

Biology and Criminal Behavior: Neurotransmitters, Neurohormones and Brain Damages

Literature Review

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Abstract

The radical development of biological sciences offers new data for understanding the multiplicity of human behavior. The innovations of biological sciences encouraged the investigation of various kinds of social disorders which vary from alcoholism and depression and extend into various types of psychological disorders. Research interest focuses on associating criminal behavior and genetical factors to the expression of criminal behavior. The existence of a biological substratum concerning the expression of violence and antisocial behavior has provoked conflicts and disagreements among scientists. This is mainly due to the fact that —so far— the investigation of criminal behavior has been based only on social and environmental factors. The present article provides a review of the literature of criminal behavior and argues for the core factors which prompt for the expression of criminal behavior. The article suggests that in order to understand the reasons why criminal behavior is manifested we need to involve forays between biological and social sciences.

Keywords: biological sciences; genetics; criminal behavior; violent behavior; genetical factors; brain damage; neurotransmitters, neurohormones

1. Introduction: Genetic and Violent Behavior

An increasing number of research seems to support the view that genes play an active role to the expression of violent and antisocial behavior (cf. Lowenstein 2003, Ferguson & Beaver 2009). Systematic studies investigating the contribution of genetics to violent and criminal behavior regard twins and adopted children. As far as monozygotic (identical) twins are concerned, studies have shown that there is a genetic influence to crime. Research has also shown that a significant percentage of children whose biological parents had a criminal background and were adopted shortly after their birth, obtained a criminal record.

The results of a meta-analysis concerning the relation between genes and crime have shown a significant interconnection between heredity and crime (Koutouvidis & Minogianni 2003). According to Raine (2003), the interrelation between genetical factors and antisocial behavior is undoubtable. He has also claimed that the affect of environment to aggressiveness is minor. However, Reine (1993) makes clear that we should be cautious in interpreting these suggestions because of the methodological vulnerability of this studies.

According to Allen (1967) and Kendler (1983), monozygotic (identical) twins share a common environment —to a greater extent than the dizygotic (fraternal) twins— because parents, teachers and friends tend to behave in a similar manner to monozygotic than to dizygotic twins. A series of 15 studies which have taken place at 3 different studies has investigated the expression of criminal and violent behavior by twins who have been separated from their parents. The parents had either a criminal or not a criminal record. The studies have indicated that even though these twins have been raised in different environments, they have later developed a criminal behavior. Hence, the findings show that there is a strong correlation between heredity and violent behavior (cf. Grove et al., 1990, Bohman

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1992, Moffitt et al., 2011).

According to Raine (2003), the studies which have been conducted to different countries by different researchers highlight the way genetical predisposition is conjoined with criminal and violent behavior. The present article suggests that we should take into consideration the findings concerning twins in order to understand and interpret the genetical base of criminal and violent behavior. However, we need more research feedback in order to argue for genetic predisposition rather than (simply) predetermining social and criminal behavior⁽¹⁾ (cf. Alper 1995, Brock 1999, Ishikawa & Raine 2002, Fisher DiLalla & Gheyara 2011, McCord, 2015).

2. Neurotransmitters, Neurohormones and Violent Behavior

According to Collins (2011), neurotransmitters (which are directly related to specific anatomical brain areas) play a crucial role in investigating the 'aggressiveness centre'. There are 3 main neurotransmitters which affect behavior and therefore the expression of violence namely, serotonin, norepinephrine and dopamine.

Serotonin (5-HT). As far as humans are concerned, the vast majority of studies regard serotonin. When serotonin is active, humans feel pleasure and satisfaction and they are calm (Lesch 2003). When serotonin is inactive or in low levels, humans express symptoms of depression, anxiety and impulsive aggressiveness (cf. Nielsen et al., 1994, Ball et al., 2002, Moore et al., 2002, Ellis 2005, de Boer et al., 2009, Molly et al., 2010). Decreased levels of serotonin, however, constitute a basic cause of aggressiveness and not its side-effect (cf. Clark & Grundstein 2004). A number of studies has shown that when the levels of serotonin increase aggressiveness decreases (cf. Raine 1993, Bell et al., 2001, Reif et al., 2007, Miczek et al., 2007). Humans who express aggressive behavior and violent outbursts due to low serotonin levels are mainly children (who express this kind of behavior at home and/or school), young soldiers (who are expelled after repetitive violent episodes) and criminals (who are responsible for a series of crimes). Many studies investigated the effectiveness of administering medications for increasing serotonin levels to imprisoned criminals (Sheard 1975), schizophrenics with high levels of aggressiveness and limited control of their sexual urges (Morand, Young & Ervin 1983), students with

Attention Deficit Disorder (with or without hyperactivity) (Siassi 1982), people with Personality Disorder (New et al., 1997, Soloff et al., 2000).

Norepinephrine (Noradrenaline).

Norepinephrine affects aggressiveness in three different levels which are interrelated: i) hormonal level, ii) autonomous sympathetic nervous system, iii) central nervous system (Terbeck et al., 2016). Experiments have shown that the expression of aggressive behavior is dependent on norepinephrine levels (McEllistrem 2004, Terbeck et al., 2016).

Dopamine. As it has been observed for norepinephrine, low dopamin levels are related to aggressiveness decrease (cf. Yudofsky 1987, Brizer 1988, Berman et al., 1998, Hibbelna et al., 1998, Annemoon, 2000, Ferrari et al., 2003, Takahashi et al., 2005, Grigorenko et al., 2010, Takahashi et al., 2010, Schlüter et al., 2013). Studies have shown that when dopamine is hyperactive and serotonin is imperturbable there is a strong probability of expressing violent behavior (cf. Van Erp & Miczek 2000, Everitt & Robbins 2000, Seo, Patrick & Kennealy 2008).

Monoamine Oxidase (MAOA) and Neurotransmitters. Various studies have shown that people who were abused at a young age and had a low activity due to MAOA gene (which deconstruct serotonin and dopamine and other neurotransmitters such as noradrenaline and adrenaline), expressed both a violent and aggressive behavior (cf. Caspi et al., 2002, Foley et al., 2004, Meyer-Lindenberg et al., 2006, Buckholtz & Lindenberg 2008, Stone 2009, Ferguson 2009).

Testosterone. The core reason of relating testosterone to aggressive behavior was the presence of high serotonin levels to adolescents. It has been observed that during adolescence antisocial behavior and bullying are increased dramatically. It has also been observed that in some cases there is a correlation between high testosterone levels and aggressiveness when serotonin levels are low. Therefore, research adjoins aggressiveness with low serotonin levels and not with high testosterone levels (cf. Archer 1991, Schaal et al., 1996, Higley et al., 1996, Harris 1999, Rowe 2004).

Arginine Vasopressin (AVP). Various studies have been conducted with guinea pigs and proved that when AVP levels are high, guinea pigs become aggressive. Guinea pigs express diminished aggressiveness in cases of been administered with AVP exogenously (cf. Ferris et al., 1997, Wersinger et

al., 2002, Wersinger et al., 2007). Research correlates AVP with violent behavior against people and this correlation is strong between men rather than women. Researchers come to the conclusion that AVP plays a role in the expression of aggressiveness (cf. Coccaro et al., 1998, Veenema 2009).

3. Brain Damages and Violent Behavior

Severe brain damages caused by blunt head traumas constitute a significant prerequisite for expressing violent and antisocial behavior (cf. Miller 1990, 2002, Mattson 2003, Walsh & Bolen 2016). Depending on the brain area which suffered damage, effects on personality and behavior may be either insignificant or significant (cf. Raine et al., 2000, Blair 2004, Yang et al., 2008). It has been observed that brain tumors affect human behavior in a similar manner. Research has shown that during birth limited oxygenation can cause a spectrum of multiplex complications in person's behavior. A person's ability to control his/her actions is based on the frontal lobes of the brain's cortex which are significantly developed. It has been observed that people who suffered traumas in the frontal lobes of the brain's cortex exhibit behavioral problems (cf. Raine et al., 1997). Recent studies examined people with extended traumas in the frontal cortex and found out that these people exhibited irritability, lack of interest for the consequences of their actions, impulsiveness, inability to have responsibilities, inability to judge the consequences of their actions, violent and disorganized behavior, shallow behavior and inability to interpret symbols and signs (cf. Grafman et al., 1996, Damasio 2000). These characteristics are termed as 'Frontal Lobe Syndrome' (cf. Mesulam 1986, Silver & Yudofsky 1987, Anderson et al., 1999).

Moreover, Henry (1973) claimed that damages in the left hemisphere (limbic system) lead to violent and aggressive behavior. Nachson (1998) confirmed these findings and he stated that the dysfunction of the left hemisphere leads to violent behavior. According to him, damages in the left hemisphere constitute a predisposition for violent behavior because a person's control over impulsiveness is deconstructed. Moreover, damages to the left hemisphere were considered to be responsible for non-violent crimes, crimes related to depression and for offensive behavior especially in women (cf. Yeudall 1977).

The Role of Cerebellar Tonsil and the

Insular Cortex (Reil's Island). Research has shown that damages in the insular cortex are related with Asperger's syndrome to a great extent (cf. Ramachandran et al., 2006). Many brain dysfunctions regarding speech and the recognition of other people's emotions are connected with the insular cortex (cf. Baxter & Murray 2002, Ashwin et al., 2007, 2009). According to Stone (2009), people who are grouped into autism's spectrum are rarely violent. However, autistics may commit violent actions as they feel unable to connect with others.

Fetal Alcohol Syndrome (FAS). Alcohol abuse during the first months of pregnancy may lead to the birth of children with FAS. Children suffering from this syndrome have neuronal damages in the overall brain structure. Such damages can cause memory problems, split attention, offensive behavior, intense sexual activity starting from adolescence, high aggressiveness, tendency towards alcoholism and drugs, violent and criminal behavior (cf. Kerns et al., 1997, Thomas et al., 1998, Sterling et al., 2000, Nwaigwe 2017).

Attention Deficit Disorder (with or without Hyperactivity). Research has shown that children with Attention Deficit Disorder can be engaged in violent actions and face law problems especially during adulthood (cf. Stone 2009, Clarke 2011). People with Attention Deficit Disorder may also express offensive-criminal behavior in case of been raised in a problematic environment (cf. Wager 2004, Young & Gudjonsson 2007). The levels of offensive and violent behavior increase when Attention Deficit Disorder coexists with other disruptive behavior disorders (cf. Savolainen et al., 2010, Stone 2009).

4. Conclusions

The discussion on violent and criminal behavior has shown that there is no common ground among theories which place central emphasis on biological factors. Recent biological and psychopathological approaches are methodologically based on technological innovations and focus on genetical, neuro-chemical and psychopathological factors which are likely to affect and shape human behavior. The discussion has also shown that researchers tend to adopt a biological interpretation of human behavior whereby molecular biology seems to play a dominant role.

The article does not intend to claim that a

genetically based interpretation of violence is due to a specific gene which is responsible for the expression of violence. The article does not aim at supporting the view that genetic predisposition constitutes always an indicator of violence. Genetically based studies should not exclude social studies (cf. Eysenck & Gudjonsson 1989) and psychological theories concerning violence (cf. Kocsis 2008, Jones 2008).

Moreover, despite the conflicts current research offers enough proof which reinforces the view that there is a genetic predisposition for violence. However, genetics does not act autonomously and at the exclusion of the environment. It is suggested that both genetics and the environment act collaboratively in the expression of violent behavior (cf. Cadoret et al., 1983, Denno 1990, Raine 2002, Brennan & Raine 1997).

The present article attempts to propose that in order to investigate the phenomenon of violence we need to depart from one-dimensional view about violence. On the contrary, we need to adopt a multiplex and multifaceted model for the interpretation of violence. Humans do not act independently of the environment or their connection with other humans with who they communicate from the very first years⁽²⁾. Therefore, the way human personality is formed and shaped derives from a range of factors, which can be either indicative or not. We should also take into consideration that the causes of offensive behavior are multiplex (cf. Tonry 1991). For this reason, we should follow an interdisciplinary approach consisting of criminologists, psychologists, sociologists and psychiatrists despite the fact that some aspects of violence can be explained by genetics.

adulthood are: physical or psychological abuse (cf. Bryer et al., 1987, Oga et al., 1990), parental abandonment (cf. Bowlby, 1952/1969, Rutter 1982, Lykken 1995), single-parent families or divorced families (cf. McCord 1982, Bill et al., 1993), parent with criminal records (cf. McCord 1977, Farrington 1999), peers (cf. Cohen 1955, Sutherland 1939), school (cf. Alderson et al., 1967, Gottfredson 2001), and urban lifestyle (cf. Shaw & McKay 1969).

Notes

- 1 The view that the tendency towards violent behavior is inherited could be correct in a limited manner. Many severe mental illnesses such as schizophrenia, bipolar disorder and repetitive depression are inherited. When these illnesses are intense, they can cause paranoid hallucinations and acoustic illusions, which along with mishandling and neurological damages can lead to the expression of violent behavior (cf. Brennan 1996, Moffit 2005, McCord 2015).
- 2 Some indicative factors which affect children and deal with the expression of violence in

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