

**THE RELEVANCE OF NEUROLOGICAL ABNORMALITIES IN THE DETERMINATION OF CRIMINAL RESPONSIBILITY IN NIGERIA\***

**Abstract**

*The central nervous system which consists of the brain and the spinal cord is an organic component of the body. Being organic in nature is susceptible to illness and therefore bound to malfunction in certain circumstances. Neural infirmity could lead the subject to behave in a manner he does not expect. Hence, the aim of this paper is to examine the effect of neurological abnormalities on people's behaviour, with the view of ascertaining whether neural disorder could lead to criminal acts or omissions. If it does, it means that criminal acts and omissions are not intended, but are independent of the person's will. This signifies the absence of mens rea, and without it conviction cannot be sustained. It therefore implies that neurologically prodded offences may be examined with the provisions of Section 24 of the Criminal Code, enshrining that a person is not criminally liable for an act or omission that is independent of his will. The above background laid the foundation of this academic investigation which is relevant to criminal jurisprudence. The paper employs doctrinal method of academic investigation to outcrop its aim.*

**Keywords:** Neurological Abnormalities, Criminal Responsibility, Nigeria, Relevance of, Determination

**1. Introduction**

The human body functions through many coordinated systems working in concert to achieve the state of homeostasis. One of such systems is the central nervous system which consists of the brain and the spinal cord.<sup>1</sup> The central nervous system, particularly the brain, is the epicentre of this scholarly investigation. It is the organ that is responsible for coordination and control of all other organs and activities of the human body.<sup>2</sup> The brain just like any other organ in the body is organic in nature.<sup>3</sup> By this, it means that the brain is a living component of all animals, including man.<sup>4</sup> Being an organic in nature its functions and operations could be severely impacted by ailments. Neurological infirmities are caused by some biochemical imbalance in the body metabolism.<sup>5</sup> On the other hand, deterministic tendencies of natural laws could be exercised beyond proportion in order to draw attention towards the actualisation of the purpose previously determined before time. Accordingly, this academic appreciation is aim at examining neurological abnormalities for the purpose of ascertaining whether they have the capacity to impact on criminal behaviour. The identified neurological disorders shall be juxtaposed with the express provisions of Section 24<sup>6</sup> to scrutinize if the act or omission is independent of the defendant's will; and if found to be independent of the defendant's will, he should not be held criminally responsible, but ought to be exculpated from criminal allegation. The background laid above is very central in the determination of criminal responsibility using neurological abnormalities as the basis. The discourse is structured on the following selected neurological abnormalities:

**2. Neuroanatomic Abnormalities**

**Secretion of Amygdala**

The amygdala doubles as an organ and endocrinal secreting mechanism of the brain. It plays some critical roles in modulating and inhibiting the activities of the brain, especially within the limbic system.<sup>7</sup> Another

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<sup>1</sup>S. T. Ramalingam, and others, *Modern Biology for Senior Secondary Schools* (Revised Edition, Africana First Publishers Plc, 2013), 308.

<sup>2</sup> *Ibidem*.

<sup>3</sup>B. Garland and P. W. Glimcher, 'Cognitive Neuroscience and the Law: Current Opinions in Neurobiology' [2006] (16) (10) *Journal of Behavioural Biology and the Law*, 103.

<sup>4</sup>P. S. Bhuiyan, and others, *Human Neuroanatomy: Fundamental and Clinical* (Ninth Edition, Jaypee Brothers Medical Publishers (P) Limited, 2014), 184.

<sup>5</sup>Dr Omekwe Dakoru Edoghotu, Consultant Neuro Surgeon, Federal Medical Centre Yenagoa, Bayelsa State (An oral interview granted at his office at about 11: 45 hours Greenwich Mean Time (GMT) on June 20, 2020).

<sup>6</sup>Criminal Code Act, Cap C38 Vol. 4, Laws of the Federation of Nigeria (LFN), 2004, which states thus: "Subject to the express provisions of this Code relating to negligent acts and omissions, a person is not criminally responsible for an act or omission which occurs independently of the exercise of his will ..."

<sup>7</sup> B. Dudas, *The Human Hypothalamus: Functions and Disorders* (Nova Sciences Publishers Limited, 2012).

of its functions is to inhibit the autonomic *neuroendocrinal* hormones within the neural correlates.<sup>8</sup> The amygdala is also responsible for the modulation of behavioural responses which enable the organism to adjust successfully to social and environmental unfriendly conditions.<sup>9</sup> By this, the amygdala secretes biochemical substances responsible for the processing and transmitting of threats and dangerous stimuli to the body.<sup>10</sup> The amygdala as an organ is seated on the interior part of the limbic system which functions is to transmit impulsive stimuli to different sensory neurons of the brain.<sup>11</sup> Several empirical researches have been conducted principally to appraise the functions of the amygdala on social and emotional behaviours.<sup>12</sup> The experimental findings have shown that amygdala has been associated with wide range of emotional disorders spanning from mood disorders, to autism, and to schizophrenia.<sup>13</sup> Specifically, the amygdala is an endogenous component of the brain neural network regulates aggressive behaviours in higher animals including man. By this the amygdala functions in secreting and circulating amygdaloidal fluids,<sup>14</sup> necessary to stimulate the hypothalamus, hippocampus, thalamus, and orbitofrontal cortex parts of the brain circuitry system.<sup>15</sup> Furthermore, neurological studies conducted over the years have shown that lesser amygdalin secretion and circulation in the brain neural circuitry system, make the subject more aggressive and inability to distinguish right from wrong.<sup>16</sup>

By the above expository analysis of the empirical findings, the amygdala is responsible for aggression and aggressive behaviours in humans. The lesser the volumetric quantity of the amygdaloidal fluids, the more aggressive the subject is susceptible to antisocial behaviours.<sup>17</sup> It has also been found neurologically that insufficient secretion and circulation of amygdaloidal fluids, the subject is bound to be in excessive aggressive mood akin to that of an insane person.<sup>18</sup> Therefore, deficiency in the secretion and circulation of amygdaloidal fluids within the brain circuitry system is responsible for some gruesome antisocial behaviour, especially murder and its sundry offences.<sup>19</sup> Consequently, if a criminal defendant through an expert witness in the specialty of neuropsychiatry, neuroanatomy, neurology or psychology testifies that the defendant did not act by his own will. And that the act was due to insufficient supply and circulation of amygdaloidal fluids within the brain neural system as at the time the offence was committed. If this piece of expert evidence is juxtaposed with the provisions of Section 24,<sup>20</sup> and was believed by the court, the defendant ought to be acquitted or punishment drastically mitigated. In either dimension, advancements in neuroscience are handy tools in the hands of the court in the evaluation of offences. Hence, neuroscientific abnormalities are quite relevant in the determination of criminal responsibility.

### **Epilepsy**

In *George vs The State*,<sup>21</sup> the highest in hierarchical order of courts in Nigeria defined epilepsy as a chronic mental disease that seriously affect the nervous system being characterized by convulsion, unconsciousness,

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<sup>8</sup> *Ibidem*.

<sup>9</sup>H. R. Monroe, and others, 'Stimulation of the Amygdaloidal Nucleus in Schizophrenic Patients' [1955] (111) (11), *American Journal of Psychiatry*, 862.

<sup>10</sup>K. Kiehl, 'Cognitive Neuroscience and Perspective on Psychopathy: Evidence for Paralimbic System Dysfunction' [2006] (14) (2) *Journal of Psychiatry Research*, 107.

<sup>11</sup>F. V. Gouveia, and others, 'Amygdala and Hypothalamus: Historical Overview' [2019] (83) (1) *Journal of Neurosurgery*, 5.

<sup>12</sup>S. Matthies, and others, 'Small Amygdala-High Aggression' [2012] (13) (7) *The World Journal of Biological Psychiatry*, 75.

<sup>13</sup> *Ibidem*.

<sup>14</sup>H R Monroe, and others, 'Stimulation of the Amygdaloidal Nucleus in Schizophrenic Patients' [1955] (111) (11), *American Journal of Psychiatry*, 862.

<sup>15</sup>F. V. Gouveia, and others, 'Amygdala and Hypothalamus: Historical Overview' [2019] (83) (1) *Journal of Neurosurgery*, 5. See also L J Siever, 'Neurobiology of Aggression and Violence' [2014] (16) (5) *American Journal of Psychiatry*, 3

<sup>16</sup>S. Matthies, and others, 'Small Amygdala-High Aggression' [2012] (13) (7) *The World Journal of Biological Psychiatry*, 75. A comprehensive research carried out on healthy females by a group of neurosurgeons discovered that there is a lesser in volume of amygdala up to 16-18 percent for persons of life history of aggression (LHA).

<sup>17</sup>K. L. Gobrogge, and others, 'Anterior Hypothalamic Neural Activation and Neurochemical Associations with Aggression in Pair-Bonded Male Prairie Voles' [2007] (5)(2) *Journal of Comprehensive Neurology*, 1109.

<sup>18</sup>S. Matthies, and others, 'Small Amygdala-High Aggression' [2012] (13) (7) *The World Journal of Biological Psychiatry*.

<sup>19</sup>World Health Organization, (WHO) Third Milestones of Global Campaign for Violence Prevention Report: Scaling Up Geneva, Switzerland, 2007.

<sup>20</sup>Criminal Code Act, CapC38, Vol.4, Laws of the Federation of Nigeria (LFN) 2004. Which says that: "Subject to the express provisions of this Code relating to negligent acts and omissions, a person is not criminally responsible for an act or omission which occurs independently of the exercise of his will, or for an event which occurs by accident."

<sup>21</sup>[1993] 3 NWLR (Part 297) 415 SC.

gnashing of teeth and tripping of sticky saliva from the two sides of the mouth.<sup>22</sup> Epilepsy, according to the Longman,<sup>23</sup> is a medical condition which affects the brain and makes the subject to suddenly become unconscious and unable to control body movement. During epileptic crisis, normally human functions cannot be achieved due to insufficient activation of neural resistors or inhibitors within the brain circuitry system.<sup>24</sup> Epilepsy is a mental illness usually associated by some African societies as punishment from the marine gods.<sup>25</sup> According to the scholarly work, it is an illness that is caused by electric fish.<sup>26</sup> Albeit, scientifically, epilepsy is a neural disorder caused by the malfunctioning of neural modulators and inhibitors within the hindbrain of the brain.<sup>27</sup> The neural performance index of the brain is being modulated and inhibited by certain neurological hormones acting like the brake and accelerator in auto mobiles.<sup>28</sup> These neural endocrinal secretions serve as brakes or sensors to the neurons of the brain.<sup>29</sup> Therefore, the neurobiological sequence of epilepsy occurs when the inhibitors neurons are unable to modulate the functions of the hindbrain due to momentary neural disorder generated within the bioelectrical circuits of the brain.<sup>30</sup> The neural disorder results in disruption of normal integration of the person's conscious metabolites and neural functioning.<sup>31</sup> This neural disorder prevents the neurons of the hindbrain responsible for movement to function without modulation and inhibition. Thereby causing interim uncontrollable jerky movement of the hands, legs, gnashing of teeth, and sometime dripping of sticky saliva from the two sides of the mouth of the victim.<sup>32</sup> Epilepsy is a dangerous and unpredictable illness that can strike at anytime and anywhere. If the crisis propels by epilepsy occurs where there is fire, and the victim is alone, he could be burnt to death. If the chaotic circumstance surfaces where there is water, and the victim cannot be assisted by another, he could be drowned to death. Consider a circumstance where a person suffering from epilepsy is a driver whose other lives are entrusted in his care for the journey to a particular destination. And while on the journey the crisis occurs and the driver could no longer use his hands and legs which results to an auto crash that maim the passengers. Should the driver be held responsible for an intentional act? Should he be exculpated under Section 24 of the Criminal Code? Should he be held liable for negligence by not taking his medication? Even if the medication is taken does the potency of the drugs last for ever? The above questions could be answered as follows: Drugs taken by an individual have elasticity period and after which the drugs stop having effect in the person's body. This response eliminates the possibility of any act of negligent. The seizure of the hands and legs to control the movement of the vehicle was not caused deliberately by the driver, but by the influence of epilepsy. Epilepsy is a neural disorder independent of the driver. Stemming therefrom, the provisions of Section 24 of the Criminal Code might be very relevant and applicable in the evaluation of the driver's criminal liability. The provision of Section 24<sup>33</sup> stipulates as follows: 'Subject to the express provisions of this Code relating to negligent acts and omissions, a person is not criminally responsible for an act or omission which occurs independently of the exercise of his will, or for an event which occurs by accident'.

In resonance with the provisions excerpted above, if the facts, circumstances, evidence and the law are judicially scaled along with the webs of the provisions of Section 24 of the Criminal Code. The defendant has the glaring chances of being acquitted from the offences that might be proffered against him. This is because the injuries sustained by the passengers or even deaths were not intended by the driver, but were caused by neural disorders completely independent of the driver's will. Consequently, epilepsy as stated above, is a neural disorder of the brain. The crisis caused by epileptic conditions could lead to criminal acts

<sup>22</sup>O A Ajayi and I K E Oraegbunam, 'Justifying Genetics as a Possible Legal Defence to Criminal Responsibility in Nigeria' [2015] 3 () Nnamdi Azikiwe University Journal of International Law and Jurisprudence, 1-16.

<sup>23</sup>Longman Dictionary of Contemporary English (New Edition, Pearson Education Limited, 2007), 526.

<sup>24</sup>Dr Omekwe Dakoru Edoghotu, Consultant Neuro Surgeon, Federal Medical Centre Yenagoa, Bayelsa State (An oral interview granted at his office at about 11: 45 hours Greenwich mean time (GMT) on June 20, 2020).

<sup>25</sup>F. I. Ogurum, *Ancient Mythology of Amuruto People* (Sarderick publications Limited, 1984).

<sup>26</sup>A specie of marine fish that exist in both brackish and fresh waters. The fish shocks in the form of mild electric current and makes jerky uncontrollable movement similar to that when a person is afflicted with epilepsy.

<sup>27</sup>Dr. Alimontaziba Ayibatonye Joseph, Consultant Neurologist, Niger Delta University Teaching Hospital, Okolobiri, Bayelsa State of Nigeria (An oral interview granted at his office at about 16: 00 hours Greenwich mean time (GMT) on June 12, 2020).

<sup>28</sup>K L Gobrogge, and others, 'Anterior Hypothalamic Neural Activation and Neurochemical Associations with Aggression in Pair-Bonded Male Prairie Voles' [2007] (5)(2) *Journal of Comprehensive Neurology*, 1109.

<sup>29</sup>*Ibidem*.

<sup>30</sup>*Ibidem*.

<sup>31</sup>P. Limousin, and others, 'Electrical Stimulation of the *Subthalamic* Nucleus in Advance Parkinson's Disease' [1998] (339) (16) *The New England Journal of Medicine*, 1105.

<sup>32</sup>I. L. Karibi, *Lectures Note in Human Biology* (Unpublished Monogram, Community Secondary School Emago/Amuruto, 1985).

<sup>33</sup>Criminal Code Act, Cap C38, Vol.4 Laws of the Federation of Nigeria (LFN) 2004.

or omissions, and could be judicially evaluated by the court. In doing so by the court, neurological considerations of the brain must be applied. The queries posed above in this paper seem to have been answered by the Supreme Court of Nigeria, in *George vs The State*.<sup>34</sup> In that case the apex court held that a person suffering from epilepsy may be exculpated from criminal responsibility. Therefore, the scientific knowledge derived from neuroscience are very apt and appropriate in the assessment of criminal responsibility of a defendant standing criminal trial in Nigeria.

Furthermore, in the Republic of Netherlands, in the case of (LJN BN0983),<sup>35</sup> the defendant while driving knocked a biker and killed the occupant instantly. In the course of proceedings, the defendant testified that he did not hit the biker deliberately, but it was as a result of epileptic seizure of which he could not control his legs and hands. The testimony of the defendant was corroborated by three expert witnesses, to wit, a psychiatrist, a psychologist and a neurologist. The District Court in Amsterdam evaluated the adduced evidence by the defence and discharged and acquitted the defendant due to the expert testimonies of epileptic seizure.<sup>36</sup> It is therefore, the practical reality that evidence related to epilepsy as a neural disorder has been used by the court in other jurisdictions of the world. Hence, there is the possibility of such evidence to be utilized in Nigeria, especially as the law of evidence allowed for the admissibility of expert evidence.<sup>37</sup> Furthermore, a wide window of criminal acts and omissions could be accommodated under Section 24.<sup>38</sup> It therefore follows that, neuroscientific abnormalities are relevant in criminal jurisprudence. Such scientific advancements acquired from the field of neuroscience can be used in the determination of criminal responsibility in Nigeria.

### **Kleptomania**

Kleptomania is a mental disorder, an illness that makes an individual to have the strong urge to steal anything possible without reason.<sup>39</sup> In some traditional climes it is considered as possession of evil spirit on a person just to disgrace and humiliate the person publicly. In whichever dimension kleptomania is an induced act either spiritually or neurologically. Since it is an act independent of the person, the provision of Section 24<sup>40</sup> of the Criminal Code might be relevant in the judicial examination acts and omission that are associated with kleptomania. Practical illustration, Chika Adindu was walking through Onitsha main Market reaching Okoye's store she picks a pair of shoes without negotiation for payment. On reaching Aham's stand, she dropped the shoes and takes a loaf of bread without payment. At Ndibuisi's stores, she picks a packet of biscuit and drops the bread. In all the items she picks, she did not make use of any of them. Now Chika Adindu has been arraigned before a chief magistrate court within the Onitsha Magisterial District for stealing a pair of shoes, a loaf of bread and a packet of biscuit. During the trial, Adindu testifies for the defence that the items were actually found in her possession at different instances and places, but she did not know how the items got to her possession. Furthermore, a psychologist and a forensic neurologist also testify before the chief magistrate court that the young lady is suffering from serious kleptomania. By the foregoing illustration kleptomania is a mental disease. Expert evidence has shown that the defendant is suffering from acute kleptomania. Being a neural disorder in which she did not negotiate to have, the act of stealing the shoes, the bread and the biscuit is independent of the Chika's will. Therefore, the defence window provided under Section 24 of the Criminal Code ought to have avail her. And by virtue whereof ought to have been acquitted and discharged from the alleged offences proffer against her. Further reiteration, though might not be a direct element for the establishment of the offence of stealing, but she was dropping the items previously taken and picking others which demonstrates clearly the absence of *mens rea*. This goes to show emphatically that Chika's act of stealing is quite different from others. Hence the expert evidence of being afflicted with the mental disease of kleptomania should be sustained by the court. For the avoidance of doubt, in all the circumstances elicited above, Chika Adindu's case is being considered and determined vide the knowledge derived from neuroscience, in that a mental illness, disease or disorder is related to neuroscience. Therefore, neuroscientific advancements and consciousness are relevant and can be used in the assessment and evaluation of criminal responsibility. Following the order of acquittal, she should be taken to a neuro-specialist hospital for treatment.

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<sup>34</sup>[1993] 3 NWLR (Part 297) 415 SC.

<sup>35</sup>L. Klaming and E. J. Kooops, 'Neuroscientific Evidence and Criminal Responsibility in the Netherlands' [2012] (15) (10), *Journal of International Neurolaw, Tilburg University, Netherlands*, 13-14.

<sup>36</sup>*Ibidem*, 12.

<sup>37</sup>Section 68 of the Evidence Act, 2011.

<sup>38</sup>Criminal Code Act Cap C38, Vol. 4 Laws of the Federation of Nigeria (LFN) 2004.

<sup>39</sup>D. Biber, and others, Eds. Longman Dictionary of Contemporary English (new Edition, Pearson Education Limited, 2007), 890.

<sup>40</sup> *Supra*.

### Damages in the Frontal Lobes of the Brain

By the insightful academic scholarship by Goodenough<sup>41</sup> and Sapolsky<sup>42</sup> in the inception of the 21<sup>st</sup> century, a paradigm shift of renewed vigour of immense consciousness on neuroscience permeated the entire nooks and crannies of world. This was significantly felt within the shores of Europe and the United States of America.<sup>43</sup> Since the works of the two scholars, neuroscientific knowledge has impacted positively on the human race.<sup>44</sup> Neuroscience has demonstrated to the world that social and cognitive behaviours are direct products of neural functional activities.<sup>45</sup> By this discovery, it is logically to submit scientifically that neuroscience can contribute significantly in the understanding of what it is meant to act intentionally or knowingly.<sup>46</sup> It has also been shown through neuroscientific research on the responsibility index that there is a link between frontal lobes dysfunction of the brain and criminal behaviour.<sup>47</sup> Furthermore, neuroscientific research over the years has shown empirically a strong connection between malfunction of the limbic systems of the brain and criminal behaviour.<sup>48</sup> The frontal lobes are parts of the brain circuitry system found within the fringes of the forebrain region.<sup>49</sup> They are connected to several other parts of the brain through the basal ganglia.<sup>50</sup> Studies have shown that dysfunction of the frontal lobes of the brain results in violent and antisocial behaviour.<sup>51</sup> The malfunctioning is caused as a result of drastic reduction in the secretion and circulation of neural inhibitors and modulators.<sup>52</sup> Neural inhibitors regulate hyper activation of the amygdala and the hippocampal complex of the cerebral hemisphere.<sup>53</sup> Deficiency in the supply and circulation of brain inhibitors can cause damages in the frontal lobes.<sup>54</sup> A damage in the frontal lobes regions can render the subject inability to control his bioelectrical impulses, thereby making the subject incapable of differentiating right from wrong.<sup>55</sup>

The negative effect of frontal lobe damages can be demonstrated with the Dutch case of (LJN BB2861),<sup>56</sup> reported in 2007 in the District Court of Hertogenbosch.<sup>57</sup> In that case a fifty year old man killed his wife during a fight about some money in the presence of their two children by repeatedly smashing her head against the wall until she died. During Police interrogation and trial, the defendant gave different and conflicting statements about the incident. When the statement of his children confronted him, he confessed unequivocally that the two children were not lying. He added that he could not remember or recollect what happened between him and his wife and that he cannot tell where his wife is. In addition to the defendant conflicting testimonies, three expert witnesses, to wit, a psychiatrist, psychologist and behavioural neurologist were called who testified that the defendant was suffering from acute frontal lobes damages. This neurological disorder has resulted in loss of impulse control, memory and inability to adequately appreciate reality. He was right to testified that he did know his wife's where about. Relying on the expert

<sup>41</sup>O. R. Goodenough, 'Mapping Cortical Areas Associated with Legal Reasoning and Moral Intuition' [2001] (41) (31) *Journal of Jurimetrics*, 429.

<sup>42</sup>R. M. Sapolsky, 'The Frontal Cortex and the Criminal Justice System' [2004] (3)(5) *Philosophical Transactions of the Royal Society of Britain: Biological Sciences*, 1787.

<sup>43</sup>*Ibid.*

<sup>44</sup>P. Catley and L. Claydon, 'The Use of Neuroscientific Evidence in the Courtroom by those Accused of Criminal Offences in England and Wales' [2015] (3) (5) *Journal of Law and the Biosciences*, 510.

<sup>45</sup>B. Garland and P. W. Glimcher, 'Cognitive Neuroscience and the Law: Current Opinions in Neurobiology' [2006] (16) (10) *Journal of Behavioural Biology and the Law*, 103.

<sup>46</sup>L. Klaming and E. J. Kooops, 'Neuroscientific Evidence and Criminal Responsibility in the Netherlands' [2012] (15) (10), *Journal of International Neurolaw, Tilburg University, Netherlands*, 12.

<sup>47</sup>*Ibidem.*

<sup>48</sup>*Ibidem.*

<sup>49</sup>S. T. Ramalingam, and others, *Modern Biology for Senior Secondary Schools* (Revised Edition, Africana First Publishers Plc, 2013).

<sup>50</sup>A. Raine, and others, 'reduced Prefrontal and Increased Subcortical Brain Functioning Using Positron Emission Tomography in Predatory and Affective Murderers' [2003] (16) (13) *Journal of Behavioural Sciences and the Law*, 319.

<sup>51</sup>I. K. Barkataki, and others, 'Neural Correlates of Deficient Response Inhibition in Mentally Disordered Violent Individuals' [2008] (2) (6) *Journal of Behavioural Sciences and the Law*, 51.

<sup>52</sup>M. C. Brower and B. H. Price, 'Neuropsychiatry of the Frontal Lobe Dysfunction in Violent and Criminal Behaviour: A Critical Review' [2001] (71) (9) *Journal of Neurology, Neurosurgery & Psychiatry*, 720.

<sup>53</sup>R. M. Sapolsky, 'The Frontal Cortex and the Criminal Justice System' [2004] (3) (5) *Philosophical Transactions of the Royal Society of Britain*, 1787.

<sup>54</sup>O. D. Jones, and others, 'Brain Imaging for Legal Thinkers' [2009] (5) (5) *Stanford Technology Law Review*, 107.

<sup>55</sup>L. Klaming and E. J. Kooops, 'Neuroscientific Evidence and Criminal Responsibility in the Netherlands' [2012] (15) (10), *Journal of International Neurolaw, Tilburg University, Netherlands*, 12.

<sup>56</sup>*Ibidem.*

<sup>57</sup>*Ibidem*, 13-14.

testimonies, the court acquitted the defendant on the ground there was no premeditation to commit the offence. The court also held that the defendant lacked the capacity to control his bioelectrical impulses due to the damages in his frontal lobes.

From the foregoing expository illustrations, the frontal lobes are parts of the brain circuitry system and being parts of the brain, it is neurologically related. A damage of that brain part was given in evidence, which evidence persuaded the mind of the court in reaching a sound judicial decision. Therefore, neuroscientific knowledge is relevant in criminal law jurisprudence. Hence, the contemporary advocacy on the interdisciplinary frontiers of neuroscience into criminal law jurisprudence is crucial and can be used in the determination of criminal responsibility in Nigeria.

### **Damages in the Limbic System of the Brain**

The limbic system of the brain is basically responsible for basic cognitive functions, particularly memory and regulations of emotions, excitements and adjustment for extraordinary emergencies.<sup>58</sup> The limbic system is a structure found in the middle region of the brain within the cerebrum hemisphere.<sup>59</sup> It is well connected to the hippocampus, hypothalamus, thalamus and the amygdala which is the natural seat for aggression and aggressive behaviours.<sup>60</sup> Recent research conducted on psychopaths has shown that psychopathic individuals have decreased glucose activation in the limbic system.<sup>61</sup> Whenever the limbic system is affected by ailment and there is less activation of neurotransmitters, the limbic system malfunctions.<sup>62</sup> The malfunctioning is caused by insufficient supply of neuropeptides to modulate the system adequately.<sup>63</sup> Reduced inhibition mechanisms in the limbic system allow it to operate without inhibition and modulation.<sup>64</sup> The neurophysiological implication of insufficient inhibitions within the limbic system is responsible for loss of environmental reality experienced by the subject.<sup>65</sup> This can also lead to loss of empathy and inability to control biological impulses, thereby making the subject unable to distinguish right from wrong.<sup>66</sup> Experiment has shown that antisocial activities perpetrated by psychopaths in the society have neurobiological foundations for their actions.<sup>67</sup> Further neuroscientific research has shown that murderers have a much reduced glucose metabolism in the prefrontal cortex and limbic system of the brain.<sup>68</sup> These scientific findings suggest that prefrontal deficits and limbic disorder can cause impulsivity and low self-control thereby leading to antisocial and criminal behaviour.<sup>69</sup> Further studies have shown that affective murderers as opposed to predatory murderers have low glucose activation in the prefrontal cortex and limbic system.<sup>70</sup> This goes to demonstrate that affective murderers have less control over aggressive bioelectrical. This is due to inadequate neuro endocrinal secretions to modulate the prefrontal cortical regions and the limbic system of the brain.<sup>71</sup> Accordingly, malfunctions in the prefrontal cortex and limbic system can severely affect an individual's ability to control his biological impulses and to foresee objectively the natural consequences of any action.

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<sup>58</sup>P. S. Bhuiyan, and others, *Human Neuroanatomy: Fundamental and Clinical* (Ninth Edition, Jaypee Brothers Medical Publishers (P) Limited, 2014), 308.

<sup>59</sup>*Ibidem*.

<sup>60</sup>K. Kiehl, and others, 'Limbic Abnormalities in Affective Processing by Criminal Psychopaths as Revealed by Functional Magnetic Resonance Imaging' [2001] (5) (3) *Journal of Biological Psychiatry*, 677.

<sup>61</sup>*Ibidem*.

<sup>62</sup>H M Garmal, 'Neuropeptides and Transmitters' [2012] 5 (9) *Journal of Comparative Medical Sciences*, 24.

<sup>63</sup>*Ibidem*.

<sup>64</sup>Dr. Alimontaziba Ayibatonye Joseph, Consultant Neurologist, Niger Delta University Teaching Hospital, Okolobiri, Bayelsa State of Nigeria (An oral interview granted at his office at about 16: 00 hours Greenwich mean time (GMT) on June 12, 2020.

<sup>65</sup>N D Volkow, and others 'Brain Glucose Metabolism in Violent Psychiatry Patients: A Preliminary Study' [1995] (61) (24) *Journal of Psychiatry Research*, 243.

<sup>66</sup>*Ibidem*.

<sup>67</sup>J. L. Muller, and others, 'Abnormality in Emotion Processing within the Cortical and Subcortical Regions in Criminal Psychopaths: Evidence Using Functional Magnetic Resonance Imaging' [2003] (5) (4) *Journal of Psychiatry Research and Neuroimaging*, 152.

<sup>68</sup>A. Raine, and others, 'reduced Prefrontal and Increased Subcortical Brain Functioning Using Positron Emission Tomography in Predatory and Affective Murderers' [2003] (16) (13) *Journal of Behavioural Sciences and the Law*, 319.

<sup>69</sup>K. Kiehl, and others, 'Limbic Abnormalities in Affective Processing by Criminal Psychopaths as Revealed by Functional Magnetic Resonance Imaging' [2001] (5) (3) *Journal of Biological Psychiatry*, 677.

<sup>70</sup>M. P. Laakso, and others, 'Prefrontal Volume in Habitually Violent Subjects with Antisocial Personality Disorder' [2002] (11) (4) *Journal of Psychiatry Research and Neuroimaging*, 95.

<sup>71</sup>K. Kiehl, 'Cognitive Neuroscience and Perspective on Psychopathy: Evidence for Paralimbic System Dysfunction' [2006] (14) (2) *Journal of Psychiatry Research*, 107.

Flowing from the foregoing, there is no doubt that the limbic system and prefrontal cortex are integral parts of the brain. The submissions canvassed above demonstrate that a damage to any of those brain parts can lead to gruesome antisocial behaviour, especially murder and other related offences. The knowledge that reveals these scientific realities to the research community is neuroscience. The act of murder and its sundry offences are acts of criminality, therefore very relevant to criminal law and its jurisprudence. Wherefore, from the overview, neuroscientific knowledge is relevant in the operations of criminal justice system of any country. This is more convincing in that brain anatomy of all humans is the same in composition and structure. Thus its scientific discoveries about the functions, operations and disorder of the brain can be used in the evaluation of criminal responsibility in Nigeria.

### 3. Neurophysiological Abnormalities

The proper functions and operations of the brain are sustained by the secretions of certain biochemical fluids often time described as brain hormones. These substances are distributed within the brain circuitry systems by neuropeptides and neurotransmitters.<sup>72</sup> The distribution of these biochemical substances is to ensure stability within the brain bioelectrical systems.<sup>73</sup> Excess or insufficient secretions of these substances could result to acute abnormality in the behaviour and conduct of the subject.<sup>74</sup> Some of these neurophysiological secretions are as follows:

#### Secretion of Serotonin

Serotonin is a brain hormone produced by the pineal glands found around the limbic system within the cerebrum hemisphere.<sup>75</sup> It is a type of neurotransmitter and modulating enzyme responsible for homeostasis within the sensitive limbic neurons.<sup>76</sup> The limbic region of the brain is primarily responsible for emotions and excitements.<sup>77</sup> Sufficient secretion of serotonin inhibits activation of the prefrontal cortical regions of the limbic system. Adequate secretion of this biochemical substance enables the orbital frontal cortex and interior cingulate cortex of the limbic system to suppress aggression and provocation.<sup>78</sup> Inversely, inadequate secretion or supply of serotonin results to an imbalance in the inhibition processes within the orbital frontal cortex and interior cingulate cortex (ICC) of the limbic system of the brain. This condition leads to an uninhibited activation of the limbic neurons thereby resulting to uncontrollable aggression and provocation. When the subject (defendant) is excessively angry and provoke criminal acts and omissions could be perpetrated during the period insufficient secretions of serotonin.<sup>79</sup> It therefore means that physiological abnormality are relevant in the determination of criminal responsibility.

#### Glucose Supply in the Cerebral Systems

It is neurologically proven that the neurons of the brain function with only sugar.<sup>80</sup> Sugar in the metabolic system of higher animals is converted by the pancreatic juice,<sup>81</sup> into amino acids in the form of either glucose or glycerol.<sup>82</sup> Experiment conducted on psychiatry patients with history of violence behaviours, and to persons who often commit the offence of murder show inadequate supply of glucose in their brain.<sup>83</sup> Further,

<sup>72</sup>L J Siever, and others, 'The Serotonin System and Aggressive Personality Disorder' [1993] (8) (2) *International Journal of Clinical Psychopharmacology*, 44.

<sup>73</sup>*Ibidem*, 35.

<sup>74</sup>H M Garmal, 'Neuropeptides and Transmitters' [2012] 5 (9) *Journal of Comparative Medical Sciences*, 26.

<sup>75</sup>J. L. Muller, and others, 'Abnormality in Emotion Processing within the Cortical and Subcortical Regions in Criminal Psychopaths: Evidence Using Functional Magnetic Resonance Imaging' [2003] (5) (4) *Journal of Psychiatry Research and Neuroimaging*, 152.

<sup>76</sup>*Ibidem*.

<sup>77</sup>Limbic is an area or region of the brain responsible for transmitting emotions and excitements. The limbic system has both hyper activity neurons and inhibiting neurons functioning in conjunction to maintain a state of homeostasis in that particular organ of the brain. Just like the coordination of the brake and accelerator in a moving vehicle. Also in support is the oral interview granted on Dr Alimontaziba Ayibatonye Joseph, Consultant Neurologist, Niger Delta University Teaching Hospital, Okolobiri

<sup>78</sup>E F Coccaro, and others, 'Central Serotonin Activity and Aggression: Inverse Relationship with Prolactin Response' [1997] (15) (4) *American Journal of Psychiatry*, 1430; L J Siever, and others, 'The Serotonin System and Aggressive Personality Disorder' [1993] (8)(2) *International Journal of Clinical Psychopharmacology*, 33.

<sup>79</sup>L J Siever, 'Neurobiology of Aggression and Violence' [2014] (16) (5) *Americans Journal of Psychiatry*, 1.

<sup>80</sup>J C Olumati, *Contemporary Human Psychology* (Harey Publishers Limited, 2003), 35.

<sup>81</sup>The pancreatic juice is called insulin which is an hormone responsible for the conversion of sugar into amino acid either in the form of glucose or glycerol. It produced by the pancreas, a ductless grand within the liver.

<sup>82</sup>I L Karibi, *Lectures Note in Human Biology* (Unpublished Monogram, Community Secondary School Emago/Amuruto, 1985).

<sup>83</sup>M. C Brower and B. H. Price, 'Neuropsychiatry of the Frontal Lobe Dysfunction in Violent and Criminal Behaviour: A Critical Review' [2001] (71) (9) *Journal of Neurology, Neurosurgery & Psychiatry*, 720.

experiment conducted on serial killers through functional magnetic resonance imaging (fMRI) has also shown insufficient supply of glucose metabolism in the orbital frontal cortex and prefrontal *brodmann* regions of the brain.<sup>84</sup> The deficiency or inadequate supply of glucose metabolism within the cerebral systems of the brain is responsible to suppress activation of neuropeptides, neuromodulators and neurotransmitters within the brain circuitry system.<sup>85</sup> This inadequacy results to uncontrollable aggression leading to dastard antisocial behaviours.<sup>86</sup> Therefore, inadequate supply of glucose and glucose metabolites within the neurons of brain could lead to criminal acts and omissions. It can equally result to personality disorder.<sup>87</sup> Hence, from the foregoing submissions insufficient glucose metabolism in the brain circuitry systems is relevant to criminal jurisprudence and can be used to determine criminal liability

### **Supply of Oxytocin and Vasopressin**

Oxytocin is a neuropeptides hormone that regulates the neurons of the hypothalamus area of the brain.<sup>88</sup> Adequate and sufficient supply of oxytocin in the brain modulates amygdala activation thereby maintaining a stable behaviour in humans. Conversely, deficiency in the supply of oxytocin<sup>89</sup> in the brain leads to reduced amygdala stimulations which aggravate aggression and hostility in human conducts.<sup>90</sup> Vasopressin is another hormone produced in the anterior hypothalamic neurons of the brain.<sup>91</sup> Inversely, to oxytocin, excessive supply of vasopressin in the hypothalamus regions of the brain leads to exaggerated aggression in humans.<sup>92</sup> Both oxytocin and vasopressin are hormones secreted in the brain neural cells responsible for modulation of the hypothalamus regions of the limbic system. Deficient in the supply of the former leads to excessive aggression, and surplus secretion of the latter leads to hyper aggression and antisocial behavioural conducts in humans.

From the foregoing, insufficient or excessive secretions of the two neural hormones could be dangerous to the subject. This can lead to uncontrollable aggression and aggression could lead to antisocial behaviours. Therefore, the secretions of oxytocin and vasopressin are relevant in criminal jurisprudence and could be used in the determination of criminal responsibility of a person standing criminal trial.

### **Concentration of Testosterone**

Testosterone is hormonal secretion mainly produced by male animals.<sup>93</sup> It is primarily responsible for the development of secondary sex character in humans. Testosterone is secreted in both males and females, while oestrogen another hormone for the development of secondary sex character is secreted only in females.<sup>94</sup> As it is in every biochemical substance in the body, inadequate or excess supply of the substance usually results to a negative effect in that individual. Excess secretion of testosterone in the body metabolic system makes humans inordinately aggressive<sup>95</sup> thereby exhibiting antisocial behaviours and personality disorders.<sup>96</sup> The surplus supply of testosterone and steroids saturate the concentration of the neurons

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<sup>84</sup>J Haller, 'Studies into Abnormal Aggression in Human Androdents: Methodological and Translational Aspect' [2017] (7) (6) *Journal of Neuroscience and Biobehavioural Reviews*, 77.

<sup>85</sup>*Ibidem*.

<sup>86</sup>N D Volkow, and others 'Brain Glucose Metabolism in Violent Psychiatry Patients: A Preliminary Study' [1995] (61) (24) *Journal of Psychiatry Research*, 243. See also, P. P. Guazzelli, and others 'Neural Correlates of Imaginal Aggressive Behaviour Assessed by Positron Emission Tomography in Healthy Subjects' [2000] (15) (7) *American Journal of Psychiatry*, 1772.

<sup>87</sup>L J Siever, 'Neurobiology of Aggression and Violence' [2014] (16) (5) *Americans Journal of Psychiatry*.

<sup>88</sup>K P Esslinger, and others, 'Oxytocin Modulates Neural Circuitry for Social Cognition and Fear in Humans' [2005] (25) (11) *American Journal of Neuroscience*, 114.

<sup>89</sup>J T Winslow, and R. T. Insel 'The Social Deficits of the Oxytocin Knockout Mouse' [2000] (36) (22) *Neuropeptides Research*, 221.

<sup>90</sup>H R Monroe, and others, 'Stimulation of the Amygdaloidal Nucleus in Schizophrenic Patients' [1955] (111) (11), *American Journal of Psychiatry*, 862.

<sup>91</sup>K L Gobrogge, and others, 'Anterior Hypothalamic Neural Activation and Neurochemical Associations with Aggression in Pair-Bonded Male Prairie Voles' [2007] (5)(2) *Journal of Comprehensive Neurology*, 1109.

<sup>92</sup>E F Coccaro, and others 'Cerebrospinal Fluids Vasopressin Levels: correlates with Aggression and Serotonin Function in Personality Disordered-Subjects' [1998] (55) (7) *American Journal of Psychiatry*, 708.

<sup>93</sup>P. S. Bhuiyan, and others, *Human Neuroanatomy: Fundamental and Clinical* (Ninth Edition, Jaypee Brothers Medical Publishers (P) Limited, 2014), 308.

<sup>94</sup>I L Karibi, *Lectures Note in Human Biology* (Unpublished Monogram, Community Secondary School Emago/Amuruto, 1985).

<sup>95</sup>M I Batrinos, 'Testosterone and Aggressive Behaviour in Man' [2012] (10) (3) *International of Endocrinal Metabolism*, 563.

<sup>96</sup>T Geraciotti, and others, 'Testosterone: Relationship to Aggression and Impulsivity' [2007] (41) (8) *Journal of Psychiatry Research*, 488.

correlates within the brain circuitry system leading to abnormal aggression and repulsive behaviour.<sup>97</sup> The correlation between testosterone and human aggression was further demonstrated by Dabbs.<sup>98</sup> In the text, the editors incorporated an experimental survey conducted in 1996 where the testosterone levels of 240 students selected from universities in the United States of America who belonged to 12 different fraternities were tested. The test analysis show that the circulation of testosterone of persons who belonged to the most dangerous and gruesome fraternities are higher in volume than those whose activities on campus are mild and near moderates. This Dabbs' experiment corroborated the link between excess secretion of testosterone and aggressive behaviours leading to criminal acts in the society. Furthermore, demographic research over the years has shown that population of persons with high concentration of testosterone are usually characterized by high aggression including criminal acts and omissions. Such excess secretions can also lead acute personality disorders.<sup>99</sup> Based from the foregoing submissions, testosterone is an hormone secreted vide stimulation by the brain. Excess secretion of it can lead to abnormal behaviour and personality disorder. The conditions described above could lead to an act or omission. Therefore, the excess supply and circulation of testosterone is relevant to criminal jurisprudence and could be used in the determination of criminal liability.

### Secretion of Dopamine and Tiagabine

Dopamine is a type of neural hormone produced by the pituitary glands stimulated by the brain circuitry systems. Excess production of dopamine leads to aggressive behaviour in humans.<sup>100</sup> *Gabaminergic* (abbreviated as GABA) is a physiological hormone produced in the subcortical zone of the limbic system and hypothalamus regions of the brain.<sup>101</sup> Excess secretion of this hormonal substance in the body metabolism enhances aggression and abnormal behaviour. When this hormonal secretion is circulated round the body, the subject could behave in an abnormal manner leading to the commission of offences.<sup>102</sup> Whereas *tiagabine* is a GABA uptake that inhibits GABA activation of the neurons end-centres,<sup>103</sup> therefore, an imbalance between GABA production and *tiagabine*<sup>104</sup> results in hostility against other humans leading to the commission of criminal offences in the society.<sup>105</sup>

From the overview, it seems that aggression and violent acts can result to criminal acts or omissions. Aggression is no doubt of neurologically stimulated. Since it is neurologically oriented, the human agent who aggresses is a mere mouthpiece of endogenous neurons. The hormonal secretion which leads to the commission of the offence is quite independent of the agent. Wherefore, aggression and aggressive behaviours instigated by dopamine and *tiagabine* are indeed relevant in the determination of criminal responsibility in Nigeria. The act or omission is an independent act of the human agent, therefore it can be evaluated upon the provisions of Section 24.<sup>106</sup>

### 4. Conclusion

From the foregoing submissions of this investigation, neuroscientific abnormalities are quite relevant and handy tools in the examination of criminal responsibility in Nigeria, and consequently, extremely relevant in the determination of criminal liability. The paper has no hesitation to recommend the utilization of same in the administration of criminal justice system in Nigeria. If the above recommendation is adopted in Nigeria, it shall aid in the expansion of the frontiers of the country's criminal jurisprudence and administration of criminal justice.

<sup>97</sup>E J Hermans, and others, 'Exogenous Testosterone and social Aggression in Humans' [2007] (27) (15) *Journal of Biological Psychiatry*, 554.

<sup>98</sup>J M Dabbs, and others, 'Testosterone Differences Among College Fraternities: Well-Behaved v Rambunctious' [1996] (20) (2) *Personality and Individual Differences*, 157; M. Daly and M. Wilson, *An Evolutionary Psychological Perspective on Homicide* (Eds.) Thousand Oaks Limited, 1999)

<sup>99</sup>J. Archer, 'The Influence of Testosterone on Human Aggression' [1991] (82) (Part. 1) *British Journal of Psychology*, 1. S O Fetissov, and others, 'Aggressive Behaviour Linked to Corticotrophin-Reactive Autoantibodies' [2006] (60) (8) *Journal of Biological Psychiatry*, 799.

<sup>100</sup>R M Almeida, and others, 'Escalated Aggression Behaviour: Dopamine, Serotonin and GABA' [2005] (15) (9) *European Journal of Pharmacology*, 526.

<sup>101</sup>K L Gobrogge, and others, 'Anterior Hypothalamic Neural Activation and Neurochemical Associations with Aggression in Pair-Bonded Male Prairie Voles' [2007] (5)(2) *Journal of Comprehensive Neurology*, 1109.

<sup>102</sup>*Ibidem*, 684.

<sup>103</sup>*Ibidem*, 686.

<sup>104</sup>L M Lieving, and others, 'Effects of Acute Tiagabine Administration on Aggressive Responses of Adult Male Parolees' [2007] (12) (10) *European Journal of Pharmacology*, 487.

<sup>105</sup>*Ibidem*.

<sup>106</sup>Criminal Code Act, Cap C38, Vol. 4, Laws of the Federation of Nigeria (LFN) 2010.