



INTERNATIONAL
HELLENIC
UNIVERSITY

**Hormones, Chromosome diseases and Crime: A
correlation among neuroscience, genetics,
criminology and penology**

Koufioti Georgia

SCHOOL OF ECONOMICS, BUSINESS ADMINISTRATION & LEGAL STUDIES

A thesis submitted for the degree of

Master of Science (MSc) in MSc in Bioeconomy: Biotechnology and Law

November, 2019
Thessaloniki – Greece

Student Name: Georgia Koufioti
SID: 4402180004
Supervisor: Prof. Panagiotis Vidalis

I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

November 2109
Thessaloniki – Greece

Abstract

"We do not condemn it because it is a crime, but it is a crime because we condemn it." E. Durkheim classified crime amongst the normal sociological phenomenon which are intrinsically linked to human society. The universality and transience of the criminal phenomenon though undeniable can only be evaluated on the grounds of the validity of its theoretical parameters.

Criminology encompasses a considerable number of identified knowledge principles. These include genetics, neurology, sociology, psychology, neuroscience, social science and economics in the legal process, crime and rehabilitation. Criminology science can contribute to legislative reinforcement or legislative process, while eliminating others that are inefficient. Criminology also examines crime trends, identifying patterns that are influenced by social, economic, demographic or personal factors.

Firstly, I would like to express my sincere gratitude to my supervisor, Professor Vidalis Panagiotis, for the continuous support and related research, motivation and immense knowledge. Besides my supervisor, I would like to thank the rest of my thesis committee: Prof. ??? and Prof. ???

My sincere gratefulness and deepest appreciation also should be mentioned to Prof. Genitsaris Savvas, for the overall precious support throughout the master not only in the academic matters that appeared but also in personal advices and recommendations. Last but not the least, I would like to thank my de facto spouse, my friends and family for accepting nothing less than the best from me and for supporting me spiritually throughout writing this thesis and my life in general.

Keywords: criminology, hormonal approach, chromosomal approach, genetics, penology

Georgia Koufioti

26/11/2019

Contents

Abstract	3
Introduction	5
Chapter 1	8
Setting the frame through definitions	8
Criminology and historical context	10
Chapter 2	16
Hormonal approach and criminology	16
Chapter 3	23
Chromosomal approach and criminology	23
Chapter 4	29
Neuroscience and criminology.....	29
Chapter 5	34
Genetics and criminology	34
Chapter 6	36
Potential practical measures to enhance the administration of criminal justice or the prevention of crime	36
Chapter 7	43
Discussion	43
Conclusions.....	48
Bibliography.....	50

Introduction

Criminology initially includes methods, quantitative and qualitative analysis of the criminal phenomenon, but with the wider and most common acceptance of the concept of forensic science is considered the study of crime, criminals and criminal justice. There are different approaches to criminology, and the issue itself has been shaped and analyzed by many different academic disciplines, which conclude that crime can be considered as a whole of crime in a particular region for a certain period of time. As Zedner (2007) observes, one of the greatest strengths of criminology is its disciplinary hybridity.

Crime as an act presupposes the existence of an offender, one or more, and the victim or victims, except of the cases of non-victim crimes. It is clear, however, that criminology science is a field much more extensive. The age of the individual can greatly determine the level of criminogenesis as a factor predicting human behavior guided by the inner as well as the external identity of the individual and in the case of this thesis the level of hormones and the whole state of health. (Stattin & Romelsjo, 1995)

Any study of crime must involve the study of law. Criminology explores the bases and implications of criminal laws – how they emerge, how they work, how they are violated and what happens to violators. But we know that laws vary from time to time and from place to place.

Taking into account the theories of criminal type of Lombroso, the theories of Garofalo and Ferri, a correlation to anthropological, telluric (physical) and social factors with the causes of crime is observed. Moreover, the XYY chromosome research became a particular controversy in the 1960s. 'Normal' males have an XY sex-chromosome configuration, but some males (1 in 1,000) have an extra Y chromosome, giving them an XYY configuration. Research in the 1960s found a slight suggestion of an association between XYY configuration and criminality. This led to the idea of the 'super-male criminal', full of aggression. More recent studies have refuted the idea that having the XYY configuration 'causes' men to commit crimes.

Furthermore, one criminologist named James Q. Wilson concludes that hormones, enzymes, and neurotransmitters may be the key to understanding human behavior and the tendency to crime. According to Wilson, gender differences in the crime rate may be an indication to the potential prevention of crime. Hormone levels also help explain the aging-out process. Levels of testosterone, the principal male steroid hormone, decline during the life cycle and may explain why violence rates diminish over time. As Siegel mentioned "Hormonal differences may be a key to understanding gender differences in the crime rate. Females may be biologically protected from deviant behavior in the same way they are immune from some diseases that strike males. Girls who have high levels of testosterone or are exposed to testosterone in utero may become more aggressive in adolescence."

The relationship between neuroscience and criminal law is a new field of investigation. There is a long forensic tradition linking the criminal phenomenon with brain and genetic "abnormalities". Over the last fifteen years, new neuroscientific techniques, both anatomical and functional, have become common in criminal courts. This practice is met in US courts, where jurisprudence has already been established but is also emerging recently in Europe. In particular, the issue of brain dysfunction in relation to aggressive behavior is causing the intense interest of both lawyers and psychiatrists. For example, the French legal corpus extends to security measures aimed at the isolation and "cure" of perpetrators categorized as dangerous. A prominent example is the law of 25 February 2008, as supplemented by Law No 2010-242 of 10 March 2010, which introduced a special form of preventive detention, the controversial "rétention de sûreté"

Undoubtedly, public security is seen as a commodity inherent in the social solidarity and social well-being of citizens residing in an area, which makes the citizen's security and protection a basic duty of the state and prevention a decisive factor in social coexistence. The adoption of participatory anti-criminal policy is not only about police procedures and the bureaucratic transfer of competences, but also about the reported social prevention. *Ceteris paribus* institutional intervention is a matter of paramount importance and is a direct priority.

To conclude, the aim of this thesis is to outline in some detail the structure and operation of the criminal justice system and its primary agencies, and looks at each of the major forms of criminal

activity in the context of hormonal and chromosomal deficiencies and criminal behavior. As there are supporters and opposers as far as the fact that some people may “have” in their DNA a tendency to commit crimes and because of their predisposition concerned, criminology and the institutional framework may take an important role in the prediction and prevention role from the commission of a crime. And as the question about how could a law protect against crime in situations of predisposition, or could a law punish someone for his genetic predisposition is arisen, there are also further dilemmas and thoughts that should be taken into account, as a second part of this thesis.

Chapter 1

Setting the frame through definitions

Criminology is defined as the scientific field which studies crime as a real (mental and physical) event and the means of preventing it¹. Léaute states that criminology is a "scientific study of the criminal phenomenon." At a level comparable to the above, W. Morrison concludes, "Criminology is the discussion of crime and how society deals with it". (Léaute, 1972; Morrison, 1995) On the other hand, other authors, such as American Sutherland (1883-1950), use descriptive definitions: for Sutherland, "criminology is a body of knowledge that refers to crime and crime as social phenomena". (Sutherland, 1974)

Spinelli (2014) points out that "the criminal phenomenon has generally been characterized as a drama with three acts and three actors. The actors are the perpetrator, the victim and the bodies of social control. The first involves the criminalization of laws, the second a violation or passing, and the third, the reaction of society to crime. "According to the legal dimension of crime: a crime is an act of a criminal nature that is punishable by criminal law. The concept of transgression is defined according to the ethical, religious and cultural elements that prevail in every society and change over time (Bakirtzoglou, 2015) French sociologist Emile Durkheim has argued that crime and criminals coexist with human existence. The issue of crime concerns every society with differences in its form, the acts are not the same, but there will always be people with behaviors that bring criminal penalties to them. Characteristically states that "what should be considered as normal is the existence of crime".

The crime, then observed through crime. Crime is a social phenomenon and a necessary structural characteristic, present in all societies and is made up of individual crimes, while

¹ Constantine Gardikas, (1896-1984), the first professor of criminology at the National and Kapodistrian University of Athens

constituting the most visible indicator of social pathology (Farsedakis, 1996) Depending on the ability to record the crime, the division is made into a visible (the part that can be officially counted) and an obscure or dark number (the remaining non-measurable part). But the rise in crime, despite the controversy over statistics, is widely accepted, and any increase that creates, or should create, a reaction by the state to criminal activity. It is not known exactly how the quantitative and qualitative increase in crime is affecting criminal policy.

Crime as an act presupposes the perpetrator, one or more, and the victim or victims. The most common cause of crime in the world is property crime or various types of fraud. However, it is evident that criminology is an area of research far beyond the study of fraud. The maturity of the person will ultimately determine the extent of crime as an indicator of human nature by internal and external entities. (Stattin and Romelsjo, 1995)

Crime is commonly considered to be a conduct which is prohibited by criminal law. In other words, no act can be treated as a crime, no matter how unethical or harmful it may be, unless it has been recognized as criminal act under national law, either at the level of written rule or at the level of customary law. This perception seems quite simple. Indeed, this alludes to the procedures in which some dangerous acts and victims are recognized and regarded as part of the criminal issue, whereas others remain anonymous, either as a dark number or as a consequence of non-intervention and correction. A philosophical approach to the study of criminal activity and its impact on individuals and communities consequently necessitates recognition of concerns such as: what is ' crime? 'How are lawful conceptions of "crime" and its victims generated? Victims also have a crucial role to play in shaping the criminal justice system. Without this particular versatility, a substantial part of this process of the criminal justice system would not have existed. (Carrabine et al, 2009)

There are three elements that make up the criminal phenomenon, namely the rule, referring to the criminal law, the offense, that is, the crime itself and the penalty that is mentioned in the sentence. All societies have rules governing the behavior of their members. These social rules define and reflect the values of a society. Some of the social rules are also converted into legal

rules. Through the political and judicial process laws are passed, interpreted and enforced. (Farsedakis, 2005)

Criminal negligence that leads to injuries and deaths in the workplace, environmental offenses, manufacturing and selling unsafe products, business misconduct, abuse of power by the state and so on. they are rarely considered a "real" crime. These are mostly crimes that do not have an imminent and visible victim. They are quite different for no reason due to the current lack of information of the victims. (Schur, 1965)

According to the Basic Principles of Justice for Victims of Crime and Abuse of Power, "Victims" indicates individuals who, directly or indirectly, have experienced harm, including physically or mentally damage, emotional trauma, economic loss or severe damage to their fundamental human rights, through acts or omissions which are in infringement of the criminal laws of the Member States, including those outlawing criminal abuse of power. (UNIFEM, 2015)

Attempts have been made to broaden the definition of "victims" (e.g. to include both directly and indirectly victims) and to include a range of violations and harms involved in criminal abuse of power (such as the deterioration of fundamental rights of the victim) in the 1985 United Nations Declaration on the Fundamental Principles of Justice for Victims of Crime and Abuse of Power. Additionally, there are no specific and unmistakable requirements to determine that actions identified as 'illegal' are always harmful to society. 'Victimless crime' as in some sexual acts involving consenting adults, prostitution and the procurement and selling of certain illicit drugs is often related to in this sense (Schur, 1965).

Criminology and historical context

The Hammurabi Code or some of the documents of ancient Greek philosophy may be regarded as precursors of criminology or simply as forensic theory, but not as the beginning of forensic science. Among the authors of the 16th century, it is worth mentioning the utopian English T Moore or Morus (1478-1535) engaging with the origin of crime and the critique of English

criminal law. Italian J Baptiste della Porta (1535-1615) is also characterized as a pre-criminologist who, by the end of the 16th century, attempted to classify the species and forms of offenders by performing anatomical examinations of the perpetrators and thus attempting "physiognomy." The French sophistication of the 17th century, and in particular Marquis de Montesquieu in the Persian Letters (1721), raised questions of criminal policy. Also, De Pitaval deals with the management of criminal justice in his prominent and fascinating book on criminal trials (1734). (Drapkin, 1983) One of the expressors of classicism was the Italian philosopher Cesare Beccaria with his work on the right to punishment and the methods of preventing crime published in 1764. (Vold et al, 2002)

From the 19th century, when the science of criminology was established, till this day, its theoretical and empirical research has gone through various stages of development. From a personalized phenomenon, defined by purely biological or psycho-intellectual variables, it has progressed to a global perspective through the interdependence of all three phases of the criminal phenomenon: the creation of laws, their transgression and their social response. Factors outside the control of the individual (biological - physiological) were sought that could provide objective knowledge. Depending on the factor being emphasized, it is distinguished in biological positivism, psychological and social. It is particularly appropriate to be referred Cesare Labroso, the chief expressionist of biological positivism, who has tried to prove scientifically that the offenders differ in physical characteristics. Other scholars such as Ferri and Garofalo have also moved in the same direction. According to Lombroso, physiological features such as the shape and size of the skull, the long arms, the protruding chin, etc. are characteristics of primitive people and indicate criminal predisposition. Lombroso believed he was a "born criminal". In 1897 he reported that this species covers only one third of criminals and added the categories of epileptic, crazy, and "occasional criminal". Another fan of biological positivity, Gorin claimed after investigations that criminals weigh less (3-7 pounds) and are shorter (3 inches). Charles Gorin used statistical techniques and found that crime is inherited to the same degree and in the same way that other traits and attributes are inherited. (Vold et al, 2002)

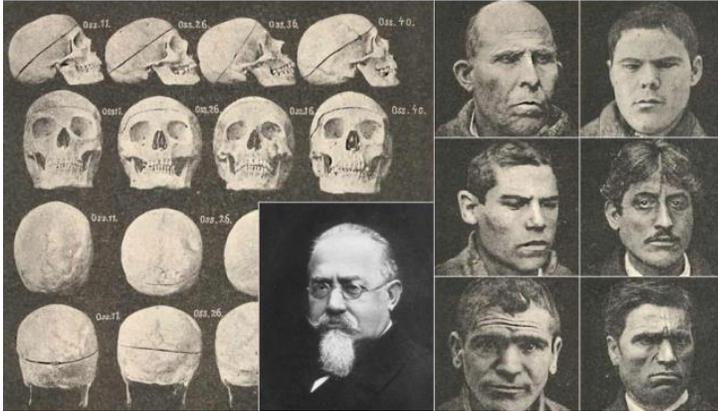


Figure 1: Cesare Lombroso's Museum of Criminal Anthropology via Pietro Giuria 15, Torino

The body-signal, as a password, as a representation of hidden meanings, does not cease to function as a sensor or a means of communication. In the 19th century, the Italian prison psychologist Cesare Lombroso focused on Charles Darwin's theories and implied that the prisoners were atavistic. He indicated that their brains were underdeveloped or not fully developed. Sheldon also categorized individuals according to the body of the criminals: endomorphs (more fleshy), mesomorphs (muscular, energetic) who were more likely to commit crime, and ectomorphs (weak types).

Merton concluded that lawlessness is the cause of the problem, by adjusting the severity of one's actions when addressing tensions within current social realities. The concern with Merton's theories is the assumption of objectives and principles. Societies are too diverse, have too many conflicting value systems, and cause too much tension to support the pure definition of Merton's criminal theory. However, it can not be accepted that people necessarily socialize to a specific set of values: on the contrary, several aspects show different patterns of socialization between different groups. Moreover, the theory seems to presume, to a large extent, that people are led to crime through tensions and grim necessity. (Schur, 1965).

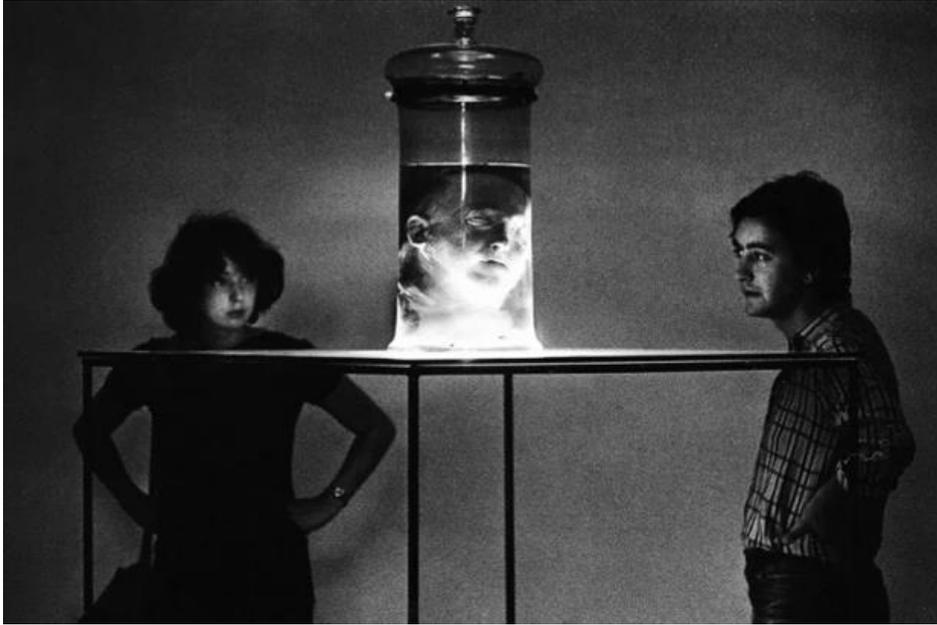


Figure 2: A couple viewing the head of Italian criminologist Cesare Lombroso preserved in a jar of formalin at an exhibition in Bologna, 1978. (Photo by Romano Cagnoni/Hulton Archive/Getty Images) source: historyextra.com

In 1895, C. Lombroso and G. Ferrero in their work "The female offender" carried out measurements of the skulls, brains and bones of female criminals and prostitutes and studied their appearance through photographs and behavior from their personal life stories. They concluded that the "criminal women" are much less than men, based on the characteristics of their atavistic degeneration, so the low rates of female crime are due to the biological "inferiority" of women. (Kourakis, 2006)

In 1960, radical criminology (Marxism) emerged, according to which crime resulted in deprivation of basic individual human rights. The emergence of critical criminology began in 1968 when a group of social scientists set up the National Council on Derogation (NDC) in Britain. Their interest in the authenticity of diversity and the unique worlds of everyday life was a continuation of a tradition that began in 1930 with the Chicago School and its theories of social interaction. Critical criminologists have attempted to shift their research attention beyond the character and status of the aberrant, subject to state and social interference. Crime is closely linked to social

circumstances and directly related to the historical conditions that govern a society at a given time. Additionally, the theory of holistic choice was based on utilitarianism and was started by Cesare Beccaria and Jeremy Bentham. This philosophy was replaced by positivism and the Chicago School until it came to prominence in 1970. He argues that criminals weigh the costs and benefits of deciding whether or not to commit a crime. They will also try to minimize the risks when they commit a crime. Since 1914 investigations by the Chicago School of Journalism led by journalist Robert Ezra Park on the justification of crime have found that crime "exhibits regularity and stability within certain physical boundaries". The Chicago suburbs where the surveys were conducted, were close to industrial areas, home to heterogeneous cultural and racial groups, and were characterized by poverty, lack of social control, and the dominance of antisocial perceptions. Shaw and Mackay in 1925 referred to a criminal tradition or "cultural transfer" of criminal values to areas of high crime. Their conclusion was that the influence of juvenile criminals and the social environment in which young people grew up resulted in their involvement in crime, which the community not only tolerated but also endured. (McLaughlin, 2001)

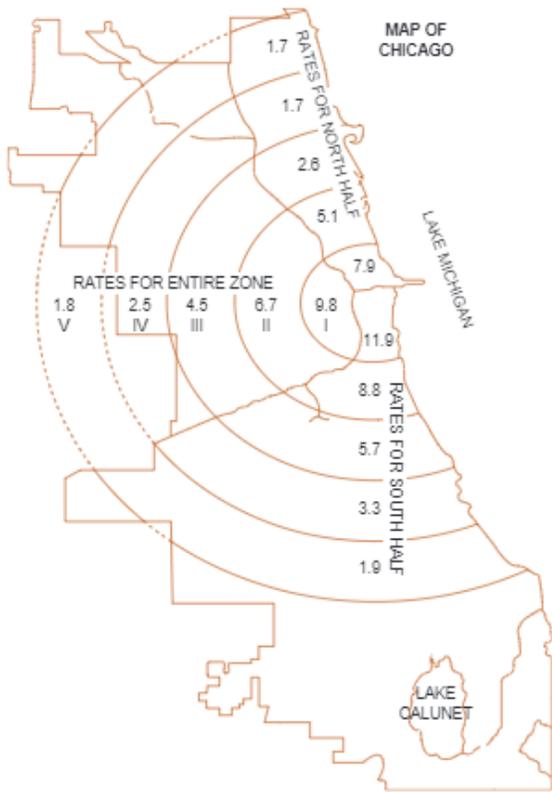


Figure 3: Zone Map of Male Delinquents in Chicago 1925–1933, 2009

Chapter 2

Hormonal approach and criminology

Numerous hormones can now be evaluated in saliva, eliminating any need for blood samples. Testosterone (T) has been shown to have a stimulatory effect on violent behavior in a broad spectrum of vertebrate species. (Booth et al, 2006) The maturation of the reproductive system during adolescence results in a rise in gonadal steroid hormone concentrations. These hormones reconstruct neural circuits throughout teenage years, a time of spectacular re-wiring of the nervous system. Intersecting sources of evidence demonstrate that teenage years may be a delicate time for steroid-dependent brain organization, and that variability in timing of interactions between puberty hormones and adolescent brains leads to differences between people in adult behavior and the risk of sex-biased psychologists. (Sisk and Zehr, 2005) And as Terbung et al mentioned *““Stop being so testosteroney”, ‘the guys’ are being told by one of ‘the girls’ in the popular sitcom ‘Friends’ after they agree to, instead of calling a girl following a successful date, “let her dangle” and wait for her to call. This joke works, because it relies on the common sense view that typical male behavior is linked to the steroid hormone testosterone”*. As seen in the Figure the mechanisms of cortisol and testosterone are considered the final products of the two hormonal axes. (Terbung et al, 2009)

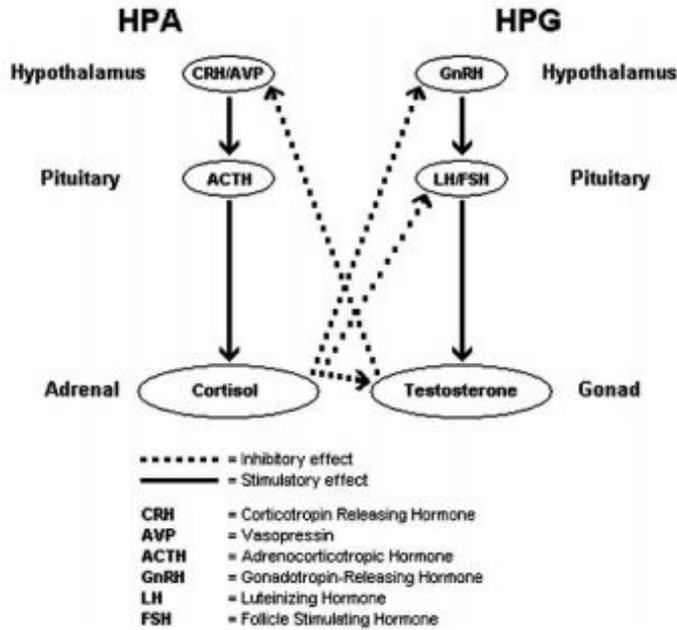


Figure 4: The two axes involved in hormones: hypothalamic-pituitary-adrenal (HPA) and hypothalamic-pituitary-gonadal (HPG) axes (Terbung et al, 2009)

Amongst the most provoking neuroendocrinological abnormalities identified in antisocial males is decreased cortisol secretion. Low plasma cortisol concentrations in reference to experimental pressures were first outlined among adult male offenders in the Maximum Safety Hospital. These male participants had a more violent conduct than the criminal control group, which usually responded to stressors by increasing cortisol levels. Ninety-three percent of the above participants had a history of periodic physical aggression. Sixty-seven per cent of the participants committed a serious crime, particularly in comparison to only 14 per cent of the criminal control group. Likewise, Virkkunen reported that criminal male offenders had reduced the production of cortisol, but that cortisol levels were common for non-violent criminals and non-criminal violent men. (Pajer, 2001)

Sex differences in cognitive recognition and age-related decreases in brain function and mood link to testosterone as a crucial modulator of brain activity. Testosterone proves to trigger the

distributed cortical network, the ventral processing stream, throughout spatial cognition functions, as well as the addition of testosterone, to enhance spatial cognition in younger and older hypogonadal males. In conjunction, decreased testosterone is correlated with major depressive disorder. The connection between depression and testosterone indicates to be partly dependent on the patient's androgen receptor genotype, and testosterone substitution may increase positive mood and reduce depressed mood in appropriate patients with low testosterone levels. The much-publicized connection between testosterone and aggressiveness is likely only of relevance in athletes who supplement their testosterone levels to inordinately high levels, while in hypogonadal men, testosterone supplementation only improves positive effects of aggression such as vigor and energy. Recent data imply that testosterone supplementing in hypogonadal males of all age groups will improve many facets of mood and cognition. (Zitzmann, 2006)

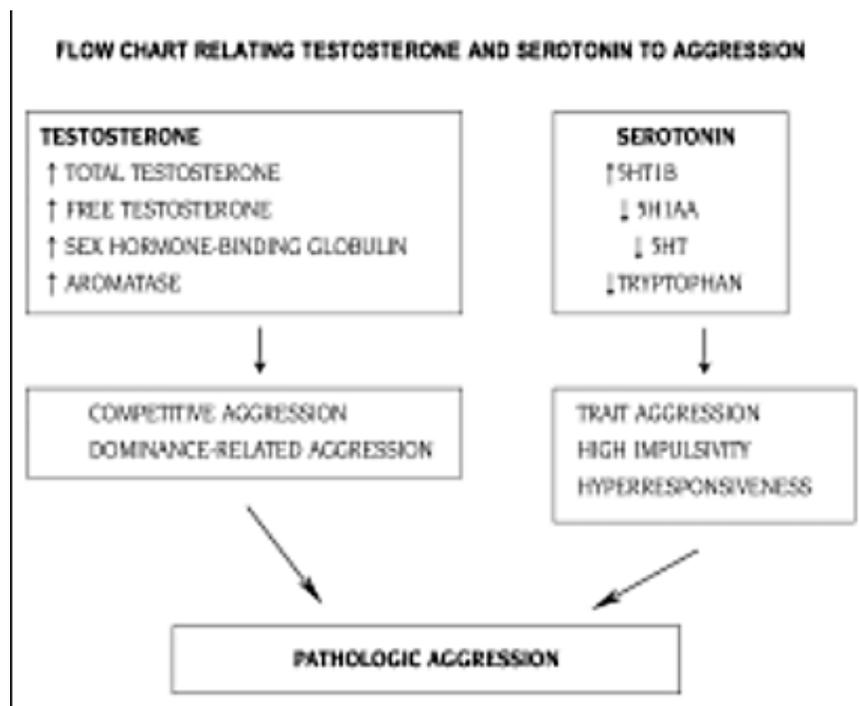


Figure 5: Flow chart relating testosterone and serotonin to aggression, (Birger et al., 2003)

According to the study entitled “Testosterone and aggression” of Archer (1994), the potential link between testosterone and human reactions of aggression is highlighted. Age and gender variations in the two parameters are similar to each other, but are influenced by other factors. Studies involving aggressive and non-aggressive individuals (e.g. vicious detainees) demonstrate higher levels of testosterone in the former. The correlations between the two parameters in the chosen and non-selected datasets are positive. These are reasonably high (0.38 overall) where aggressive behavioral tests have been used and lower where pattern action has been taken. There is scant evidence of a high correlation between testosterone and aggressivity during adolescent years. Other studies have shown that levels of testosterone are receptive to social-environmental influences, notably those connected to status and anger. Impacts between testosterone and aggression would thus be efficacious in both sides. There is weak evidence that aggressiveness reforms when the levels of testosterone are manipulated. Three distinct theoretical simulations to demonstrate these conclusions are highlighted and their implications for the rehabilitation programs of violent offenders are addressed. (Archer, 1994)

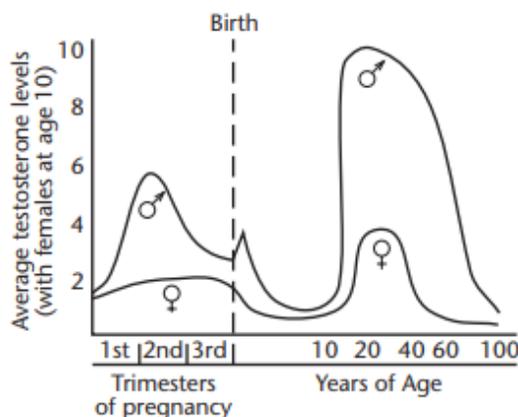


Figure 6: Testosterone levels in males and females individuals throughout lifetime (Ellis. 2005)

Female Pubescent antisocial behavior is prevalent, whether determined as conduct disorder (CD) or criminality. Conduct disorder is considered as the second most popular disorder given to female adolescents, and one-third of adolescent psychiatric patients are diagnosed. Almost 10%

of 15-to 17-year-old girls in the general population fulfill the criteria for CD. The level of juvenile delinquency and the percentage of women prosecutions for violent crimes has increased significantly in the last two decades. Antisocial female teenagers are becoming women with rates of criminal activity up to 40 times higher than those of other women, higher risk of early death, complex psychiatric problems, high rates of substance abuse, poor adult physical health, and intergenerational drivetrain of antisocial behaviour. (Pajer, 2001)

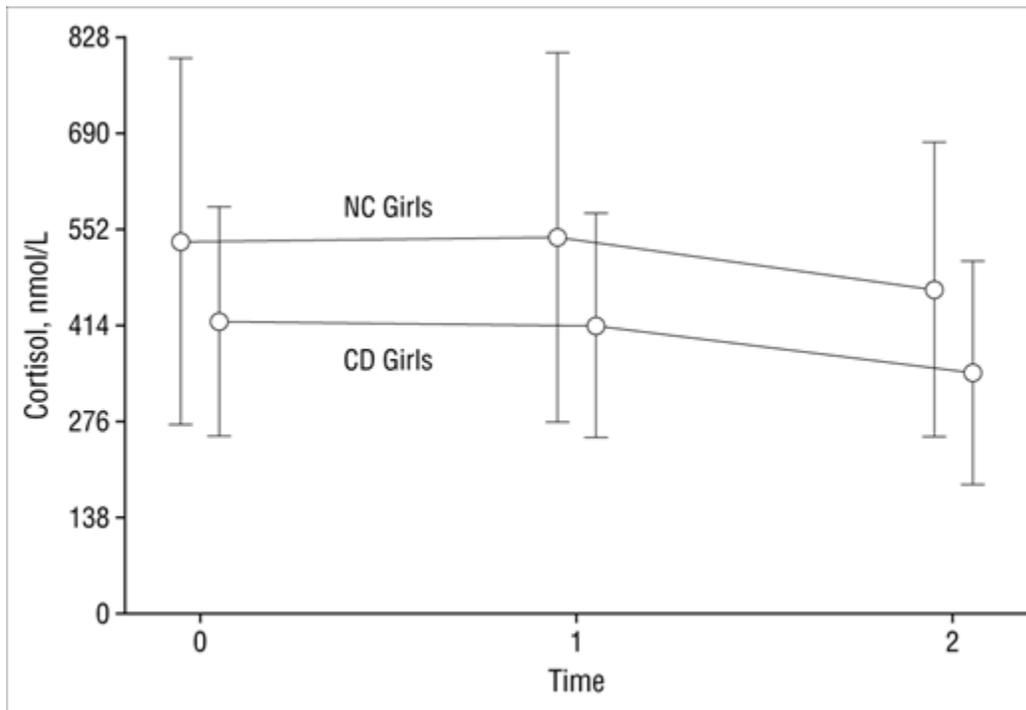


Figure 7: Cortisol levels in the girls with conduct disorder (CD) vs the normal control (NC) group. (Pajer, 2001)

Research teams also evaluated the influence of sex hormones on women's behavior, starting with two cases in England in 1980 in which two females used premenstrual syndrome (PMS) as a factor to mitigate violent offences. These attempts have contributed to accused women in the United States being able to prove for diminished culpability due to PMS. The postpartum depression syndrome is another phenomenon associated with female hormones. Such as PMS and PMDD,

postpartum depression syndrome has been widely used as a mitigating tool in the defense in court of women charged with crimes while experiencing their consequences. Both PMS and PMDD, however, are questionable notions, challenging to diagnose as medical problems, and several contend that social structures and psychiatric problems are not medical conditions. (Denson et al 2018)

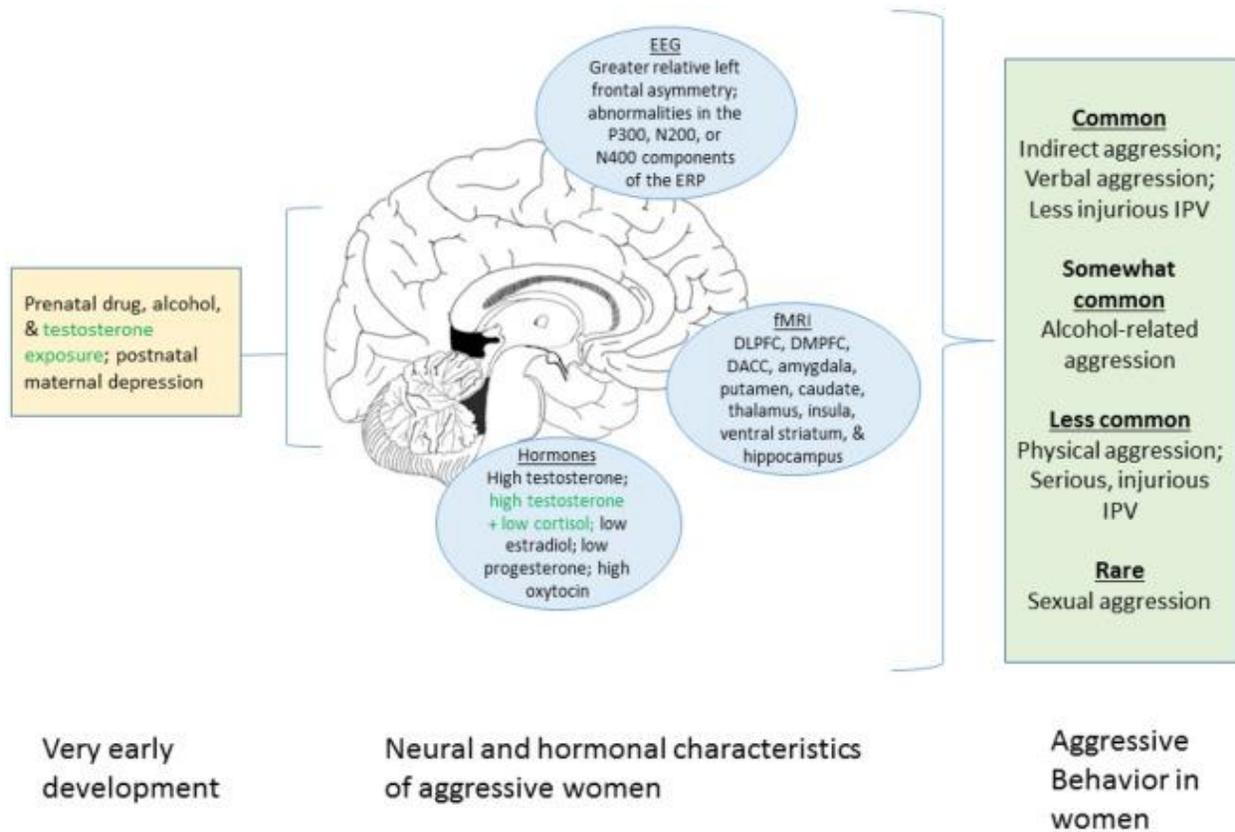


Figure 8: Graphic of the factors associated with aggression in women according to Denson et al (2018)

Dalton's theory had many supporters and particularly influenced American jurisprudence, as in several trials where female violent offenders were treated more favorably, citing personality disorders due to premenstrual syndrome or menstruation. Characteristically, in 1980 Sandra Craddock, charged with first-degree homicide, suffered from a particular form of premenstrual syndrome and was unable to control her actions. The trial was postponed for a quarter, followed

by progesterone treatment and her condition improved. The supreme court decision, which upheld the reduced charge, sentenced Craddock not to a prison sentence but to three years ' probation on the condition that she continued to receive progesterone treatment. In 1987 Anne Reynolds murdered her mother with a hammer and was convicted by the Court of First Instance of homicide. The appeals court upheld Mrs Dalton's testimony that Anne Reynolds was suffering from both premenstrual syndrome and postpartum depression, upheld the reduced sentence and turned the conviction into homicide by negligence. She was eventually sentenced to judicial custody on the condition that she undergo psychiatric treatment. Similarly, in 1989 Christine Ann English killed her lover by hitting her with her car. The defense cited the premenstrual syndrome, reduced defense charges were accepted and the defendant was sentenced to conditional release and deprivation of a driving license for one year. (Trivizas, 1993-1995)

Chapter 3

Chromosomal approach and criminology

The association of chromosomes with criminal behavior, which chromosomes are a key element of the cell and a material carrier of heredity, was started in the 19th century by Austrian G. Mendel and was based on the assumption that aggression was due to a wrong pair. After this biological report, several scientists linked this anomaly to aggression. (Zarafonitou, 2004)

Chromosomes numbered 1 to 22 are identical in males and females and are referred to as autosomal chromosomes. The 23rd pair is different in males and females, and the chromosomes that comprise the pair are called sex chromosomes. There are two forms of sex chromosome, the X chromosome and the Y chromosome. Females usually have two X chromosomes (XX). The female inherits the X chromosome from her mother and the X chromosome from her father. Males usually have an X and an Y chromosome (XY). The male inherits his mother's X chromosome and his father's Y chromosome. The pair who are interested the criminologists is the one that determines the sex, which determines also the main and secondary characteristics of the person. The Y chromosome provides the characteristics of the individual males. Some researchers have suggested that the Y chromosome is found in the genetic structure of female offenders. The Y chromosome is what exists in the male molecular structure and plays a key role in aggression and crime. However, the fact that the Y chromosome is not detectable in women indicates the rarer occurrence of criminal behavior (Zarafonitou, 2004)

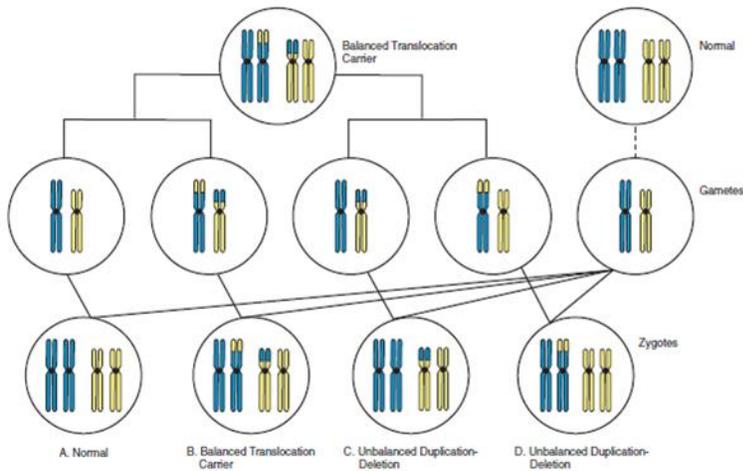


Figure 9: Gametes produced by a balanced carrier (Hoffman et al, 2012)

Triploidy and tetraploidy are two forms of polyploidy syndromes. Unlike the aneuploidy syndromes described with an extra chromosome, the polyploidy syndromes consist of whole additional sets of genetic material. Therefore, a triploid cell has 69 chromosomes and a tetraloeides cell 92 chromosomes. Polyploidy can occur in up to 1% to 2% of pregnancies, but only in 1 / 10,000 live births. In triploidy, the additional set of chromosomal material is due to failure to divide into the I or II reduction in the sperm cell or oocytes, or alternatively, the additional chromosomal material may result from double fertilization of a normal egg. The source is most often paternal (75%), with the most common karyotype being 69 XYY (60%) and the least common 69 XYY (37%) or 69 XYY (3%).(Kline-Fath et al, 2015)

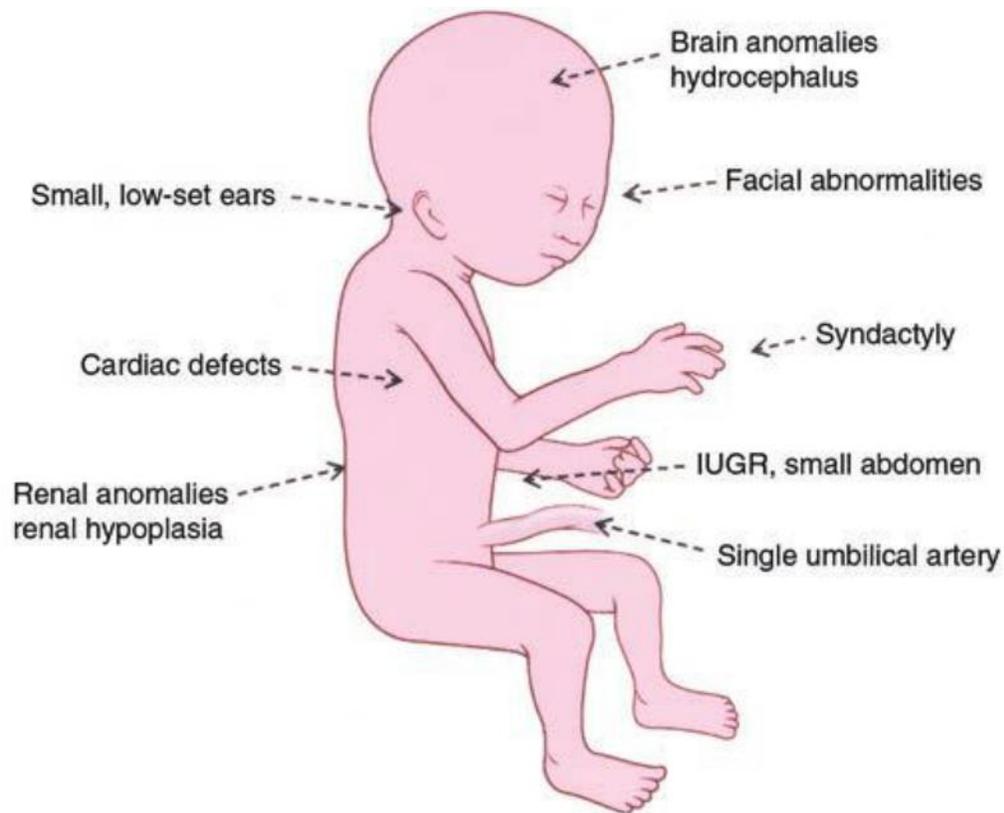


Figure 10: Common Triploid Characteristics (Kline-Fath et al, 2015)

Genital abnormalities are rarely seen in males with karyotype 47, XXY (Lee et al., 2007), although progressive deterioration of testicular function is characteristic in the majority of patients (Wikstrom and Dunkel 2008) and testosterone replacement therapy is required for many patients (Forti et al., 2010). Most men with KS are oligospermic or azospermic, with high levels of FSH and LH but some successes with assisted reproductive technologies have been reported, particularly with regard to sperm infusion (ICSI) (Paduch et al., 2009). Males with KS tend to be higher than average. Intelligence falls within the normal range, but there is a deficit of 10-15 IQs compared to siblings (Linden et al., 1996). Verbal IQ is more influenced by performance IQ. In adolescence, gynecomastia occurs in one third of boys and this may require surgical treatment. There is an increased risk of developing breast cancer. People with KS are also at increased risk of developing non-cancerous germ cell cancers, especially in the medulla (Hiramatsu et al., 2008).

People with Klinefelter's syndrome have a reduced social status and in some cases aggressive behavior. Also, people with karyotype XYY syndrome are more aggressive and impulsive than normal people. Physical defects in children suffering from the above syndromes cause feelings of disadvantage and emotional instability, which is a catalyst in the collision of inhibitory and excitatory forces for the manifestation of criminal behavior and behavior. However, in addition to chromosomal abnormalities, in recent years there has also been an emphasis on inheritance that may play a role in the manifestation of abusive behavior.

The 47,XYY sex chromosome abnormality has been outlined in different settings since the first outline of a group of males with 47,XYYY in 1965 by Jacobs et al, who performed a chromosome study of male subjects at the State Hospital in Carstairs, Scotland, and found that males with 47,XYYY caryotype were particularly prevalent among prisoners in punitive institutions. In the 1960s and 1970s, epidemiological studies with KS and 47,XYY pinpointed an increased probability in mentally handicapped hospitals, and men with 47,XYYY appeared to be over-represented in penitentiaries. Several of these studies identified an overall increase in the number of criminal behavior prevalence and an increase in the average of crime between the two cohorts, in particular as a result of sexual assaults. In order to analyze the criminal profiles of people with KS and 47,XYY, we have conducted this national review, concentrating not only on the overall number of convictions, but also on the separate forms of crime. As a result, Stochholm K, Bojesen A, Jensen AS, et al, studied the criminal behavior of all people diagnosed with 47,XYY and KS compared to a large age-and calendar-time-matched control group. All males diagnosed with KS (N=934) or 47,XYY (N=161) at risk and their age-and calendar-time-matched controls (N=88 979 and 15 356, respectively). The prevalence of prosecutions was increased in men with KS (nominating traffic offenses) particularly in comparison to HR controls of 1.40 (95 per cent CI 1.23 to 1.59, $p<0.001$), with significant increases in sexual abuse, robbery, vandalism and ' other ' but with a reduced risk of public transport and drug-related offences. The prevalence of convictions was substantially increased among men with 47,XYYY likened to HR controls of 1.42 (95 per cent CI 1.14 to 1.77, $p<0.005$) in all kinds of crime, except drug-related and traffic-related crimes. Making adjustments for socio-economic factors (education, paternity, employment and cohabitation) reduced overall HR for both KS and 47,XYY to comparable levels to controls, while

some particular forms of crime (sexual abuse, arson, etc.) remained elevated. (Stochholm K, Bojesen A, Jensen AS, et al, 2012)

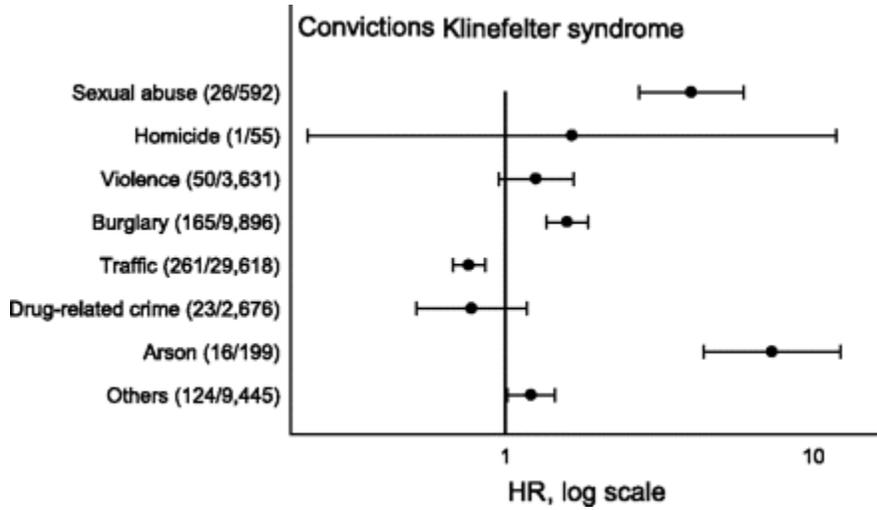


Figure 11: HRs of convictions due to cause in Klinefelter's syndrome (KS) compared to age-matched men (Stochholm K, Bojesen A, Jensen AS, et al, 2012)

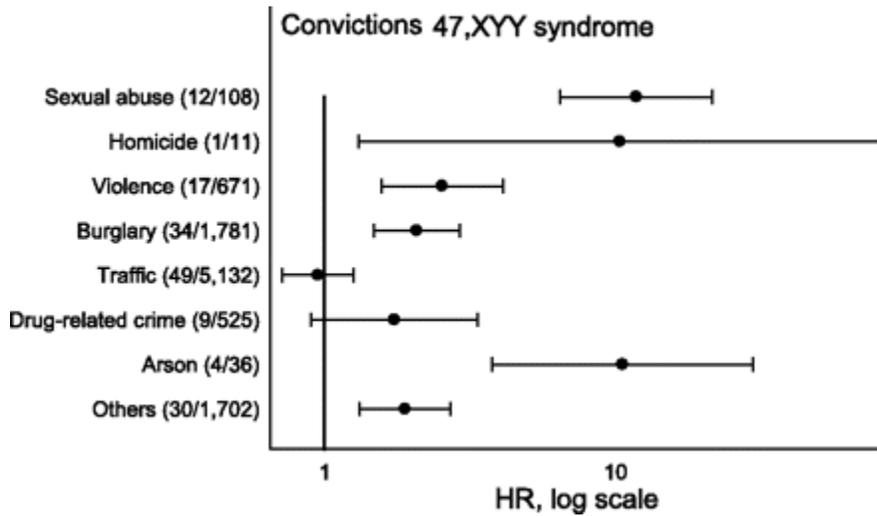


Figure 12: HRs of convictions due to cause in 47,XYY syndrome compared to age-matched men (Stochholm K, Bojesen A, Jensen AS, et al, 2012)

In 2008, D.Soudek Parvahan Laroya conducted experiments on 84 male offenders with no mental health problems. The length of the Y chromosomes was determined and correlated with the Y chromosome of 38 people in the mental health facility. It was observed that the length of the Y chromosome was substantially increased in detainees especially in comparison to controls. The length of both the fluorescent and non-fluorescent segments of the Y chromosome was estimated to be increased. (D.Soudek, 2008)

Chapter 4

Neuroscience and criminology

There has been a growing interest in the involvement of the brain in anti-social / criminal behaviour. In general, research indicates that antisocial / criminal human beings often seem to have decreased brain volumes as well as deficient functioning and connectivity in key areas linked to cognitive functions, emotional regulation, decision-making, and moral values, while also demonstrating enhanced volumes and functional abnormalities in compensation regions of the brain. While many surveys of brain differences involved in criminal conduct have comprised of correlational analyzes, lesion studies have gained insight into the correlational neural mechanisms of antisocial / criminal behaviour. A very well-known example of the consequences of prefrontal lobe lesions is Phineas Gage, who was recorded to have had a drastic change of personality after an iron rod was shot via his head and destroyed his left and right prefrontal cortex. Empirical studies indicate that pre-frontal lesions purchased earlier in life interfere with social and moral advancement. A research of 17 participants who developed criminal conduct regarding a brain lesion showed that while these lesions were in various locations, they were all structurally linked to the areas triggered by moral decision-making, implying that the disturbance of the neuromoral network is linked to the criminal act. However, while lesion surveys have involved particular brain areas in various psychological procedures, such as moral development, generalizability is limited due to the diversity of the lesion characteristics, as well as the characteristics of subjects that may regulate the behavioral effects of the lesion. (Ling, S., Umbach, R., & Raine, A. (2019)

The pertinence of central neurotransmission to aggressive and impetuous behavior is becoming more apparent due to constant studies in both humans and animals. Amongst many other observations, there are extensive data on low serotonergic activity - as assessed by low cerebrospinal fluid 5-hydroxyindolacetic acid and a blunt response of prolactin to fenfluramine - to impulsiveness. Many testosterone activity research indicates a relationship between high

plasma concentrations and an inclination towards aggressiveness. It is presumed that the relationship regarding low serotonin levels and high testosterone levels in the central nervous system has a significant impact on the neural mechanisms engaged in the presentation of aggressive behaviour. Testosterone tends to modulate serotonergic receptor activity in a manner that directly impacts aggression, fear, and anxiety. (Birger et al., 2003)

As the development of neuroscientific methods allows for more fine-grained analysis of differences in brain structure and function, the structural, cognitive and behavioral lateralization of offenders and non-criminals is studied to ascertain the validity of Lombroso's theory and to examine evidence of the physiological underpinning of criminal behaviour. Although the body of evidence in the study of Savopoulos and Lindell is currently small, it indicates to be compatible with Lombroso's proposal: criminal psychiatric brains show atypical structural asymmetries, decreased right hemisphere gray and white matter volumes, and abnormal interhemispheric connectivity. Functional asymmetries are also atypical, with criminal psychologists demonstrating less lateralized cortical reaction than non-criminals performing verbal, visual, and emotional assignments. Finally, the prevalence of non-right-handedness in criminal population groups is higher than in non-criminal population groups, coherent with decreased cortical lateralization. Thus, despite Lombroso's comparatively primitive and inferential research methods, his statement that the lateralization of criminals differs from that of non-criminals is largely driven out by neuroscientific analysis. (Savopoulos & Lindell 2018)

Several reputable studies propose a connection between the amygdala and the activation of aggressive behavior. Prior morphometric neuroimaging studies have concentrated on the role of amygdala in pathological neuropsychiatric situations such as depression, personality disorders, and dysphoric and aggressive behavior in epilepsy. In terms of understanding the physiological role of amygdala in attenuating aggressive behavior, Matthies et al evaluated the connection between amygdala volume and lifetime aggression in healthy individuals. Morphometric brain scans were conducted in 20 healthy subjects. Amygdala volumes were evaluated by manually highlighting the parameters of the structure following a well-established and verified procedure. Cautious psychological and psychometric testing was carried out to exclude any psychiatric disorder and to determine lifelong aggressiveness with the proven and established psychometric

system (i.e. Life History of Aggression Assessment (LHA)). In the normal range of lifelong aggression, each volunteer ranked to this range. Participants with higher aggression scores showed a 16–18 percent decrease in amygdala volumes. There was a very substantial negative association regarding amygdala volumes and trait aggression. The magnitude of the volumetric variations in this research is noteworthy and indicates that amygdala volumes may be a proxy indicator for the personality properties of aggressiveness in healthy human subjects. (Matthies et al, 2012)

Moreover, Evolutionary Neuroandrogen (ENA) Theory asserts that men are more addicted in crime behaviour than females because of an evolving female inclination for mates who are (or at least attempt to be) reliable resource providers. To accommodate this female personal choice, the theory posits that men have developed genetic inclinations to produce high levels of testosterone and other androgens that augment their competitiveness, sometimes to the extent of victimizing someone else. Adolescent representations of competitive / victimizing activity are often coarse, frequently perceiving themselves in the form of actions that others try to eradicate. By complete adult years, most human beings with highly androgenized brains will have shifted from crude to refined forms of competitive / victimizing behavior, frequently as part of their regular business and financial activities. The theory suggests that new skills, as well as learning opportunities modes of competitiveness that are minimally abused by others, dictate how quickly individuals progress from crude to refined types of competitiveness. (Ellis & Hoskin, 2015)

As per the evolutionary neuroandrogen (ENA) theory of criminal and antisocial behavior mentioned above, androgens (male sex hormones) have established a propensity to modify brain functioning in forms which increase the likelihood of criminal behavior, particularly in the case of violent and other types of crime. If the hypothesis is correct, criminal activity should be higher for men than in women and, within each sex, crime should be correlated with physiological symptoms of high androgen exposure. These exemptions have been examined with a representative sample of North American college students. Criminal activity was more prevalent among males than females, as expected. In particular, various small but statistically meaningful positive associations regarding self-reported criminality and androgen-promoted physiological characteristics have been identified between both sexes. In fact, self-reported violent crime was

strongly correlated with masculine mannerisms, masculine appearance, physical power, the strength of sex drive, low-deep voice, muscular strength, and body hair volume. Even the size of the penis was found to be profoundly associated with criminal activity among males. Several correlations indicated that it is probable to statistically eradicate gender differences in criminal activity by including androgen-promoted physiological features in the prediction equation although this did not remove gender differences in other offending groups. (Ellis et al, 2008)

Amygdala is a significant area of the brain that has been involved in emotional processes such as facial and auditory mannerisms of emotion, particularly in negative emotions such as anxiety (Sergeie, Chochol, & Armony, 2008). The proper functioning of the amygdala was believed to be essential to the production of fear conditioning, and the correct integration of the amygdala and PFC was argued to underpin the development of morality (Blair, 2007). The amygdala is assumed to be engaged in stimulus-enhancing learning, which combines actions that harm others with the aversive reinforcement of victims ' discomfort and the recognition of threats that typically dissuade human beings from risky behaviour. However, ammygdala maldevelopment can contribute to a decreased ability to identify distress or threat; disrupt stimulus-enhancing learning that prevents antisocial / criminal behaviour. Nevertheless, while the decreased volume of amygdala in adult years has been linked to higher aggressive and psychotic attributes from childhood to early adulthood, it is also associated with an increased risk of potential antisocial and psychotic behavior (Pardini, Raine, Erickson, & Loeber, 2014). Even though the amygdala has been accused of being involved in criminal conduct, there may be substantial differences between variants of offenders. Whereas psychotic antisocial human beings might be more likely to display cold, estimating types of aggression, non-psychopathic antisocial individuals may be more likely to participate in impulsive, emotionally-reactive aggressiveness. Studies indicate that the former may demonstrate amygdala hypoactivity and the latter, amygdala hyperactivity (Raine, 2018)

In fact, violent criminals have been observed to demonstrate increased amygdala response to provocative actions. Spousal abusers have also been observed to demonstrate enhanced amygdala activation when reacting to assertive phrases versus non-abusers. Psychopathy scores were negatively linked to amygdala reactivity in a group study of healthy individuals, while

antisocial personality disorder ratings were positively correlated with amygdala reactivity after correction for similar variation among psychopathy and antisocial personality disorder. Nonetheless, further research is required to establish whether the existence of callous-unemotional traits (e.g. avoidance of guilt) or the frequency of antisocial behavioral traits is most appropriate to the hypo-reactivity of amygdala reported. (Ling, S., Umbach, R., & Raine, A. 2019)

Brain research is making significant progress. Nevertheless, considering the vast amount of human deprivation due to brain diseases, mental illnesses or neurological diseases, this kind of neurological research consists an ethical position. A greater understanding of human brain activity, even if it is pursued for strictly medical reasons, would undoubtedly have secondary applications. Some of them are likely to be in criminology. In this brief review, there is no aim of claiming to have addressed all potential uses of neuroscience in criminology. In this brief review, we make no claim to have addressed all potential uses of neuroscience in criminology. (Greely & Farahany, 2019)

Chapter 5

Genetics and criminology

Gene-environment (G x E) relations have gained growing exposure over the decades as they may increase the likelihood of antisocial behavior and/or cause epigenetic changes in human beings. Longitudinal researches and meta-analyses identified the moderating influence of the monoamine oxidase A (MAOA) gene on the association between maltreatment and anti-social behaviour, with the anti-social behavioral interaction being higher for persons with low MAOA compared to high MAOA. Additionally, in a longitudinal study of African-American women, having an A1 allele of the DRD2 gene or a delinquent father did not independently indicate antisocial behaviors, although both variables increased the risk of severe criminality, aggressive delinquency and police interaction. This form of G x E association illustrates how genotypes can affect the responsiveness of humans to environmental stimuli. Nevertheless, there may be significant differences in subgroups to acknowledge when assessing the genetic risk of criminal conduct. For instance, low-MAOA has been linked to a higher risk of serious crime in convicted Caucasian criminals but not incarcerated non-Caucasian offenders. In particular, high-MAOA may prevent neglected and abused Caucasians from higher risk of becoming aggressive or antisocial, but this playback effect has not been reported for neglected and abused non-Caucasians. Therefore, while the MAOA gene has been correlated with antisocial / criminal behavior, there are still aspects of this connection that need to be understood. (Ling, S., Umbach, R., & Raine, A. (2019)

Another manner in which G x E associations express themselves is when environmental stimuli result in epigenetic changes and thus become part of physiology, resulting in lengthy-term symptomatic effects. For instance, women subjected to childhood sexual abuse experienced methylation alterations in the 5HTT promoter region, which in turn were associated with subsequent symptoms of antisocial personality disorder (Beach, et al, 2011). The body of work on such epigenetic mechanisms implicated in the biological embedding of early childhood

stressors and transgenerational trauma has expanded. Thus, just as biological processes may have an impact on environmental reactions, environmental stimuli may have an impact on biological expression.

Maternal internalizing (INT) and externalizing (EXT) activity scores were obtained in a broad population-based observational study of Bartels et al. The total of partaking twin pairs at age groups of 3, 7, 10 and 12 was 5,602, 5,115, 2,956 and 1,481, respectively. The stability of both behavior patterns was due to genetic and exchanged environmental factors. The genetic component to stabilization (INT: 43 per cent; EXT: 60 per cent) culminated from the reality that a subset of genes expressed at an earlier age was still present at the next point in time. A similar collection of mutual environmental factors served at all ages (INT: 47%; EXT: 34%). The minimal influence of non-shared environmental conditions (INT: 10%; EXT: 6%) could not be recorded by a simplistic model. Considerable age-specific perspectives have been identified for all components, suggesting that genetic and environmental factors have also made a significant contribution to adjustments in problem behaviour. (Bartels et al, 2004)

Chapter 6

Potential practical measures to enhance the administration of criminal justice or the prevention of crime

Every society forms a dominant ideology, that is, the dominant ideology of a social class. The dominant ideology is embodied in state law in a process of long-lasting interaction between social relations and state power. The law provides the rules of social reconciliation and expresses them in a specific way while without it, it is impossible to delineate criminal behavior. The nature and rationale of the crime cannot be regarded as two unrelated concepts. There is an interdependent relationship between them, such that one can not comment about the nature of the crime without first considering the motives for it, although, on the other hand, the question of explaining the crime is directly linked to the nature of the crime. Vidali mentions that the term of crime prevention refers to a complex range of forensic and criminal theory applications that, through measures and policies, attempt to prevent, deter or repress crime and integrate anti-criminal policy into social control instruments. (Vidali,2014)

Crime prevention corresponds to a spectrum of strategies enforced by individuals, societies, businesses, non-governmental organizations and all layers of government to address multiple social and environmental factors that affect the possibility of crime, disorder and victimization. (AIC, 2003; IPC, 2008) There are indeed a multitude of different strategies to crime prevention that diverge in terms of the emphasis of the intervention, the forms of practices that are carried out, the principle behind how those activities are designed to deliver the expected results and the techniques that are implemented.

Various components have been evolved to categorize the variety of activities that fall within the nature of crime prevention. (Sutton, Cherney & White 2008) It is important to recognize the various approaches to crime prevention, since there are repercussions for the determination of appropriate institutional and management arrangements needed to maintain specific crime prevention interventions. (Weatherburn 2004) Comprehending the various approaches

obtainable and their underlining rationale and concept is also essential to the development of efficacious crime prevention projects and programs. (Homel 2009)

For example, the environmental approach, which involves situational crime prevention methods and wider urban planning measures, seeks to address the physical environment in order to minimize possibilities for crime to occur. (Hughes 2007) The social approach relies on the inherent social and economic causes of crime in the community (e.g. lack of social cohesiveness, minimal access to public services, employment, health care and education services) and on reducing the supply of empowered offenders, including developmental prevention and community development components. (Sutton, Cherney & White 2008) The approach to criminal justice applies to the different services provided by the police, the courts and the probation to avoid recidivism for those individuals who have already participated in crime and who have interacted with the criminal justice system. (UNODC 2010)

Anti-criminal policy like any policy is a form of power-based social life organization that defines and guarantees institutions and proposes values. It is also a strategy and a tendency towards a goal dictated by some ideology. Boundaries in criminal policy are set before the commission of the crime (*ante delictum*) but also after the commission (*post delictum*).

Even if hormonal interpretations of for example female crime on the one hand cannot explain and analyze female crime and on the other hand reinforce the negative stereotype of the female gender as inherently more unstable than the male one, may cause the reaction of members of the feminist movement. As mentioned of several scientists, women may become more aggressive due to hormonal factors, but this does not mean that they cannot control their actions. Acceptance of this hormonal approach can lead to more lenient treatment of women by the penal system and stigmatization on the one hand.

Predisposition to violent activity is doubtful to be limited to one or two specific brain circuits, but is expected to include specific brain dysfunctions and multiple circuits that lead to various risk factors for crime. Thus, the potential use of brain imaging in the evaluation of the likelihood of criminal activity would entail a quite thorough understanding of these circuits. While brain imaging techniques have progressed rapidly over the last few years, there are still many

weaknesses to these techniques. (Wahlund, K. & Kristiansson, M., 2009) Nonetheless, with continuing empirical advances in neuroscience studies, researchers can obtain more knowledge about how brain structures function together to predispose to criminal activity. Neurocriminology interacts with the justice system at three primary levels: punishment, prediction and prevention. While it is doubtful that neurocriminology would result in some dramatic or substantial improvement in the operation of the criminal justice system in the very near future, it is not inconceivable that any significant progress may occur in such areas at some stage, given that the field continues to grow and evolve, as the last two decades have indicated. Rational capacity is usually explained by the fact that an individual knew what he or she was doing and recognized that his or her actions would have consequences. Unless biological factors could guarantee future violence beyond forecasts centered on social variables, then proponents of a neuroscientific crime viewpoint will have to accept that neurobiology has additional value.

Whether or not these biological factors are triggers or merely indicators of violence is irrelevant to the subject of prediction— the assumption that they provide predictive ability is the cornerstone of risk assessment in prisoners who are about to be released. Considering that approximately 50% of the variation in violent and antisocial behavior can be interpreted by genetic factors, it would seem that there is a persuasive argument for using biological knowledge to enhance the prediction of aggression. Nevertheless, as genome-wide studies have generally failed to classify unique genes that could account for more than 1% of variation in any complex behavioral trait, there is significant pause for thought. (Frazer et al, 2009; Hariri, 2009) In theory, molecular genetic advancements have the potential to further elucidate and classify particular genetic factors biological predisposition to crime in the future, but currently the utility of genotyping individuals to predict future violence is restricted. Remarkably, endophenotypes such as pre-frontal dysfunction and low heart rate, suggesting complex genetic and environmental factors, may currently reflect more of the variation in adult violence than any individual genotype, and may have more impact in predicting potential violence.

There are quite a variety of instances where bio-based evidence has been used as a mitigation element. *People v. Weinstein*, a New York state lawsuit, concerned a sixty-four-year-old accounting officer with no previous history of abuse or illegal behavior. One morning, during a

domestic argument, the accused exploded and strangled his spouse, then hurled her out of their twelfth-story window to make the incidence seem like a suicide. The defendant claimed insanity, using neuroimaging proof that he had a subarachnoid cyst and alleging that it had affected the functioning of his brain. His attorney suggested that, because of the cyst, the defendant "*lacked a substantial capacity to appreciate the criminality of his actions.*" Because the case was eventually settled before the court, the judge held that the neuroimaging proof was prosecutable. In *Weinstein*, it was not evident (and perhaps doubtful because of his apparently normal conduct) that the cyst actually induced the violent actions of the defendant; they only know that the cyst existed at the time of the violent behaviour. Notwithstanding this absence of a causal link, the judge was also able to accept this evidence at the trial. (*People v. Weinstein*, 591 N.Y.S.2d 715 (Sup. Ct. 1992))

In *Tennessee v. Waldroup*, the accused was charged with the gruesome murder of a friend of his pregnant wife's. The defense provided evidence of the defendant's potential for aggression due to genetic disorder and childhood abuse. Explicitly, the defendant was diagnosed with low-level monoamine Oxidase A (MAOA) genotype activity. Allegedly, the jury placed considerable emphasis on this genetic evidence, eventually sentencing the defendant to voluntary manslaughter instead of murder. One jury member said that "*evidence helped convince her that Waldroup was not fully in charge of his behavior,*" claiming that "[a] *diagnosis is a diagnosis. [b] Bad gene is a bad gene*". (Bradley Hagerty, 2010)

In another incident of genotyping evidence, the defendant accused with first-degree murder presented evidence of low serotonin levels in order to create a reduced defense capability. In the conclusion, the jury found him guilty of second-degree murder instead of first-degree murder, and it is probable that the court relied on this testimony to minimize the defendant's accusation. In fact, this case shows that the application of genotyping mitigation proof has the potential to support the accused in capital crimes. (*Tennessee v. Godsey*, No. E2000-01944-CCA-R3-CD, 2001 WL 1543474)

Moreover in an article of Times mentioned "A genetics argument in criminal court may make scientists squeamish, and Appelbaum says that should apply to civil court—which handles things

like divorce and some property damage cases—as well. An interesting case in Canada raised this red flag. In *Adacsi v Amin*, a woman named Tammy Adacsi sued her landlords after the house she was staying in caught on fire. She was hospitalized for months and claimed that her injuries prevented her from ever working again. The landlords demanded in court that Adacsi be ordered to submit a blood sample to test for whether she is a carrier of a gene mutation for Huntington's Disease, which runs in her family. The landlords argued some of her symptoms could be a result of that disorder. The court ruled in their favor. Appelbaum says it's not out of the question that a similar thing could happen in the U.S." (Sifferlin, 2014)

In reality, bio-based evidence would practically never have been generated without expert analysis. As a result, the significance of this proof is likely to be determined by interpretive expert testimony. The incorporation of bio-based evidence is capable of passing the first two phases of the admissibility inquiry. Ultimately, the criterion of "general acceptance" depends on the area from which the findings derive and is only as good as those which approve or reject the results. Some areas have potentially substituted critical judgment with consensus. In view of the potential for biobased forecasts to be more reliable and unbiased than the existing forecasting system, bioprediction should be introduced into the law as soon as biomarkers are verified in replication studies. The added advantage of bioprediction will be a more reliable prediction system with less false positives and false negatives.

As Bedard mentioned "In a hypothetical legal system that only uses biomarkers to predict for future dangerousness, the scheme might resemble the following. Any offender charged with a crime would be given both a structural and a functional MRI scan, and he or she would also provide a DNA sample. An expert would then analyze the neuroimages for any neural markers and the DNA for any genetic markers. Depending on which biomarkers the expert finds, the court would then determine the likelihood that the offender would commit a future criminal act and sentence accordingly (where the sentencing might include diversion to a treatment facility, civil commitment, or the death penalty)... Biomarkers could be integrated with actuarial assessments, structured clinical judgments, and clinical judgments. For biomarkers that are confirmed to relate to increased risk by a certain amount, clinicians could use this knowledge in making their

assessment by considering the biomarker as one of the patient's signs of mental abnormality.” (Bedard, 2017)

Few countries have made it possible to recognize potential dangerousness as a mitigation factor in capital punishment laws. For those countries, the defendant can, by means of expert testimony, character witnesses or arguments, provide proof of potential risk. A few jurisdictions, including California's, have common law prohibitions from litigation for offering expert evidence on the subject of potential hazards. Furthermore, even though potential dangerousness is not a statutory aggravating factor, it may still creep into evidence as the defendant presents similar facts. Provision of bio-based evidence in capital punishment cases will indicate that the court makes the most reliable decision possible before depriving a individual of life and liberty. (Bedard, 2017)

Moreover, identifying biomarkers can provide the framework for designing rehabilitation programs to help offenders prevent recurrence. In addition to determining broadly between treatment and commitment, potential jurisdictions will also be able to refer offenders to recovery facilities explicitly tailored for certain biological risk factors. Neuroscience and genomic technology have the ability to support jurisdictions identify biological root conditions—such as addiction and post-traumatic stress conditions—and to build recovery services explicitly for criminals with these disorders. (Bedard, 2017)

But all the above may arise several bioethical issues and concerns. Any individual assumes of their brains and genes as distinguishing features of themselves: a special aspect of them that makes them different from any other human. The use of the brain or genes of an individual in the courtroom can propose changes to the use of personal information, such as the disclosure of personal views and information. Collecting data from the brain and genes of a person may be considered an interference with the personality. Using this data to determine not only the probability of a person recidivate, but also to predict whether care will be successful will pose concerns that have not yet been addressed by jurisdictions. Biodata could possibly become quite sophisticated in the future that it could be used to classify individuals who are dangerous before they commit a serious crime and to place them in preventive care. The dilemma of whether it is

morally justifiable to punish an individual who has "bad genes" will certainly cause controversy among intellectuals. Some scholars believe that even if science might inform everyone that the physiology is the cause of human's actions, it would not change the law that those who commit criminal acts deserve to be punished.

Chapter 7

Discussion

High criminality is partly the price of democratic governance and respect for individual freedoms and procedural rights. The great difficulty lies in combining the two elements (social control and democratic rights) with the aim of an effective anti-criminal policy. In recent years, the crime rate has been on the rise worldwide, which rightly raises concerns for citizens. It is also differentiated from the classical forms of the past into new ones, taking advantage of the achievements of modern technology and taking advantage of the guarantees of open democratic states, finding suitable ground for development.

Crime as a social phenomenon is not detached from the wider space in which it appears and develops. Thus the rapid economic changes, unemployment, the transition of the economy to the globalization phase, the changes of policies in the neighboring countries of the Balkans and Eastern Europe, which have stuck hundreds of thousands of economic immigrants, have triggered the crime in our country. The consequences of crime are enormous both on a personal and financial level. Indicators of the levels of violence a society presents in space and time are the most reliable measure of social pathogenicity. The social and collective (financial, psychological, moral, etc.) costs of crime include all the direct and indirect damages that crime inflicts, both on citizens (already victims or potential victims) and on the state that has political responsibility for prevention, deterrence, suppression of crime. The causes investigated are biological on one hand (such as physical and mental properties, psychotic abnormalities, mental illness, race, gender, age) on the other social (family status, education, economic factor, occupation, climate, time of year, education, alcohol, gambling, drugs, indecent art, etc.). The means of combating crime are the various penalties, deprivation of liberty, security measures for adults, security measures for minors, penitentiary institutions for suspended sentence and suspended dismissal; social policy measures, protection of minors, crime prevention measures.

But the consequences of crime are not only limited to offending the personal belongings and rights of specific persons who are victims of illicit acts, but are also expanding dangerously, instantly creating a climate of insecurity for citizens, undermining the cohesion of the social fabric and threatening to democratize them.

Anti-crime policy is the responsibility of the state and is practiced by social workers, judges, police officers and, more generally, public authorities, both at the stage of crime prevention and repression. *Ceteris paribus* institutional intervention is a matter of paramount importance and is a matter of immediate priority. Due to the advancement of technology and the deepening of social sciences in areas related to biological and genetic sciences, concerns such as whether biology is directly linked to criminology or whether a criminal individual is born or influenced by his / her cultural environment remain as of today. Many scientists disclose that the dogmatic complexity of the sociological connection with criminal activity can overlook indications that many characteristics, including human interests and preferences, are significantly influenced by genetics. (Schermer and Vernon 2008) Research is examined on the connections between crime and multiple biological factors, namely testosterone, mesomorph, maternal smoking during pregnancy, hypoglycemia, epilepsy, altered heart rate and skin conductivity, cortisol, serotonin, monoamine oxidase, and certain brain wave patterns, as mentioned by Ellis. (2005)

Over 100 years ago, Lombroso [(1876/2006) in *Criminal Man* introduced a biological basis for criminal activity. Depending on the examination of the criminal skulls, he concluded that the difference in the cerebral hemisphere was among the 18 distinguishing features of the criminal brain. Furthermore, offenders were less lateralized than non-criminals. (Savopoulos & Lindell 2018) Crime associations are factors that have been consistently tested in connection to criminal activity, and have been confirmed to have clear (or at least fairly compatible) relationships with such behaviour. (Ellis. 2005)

As far as the dimension of the sex oriented criminal behavior, criminological approaches to various theoretical discrepancies, in so far as they deal with female criminality, tend to base their explanations on sexist assumptions and attribute some degree of "abnormality" to female criminal behavior. This also extends to hypotheses that are dismissive of the nature of male

crime. Thus, while the conceptions of male criminal activity prematurely denied the biological contentions of classical criminology and centered their arguments on the conceptions of the class and political nature of crime and the reaction to it (e.g. Marxist Criminology, New Criminology Criminology, the "label" theory), women's interpretations of crime have remained unproven until relatively recently. The basic principles for the biological interpretation of women's criminal behavior were established by theorists such as Lombroso and Ferrerò, W.J. Thomas, Otto Pollak during the "classical" era of criminology. The axiom of linking women's crime to the phases of the menstrual cycle has been successfully and unsuccessfully proposed for the judicial defense of women who have committed violent crimes. The argument, however, that premenstrual syndrome justifies part of female criminal behavior, adds scientificity and legitimacy to the argument that female behavior has a biological basis. To the extent that female biology changes (fluctuating hormones that cause disorders), women are considered unreliable. By extension, if women are oppressed by their unstable biology, they are considered ineligible to participate in a rationally organized and hierarchically superior public sphere, thus legitimizing any attempt to exclude them. (Chait Lind R., 1986)

There seems to be a lack of data that has evaluated public perception on the importance of biosocial impacts in comprehending the possible explanations of criminal and delinquent intervention. Gajos et al investigated this differential in the recent study by investigating a representative sample of adults on the significance of biosocial factors to influence criminal conduct. Results demonstrate that the general public thinks that the environment is more important than genetic factors that influence whether someone may become a violent offender. Though, the information collected also exposes an increased adoption of the significance of neuropsychological factors to the influence of criminal behavior. Results have also shown that income, sexual orientation, family status and employment status are considerably related to whether the participant claims to support the role of biosocial factors in the cause of crime. (Gajos et al, 2014)

While Beccaria had a clearly worded philosophy of law, there is no particular concern about the scope of the history of criminology. Although the theory of law did not rely on criminology, the jurisprudence does exist. Legislators do not identify components of individuals, groups,

interactions or economic behavior, but define crime, and these definitions differ slightly across time and space. Explanations about crime should be relevant to the legal system and the historical period and could not have the capacity for scientific (ie, universal) explanations. Thus, criminal laws can be divided into at least two categories:

1. Those who seek to control the behaviors that must be controlled (eg homicide) and
2. Those whose regulation reflects values and political decisions at a particular place and time (eg drug offenses). (Miller, 2009)

Often, studies of crime, violence and related behaviors emphasize the negative aspects of people's lives that are linked to or lead to divergence and crime. It is commonly reported that human relationships are more influenced by destructive encounters than by constructive or positive ones - "evil" is often considered more powerful than "good" (Baumeister et al., 2001). Prominent criminology theories tend to be examples of the dominant role of the bad ones in criminology.

Despite some criticism, several biological theories have been incredibly useful in getting scientific proof, and the studies used have been quantifiable and objective in such a way that they can be examined for accuracy. Lombroso's significant contributions include the development of the research of crime, the use of a medical model to interpret the analysis, the revolution in phrenology and atavism connected combined, and eventually the creation of a 'mind map' that could relate to new ways of approaching illegal activity and behaviour. Durkheim was unable to grasp the concept of crime and derogatory behavior without thinking and referring to the abolition of forced division of labor, the abolition of hereditary enrichment, and the creation of professional associations based on biological merit. For Marx, the concept of crime was incomprehensible without reference to the political and social context of the Lumpenproletariat, the most degraded social strata of the working class, the non-productive group. All cases of imprisonment are inextricably linked to the identification of aberrant behavior with pathology. A completely social theory of derogation must by its very nature be completely detached from correctionalism. The causes of crime must be closely linked to the form they are supposed to take from the social arrangements of each era. Crime is always and always behaviors that seem

problematic in the context of those social arrangements. The abolition of crime should therefore coincide with social arrangements, which should be subject to fundamental change in society. (Taylor et al, 2009)

To the degree that the origin of the criminal behavior is biological and the social conditions under which it manifests itself or is insensitive, or at best considered to be the catalyst for the biological / hereditary factors that determine it, any "therapeutic" action shall be legalized. In large extent, therefore, both the original biological interpretations of crime and later criminology theories advocate social control as a solution to the problem of crime. Criminal activity, its definition and characteristics are accepted as fact, and not only are they not contested, but are also considered to offend the hierarchical structure of the social organization, the widely accepted principles and values. At the same time, both law and science, in the sense of objectivity and fairness, advocate ideal models and require human actions to be adjusted to them. But the ideal human type, as promoted through supposed objectivity and neutrality, has, at a minimum, a specific gender and a specific social class. Institutional intervention is recognized not only at the level of the organization of the state, but also at the level of the state, the police, justice and the prison system, in the context of policies of action and control.

Conclusions

Criminology, despite the intellectual rigour of the biological sciences, has historically reviled biological interpretations. Indeed, in recent years, an overwhelming number of criminologists have incorporated biological, neurological, genetic and neuropsychological paradigms and environmental mechanisms into their research. (Wright, J. P., & Boisvert, D. 2009)

Crime is a subject of fundamental interest to public opinion, scientists and politicians, and impacts innumerable areas of social organization. Theoretical interpretations of criminal conduct are of particular importance, by association. The nature of crime must be recognized in all its proportions (gender, class, national, etc.) and, in particular, must be viewed as a product of the changing social conditions produced by the constant conflicts between different interests, different wealth, different power and different sex.

A variety of factors have been described as relating to the successful implementation of developmental crime prevention programs, namely the value of approaches to make services affordable, to keep people engaged and to avoid stigmatizing young people or families at risk and the value of comprehensive evaluation of community readiness as a key component of the programs. (Crow et al. 2004)

"Ensuring that no one is left behind" is perceived to be a fundamental principle of justice. This aspect can only be focused on the rule of law, an efficient criminal justice system, the security of victims of crime and the prevention of transnational organized crime and corruption. It is obvious that every governmental party should regard prevention of crime as a national priority. In a well-governed society, the social subject should feel secure in order to be comfortable and productive. The sense of crime control has a minimized meaning as crime prevention is the "step" before control and this should lead in minimized crime levels. The pillars of public values and education tend to be helpful for every aspect of crime prevention and control afterwards. Moreover, the socio-economic marginalization or poverty may also impede the normal socialization process and may function as a trigger to several personalities. Additionally, a social label or stigmatization of

individuals with a particular appearance due to hormonal malfunctions in many cases facilitates the path to antisocial behavior or delinquency.

Scientists and policy makers find that it would be important for researchers and practitioners to concentrate their energies on

- (1) developing creative and safe biological programs for the prevention of crime;
- (2) making an effort to improve the prediction of recidivism with socially acceptable precision, including neurobiological predictors;
- (3) incorporating empathy alongside awareness about how judicial leaders legally conceptualize responsibility;
- (4) considering the implementation of a relational definition of partial liability, and
- (5) exploring the thorny neuroethical consequences of this growing body of neurocriminology research that incorporates the possibilities for criminal medicalization (e.g. seeing crime as a result of psychological deficits),

Determining "responsibility" and measuring "personal responsibility" are two age-old problems in the legal science. The cornerstone and prerequisite for criminal liability under Greek and Greek law, is the legal principle that "an act is not criminal if its mind is not guilty" (*actus non git reus misis mens sit*). Since then, every crime is punished by the criminal system only if it is consciously, willfully and voluntarily liable. However, in recent years, court decisions have been significantly influenced by current neuroscientific findings regarding its neurobiological causes and biological causes of human crime, based on the phrases "My Genes Made Me Do It"? Biomarkers and epigenetics may potentially be integrated into any of the three current statistical tools— clinical decisions, actuarial risk assessments, or standardized professional decisions. Whether the prosecution or the defense, depending on the state law, may use bio-based evidence to prove a probability of potential risk. Where the prosecutor presents bio-based evidence, Countries must be able to give expert counsel to indigent defendants.

Bibliography

Aharoni, E., Funk, C., Sinnott-Armstrong, W., & Gazzaniga, M. (2008). Can neurological evidence help courts assess criminal responsibility? Lessons from law and neuroscience. *Annals of the New York Academy of Sciences*, 1124(1), 145-160

Australian Institute of Criminology (AIC) 2003. Preventing repeat victimisation. *AICrime Reduction Matters* no.12. <http://aic.gov.au/publications/current%20series/crm/1-20/crm012.aspx>

Archer J (1994) TESTOSTERONE AND AGGRESSION, *Journal of Offender Rehabilitation*, 21:3-4, 3-25, DOI: 10.1300/J076v21n03_02

Bakirtzoglou, S. (2015). *Crime / Delinquency / Criminology*. Athens: National and Kapodistrian University of Athens. Available in Greek

Bartels M, van den Oord EJ, Hudziak JJ, Rietveld MJ, van Beijsterveldt CE, Boomsma DI (2004) Genetic and environmental mechanisms underlying stability and change in problem behaviors at ages 3, 7, 10, and 12. *Dev Psychol*. 2004 Sep;40(5):852-67

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology*, 5(4), 323–370.

Beach SRH, Brody GH, Todorov AA, Gunter TD, & Philibert RA (2011). Methylation at 5HTT mediates the impact of child sex abuse on women's antisocial behavior: An examination of the Iowa adoptee sample. *Psychosomatic Medicine*, 73, 83–87.

Bedard H, (2017) The potential for bioprediction in criminal law, *The Columbia Science & Technology Law Review*, Vol XVIII

Birger M., Swartz M, Cohen D, Alesh Y, Grishpan Ch and Kotelr M (2003) Aggression: The Testosterone-Serotonin Link, *IMAJ* 2003;5:653±658

Blair RJ (2007). The amygdala and ventromedial prefrontal cortex in morality and psychopathy. *Trends in Cognitive Sciences*, 11, 387–392.

Booth A, Granger D, Mazur A, Kivlighan K, (2006) Testosterone and Social Behavior, *Social Forces*, Volume 85, Issue 1, September 2006, Pages 167–191, <https://doi.org/10.1353/sof.2006.0116>

Bradley Hagerty, (2010) Can Your Genes Make You Murder?, NPR, <http://www.npr.org/templates/story/story.php?storyId=128043329>

Carrabine et al, (2009) *Criminology, a sociological introduction*, second edition, Taylor & Francis e-Library

Chait Lind R., 1986, «Premenstrual Syndrome and Our Sisters in Crime: A Feminist Dilemma», *Women's Rights Law Reporter*, 9 (3 και 4), σ. 267-293.

Crow I, France A, Hacking S & Hart M 2004. *Does communities that care work? An evaluation of a community-based risk prevention programme in three neighbourhoods*. York: Joseph Rountree Foundation

Denson et al (2018) *Aggression in Women: Behavior, Brain and Hormones*, *Front Behav Neurosci*. 2018; 12: 81.

Drapkin I, (1983) *Criminology: Intellectual History*, S. E. Kadish, ed., *Encyclopedia of Crime and Justice*, v. 2, New York

Ellis L. (2005) A Theory Explaining Biological Correlates of Criminality. *European Journal of Criminology*, 2(3), 287–315. <https://doi.org/10.1177/1477370805054098>

Ellis L, Shyamal D, Buker H., (2008) Androgen-promoted physiological traits and criminality: A test of the evolutionary neuroandrogenic theory, *Personality and Individual Differences*, Volume 44, Issue 3, February 2008, Pages 701-711

Ellis & Hoskin, (2015) The evolutionary neuroandrogenic theory of criminal behavior expanded, *Aggression and Violent Behavior*, Volume 24, September–October 2015, Pages 61-74

Farsedakis, I. (1996), *Elements of Criminology*. Athens: Law Library. Available in Greek

Farsedakis, (2005) Elements of Criminology. Athens: Law Library. Available in Greek

Frazer, K.A., Murray, S.S., Schork, N.J. & Topol, E.J. (2009) Human genetic variation and its contribution to complex traits. *Nat Rev Genet* 10, 241-51 .

Gajos J, Beaver K, Gertz M & Bratton J (2014) Public Opinion of Genetic and Neuropsychological Contributors to Criminal Involvement, *Journal of Criminal Justice Education*, 25:3, 368-385, DOI: 10.1080/10511253.2014.919010

Greely & Farahany, (2019) Neuroscience and the Criminal Justice System, *Annual Review of Criminology* 2019 2:1, 451-471

Hariri, A.R. (2009) The neurobiology of individual differences in complex behavioral traits. *Annual Review of Neuroscience* 32, 225-247

historyextra.com, The 'born criminal'? Lombroso and the origins of modern criminology, accessed November 2019

Hiramatsu H, Morishima T, Nakanishi H et al (2008) Successful treatment of a patient with Klinefelter's syndrome complicated by mediastinal germ cell tumor and AML(M7). *Bone Marrow Transplant* 41(10):907–908

Hoffman, Schorge, Schaffer, Halvorson, Bradshaw, Cunningham, (2012) *Williams Gynecology*, Second Edition, The McGraw-Hill Companies, Inc., ISBN: 978-0-07-180465-3

Homel P 2009. Lessons for Canadian crime prevention from recent international experience. *IPC Review* 3: 13–39.

Hughes G 2007. *The politics of crime and community*. Basingstoke: Palgrave/MacMillan

Institute for the Prevention of Crime (IPC) 2008. *What is crime prevention?* Canada: University of Ottawa. <http://www.sciencesociales.uottawa.ca/ipc/eng/>

Kline-Fath B., Bulas D., Bahado-Singh R, (2015) *Fetal Imaging Ultrasound and MRI*, Wolters Kluwer Health, ISBN 978-1-4511-7583-7

Kourakis, N. (ed.) 2006. Gendered Crime. Criminal and criminological approach to gender. Athens-Komotini: Sakkoula, available in Greek

Leaute J, (1972) Criminologie et science pénitentiaire, Paris

Lee YS, Cheng AW, Ahmed SF et al (2007) Genital anomalies in Klinefelter's syndrome. Horm Res 68(3):150–155

Linden MG, Bender BG, Robinson A (1996) Intrauterine diagnosis of sex chromosome aneuploidy. Obstet Gynecol 87(3):468–475

Ling, S., Umbach, R., & Raine, A. (2019). Biological explanations of criminal behavior. Psychology, crime & law : PC & L, 25(6), 626–640. doi:10.1080/1068316X.2019.1572753

Matthies S, Rüsçh N, Weber M, Lieb K, Philipsen A, Tuescher O, Ebert D, Hennig J & Tebartz van Elst L (2012) Small amygdala – high aggression? The role of the amygdala in modulating aggression in healthy subjects, The World Journal of Biological Psychiatry, 13:1, 75-81, DOI: 10.3109/15622975.2010.541282

McLaughlin, Muncie John, The Sage Dictionary of Criminology, 2001, London, Sage

Miller M (2009) Criminology, a reference handbook, SAGE Publications, Inc

Morrison W, (1995) Theoretical Criminology: from modernity to post-modernity, Great Britain

Moulin, V., Palaric, R., & Gravier, B. (2012). Quelle position professionnelle adopter face à la diversité des problèmes posés par l'évaluation des dangersités?. L'Information Psychiatrique, 88(8), 617-629

Paduch DA, Bolyakov A, Cohen P et al (2009) Reproduction in men with Klinefelter syndrome: the past, the present, and the future. Semin Reprod Med 27(2):137–148

Pajer K, Gardner W, Rubin RT, Perel J, Neal S. Decreased Cortisol Levels in Adolescent Girls With Conduct Disorder. Arch Gen Psychiatry. 2001;58(3): 297–302. doi:https://doi.org/10.1001/archpsyc.58.3.297

Pardini DA, Raine A, Erickson K, & Loeber R (2014). Lower amygdala volume in men is associated with childhood aggression, early psychopathic traits, and future violence. *Biological Psychiatry*, 75, 73–80.

Raine A (2018). Antisocial personality as a neurodevelopmental disorder. *Annual Review of Clinical Psychology*, 14, 259–289.

People v. Weinstein, 591 N.Y.S.2d 715 (Sup. Ct. 1992)

Savopoulos & Lindell (2018) Born criminal? Differences in structural, functional and behavioural lateralization between criminals and noncriminals, *Laterality*, 23:6, 738-760, DOI: 10.1080/1357650X.2018.1432631

Schermer JA, Vernon PA (2008) A behavior genetic analysis of vocational interests using a modified version of the Jackson Vocational Interest Survey. *Personal Individ Differ* 45:103–109

Schur, E. (1965) *Crimes without Victims: Deviant Behavior and Public Policy*, Englewood Cliffs, NJ: Prentice Hall.

Sifferlin A (2014) Genetics In Court Is a Very Messy Business, *Time*, <https://time.com/2822174/genetics-in-court-is-a-very-messy-business/> accessed February 2020

Sisk and Zehr, (2005) Pubertal hormones organize the adolescent brain and behavior, *Frontiers in Neuroendocrinology*, Volume 26, Issues 3–4, October–December 2005, Pages 163-174

Soudek D. (2008) Longer Y chromosome in criminal clinical genetics, volume 6, issue 3, pages 225-229

Spinelli, K. (2014). *Criminology: modern and past approaches*. Athens: Law Library., available in Greek

Stattin & Romelsjo, (1995) Adult mortality in the light of criminality... , *Criminal Behaviour and Mental Health*, 5, 279-311

Stochholm K, Bojesen A, Jensen AS, et alCriminality in men with Klinefelter's syndrome and XYY syndrome: a cohort study *BMJ Open* 2012;2:e000650. doi: 10.1136/bmjopen-2011-000650

Sutherland, D. Cressey, (1974) *Criminology*, 9th ed. Philadelphia / N. Y. / Toronto

Sutton A, Cherney A & White R 2008. *Crime prevention: Principles, perspectives and practices*. Port Melbourne, Victoria: Cambridge University Press

Taylor I., Walton P , Young J (2009), *The new criminology : For a social theory of deviance*, Ed International Library of Sociology edited by John Rex

Tennessee v. Godsey, No. E2000-01944-CCA-R3-CD, 2001 WL 1543474, at *3 (Tenn. Crim. App. Dec. 4, 2001)

Terbung et al, (2009) The testosterone–cortisol ratio: A hormonal marker for proneness to social aggression, *International Journal of Law and Psychiatry* 32 (2009) 216–223

Trivizas, E. (1993-1995). Pre-menstrual syndrome and female crime. *Greek Journal of Criminology*, 11-16, pp. 67-112.

United Nations Development Fund for Women (UNIFEM), (2015) *International Humanitarian Law, International Criminal Law, International Criminal Court, United Nations Latin-American Institute for Crime Prevention and Treatment of Offenders*

United Nations Office on Drugs and Crime (UNODC) 2010. *Handbook on the crime prevention guidelines: Making them work*. Vienna: UNODC

Wahlund, K. & Kristiansson, M. (2009) Aggression, psychopathy and brain imaging - Review and future recommendations. *International Journal of Law and Psychiatry* 32, 266-271

Weatherburn D 2004. *Law and order in Australia: Rhetoric and reality*. Leichhardt, NSW: The Federation Press

Wikstrom AM, Dunkel L (2008) Testicular function in Klinefelter syndrome. *Horm Res* 69(6):317–326

Wright, J. P., & Boisvert, D. (2009). What Biosocial Criminology Offers Criminology. *Criminal Justice and Behavior*, 36(11), 1228–1240. <https://doi.org/10.1177/0093854809343140>

Vidali S. (2014) Criminal policy. From micro crime to organized crime. Law Library, Athens (available in Greek)

Vold George, Bernard, Thomas, Snipes, Jeffrey, Theoretical Criminology, 2002, London, Oxford University

Zarafonitou, C. (2004). Empirical Criminology. Athens: Law Library. Available in Greek

Zitzmann M (2006) Testosterone and the brain, The Aging Male, 9:4, 195-199, DOI: 10.1080/13685530601040679

(2009). THE CHICAGO SCHOOL AND CULTURAL/ SUBCULTURAL THEORIES OF CRIME.