Linking Genetic and Aggression Factors with Criminal Behaviour: A Systematic Review

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A substantial body of literature has suggested that biology and personality traits play a major role in predicting antisocial behaviour. Thus, the purpose of this article is to review the link between genetic and aggression factors with criminal behaviour. A systematic review was conducted to obtain relevant information regarding biological and psychological perspective on criminality in Sage, Elsevier and Google Scholar database. The results indicate that moderate-to-large number of variance in criminal behaviour is ascribed to genetic and aggressive factors. As an overall impact, the study provided implications to the concerned parties regarding the interpersonal elements that trigger antisocial behaviour hence a preventive measure to assist at-risk group can be initiated soon.

Keywords: genetic, aggression, criminal, behaviour, systematic review

Criminal behaviour is a multi-layer dimension that has been successfully explored by myriad scholars (Nussbaum 2005; Delisi 2009; Ulmer et al. 2014; Fauziah et al. 2017). In general, crime is an immoral act that eradicates the well-being of community members and jeopardise the growth of a nation. A handful number of studies has disclosed that an individual involvement in antisocial behaviour is influenced by various risk factors such as biological, social and environmental elements (Walker et al. 2006; Andrews et al. 2010; Taylor 2015).

Criminology and psychology field of studies has a long history of examining how individual-level risk factors affect the propensity to get involved in criminal behaviour. In order to further understand the evolution of crime studies, it is worth noting that sociological perspective too has predominated various research related to crime (Walsh 2000). Bringing these points together, it is essential to highlight that in the past few years an emerging paradigm has also been identified in the field of biosocial that majorly links between genetic and biological influences on criminality and criminal behaviour (Faraone et al. 2001; Rhee et al. 2002; Beaver et al. 2007; Beaver et al. 2011).

Hitherto, numerous studies have started to explore and incorporate the influence of genetic and aggressive dimension to construct a theoretical, conceptual and statistical model (Walsh 2002; Burt et al.

2008). Acknowledging the role of biological and psychological elements in relation with criminal behaviour, thus the current study seeks to integrate and extend contemporary criminology, biosocial and psychology findings in the form of systematic review.

Method

A systematic review methodology was employed to retrieved articles on the topic of interest. The following combination of keywords such as "genetic", "aggression", "criminal behaviour", "crime" and "antisocial behaviour" were typed in Sage, Elsevier and Google Scholar database to find the relevant information. A large number of articles, review papers, thesis, prison reports and letter to editors were obtained from the search engines.

The search netted a total number of 114 articles from the above-mentioned database. Furthering this, all the retrieved articles were carefully refined and explored. The most relevant and authentic information was chosen as a guideline to begin the writing process. After the implementation of few exclusion criteria, a total number of 31 articles were mainly used to write this review. In addition, the findings that were scrutinised in this review comprise the time period of 1-January-2000 until 1-July-2018. Figure 1 depicts the flowchart of the systematic review process.

Inclusion Criteria

Studies that were included in this review are articles: (i) written in English, (ii) published in peer-reviewed journals, (iii) research with at least 20 respondents (to reduce the bias associated with small studies) and (iv) studies examining the links between genetic-criminal behaviour and aggression-criminal behaviour.

Exclusion Criteria

Studies that were excluded in this review is articles and review papers: (i) written in languages other than English, (ii) loosely related finding that failed to explain the link between genetic-criminal behaviour and aggression-criminal behaviour.

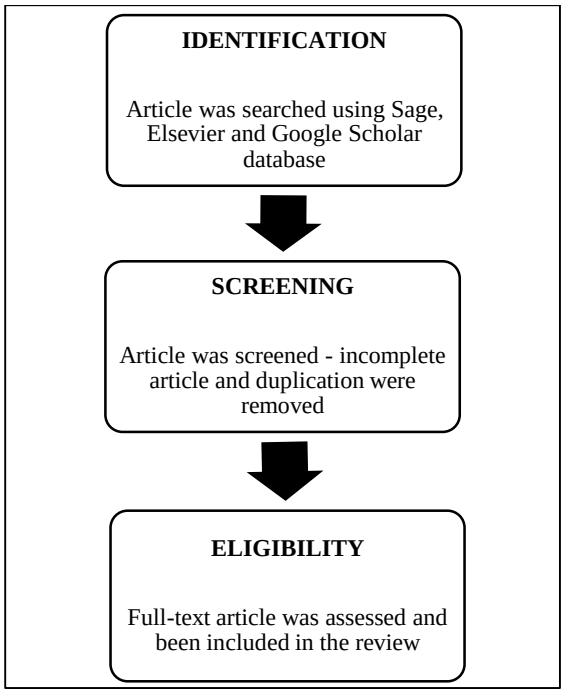

Figure 1 Flowchart of the Review Process

Results

Genetic

Research that incorporates the link between genetic and antisocial behaviour has blossomed over the past few decades (Cullen 2011; Delisi et al. 2011; Piquero 2011; Barnes et al. 2013). As noted above, it is disclosed that genetic factors comprise

almost 50.0% of the variance in antisocial behaviour whereas shared environment contributes approximately 10.0% of the variance in antisocial outcomes (Connolly et al. 2014). Recent research has demonstrated that certain genetic polymorphisms have been linked to diverse antisocial behaviour namely; (i) childhood conduct disorder, (ii) ADHD and (iii) adulthood violent behaviour (Moffitt et al. 2011). In addition, scholars have also identified that dopamine levels are significantly correlated with violent behaviour (Schwab-Reese et al. 2017). Adding to this, diverse studies have suggested that 10-repeat allele is closely linked with delinquency among men and escalate sensitivity to the environment when homozygous (two 10-repeat alleles) (Bakermans-Kranenburg et al. 2011).

Genetic risk factors (i.e., dopamine and serotonin) play a vital role in the etiology of criminal, antisocial behaviour and delinquency (Ferguson 2010; Schilling et al. 2011). According to Beaver et al. (2010), two genes that have acquired much attention in the literature is known as; (i) MAOA and (ii) DAT1. As such Fergusson et al. (2012) has identified that MAOA moderates the effects of childhood maltreatment and school dropout on violent and property related crime; subsequently predicts criminal convictions later in adolescence. Relatively, it has been discovered that DAT1 along with 5-HTT predicts chronic criminal behaviour among adults (i.e., sensation seeking, risk taking) (Beaver & Belsky 2012).

Contemporary biosocial studies have found that serotonin is also related to criminal violence (Heinz et al. 2005). Generally, serotonin elevates the brain activities which is associated with feelings of contentment and calmness (Liao et al. 2004). However, it has been identified that low level of serotonin causes gloomy and irritability. According to Gottschalk and Ellis (2009) impulsive violence is more prevalence among individual with a low level of serotonin activity. Besides serotonin, testosterone (T) which is largely known as a steroid hormone (androgen) also contributes towards aggression and violence behaviour among male (Reynolds et al. 2007). In addition, recent findings have identified that reduction of cognitive empathy caused by exogenous testosterone further predicts criminality especially among male with low digits ratios (2D: 4D) (Jolliffe et al. 2004; Honekopp et al. 2011; Carre et al. 2015).

Substantial evidence implicates that genes contributes nearly half of the variance in antisocial behaviour, while the remaining variance is influenced by nonshared environment factors (Ferguson 2010). Findings from Gene-Environment (G X E) research has stipulated that the effects of a genetic risk factor on antisocial behaviour will vary across individual based on their exposure level to environmental risk factors. In short, individuals who are at-risk and more "vulnerable" is prone to response towards environmental influences; thus encounter pleasure and displeasure (rewards – punishment) compared to others (Taylor et al. 2000; Arseneault et al. 2003; Jaffee et al. 2007; Van Hulle et al. 2009).

Aggression

Considerable advancement has been made in recent years to understand the link between aggression and antisocial behaviour. As a baseline reference,

evidence has disclosed that there is a significant relationship between aggression and individual involvement in criminal activities (Thomaes et al. 2011; Aleyasin et al. 2018). In general, aggression can be categorised into reactive aggression (i.e., retaliating, defensive and hostile) and proactive aggression (described as purposeful behaviour - i.e., goal-oriented and calculated risk-taking) (Jones & Paulhus 2010). Several lines of exploration have concluded that individual with narcissistic personality become aggressive (reactive aggression) when defamed which later increases the likelihood to get involved in antisocial behaviour such as murder, bullying, theft and burglary (Cui et al. 2014).

In general, aggression is an innate social behaviour however inappropriate aggressive reactions can cause a devastating consequence for individual and society. Growing evidence indicates that individual in emerging adulthood phase tend to seek their "real identity" and experience more stress compared to other people (Atak & Cok 2010). Subsequently, this is also the period when an individual is prone to get involved in antisocial behaviour (Atak & Cok 2010).

Based on neuroscientific perspective, it has been noted that prefrontal cortical regions predominantly control over aggressive and anger urge among human being (Denson et al 2011). Furthering this, according to Yavuzer et al. (2013) and Doran et al. (2012) the emotional component of aggression is caused by the arousal of anger whereas the cognitive component of aggression is provoked by hostility and ruthlessness.

Even though offending behaviour emerges in response to various negative emotions however it has been scientifically proven that aggression factor occupies a central role in numerous empirical studies (Brezina 2010). As such, an extensive body of research has demonstrated that a child uncontrolled expression of anger predicts physical aggression (kicking and hitting) later in adulthood (Murray 2013; Lee 2014; Lansford 2018).

Table 1 presented below is the summary of articles that have been reviewed in this research.

Table 1
Summary of Articles

AUTHORS	SAMPLE	MEASURES	FINDINGS
Barnes & Jacobs (2013)	-1,078 respondents (female were excluded)	-Violent behaviour -Dopamine risk -Neighbourhood disadvantage	-Dopamine risk scale - positive and statistically significant. -Dopamine risk - positively related to the respondent's self-reported violent behaviour. .
Schwab-Reese et al. (2017)	-24 to 32 years old adolescents	-Physical intimate partner violence (IPV) -Dopamine genes	-Presence of risk alleles - not associated with IPV perpetration but increase exposure to violence. -Disconnection from the school social environment - associated with physical IPV perpetration.
Aleyasin et al. (2018)	-Review	-Motivational processes -Aggression	-Regulate aggression - rewarding or reinforcing properties - leads to aggressive behaviour.
Thomaes & Bushman (2011)	-Systematic review -20 articles (25 separate samples)	-Narcissism -Violence	-Strong association between narcissism and aggression - following an ego threat.
Brezina (2010)	-Male public high school students in the United States	-Anger -Attitudes favouring aggression -Aggression	-Anger exerts a significant effects - attitudes favouring aggression (.11, p < 05). -Attitudes exerts a significant effect - aggression (.22, p < .05). -Indirect effect - anger on aggression (.02, p < .05). -Anger - direct effect - aggression (.47, p < .05).
Denson et al. (2011)	-54 participants -34 women -69% Asian, 19% White, 13% Other	-Provocation manipulation -State self-control -Manipulation check and debriefing	-Provocation condition leads to feeling more angry (M = 2.86, SD = 1.49) -The non-provocation condition (M = 1.28, SD = 0.48), F (1, 52) = 29.28, p < .001) - suggesting an effective manipulation.
Jones & Paulhus (2010)	-82 undergraduate students -mean age - 20.4 years -60% were female.	-Psychopathy -Narcissistic -Machiavellianism -Self-esteem	-Narcissists - response to ego threat when provoked. -Psychopathy - predicts aggression- in response to physical provocation.

Murray-Close (2013)	-Systematic review	-Psychophysiological processes -Adolescent peer functioning	-Physiological arousal - predicts peer-based behaviours.
Lee (2014)	-235 children -110 boys and 125 girls -10 classrooms in Grades 5 and 6 of two elementary schools in South Korea. The -Average age - 11.2 years (SD = 0.83 years)	-Self-esteem -Aggression	-Simple correlations between aggression and self-esteem - not significant (rs = −.077 and −.010) for proactive and reactive aggression, respectively. -Level of self-esteem did not sufficiently explain aggression.
Honekopp & Watson (2011)	-Meta-analyse	-2D:4D -Aggression	-No evidence of 2D:4D - predicting aggression in females. -Small negative relationship between 2D:4D and aggression (r .06) among men.
Stappenbeck & Fromme (2010)	-Recent high school graduates (n = 2,941)	-Aggressive behaviours -Typical alcohol use	-Men and women did not differ in their frequency of reported general or sexual aggression -Women reported more frequent perceived social and emotional consequences of general (but not sexual) aggression than did men. -Alcohol consumption co-occurred more frequently with sexual aggression (28%) than general aggression (9%). -Perceived social and emotional consequences were reported by a larger percentage of people who engaged in general aggression (79%) than by those who engaged in sexual aggression (59%).
Carre et al. (2015)	-Healthy young men (n = 30)	-Psychopathic traits -Testosterone	-Both 2D:4D ratio and psychopathic traits moderated the effect of testosterone on task performance. -2D:4D ratio among individuals scoring relatively low on psychopathy factor.
Burt (2008)	-211 undergraduate men of European-American ancestry	-Genetic -Antisocial behaviour	-Two of the three polymorphisms (i.e., His452Tyr and DAT1) - associated with adolescent antisocial behaviour.

Rhee & Waldman (2002)	-Meta-analysis -51 twin and adoption studies	-Genetic -Environmental influences -Antisocial behaviour.	-Moderate proportions of variance: -Additive genetic influences (.32), non-additive genetic influences (.09), shared environmental influences (.16), and non-shared environmental influences (.43).
Faraone et al. (2001)	-Meta-analysis	-ADHD -DRD4	-Significant association between ADHD and DRD4.
Beaver et al. (2007)	-National Longitudinal Study of Adolescent Health (Add Health)	-Dopamine -Victimization	-A significant gene X environment interaction in the creation of victimization for White males. -Specific DRD2 interacted with delinquent peers to predict victimization.
Yavuzer & Karatas (2013)	-224 adolescents -9th grade of 3 different high schools in central Burdur during the 2011-2012 academic year.	-Aggression -Automatic thoughts	-Positive correlations between the adolescents' automatic thoughts, physical aggression and anger. -Automatic thoughts effectively predicted the level of physical aggression ($b= 0.233$, $P < 0.001$)) and anger ($b= 0.325$, $P < 0.001$). -Anger fully mediated the relationship between automatic thoughts and physical aggression (Sobel $z = 5.646$, $p < 0.001$).
DeLisi & Piquero (2011)	-364 studies on criminal careers - Narrative meta-review	-Criminal career	-Identifies 16 pressing research gaps.
Schilling et al. (2011)	-102 studies is a primer on ADHD	-Neurological, -Genetic -Criminal justice -ADHD	-ADHD - closely connected to externalizing behaviours, conduct problems and criminal behaviour across the life course.
Ferguson (2010)	-Meta-analytic review	-Behavioural genetic -Antisocial personality behaviour	- 56% of the variance in APB can be explained through genetic influences. -11% due to shared non-genetic influences and 31% due to unique non-genetic influences.
Connolly & Beaver (2014)	-Youth born between 1980 and 1984	-Gang involvement -Carrying a handgun	-Genetic and nonshared environmental influences – association between gang membership and handgun carrying
Beaver et al. (2010)	-National Longitudinal Study of Adolescent Health	-Gang membership -Weapon use	-Low MAOA - increased risk of joining a gang and using a weapon in a fight for males but not for females.

	-1155 females & 1041 males		-Male gang members - those who used weapons in a fight were more likely to have a low MAOA compared with male gang members who do not use weapons in a fight.
Fergusson et al. (2012)	-399 males from the Christchurch Health and Development Study	-G x E interactions -MAOA	-MAOA genotype was associated with an increased response to a series of risk factors.
Beaver & Belsky (2012)	-National Longitudinal Study of Adolescent Health (Add Health)	-10R allele of DAT1 -A1 allele of DRD2 -7R allele of DRD4 -Short allele of 5HTTLPR	-Differential susceptibility is operative in the case of the intergenerational transmission of parenting.
Ferguson (2010)	-Meta-analytic review	-Genetic -Antisocial personality behaviour	-56% of the variance in APB can be explained through genetic influences. -11% due to shared non-genetic influences. -31% due to unique non-genetic influences.
Arseneault et al. (2003)	-1116 pairs of 5 year old twins	-Antisocial behaviour -Genetic	-Antisocial behaviour - influenced by genetic factors (82%) and experiences specific to each child (18%). -Variation in antisocial behaviour - influenced by genetic factors (from 33% for the children's report to 71% for the teachers' report).
Van Hulle et al. (2009)	-2,482 sibling pairs of varying genetic relatedness -4 to 17 years old	-Genetic influences -Antisocial behaviour	-Youth reported to be persistently antisocial during childhood and adolescence - influenced by one set of genetic factors. -Conduct problems in childhood and a second set of genetic - influences on youth reported delinquency that come into play around the time of the pubertal transition.
Taylor et al. (2000)	-36 early starters, 86 late starters, and 25 non delinquent controls -11 years old twins	-Age -Antisocial behaviour	-Early starters had more psychological, behavioural and emotional problems -Greater genetic influence on early-onset than late-onset delinquency.
Liao et al. (2004)	-Chinese males -Convicted for extremely violent crime (n = 135)	-Serotonin -Violent crime	-Low activity S allele is associated with extremely violent criminal behaviour in Chinese males.

	-Normal control group (n = 111)		
Reynolds et al. (2007)	-179 boys with high risk paradigm -Early adolescence age 12-14 -Middle adolescence age 16 -Late adolescence age 19 -Young adulthood age 22	-Testosterone level -Sexual maturation	-Testosterone level predicted social potency and approval of aggressive/antisocial behaviour. -Sexual maturation mediated the relation between testosterone level in early adolescence and later affiliation with deviant peers. -Social potency, approval of aggressive/antisocial behaviour, and deviant peer affiliations predicted illicit drug use by late adolescence that in turn predicted SUD in young adulthood.
Jolliffe & Farrington (2004)	-Systematic review and meta-analysis -n = 35 studies	-Cognitive -Affective empathy -Offending	-Low cognitive empathy was strongly related to offending. -Low affective empathy was weakly related to offending.

Conclusion

In sum, the present study adds to the growing literature regarding biological and psychological factors that contributes to individual involvement in antisocial behaviour. Based on the review, it can be fairly concluded that genetic and aggression is one of the major elements that triggers a person to dwell in an immoral act. In addition, the identification of risk factor regardless of gender is essential to initiate an intervention and prevention strategies for the vulnerable groups in near future.

Conflict Of Interest

The author proclaimed that there are no conflicts of interest regarding the research, publication and authorship of this article.

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