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## **Neurobiology of aggression and criminal violence**

Physical criminal violence is mainly committed by young men. A hard core of roughly 5% of men shows remarkably high readiness to use aggression and violence already in early adolescence. Biopsychological bases of female violence are widely unexplored and only play a subordinate role so far from a criminal statistical point of view.

An increased tendency to aggressivity and physical violence is the result of the interaction of the following three factors: (1) a genetic predisposition to gene polymorphisms, (2) deficits in brain development and (3) psycho-traumatic experiences in the first years of life due to neglect, ill-treatment or sexual abuse. All three factors cause anatomic and functional brain damages.

From a psycho-neurobiological point of view, it is necessary to distinguish between two groups of perpetrators when it comes to individual control of impulses, empathy, regulation ability concerning irritation or fear, and the corresponding brain functions. Individuals with a reactive-impulsive violent behavior show an increased reactivity to emotionally negative stimuli. This involves a reduced volume and a decreased level of activity in the frontal brain areas, which are related to the control of stimuli, irritation and fear. Simultaneously, sub cortical activity increases, especially in the amygdala – the center for fear conditioning and recognition of negative emotional communicative signals. This therefore implies that impulsive-reactive perpetrators of violence consider the world to be more threatening and provocative compared to the majority of fellow citizens. Additionally, they are less capable to remain calm and forget their troubles due to deficits in the frontal brain areas. In such perpetrators, significant more gene variants (polymorphism) can be found that thoroughly affect serotonin metabolism. The neurotransmitter serotonin is generally responsible for calming, stimuli-inhibiting and fear-reducing actions. Genetic deficits or



those related to brain development are usually aggravated by traumatic experiences in childhood or early adolescence.

Individuals with a proactive-instrumental violent behavior and a typical lack of compassion, remorse and empathy – which is often related with eloquence and diplomatic skills (so-called psychopaths) – show a reduced vegetative reactivity to negative emotional stimuli. This contributes to the assumption that this group of violent perpetrators has a reduced emotional activity. Studies carried out using functional imaging are to some extent contradictory. The majority of studies found a reduced activity of limbic centers at negative emotional conditioning, particularly of the amygdala. This could explain the reduced emotional activity as explained above. Other studies, however, detected a higher activity in the amygdala and the upper and lower frontal lobe. These differences might result from methodological insufficiencies. In the case of psychopathic offenders, the brain centers related to empathy are significantly affected, such as the upper temporal gyrus, which is a good explanation for the lacking empathy of the perpetrator.