most original and intense thoughts while walking. Walking itself is not rationally relevant, but for some individuals, this physical activity is thus of great help for their mental and creative process. External factors such as favored environmental factors and the presence of special people can aslo be very stimulating. One can make intense mental and emotional connections with objects and individuals around himself or herself while getting mental and emotional energy from them, which can easily be transformed into mental creativity and activity. In fact, although moral functions depend on various external and internal factors, the nervous system is of great importance in the regulation, integration, and if necessary, neutralization of the impact and interactions of (morally significant) external and internal stimuli.

There is no artificial splitting between the intellectual capacities and emotions. In fact, emotions provide us with a specific understanding of the relationship between the world and ourselves. Although emotions can make connections with the external world and the inner world of others, rational abilities cannot do so alone. Neurological disorders can dramatically disturb the emotional life of patients and, as a consequence, their relationship with the external world. Furthermore, their sense of social awareness and reality (both morally significant) can be severely impaired.

Moral dysfunctions will often be related to violent and/or criminal behavior. There are many violent forensic psychiatric patients who demonstrate neurological, emotional, and moral abnormalities and/or whose deviant behavior and/or personality traits are determined by heredity (Martens, 1997, 2000). In such cases, this should be taken into consideration in decisions reached in a court of law. Unfortunately, the administration of justice often shows only minimal consideration for the neurobiological correlates and/or genetic determination of immorality and criminality. Indeed, many actors in a court of law are not aware of or are only minimally acquainted with the neurobiological and/or genetic determination of criminal behavior. Many criminals, including the mentally disordered, are sentenced and held responsible for immoral and criminal behavior that basically may be due to neurobiological and/or genetic factors. Therefore, it is fair and necessary to investigate such possible underlying neurobiological defects in mentally disordered criminals to provide relevant and significant information, which should be considered in their defense and in the final juridical decisions reached by the court. In addition, it would be advisable that (forensic) neurologists be participants in forensic psychiatric or prison therapeutic treatment teams to provide the most adequate treatment.

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