

## BIOLOGICAL POSITIVISM: EVOLUTION, DEVELOPMENT AND CONTEMPORARY APPLICATIONS

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### ABSTRACT

*One of the most confounding questions as regards criminal behaviour is whether criminals are born or made (nature or nurture). For decades, social scientists have held to the postulation that criminal behaviour is almost autonomously caused by social factors. However, contemporary studies in the fields of genetics, evolutionary psychology and neuroscience have weakened that postulation. There is now compelling evidence that indicate that both biological and social factors are associated with criminal behaviour. Consequently, the criminology theory of biological positivism has once again gained momentum and as such this study seeks to trace the evolution, development and contemporary applications of biological positivism. The relationship of genetics, evolutionary psychology and neuroscience with criminal behaviour will be explored. Further, the implications of biosocial research on crime prevention will be highlighted.*

**Key Words:** Biological positivism, criminal behaviour, evolutionary psychology, genetics, neuroscience

## INTRODUCTION

The question of whether criminal behaviour<sup>i</sup> is caused by nature or nurture has invoked much debate among criminologists and still confounds many theorists and researchers (Fox 2017). Criminology has many theories that seek to answer that question. However, most of those theories are dichotomized according to nature and nurture, with nurture almost exclusively dominating social science research (Tielbeek *et al.* 2012; Fox 2017). Notwithstanding, as the *corpus* of empirical evidence on the association of both biological and social factors on criminal behaviour increases, a criminology theory that continues to be dichotomized diminishes its relevance.

Biological positivism remains relevant because its contemporary manifestation as the biosocial theory of criminology associates both biological and social factors with criminal behaviour as elucidated in the studies discussed in this article. Notwithstanding that biosocial criminologists have provided compelling evidence of the association of both biological and social factors with criminal behaviour, mainstream theories of criminology have not incorporated those findings (Barnes *et al.* 2014). It is pellucid that criminal behaviour must be explicated from a multidisciplinary standpoint; therefore, this article seeks to trace the evolution, development and contemporary applications of biological positivism. The article explores the relationship of genetics, evolutionary psychology and neuroscience with criminal behaviour and highlights implications of biosocial research on crime prevention.

## EVOLUTION OF BIOLOGICAL POSITIVISM

Biological positivism which is also referred to as the biological variant of the predestined actor model of crime and criminal behavior is anchored in the works of Lombroso, Ferri and Garofalo who postulated that criminology should be based on scientific studies (Burke 2014). The predestined model of crime and criminal behaviour

is also known as positivism which developed as a rejection to the rational model of crime and criminal behaviour (Burke 2014). The rational model of crime and criminal behaviour is rooted in the belief that individuals possess free will and they make rational choices about their behaviour (Burke 2014). Positivism rejected the prominence of free will and postulated a paradigm based on determinism because it was believed that there were internal and external factors that influenced criminal behaviour that individuals had limited control over (Burke 2014).

The notion of evolution and science was one of the intellectual foundations of positivism (Burke 2014). Biology was significantly impacted by the works of Darwin which is said to signify the end of pre-scientific philosophy about human behaviour (Burke 2014). Social evolutionism<sup>ii</sup> which was greatly impacted by the works of Spencer who postulated that human characteristics are inherited was another intellectual foundation of positivism (Burke 2014). Spencer is acclaimed to have had the most profound influence on positivism (Burke 2014). Comte had also profoundly impacted positivism due to his postulation that data on human nature and society should be collected using the methods employed in the natural sciences (Burke 2014).

Lombroso is credited as being the father of modern criminology since he laid the scientific foundation for the study of criminology via the meticulous collection of data that was measurable and verifiable and subjected to rigorous analysis (Williams 2012). Lombroso was an Italian medical doctor who also pursued studies in psychiatry, hygiene, forensic medicine, anthropology and criminology. In 1863 he commenced teaching psychiatry, nervous pathology and anthropology at the University of Pavia and from 1871 to 1873 he was the director of the insane asylum in Pesaro, after which he became a fulltime professor of forensic medicine at the University of Turin (Mazzarello 2011). Lombroso gained infamy for his postulation that criminality, madness and genius all resulted from the same psychobiological condition of degeneration (Mazzarello 2011). The stimulus for that postulation was the physical abnormality he noticed

while examining the brain of a criminal. He attributed the brain abnormality to an evolutionary reversion.

Lombroso hypothesized that if a criminal was an evolutionary reversion, his anthropological features and physiological reactions would diverge from that of a normal 19<sup>th</sup> century man (Mazzarello 2011). In his early studies Lombroso studied the cadavers of executed criminals and concluded that criminals suffered from degenerate physical characteristics, such as, sloping foreheads, receding chins, unusual sized ears, twisted nose and very long arms attributed to earlier forms of evolution which made them atavistic (Burke 2014). Biosocial criminologists deemed Lombroso's works on physical attributes to be methodologically flawed and unscientific because the criminals in his studies were Sicilians who were different in appearance to Italians and as such they diverged on the hypotheses of the born criminal and atavism (Carrier and Walby 2014).

Notwithstanding the divergence of biosocial criminologists on Lombroso's hypothesis of the born criminal, that hypothesis permeates contemporary biosocial studies of genetics, evolutionary psychology and neuroscience as will shortly be discussed. Consequently, Lombroso's paradigm has been ptoleimized as opposed to revolutionized as proclaimed by new biosocial criminologists because biosocial criminology retains Lombroso's basic framework of the born criminal (Carrier and Walby 2014).

## **GENETICS AND CRIMINAL BEHAVIOUR**

It is commonly perceived that genetic explanations of the etiology of crime are new; however, such explanations are as old as the field of criminology and had profoundly shaped the thinking of Lombroso (Gibson 2002). Early studies on genetics and criminal behaviour employed the methodology of twin studies. Thus, a set of questions was administered to a sample of monozygotic (identical) twins and then those same questions would be administered to a sample of

dizygotic (fraternal) twins and the results were compared. If the results showed that the responses of the monozygotic twins were more similar than those of the dizygotic twins, it was assumed that this additional similarity was as a result of additional genetic similarity (Schwartz 2005). Schwartz (2005) criticized this assumption contending that it results in a misunderstanding between hypothesis testing and parameter estimation.

Hans Eysenck was one of the first social scientists to postulate that criminal behaviour may be influenced by factors that were not social (Rafter *et al.* 2016) and as such executed research on genetic and neurobiological influences on criminal behaviour utilizing twin data (Eysenck 1964). Eysenck and Prell (1951) executed an experimental study on the inheritance of neuroticism<sup>iii</sup>. Their sample comprised 25 pairs of monozygotic twins, 25 pairs of dizygotic twins and a control group of 21 children that suffered from neuroticism. Seventeen tests associated with personality were administered to the participants. The correlations derived for the monozygotic and dizygotic twins were 0.851 and 0.217 respectively which resulted in an  $h^2$  value of .810; thus, suggesting that heredity accounted for approximately 80% of individual differences in the neuroticism factor. They concluded that neuroticism is not a statistical artifact but comprised an inherited biological unit. Notwithstanding that the accuracy of their measurement may be questioned, Eysenck and Prell were the first to identify correlations between genetics and criminal behaviour (Fox 2017).

In the early stages of the development of the area of genetics and criminal behaviour, it was believed that genetic abnormality as in the case of the XYY syndrome (males being born with an extra Y chromosome) could be responsible for criminal behavior in males. The condition of males being born with an extra Y chromosome is a relatively common occurrence since 1 in 1000 male live births has the condition (Boyd *et al.* 2011). The XYY syndrome (Jacob's syndrome) hypothesized that males born with an extra Y chromosome were prone to aggressive behaviour<sup>iv</sup> and were more likely to commit crimes. In 1965 Jacobs *et al.* (whom the syndrome was named after)

executed a chromosome survey of 197 male patients (psychopath criminals) at the State Hospital in Carstairs, Scotland, 7 of which were found to have the XYY condition. They found that there was an increased frequency of males with the XYY condition in the institution; however, it was not pellucid whether this increased frequency was caused by aggression or mental subnormality<sup>v</sup> or both.

The further studies executed in the 1960s and 70s on the XYY syndrome and criminal behaviour showed an apparent over-representation of men with this condition in prisons (Finley *et al.* 1973). However, the studies executed on the XYY syndrome were discredited for flawed methodology and lack of empirical support for the correlation between an extra Y chromosome and criminal behaviour (Stochholm *et al.* 2012; Burke 2014). The most profound weakness of the theory lies in the fact that there are many normal and harmless males with an extra Y chromosome (Burke 2014).

As regards methodological flaws of the XYY studies, according to Stochholm *et al.* (2012) the studies executed have been confined to selected groups of persons of either institutionalized or clinic patients; the sample sizes were small; control groups were poorly defined; types of crimes were inadequately defined; and the studies relied on self-reporting of crimes (See: Jacobs *et al.* 1965; Casey *et al.* 1966; Price and Whatmore 1967; Welch *et al.* 1967; Hook and Kim 1970; Witkin *et al.* 1976; Nanko, 1979; Schröder *et al.* 1981; Fryns *et al.* 1995; Götz *et al.* 1999; Briken *et al.* 2006 and Gosavi *et al.* 2009).<sup>vi</sup> Re and Birkhoff (2015) reviewed 50 years of data on the XYY syndrome and its correlation to deviancy<sup>vii</sup> which included *inter alia* the studies executed from Jacobs *et al.* (1965) to Stochholm *et al.* (2012)<sup>viii</sup> and not surprisingly found that there was no compelling evidence that a male with an extra Y chromosome will be an antisocial<sup>ix</sup> or deviant individual.

Contemporary research has shown that there exist no genes that are responsible for criminal behaviour; rather there are genes that may contribute to specific traits, for instance, aggression, low intelligence<sup>x</sup>, low empathy<sup>xi</sup> and impulsiveness<sup>xii</sup> which when

combined with detrimental environmental factors increases the probability of criminal behaviour (Walsh 2014). Thus, the underlying core principle of biological positivism has shifted from biological determinism to biological predisposition to do harm which illuminated the ptolemization of Lombroso's theory (Carrier and Walby 2014). Notwithstanding, the idea of the environment influencing behaviour is not novel since in later works Lombroso had started to explore the effects of the environment on criminality (Burke 2014).

The study executed on the Dutch Family Criminal Kindred provided compelling evidence that there are genes that maybe linked to traits which when combined with detrimental environmental factors result in criminal behaviour. Fourteen males from the Dutch family in the study by Brunner *et al.* (1993) suffered from a condition that caused them to exhibit borderline mental retardation, impulsive and abnormal behaviours<sup>xiii</sup> and for some, serious physical violence. Records from the town which the family resided indicated that the males in the family had displayed these behaviours for generations. Since the condition only affected the males in the family, Brunner *et al* hypothesized that the gene that caused this condition would be found on the X chromosome.

Brunner *et al.* (1993) tested their hypothesis by using genetic linkage analysis and found that all the males who displayed this condition had a rare mutation which caused them to lack the Monoamine Oxidase A (MAOA) gene and as such could not produce the MAOA enzyme. The MAOA gene codes for the production of the MAOA enzyme which breaks down neurotransmitters which causes nerve impulses to be active or inactive. The males in the family who had the MAOA gene did not display criminal behaviour. It was not until twenty years later that the mutation identified in the Dutch family study was identified in two other families and documented by Piton *et al.* (2013) whose study confirmed the findings of Brunner *et al.* (1993) that the MAOA mutation was linked to mild mental retardation and abnormal behaviour.

Contemporary research on the link between MAOA variants and violence has shown that there is not a direct or main association between MAOA and antisocial behaviours (Ferguson and Beaver 2009). Notwithstanding, there is a remarkable amount of research that shows that low levels of MAOA activity alleles may increase aggression and violence when coupled with adverse environmental conditions as elucidated in the study by Caspi *et al.* (2002).

Caspi *et al.* (2002)<sup>xiv</sup> executed a longitudinal study on the role of the MAOA gene in the cycle of violence in abused (sexual and physical) children in order to determine why some abused children grow up to develop antisocial behaviour (which increases the probability of criminality) and others do not. The sample comprised males from the Dunedin Multidisciplinary Health and Development Study. Approximately 12% of the sample were abused and had low MAOA activity allele and this 12% were responsible for 44% of the convictions for violent crimes. The researchers found that MAOA moderated the effect of the abuse and those who had high levels of MAOA were less probable to develop antisocial behaviour which offered a partial explanation to why not all abused children grew up to victimize others (Caspi *et al.* 2002). Independently genetic (low MAOA) and environmental (maltreatment) risk factors had little effect on antisocial behaviour but when combined they significantly increased the risk of criminality (Caspi *et al.* 2002).

Within approximately the last three decades, one of the most persistent issues related to genetic research is genetic discrimination<sup>xv</sup> (Otlowski *et al.* 2012; Joly *et al.* 2017). Historically, genetic explanations of human behaviour were used to further forms of discrimination such as racism, eugenics<sup>xvi</sup>, sexism; the postulation that there are racial differences in intelligence; and discrimination pertaining to employment and insurance coverage (Gostin 1991; Dolgin 2001; Ferguson and Beaver 2009). Genetic discrimination may lead to similar adverse effects as other forms of discrimination, for instance, social exclusion, loss of opportunities and psychological sufferings (Van Hoyweghen and Horstman 2008). Further, genetic discrimination generates anxiety which may result in individuals

declining to take part in genetic research and even refusing to take genetic tests recommended for medical purposes (Wauters and Van Hoyweghen 2016).

Cognizant of the potential for the abuse of genetic information, the concept of genetic exceptionalism emerged in the mid-1990s and advocated that genetic information is more sensitive than other types of medical information and as such warrants more robust protection (Murray 1997). Consequently, many developed countries formulated laws, policies and moratoria to address the issue of genetic discrimination (Joly *et al.* 2017). Notwithstanding, these initiatives have had some limitations, such as, inadequate public visibility, rigid formulation, offer limited protection and encompass convoluted administrative procedures (Joly *et al.* 2017).

## **EVOLUTIONARY PSYCHOLOGY AND CRIMINAL BEHAVIOUR**

The field of evolutionary psychology seeks to explicate human behaviour by using the history of human evolution as the reference point (Walsh 2014). Evolutionary psychology enhances the field of genetics because it provides the historical account of how genes in the human gene pool evolved (Walsh 2014). Notwithstanding, genetics examine what causes divergences in humans while evolutionary psychology examines the similarities in humans (Walsh 2014). Biologists generally agree that natural selection save and except in the case of mutation is the primary driving force for gene selection and population genetics (Gottschalk and Ellis 2009). Thus, if certain behaviour gives organisms a selective advantage, it is more likely that the genes that foster that behaviour will be passed down to future generations (Ferguson and Beaver 2009).

Criminologists have executed exploratory studies to show how criminal behaviours may have been adaptive from the environments of ancestors; for instance, behaviours exhibited in the quest for

reproductive triumph (Walsh 2014). According to Schwartz (2005), these studies amount to nothing more than stories after the fact and they cannot explain the complexities of human motivation, consequently, they are to be completely discarded. Notwithstanding, in light of contemporary empirical studies (Ellis and Walsh 2000; Beaver *et al.* 2008; Gou *et al.* 2008), evolutionary psychology appears to be more than stories as explicated in molecular genetics research which point to a significant relationship between sex partners and criminal behaviour.

An understanding of the evolutionary and biological processes of normal, adaptive aggression from which extreme violence originates is paramount to the comprehension of the processes which causes some humans to become genetically predisposed to extreme violence (Ferguson and Beaver 2009). Notwithstanding that there may be slight variations in the level of aggression in different cultures aggression pervades all human species (McCall and Shields 2008). Aggression is associated with increased reproductive triumph which is amplified by two ways: mating effort and parenting effort (Buss and Duntley 2006; Gottschalk and Ellis 2009). Males experience more sexual competition so they amplify their reproductive triumph by mating effort while females being more devoted to taking care of their progenies, amplify their reproductive triumph by parenting effort (Buss and Duntley 2006; Gottschalk and Ellis 2009). Thus, mating efforts correlate positively with greater aggression which is associated with violence (Gottschalk and Ellis 2009).

There is compelling empirical evidence that adult male criminal behaviour correlates positively with mating effort (Ellis and Walsh 2000; Beaver *et al.* 2008). These studies indicate that antisocial adult males reported having more than the average number of sex partners and also experienced sexual onset at an early age (Ellis and Walsh 2000). Ellis and Walsh (2000) executed a review of 51 studies which examined the relationship between number of sex partners and criminal behaviour and found that 50 of the studies showed a significant positive correlation between sex partners and criminal

behaviour. They further reviewed 31 studies that tested the correlation between the age of onset of sexual intercourse and antisocial behaviour and found that all of the studies showed a positive correlation between early age of onset of sexual intercourse and greater involvement in criminal behaviour.

Beaver *et al.* (2008) tested the hypothesis that most antisocial persons should have the greatest number of sex partners using data obtained from the National Longitudinal Study of Adolescent Health (Add Health). In wave 3 of the Add Health study the respondents who had attained ages between 18 and 26 years were asked *inter alia* about their sexual experiences, marital history, contact with the criminal justice system and involvement in serious violent behaviour. Further, a subsample participated in DNA testing for genetic polymorphism such as the Dopamine Transporter (DAT1) gene. Beaver *et al.* (2008) examined whether variants of the DAT1 gene correlated with number of sex partners and adult criminal behaviour. They found firstly, that there was a strong positive relationship between sex partners and antisocial behaviour since the same polymorphism of the DAT1 gene which related substantially to number of sex partners also related substantially to antisocial behaviour. Secondly, the variation in both the number of sex partners and male criminality was explained by the variation in the DAT1 gene. Further, in addition to number of sex partners and the DAT1 gene, age was also a statistically significant predictor of criminal behaviour for adult males.

Notwithstanding that the study executed by Beaver *et al.* (2008) was possibly the first study to show that the covariation between mating effort and criminal behaviour was associated with a common genetic route, the researchers did illuminate some limitations in their study. Thus, the genetic subsample from the Add Health may not have been nationally representative and as such generalizations about the larger population must be approached cautiously. Further, given that both the number of sex partners and criminal behaviour are possibly created by multiple genes and the study only examined one gene, there needs to be more research in the area. In addition, the study

was limited to only males.

Similarly, a study executed by Guo *et al.* (2008) showed a positive correlation between sexual partners and delinquency<sup>xvii</sup> due to the DAT1 gene. Guo *et al.* (2008) found that in order to explain a human trait or behaviour, a theory that facilitated the intricate interaction between social circumstantial and personal influences and genetic susceptibilities may be required. That postulation illuminated the gene and environment shift in contemporary biological positivism and gave credence to Schwartz's (2005) contention that pure evolutionary psychology studies cannot explain the complexities of human motivation, which must be done through multidisciplinary studies as are currently being executed by biosocial criminologists.

## NEUROSCIENCE AND CRIMINAL BEHAVIOUR

Neurocriminologists view the brains of criminals as different due to environmental events or the presence of genes coded for structural pathologies (Carrier and Walby 2014). From the perspective of methodology, contemporary neurophysiological examinations are probably the criminological practices that bear the closest proximity to that of Lombroso's as regards studying abnormalities (Carrier and Walby (2014). Contemporary studies showed that malfunctions of the brain can partially account for criminality as exemplified by Lee *et al.* (2008) who executed research on functional magnetic resonance imaging (fMRI) and spousal abusers<sup>xviii</sup>.

Prior to the execution of the study by Lee *et al.* (2008) spousal abuse was almost purely viewed from a social standpoint. The network of regions of the brain associated with emotional regulation includes *inter alia* the prefrontal cortex, amygdala, hypothalamus, anterior cingulate cortex, insular cortex and ventral striatum (Lee *et al.* 2008). An inhibitory connection between the frontal and limbic regions causes negative emotion to be suppressed (Davidson *et al.* 2000; Bush *et al.* 2000). Consequently, Lee *et al.* (2008) hypothesized that if one or more of these regions or their interconnections have

abnormalities (functional or structural) the propensity for impulsive aggression is likely to increase due to negative emotion not being successfully suppressed.

In order to test their hypothesis, Lee *et al.* (2008) performed cognitive and emotional Stroop tasks executed in block on 10 male spousal abusers and 13 controls. The brain activities of the men were monitored during the cognitive and emotional Stroop tasks by a 3T Philips Achieva scanner. On the emotional Stroop task, the spousal abusers responded to negative stimuli relatively slower than they did to neutral stimuli. On the other hand, the cognitive Stroop task revealed no significant group-by-condition interaction. The fMRI data which was analysed using SPM2.7 revealed that when responding to aggressive words the spousal abusers when compared with controls showed less activation of the left middle frontal gyrus, right anterior cingulate gyrus, left calcarine fissure, left lingual gyrus, left fusiform and left middle and inferior temporal gyri. However, the right amygdala, right hippocampus, right parahippocampal gyrus, right insula, right calcarine fissure, right middle occipital gyrus, right fusiform, right superior and middle temporal gyri, right caudate nucleus, left middle cingulate gyrus and left precuneus of the spousal abusers showed activation when responding to aggressive words.

Bueso-Izquierdo *et al.* (2016) also executed neuroimaging testing on batterers but they deviated from Lee *et al.* (2008) by comparing the brain functioning of batterers with those of other criminals. Their study signified the first time that batterers were compared with other criminals from a neuroimaging perspective. They compared the brain functioning of 21 batterers with 20 other criminals by showing them intimate partner violence images (IPVI), general violence images (GVI) and neutral images (NI) while scanning their brains with fMRI technology. They found that batterers when compared with other criminals as regards IPVI and NI comparisons displayed higher activation in the anterior and posterior cingulate cortex and in the middle of the prefrontal cortex and a decreased activation in the superior prefrontal cortex.

Bueso-Izquierdo *et al.* (2016) utilized paired t-test comparison between IPVI and GVI for each group and the results revealed as regards IPVI, only the batterers showed engagement in the medial prefrontal cortex, the posterior cingulate and the left angular cortices. Thus, the results of this study could be vital to a better comprehension of intimate partner violence which is a global phenomenon (Bueso-Izquierdo *et al.* 2016). Notwithstanding, the generalization of the findings of this study is limited by the sample size being relatively small which may have impeded statistical significance as regards some comparisons; the complexity of categorizing crime; the representativeness of the IPV group; lack of objective evidence of the stimuli being equally attended by both groups; and the sample of batterers who were first episode batterers and did not have a high severity of violence (Bueso-Izquierdo *et al.* 2016).

Notwithstanding, the advancements in technology of CT scans, MRI and fMRI which resulted in more advanced methodologies than that of past biological positivism theorists, the premise that remained constant was that abnormality may account (at least partially) for criminal behaviour; thus, resonating Lombroso's contention of born criminals.

## **IMPLICATIONS OF BIOLOGICAL RESEARCH FOR CRIME PREVENTION**

Early influence of biological factors on crime prevention evidenced calls for eugenics, a notion that is no longer acceptable given the preeminence of human rights in crime prevention policies. Thus, new biological crime prevention strategies significantly diverge from those of the past since these policies recognize the association of both biological and social factors with criminal behaviour. The crime prevention policies that developed focused on preventing the development of criminal potential (development prevention), changing social conditions and institutions (community prevention),

reducing opportunities for criminal behaviour and also making such behaviour difficult (situational prevention) and the traditional aims of punishment (criminal justice prevention) (Rocque *et al.* 2012).

When biological factors that predispose an individual to criminal behaviour are identified measures such as early family/parent training programmes (Piquero *et al.* 2009; Piquero *et al.* 2016) and self- control improvement programmes (Piquero *et al.* 2010) can be beneficial. Early family/parent training programmes, for instance, The Incredible Years, Triple P Parenting and Nurse Family Partnerships aim to equip families and parents with training and skills critical to the better socialization of their children (Piquero *et al.* 2016). In 2009 Piquero *et al.* executed a meta-analysis of 55 high quality early family/parent programmes and found that those programmes proved propitious to deterring antisocial behaviour later in life. In 2016, they updated their study by analyzing 23 more studies in addition to the 55 previously studied and found that early family/parent training programmes are effective evidence- based programmes for the prevention of antisocial and delinquent behaviour.

Biosocial research may be beneficial to the rehabilitation of offenders since programmes can be personalized to suit the needs of the particular offenders (DeLisi and Piquero 2011). According to Vaske *et al.* (2011, p. 97) “*efforts to move toward a biosocial theory of offender rehabilitation may provide a powerful rationale for why treatment intervention must be a core goal of the correctional enterprise.*” Notwithstanding, rehabilitation is sometimes prohibitively expensive and may cause policy makers to opt for longer incarceration periods to prevent reoffending. Recently, a study executed by Umbach *et al.* (2015) on brain imaging and psychopaths<sup>xix</sup> (a relatively new development) found that psychopaths have amygdala impairments and prefrontal deficits which may help in explicating the development of fearlessness, loss of inhibition and lack of empathy in adolescents and that such knowledge left policy makers at crossroads. Policy makers will have to decide whether new biological interventions should be developed

to remedy brain pathologies and whether those findings provide a defense for psychopaths or justification for longer incarceration; however, they recommended dealing with psychopathy as treatable and the development of innovative treatment programmes based on neuroscience.

Given the findings of contemporary biosocial research, it is material to question whether the advancement in technology of DNA testing which identifies genes that make a person predisposed to criminal behaviour and/or brain imaging by CT scans, MRI and fMRI technology which shows brain pathologies linked to criminal behaviour will result in offenders with those abnormalities being incarcerated longer to prevent them from committing more crimes and being sterilized in the case of hereditary pathologies, or even facilitate women having abortions out of the fear of giving birth to children with criminal tendencies.<sup>xx</sup>

## CONCLUSION

While biological positivism has not lost its focus on scientific methods, there were vast developments in underlying core principles, moving from a paradigm focused on physical attributes and criminal behaviour to that of gene and environment interactions. In the field of genetics and criminal behaviour there were profound developments in terms of postulations and methodologies due to advancements in technology. There was a shift from the early postulation of genes being responsible for criminal behaviour to genes and the environment contributing to traits that are linked to criminal behaviour. Further, there were advancements in methodologies from twin studies to DNA testing as exemplified by the MAOA gene studies executed by Brunner *et al* (1993) and Caspi *et al.* (2002). This shift resulted in biological determinism being replaced with biological predisposition which was essentially a Lombrosian ptolemization.

Evolutionary psychology has moved from after the fact stories on adaptive behaviours and criminal behaviour to molecular genetics studies on gene and environment interactions as elucidated in the DAT1 gene studies executed by Beaver *et al.* (2008) and Guo *et al.* (2008). The field of neurocriminology reverberated Lombroso's postulation of the born criminal albeit its divergence in terms of focusing on brain abnormalities as opposed to physical abnormalities. Contemporary neurocriminologists have benefitted methodologically from advancements in technology, for instance, MRI, fMRI and CT scans which allowed them to image the brains of criminals in order to identify pathologies which may partially explain criminal behaviour as illuminated in the studies executed by Lee *et al.* (2008) and Bueso-Izquierdo *et al.* (2016).

Biosocial research has influenced contemporary crime prevention strategies which significantly differ from the strategies in the past that called for eugenics because such research is premised on the postulation that both biological and social factors are associated with criminal behaviour. Biosocial research has influenced the formulation of programmes that seek to prevent the development of criminal behaviour, for instance, early family/parent programmes. Early family/parent programmes have proven propitious in the reduction of antisocial behaviour in later years of children who were predisposed to criminal behaviour as elucidated in the studies executed by Piquero *et al.* (2009, 2016). Biosocial research can also be instrumental in personalizing treatment for offenders. However, cognizance must be given to the fact that rehabilitative programmes are sometimes prohibitively expensive and may result in policy makers opting for longer incarceration periods to prevent criminal behaviour. Biosocial research also has the potential to facilitate a reversion to eugenics since some individuals may find that having children that are predisposed to criminal behaviour is undesirable. Time will reveal what humanity will do with these new findings.

## ENDNOTES

- <sup>i</sup> Criminal behaviour refers to any act that contravenes criminal law.
- <sup>ii</sup> Theories that seek to explicate why and how modern cultures diverge from past cultures.
- <sup>iii</sup> Neuroticism refers to being perpetually in a negative emotional state.
- <sup>iv</sup> Act/s intended to cause harm to others.
- <sup>v</sup> Mental subnormality refers to mental capacity being developed incompletely or insufficiently. Mental retardation, now called intellectual disability is subsumed under mental subnormality.
- <sup>vi</sup> These studies are briefly summarized to highlight methodological flaws and findings. Casey *et al.* (1966) surveyed 942 mentally subnormal patients, 21 had the XYY condition and they found these males to be more violent and aggressive. Price and Whatmore (1967) surveyed 342 male patient's at a Scottish State maximum Security Hospital at Carstairs, 9 had the XYY condition and the condition was said to be associated with personality disorder and cognitive impairment. Welch *et al.* (1967) surveyed 21 inmates who were more than 187 cm tall (it is contended that males with XYY grow taller), one had the XYY condition and they found that it was impossible to associate the condition with aggression, deviancy or low intelligence. Hook and Kim (1970) surveyed 337 juvenile offenders less than 16 years old, 4 had the XYY condition and they found that those boys had committed more crimes than the XY boys who were taller than 184cm, 2 had the XYY condition. They found that 41.7% of these males had committed one or more crimes as opposed to 9.3% of XY males. Further XYY males had lower intelligence levels which the researchers believed accounted for the incidence of antisocial behaviour. Nanko (1979) surveyed 1371 juvenile delinquents in Yokohama Juvenile Detention and Classification Home, 5 had the XYY condition and they found that these males had an increased frequency in violent behaviour. Schröder *et al.* (1981) surveyed 1040 criminals in Finland undertaking mental examination between 1972 and 1979, 9 had the XYY condition. It was found that the delinquency of these men was associated with intelligent defect and abnormality of their central nervous systems. Fryns *et al.* (1995) surveyed 98,735 male patients at the Leuven Center for Human Genetics from 1968 to 1992, 50 had the XYY condition. They found that the XYY males

with mild to borderline mental retardation had higher behavioural abnormalities. Götz *et al.* (1999) studied 16 XYY male infants and 45 controls and found that XYY males had low intelligence and marginally increased antisocial behaviour. Briken *et al.* (2006) studied 13 sexual offenders, 3 were XYY males and they concluded that there was a high frequency of XYY males in sexual homicide. Gosavi *et al.* (2009) examined 94 murders who were convicted in Nagpur, 2 were XYY males. They concluded that while there was an association between XYY and criminal behaviour larger studies have to be done.

<sup>vii</sup> Deviancy refers to actions that do not conform to social norms.

<sup>viii</sup> Stocholm *et al.* (2012) studied 161 XYY male criminals aged 15 to 70 and found that there was a moderate increase in the overall risk of conviction for XYY men which was similar to controls (15365 males) when socioeconomic parameters were adjusted. They concluded that poor socioeconomic conditions associated with the chromosome abnormality may explain the increased risk of convictions partly or fully.

<sup>ix</sup> An antisocial display antisocial behaviour which refers to acts characterized by overt and covert hostility and intentional aggression.

<sup>x</sup> Low intelligence refers to inability or limited ability to learn, reason and solve problems.

<sup>xi</sup> Low empathy refers to little ability to feel and share the emotions of others.

<sup>xii</sup> Impulsiveness refers to the inability to control one's behaviour.

<sup>xiii</sup> Abnormal behaviour is behaviour that deviates from what society conforms as normal behaviour.

<sup>xiv</sup> The study by Caspi *et al.* (2002) was replicated by Ferguson *et al.* (2011) and the findings on the correlation between genes and environment and antisocial behaviours were in keeping with Caspi *et al.* (2002).

<sup>xv</sup> Genetic discrimination is defined by Gostin (1991 p. 10) as “*the denial of rights, privileges or opportunities on the basis of information obtained from genetically-based diagnostic and prognostic tests.*”

<sup>xvi</sup> Eugenics emerged in Europe and North America from the late 19<sup>th</sup> century to post World War 2 as a movement aimed at improving the genetic pool through the eradication of genes which were believed to be responsible for undesirable behaviours, such as, criminality, psychiatric disorders and mental retardation (Savulescu *et al.*

2006). Thus, individuals with these supposedly inferior genes were discouraged from reproducing to the extent that sterilization was sometimes forced upon them (Savulescu *et al.* 2006) as exemplified in the case of *Buck v. Bell* where the State of Virginia decided that it had the right to sterilize Carrie Buck, a judicial decision that was never overturned (Goldstein 2016).

<sup>xvii</sup> Committal of a crime that is usually minor in nature.

<sup>xviii</sup> Further, Schlitz *et al.* (2013) who studied MRI and computerized tomography (CT) brain scans from prisoners found that violent prisoners had high levels of brain pathology. Their sample comprised 162 violent offenders and 125 non-violent offenders not previously considered neuropsychiatrically ill and 52 non-offending controls. It was found that offenders displayed a significantly greater rate of morphological abnormality and violent offenders displayed a significantly greater rate than non-violent offenders and controls. There was a statistically detectable difference for the frontal/parietal cortex, medial temporal structures, third ventricle and the left but not the right lateral ventricle.

<sup>xix</sup> Psychopaths are individuals that exhibit *inter alia* antisocial behaviour, low empathy and egotistical behaviour.

<sup>xx</sup> Savulescu *et al.* (2006) argued that if indeed genetics is a predictor of criminal tendencies and avoidance of harm is of paramountcy a eugenic selection is acceptable when genetic selection is employed over genetic enhancement. They further argued that such a course of action can mitigate the moral problems associated with having children with a propensity of criminality (Savulescu *et al.* 2006). Notwithstanding, human germline gene editing or human germline modification has been considered off-limits for safety and social reasons and is legally prohibited in over 40 countries (Center for Genetics and Society, 2016). Further, the experiments conducted in China on editing the gene associated with the blood disease beta-thalassemia (published in 2015) and editing the gene associated with resistance to the HIV virus (published in 2016) using CRISPR (*Clustered Regularly Interspaced Short Palindromic Repeats*) in non-viable human embryos were unsuccessful to a great extent (Center for Genetics and Society, 2016). However, as the tools for editing genes become more refined, their accuracy in gene insertion and deletion is projected (Center for Genetics and Society 2016).

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