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**A Historical Overview of Law and Neuroscience:
From the Emergence of Medico-Legal Discourses
to Developed Neurolaw**

Nowadays, law is led to a widespread connection with neuroscience. Neurolaw as an interdisciplinary field of study has emerged in the post-modern era of law and neuroscience. However, it clearly has roots that directly trace back to several discourses have traditionally upheaved from the field of medico-legal approaches in the 19th century (the classic era), or the EEG and psychosurgery era in the 20th century (the modern era). This paper strives to put these three periods under scrutiny in order to display a relatively clear image of developed neurolaw background. In this paper it was found that the classic era was the platform for multidimensional medico-legal discourses to provide the ground for the brain evidence-based analysis of legal phenomena in the modern era and bring neurolaw into being as a consequence, which is increasingly encompassing litigations, legislations, and legal thoughts by employing the modern neuroscience findings. By scrutinizing these distinct historical periods, it became clear that medico-legal discourses took their path to the realm of neurolaw as a distinct field of study to transmute the practical and theoretical context of law by transition of the perspective from a pure legal to a specialized neurolaw approach.

Introduction

By following out the post-modern³ approaches to any legal phenomena and

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³ We used the term 'post-modern' for the age of neurolaw due to the two main reasons. First, postmodernity is a contemporary state of human rationality evolution in the cultural, social, political, and legal plural contexts. As acknowledged in numerous scholarly works, inspired by the ideas of Foucault, Habermas and other postmodernists, modern thoughts gave way to postmodernism in the late 20th century. Neurolaw was born in this new age of the rationality and it seems that this interdisciplinary field of study is one of its outcomes. Second, in the context of 'law and neuroscience' history, as a result of brain-wave scanning in 20th century, neuro-legal analysis have begun to modernize. This path of progression continued with brain image evidence in the late 20th and 21st centuries. Since there is a dramatic development in the way of studying the human brain to understand the cognitive activity and sort it out, as well as employing neurolaw unparalleled approach in the analysis, the modernism took a great step forward, which can be called postmodernism. For a detailed description of post-modern era, see: Alain Pottage, *A unique and different subject of law*; LAW AND THE POSTMODERN MIND (P. Goodrich and D. G. Carlson, Eds., 2001); GARY MINDA, POSTMODERN LEGAL MOVEMENTS: LAW AND JURISPRUDENCE AT CENTURY'S END (1995); Arian Petoft, *A Foucauldian Analysis of Post-*

accentuating interdisciplinary studies on the relationship between the brain and law, to have a multi-dimensional delineation of human behavior in the context of legal system, law is led to a widespread connection with neuroscience. Mostly, in the late 20th century, owing to the fact that neuroscience evidence was increasingly risen in courtrooms and some novel studies on neuro-legal analysis of criminal responsibility were taken into account, 'Neurolaw' as a post-modern interdisciplinary field of study has emerged.⁴ Intersection between law and neuroscience actually evinced neurolaw promising face as a portrait of the quite post-modern study which came forth into the realm of social sciences; however, it clearly has roots that directly trace back to several discourses that have traditionally upheaved from the field of 'medico-legal interchanges' in the 19th century or the 'electroencephalography and psychosurgery era' in the 20th century. Therefore, it must be acknowledged that the relationship between law and neuroscience is in line with history; somehow, it has been matured over the two centuries. Neurolaw was however born in the late 20th century. Hence, the history of law and neuroscience might be divided into the three main time frames:

The classic period: The subjection of medico-legal discourses in the nineteenth and early twentieth centuries;

The modern period: The consideration of EEG findings in the legal context and the use of psychosurgical techniques to prevent violence in the 20th century;

The post-modern period: The representation of fMRI findings, the rise of neuroscience evidence in courtrooms and the advancement of neurolaw.

We divided the history into the three aforementioned periods in the interest of the essential differences in the three components that characteristically signify the substance of intellectual movements: 1) Perspective: In addition to sociopsychological scrutiny, the classic era chiefly employs a biological approach to legal phenomena, whereas a neurological inquiry into them was widespread in the modern era. With the emergence of neurolaw, the post-modern era confronted with a new innovative approach which is revolutionized, as it seems, despite maintaining its background; neurolaw provides us a new perspective in light of an authoritative distinct (medico-social) science. 2) Evidence: In the first period, scholars deal with biological evidence predomi-

Modern Concept of Sovereignty in the Light of Public Law, 18 QJPL 9 (2016).

⁴ See: Greely, Henry T., *Neuroscience and Criminal Justice: Not Responsibility but Treatment*, 56 U. KAN. L. REV. 1103 (2008); Amanda C. Pustilnik, *Violence on the Brain: A Critique of Neuroscience in Criminal Law*, 44 WAKE FOREST L. REV. 183 (2009).

nantly, while EEG evidence was at the core of modern investigations. In the age of neurolaw, scholars are exceedingly trying to discover the secrets of the brain and shed light on the cognitive networks; on that account, functional MRI evidence is ponderously considered. 3) Main subject: Law and neuroscience, as we will see below, took a historical path in which criminality elements revelation, violence eradication, and mind reading were the key factors in the three time frames, relatively.

This paper strives to put these three periods under scrutiny in order to display a relatively clear image of developed neurolaw background. It mainly seeks out the intersections during the time; since Shen briefly depicts neurolaw history,⁵ his pattern could be fruitful for the generality of the issue, mainly, among the existing literature. Actually, some scholars in law and neuroscience have fully researched and described the history of law and neuroscience for the same time period covered by this paper; but This historical overview is a novel research because of the four distinctive features: 1) Dual aspect viewpoint: In this research we consider the historical intersections by an extensive medico-legal approach; while in other existing works one of these two aspects has been focused for the most part. 2) Neurolaw integrity appraisal: This research mainly is an attempt to substantively assess the neurolaw discourses in terms of originality, modernization and possible transitions. 3) Comprehensiveness: This paper presents a thoroughly-researched and concise history to a significant extent compared to other existing studies; nevertheless, this is not a decisively comprehensive study either; it looks into the time frames for the foremost issues. 4) Discourse-oriented: Here, many discourses are scrutinized in line with history to elucidate the advancement of pertinent arguments and illustrate succedent or contemporaneous argumentative chains. In order to somewhat remove shortcomings of the works in this regard, the main purpose of this paper is to review the history of neurolaw in the three phases to learn about what are the historical components of developed neurolaw and clarify the route through which law and neuroscience have jointly traversed. The history would show us whether there are possibilities and challenges that should be considered in the future of neurolaw. As a hypothesis, it seems that the discourses in neurolaw are the same traditional ones which have deep roots in the classic era; accordingly, neurolaw discourses are simply the repetition of previous issues. Hereupon, if there was a deadlock in the past, then homogeneous current neurolaw discourses will eventually meet the same.

⁵ See: Francis X. Shen, *The Overlooked History of Neurolaw*, 85 *FORDHUM L. REV.* 667 (2016).

The Classic Era: Medico-legal discourses

This era was the platform for communication between lawyers and medics who stoutly decided to engage and cooperate with one another for the first time in the context of medical law and some other related areas.⁶ On the one hand, medics have confronted with numerous ethical and legal issues in fulfilment of their professional duties which put forward the need to employ legal proficiency; on the other hand, lawyers, having met the requirement of applying medical findings in legal systems (especially in criminal cases, such as main, battery, insanity, etc.), acquainted with opportunities in medical sciences. This bilateral engagement kept the connection more robust. In 19th century, legal medicine began to be promoted.⁷ Legal medicine was supposed to accumulate materials for applying medical knowledge to the administration of justice.⁸ Later this field of study has expanded in a broad forensic science. It was an effort to “identify a growing group of subspecialties in science and medicine, all of which convey the fundamental concepts of methods, hopefully both scientifically valid and legally admissible, for the presentation of evidence in courts of law”.⁹ Legal medicine has accompanied by newly raised issues in the field of social sciences and humanities, which attracted the attention of

⁶ E.g., New York meeting on March 19, 1873 that lead to a dialogue between jurists and medics. The main purpose of this event was to design some significant medico-legal discussions; such as taking advantage of some medical findings in the legal system, medical violations and appropriate disciplinary measures, the mental states of the human mind, juvenile delinquency, mental capacity and individual responsibility. See: Shen, *supra* note 5, at 670-671. For further medico-legal events in other countries, see: A. S. George, *The Co-Operation of the Medical and Legal Professions*, 143 NEW ENG. J. MED. 499 (1900).

⁷ As a matter of fact, the first known medico-legal clinics were established in Vienna and Berlin relatively in about 1830 and 1833. Medico-legal studies formally were inaugurated in France by establishing a clinic in 1840. From the very beginning of the nineteenth century, French judges were allowed to appoint medical experts who must have passed an examination in legal medicine. At the same time, Great Britain established its first Chair of Forensic Medicine at the University of Edinburgh. By 1876, there were chairs in all of its medical schools. See: S. E. Chaille, *Origin and progress of medical jurisprudence*, 40 J. CRIM. LAW CRIMINOL. 397 (1949). In the United States, the first lecturer on legal medicine was Dr. J. S. Stringham, who gave his lectures in New York beginning at around 1804. After that, many American scholars' books provided legal medicine issues; e.g., see: THOMAS COOPER, *TRACTS ON MEDICAL JURISPRUDENCE* (1819); ISAAC RAY, *A TREATISE ON MEDICAL JURISPRUDENCE OF INSANITY* (1838); JOHN J. ELWELL, *A MEDICO-LEGAL TREATISE ON MALPRACTICE, MEDICAL EVIDENCE, AND INSANITY COMPRISING THE ELEMENTS OF MEDICAL JURISPRUDENCE* (1860); JOHN ODRONAU, *JURISPRUDENCE OF MEDICINE* (1867); RANDOLPH A. WITTHAUS AND TRACY C. BECKER, *MEDICAL JURISPRUDENCE, FORENSIC MEDICINE AND TOXICOLOGY* (1894).

⁸ W. J. Curran, *Titles in the medicolegal field: a proposal for reform*, 1 AM. J. LAW MED. 1 (1975).

⁹ Cyril H. Wecht, *The History of Legal Medicine*, 33 J. AM. ACAD. PSYCHIATRY LAW 245 (2005).

medico-legal discourses to bio-psychological attitudes. In parallel with that, we have witnessed the emergence and development of neurology. In April 1878, the first issue of *Brain: A Journal of Neurology* has been published at Oxford University;¹⁰ at that time, in particular, the journal was supposed to be a complementary source for psychology.¹¹ Nevertheless, this expert medical journal has shared some unprecedented experimental and clinical findings of the brain and introduced a new medical science of ‘Neurology’. In the very first issues of the journal, we can find some topics that are essentially concerned with the current neuro-legal debates; howbeit, the approaches were purely medical and did not discuss the legal issues due to the subjects covered by the journal (e.g. children’s brain force at school¹² or the effects of alcohol on the human brain¹³). Almost concurrent with the advances of neurology, prominent psychologists and psychiatrists of the nineteenth century were also addressing new issues in the field of mental disorientation and mesmerism,¹⁴ telepathy,¹⁵ spiritualism,¹⁶ and phrenology.¹⁷

By considering the relationship between the mind and brain, and their interactions whereby human behavior is manipulated, psychology and neurology researches have indeed gotten closer by the middle of the century – in particular, by proposing issues related to physiological psychology (as it is clear in some novel works including the pathological study on some neuropsychological problems through nerve stimulation of ganglion cells).¹⁸ This includes attempts for pondering over the state of mind in the organism, as well as its relation to the activity of the brain,¹⁹ and the conceptualization of consciousness

¹⁰ <https://academic.oup.com/brain>

¹¹ Chiefly for the journal entitled ‘MIND: A QUARTERLY REVIEW OF PSYCHOLOGY AND PHILOSOPHY’ (1876).

¹² Clifford Allbutt, *On Brain Forcing*, 1 BRAIN 60 (1878).

¹³ Robert Lawson, *On the Symptomology of Alcoholic Brain Disorders*, 1 BRAIN 182 (1878).

¹⁴ ALISON WINTER, *MEZMERIZED: POWERS OF MIND IN VICTORIAN BRITAIN* (1998).

¹⁵ ROGER LUCKHURST, *THE INVENTION OF TELEPATHY* (2002).

¹⁶ Richard Noakes, *The Sciences of Spiritualism in Victorian Britain: Possibilities and Problems*, in THE ASHGATE COMPANION TO NINETEENTH-CENTURY SPIRITUALISM AND THE OCCULT 25 (T. Kontou and S. Willburn, Eds., 2012); PAMELA THURSCHELL, *LITERATURE, TECHNOLOGY AND MAGICAL THINKING: 1880-1920* (2001).

¹⁷ ROBERT M. YOUNG, *MIND, BRAIN AND ADAPTATION IN THE NINETEENTH-CENTURY: CEREBRAL LOCALIZATION AND ITS BIOLOGICAL CONTEXT FROM GALL TO FERRIER* (1970); ROGER COOTER, *THE CULTURAL MEANING OF POPULAR SCIENCE: PHRENOLOGY AND THE ORGANISATION OF CONSENT IN NINETEENTH-CENTURY BRITAIN* (1984).

¹⁸ S. Weir Mitchell, *Some of the Lessons of Neurotomy*, 1 BRAIN 287 (1878).

¹⁹ For instance, the arguments of G. H. Lewes in *Spiritualism and Materialism*, 19 FORTNIGHTLY REV. 707 (1876) that mind could only be understood as a constant process of interaction between the

by depicting the mind in anticipation of the pertinent modernist ideas.²⁰ Inspired by such physio-psychological thoughts, some controversial criminal doctrines have theorized the bio-legal analysis for the first time. Indeed, the most significant amongst them is Lombroso's "*Luomo delinquent* (criminal man)."²¹ In quest of chromosomal (genetic), physical (physiological, sexual, etc.), psychological (mental disorders), and successional factors,²² Lombroso augmented the criminological positivism by seeking the crime's roots in an offender who is *ipso facto* a criminal man intrinsically. Relying on some physiological findings on the human body and brain, to take into account the determinism, he concluded that a culprit congenitally commits any offenses since he/she is a criminal offender biologically. Thus in the context of anthropological criminology, he believed in criminal atavism by which countervailing measures (such as exile and execution) are advisedly subjected.²³ With more emphasis on sexual crimes, inasmuch as the body follows some physiological interactions of the pituitary, pineal, thyroid, and adrenal gland, especially due to hormonal disorders, he considered the effects of endocrine disruption on human behavior. Since internal glandular hormones directly enter the bloodstream and spread to all parts of the body, according to Lombroso, they are associated with different characteristics of human individuality and could impair the ordinary function by inducing bad temper, hatred, abhorrence, spite, etc.; so that it, in turn, may result personality disorder.²⁴ Brown-Séquard thoughts also reinforced these assertions.²⁵ At the present time, startling discoveries in genetics and neurology that have prompted a biological approach in developed neurolaw have likewise led to the emergence of a subfield in neurocriminology. Though the classic discourses were currently modernized, but their arguments paved the way for psychophysiological studies (that began in the middle of 20th). Literally hundreds of studies assessing EEG in criminals have been done over the past eighty years to implicate EEG abnormalities in

whole organism and a physical and social medium.

²⁰ This is evident as well in Lewes' thought; he allegorically depicted the mind as a lake mingling beneath the surface of multiple streams entering at different levels. See: G. H. LEWES, *PROBLEMS OF LIFE AND MIND* (1877), at 363.

²¹ MARY GIBSON, *BORN TO CRIME: CESARE LOMBROSO AND THE ORIGINS OF BIOLOGICAL CRIMINOLOGY* (2002), at 47-49 & 97-101.

²² CESARE LOMBROSO, *CRIMINAL MAN* (M. Gibson and N. H. Rafter, Trans., 2006).

²³ Bahman Shahryari and Mohammad ebrahim Shams nateri, *Extensive societal hazards in the context of criminal justice and criminology schools and thoughts*, 3 *JOURNAL OF HAZARDS*, 275 (2015).

²⁴ Marvin E. Wolfgang, *Pioneers in Criminology: Cesare Lombroso (1835-1909)*, 52 *J. CRIM. L. CRIMINOLOGY & POLICE SCI.* 361 (1961).

²⁵ M. J. Aminoff, *Brown-Séquard and his syndrome*, 5 *J. HIST. NEUROSCI.* 14 (1996).

violent recidivistic offending. Actually what we consider now as the neurological and genetic factors of crime roots in the modern neurocriminology emerged from the shadows of such classical discourses.²⁶

In contrast, based on sociopsychology, Emile Durkheim and some other scholars define the concept of crime in the context of society.²⁷ For Durkheim crime is immanent in society and results from social interaction. It may seem strange that he described criminality as a “Normal” factor rather than a pathological one: “Crime is normal because a society exempt from it is utterly impossible.”²⁸ Similarly, Prins said: “Criminality proceeds from the very nature of humanity itself, it is not transcendent, but immanent”.²⁹ Gabriel Tarde, contrary to Lombroso's theory of the determinism, believed that a wrongdoer consciously perpetrate a misdeed; however he/she is affected by nervous and mental factors *ad infinitum* that may give him a fearlessness, aggressiveness or abusiveness sense of doing so.³⁰ In the core of sociological psychology they believe that individual is rather a product than an author of society; in other words an offender is but a small image of the criminal constructor world in which he/she lives. However scientific investigations on criminal behavior showed that biological factors sporadically play a crucial role in that criminal constructing, in conjunction with environmental and sociological ones; like what modern neuroscientific models on brain-behavior interactions demonstrate, which have considerably profited from the advent of neuroimaging techniques and genetic analyses.³¹ In the definition of offender, beside many biological factors, the psychosocial characteristics were kept under scrutiny; that is why Enrico Ferri's criminology explains the three radical components of a crime:³² anthropological, physical, and the most forcefully, social.³³ This was an endeavor to advocate the crime predictability argument,³⁴ which indi-

²⁶ See: NICOLE H. RAFTER, *THE CRIMINAL BRAIN: UNDERSTANDING BIOLOGICAL THEORIES OF CRIME* (2008). Advanced neurolaw discourses are provided at least in the context of five major domains: evolutionary criminology, biological criminology, behavior genetics, molecular genetics, and neurocriminology.

²⁷ Nasser Mehran, *Crime as an Uncertain Reality*, 25 STRAT. MANA. RES. Q. 144 (2001).

²⁸ E. DURKHEIM, *THE RULES OF SOCIOLOGICAL METHOD* (G. E. Galtin, Ed., 1938).

²⁹ A. PRINS, *CRIMINALITE ET REPRESSION* (1886).

³⁰ Margaret S. Wilson, *Pioneers in Criminology I—Gabriel Tarde (1843-1904)*, 45 J. CRIM. L. CRIMINOLOGY & POLICE SCI. 3 (1954).

³¹ Hans J. Markowitsch, *Neuroscience and crime*, 14 NEUROCASE: THE NEURAL BASIS OF COGNITION 1 (2008).

³² EAMON CARRABINE et al., *CRIMINOLOGY: A SOCIOLOGICAL INTRODUCTION* (2004).

³³ Based on these factors, he divided criminals into five categories: lunatic, born incorrigible, irreversible, habitual, occasional and emotional.

³⁴ SHEILA BROWN, *UNDERSTANDING YOUTH AND CRIME*, (2005), at 28.

rectly distinguishes delinquents from the ordinary people of a society. In explaining the causes of the crime realization, Ferri has put forward an idea that the combination of those aforementioned factors is incontrovertible.³⁵

These classic discourses were being advanced in light of neurocriminology during the progress of neuroscience (also genetics and neurobiology) in identifying and intervening in neural correlates of crime.³⁶ There is an evolutionary theory in neuropsychology that mainly focus on “ultimate” causes of crime instead of “proximal” ones. Evolutionary forces over the deep time of evolution shape ultimate causes of behavior while proximal causes are the specific developmental, biologic, and environmental variables.³⁷ Apart from the mental effects on human behaviors during the time³⁸ evolutionary neurobiological roots in a criminal mind might offer us an elucidation for the etiology of a wide range of human phenotypes; such as what Daly and Wilson explained for some types of homicides (e.g., infanticide, patricide, etc.).³⁹ Neurocriminologists track down the importance of neurological mechanisms in the etiology of human behavior.⁴⁰ For understanding the etiology of antisocial behavior, modern neuroscience researches clearly demonstrate that certain regions of the brain appear to be critically important. There are evolutionary, genetic, and biological risk factors that engender antisocial behavior; as some studies showed, it is likely that most of them are mediated by the brain by impacting on either the structure or the functioning of it.⁴¹

Reflecting on some medico-legal issues such as the consciousness, will, personality disorder, etc., numerous moral, legal and philosophical ideas have adhered to bio-psychological thoughts. These issues propelled scholars to an

³⁵ CARRABINE, *supra* note 32, at 36.

³⁶ E.g., see: Joseph Glicksohn, *Criminality, Personality and Cognitive Neuroscience*, THE NEUROBIOLOGY OF CRIMINAL BEHAVIOR (Joseph Glicksohn, Ed., 2002); Focquaert, Farah, *Neurobiology and crime: A neuro-ethical perspective*, JOURNAL OF CRIMINAL JUSTICE (10 JANUARY 2018).

³⁷ Y. L. Quinsey, *Evolutionary theory and criminal behavior*, 7 LEGAL AND CRIMINOLOGICAL PSYCHOLOGY 1 (2002).

³⁸ Evolutionary psychology views humans as organism that confronted with millions of years of selection pressures and gives attention to aspects of the mind that were adept at solving ancestral problems (most notably survival and reproduction).

³⁹ M. DALY AND M. WILSON, *HOMICIDE* (1988).

⁴⁰ Y. E. Moffitt, S. Ross and A. Raine, *Crime and biology*, CRIME AND PUBLIC POLICY (J.Q. Wilson & J. Petersilia, Eds., 2011); Raine, A., et al., *Corpus callosum abnormalities in psychopathic antisocial individuals*, 60 ARCHIVES OF GENERAL PSYCHIATRY 1134 (2003).

⁴¹ A. Raine, *From genes to brain to antisocial behavior*, 17 CURRENT DIRECTIONS IN PSYCHOLOGICAL SCIENCE 323 (2008); Yang, L., et al., *Volume reduction in prefrontal gray matter in unsuccessful criminal psychopaths*, 57 BIOLOGICAL PSYCHIATRY 1103 (2005).

intellectual movement in which multi-dimensional analysis of phenomena was prevalent. Among them was Lewes who has described the body and mind in the social and cultural context.⁴² Lewes linked the brain to mind in his neuropsychological explanations. He objected to one element being selected as indispensable. The interdependence of the brain and mind is an important issue in the modern neurolaw. Current neuropsychological studies on violence have gone deeper in understanding the brain-mind relationships. It often involves an objective assessment of how brain abnormalities produce psychological effects. It also evaluates brain damage and brain disorders in criminal responsibility.⁴³ This will be discussed further. Adding the brain to the analysis increasingly made the discourses more intricate. Alongside neurological disorders and their impact on human behavior,⁴⁴ there were some sophisticated issues (such as the concept of feeling, emotion, and aggression)⁴⁵ invited scholars to take advantage of neurology findings in the context of such an analysis. The researches emphasized on the psychological explanation at any rate. One of the outcomes of such a multidimensional dialogue (in the context of legal medicine and the abovementioned discourses) was the *Medico-Legal Journal* at the beginning of the twentieth century, during which some remarkable researches on the insanity,⁴⁶ validity of medical evidences,⁴⁷ legal impli-

⁴² See generally *supra* note 20.

⁴³ FEGGY OSTROSKY AND ALFREDO ARDILA, *NEUROPSYCHOLOGY OF CRIMINAL BEHAVIOR* (2017).

⁴⁴ E.g., see a study of paralysis and convulsion by J. Hughlings Jackson, *Clinical and Physiological Researches on the Nervous System* 1 MIND 125 (1876) on the anatomical and physiological localization of movements in the brain. He attentively has given throughout his inquiries to the latest results of psychological science, while he has at the same time a singularly clear apprehension of the limits of his functions as a clinical and physiological observer. He concluded that the organ of mind is made up of processes representing impressions and movements; hence, the physical substrata of mental states are sensori-motor processes. The brain areas are connected with conscious mental action; to take an example, the higher and highest parts of the nervous system are involved in intellection, feeling, and volition; Jackson puts forward the view as the only one consistent with the doctrine of organic evolution. Similarly see his work, *On Affections of Speech from Disease of the Brain*, 1 BRAIN 304 (1878).

⁴⁵ Lewes neuropsychology principally recognized that identity of "Tissue" everywhere carried with the identity of physiological "Property"; in his words, "similarity in the structure and connections of Organs involved corresponding similarity in Function". Lewes believed that the conception of "the Brain as the Organ of Mind" is irrational, since it would be the parallel conception of "the Heart as the Organ of Life". He particularly referred to the sensational and volitional functions of the spinal cord and asserted the histological identity of spinal cord and Brain. Lewes experiments showed that the brainless animal feels nothing, and therefore that its spinal cord is not a sensational center. The evidence of feeling being thus manifested when an individual has the brain. It is absolutely true about the mind. See: G. H. Lewes, *What is Sensation?*, 1 MIND 157 (1876); G. H. Lewes, *Motor Feelings and the Muscular Sense*, 1 BRAIN 14 (1878).

⁴⁶ T. Claye Shaw, *Impulsive Insanity*, 1 MEDICO-LEGAL J. 30 (1903).

cations of drug use,⁴⁸ compensation for mental injuries⁴⁹, lie detection techniques,⁵⁰ and legal issues of traumatic brain injury (TBI) have carried out. Due to a fundamental principle in criminal law “volition” is a requisite element of every crime. The chief reason for this requirement is that without volition there can be no act. In this classic doctrine, it is stated that criminal intent requires volition. Since an irresistible impulse, resulting from mental derangement, necessarily negates volition and criminal intent requires volition, the doctrine has logically followed that “irresistible impulse should constitute a defense.” A committee of lawyers and physicians has recommended on this subject, that “No person suffering from mental disease shall hereafter be convicted of any criminal charge, when at the time of the act or omission alleged against him, he did not have, by reason of such mental disease, the particular state of mind that must accompany such act or omission in order to constitute the crime charge”.⁵¹ There are however some convincing reasons that this

⁴⁷ Earl Russell, *The Weight to Be Attached to Medical Evidence*, 1 MEDICO-LEGAL J. 94 (1903).

⁴⁸ T. D. Crothers, *Legal Responsibilities of Drug Takers*, 33 MEDICO-LEGAL J. 14 (1916). Scholars indicated that during the short time dramatic changes have occurred in drugs abuse and crime. Drug dependence and drug abuse was recognized as a disease that over the long term results in physical harm, behavioral problems, and association with people who also abuse drugs. Drug users turn to some form of crude amateur crime like burglary, robbery and even the prostitution to support their habits. Juvenile’s addiction in the larger cities has become a major problem causing substantial harm to the society in every field. The majority of drug victims are neurotic individuals who are mentally unbalanced. Hence, this required a room for medico-legal debate. Some classic discourses claim that drug addicts cannot satisfy the conditions for criminal responsibility. In contrast, other ones defended the criminal law’s commitment to holding people responsible for what they do. In recent years, neuroscientific studies have uncovered many of the physical processes and mechanisms involved in drug addiction and addiction-related behaviors. This evidence has prompted the diminish responsibility discourses; however, Stephen Morse believed that neuroscientific findings will not support the claim that drug addiction diminishes criminal responsibility. As a matter of fact, it is difficult to prove that drug addicted criminals “are relevantly compelled, coerced, or irrational and that they have either not had adequate opportunity to instigate self-control strategies, including receiving treatment that would have prevented their offending, or that they have mental impairments that render those strategies largely unavailable or ineffective” see: Jeanette Kennett, Nicole A. Vincent, and Anke Snoek, *Drug Addiction and Criminal Responsibility*, HANDBOOK OF NEUROETHICS (J. Clausen and N. Levy, Eds., 2015).

⁴⁹ Herbert Funk Goodrich, *Emotional Disturbance as Legal Damage*, 39 MEDICO-LEGAL J. 129 (1922).

⁵⁰ R. E. House, *Why Truth Serum Should be Made Legal*, 42 MEDICO-LEGAL J. 138 (1925).

The first psycho-physiological lie detection technique was the Polygraph, which was patented in 1921 at the University of California. The device provides possibilities to examine and record several physiological indicators such as blood pressure, heartbeat, respiration, and nerve reflexes when an object responds to a set of questions, to manifest falsehood. Polygraph is also known as Psychophysiological Detection of Deception (PDD). See: J. P. Rosenfeld, *Alternative Views of Bashore and Rapp’s (1993) alternatives to traditional polygraphy: a critique*, 117 PSYCHO. BULLETIN. J. 159 (1995).

⁵¹ Committee on Insanity and Criminal Responsibility of the American Institute of Criminal Law and Criminology, 3 J. CRIM. L. AND CRIMINOL. 719, 720 (1913).

doctrine could not be reliable in some way: 1) when someone knows the difference between right and wrong to do harm, an impulse cannot be irresistible. 2) It is difficult to prove the impulse in many cases. 3) Impracticability of application. Nonetheless, a similar objection may be made to other types of mental disease; wherefore these objections are not an adequate reason for decisively rejecting the defense. The main subject in this dialectical discourse about medical evidence in courtroom was the “Difficulty of Proof”. The core objection was that proving some mental diseases is positively difficult which leads to rejection of the defense. This was clearly recognized by the Supreme Court of Utah in *State v. Green*: “Insanity in all its forms is frequently difficult to determine with certainty, and yet courts all recognize that, if an accused does not know right from wrong and does not know the nature and quality of the act charged he should not be punished”.⁵² Admissibility of proof is quietly different from receiving it. Some neurological or psychological diseases are difficult to prove, but it is not likely that a court would refuse to receive evidence merely because of the difficulty of proof. Accordingly, in *Parsons v. State*, regarding to insanity proof, the court stated the following: “It is no satisfactory objection to say that the rule above announced by us is of difficult application. The rule in *McNaghten's Case* is equally obnoxious to a like criticism. The difficulty does not lie in the rule, but is inherent in the subject of insanity itself”.⁵³ Currently, Criminal responsibility is a neurocriminology core question; the modern rules (based on neuroscience findings) for determining such responsibility derived from the classic discourses. Principally, when a mental or neurological disease is set as a defense to a criminal charge, the testimony of qualified physicians is unavoidable. It is then the function of the jury to apply the rule of law to the medical testimony and arrive at a verdict accordingly.

One of the most important controversial discourses in the dialogue was the neuropsychological concept of ‘Insanity’⁵⁴ by some determinative criteria, which were generally in disagreement due to differences in the literature of lawyers and medics as well as a dominant discrepancy in the conceptualization. Some scholars nonetheless expressed their hope to find a more precise understanding of the biological implications of mental disorders by under-

⁵² *State v. Green* 78 Utah 580, 600, 6 P.2d 177, 185 (1931).

⁵³ *Parsons v. State*, 8 Ala. 577, 593, 8 So. 854, 864 (1887).

⁵⁴ R. H. Ahrenfeldt, *Legal and Medical Insanity*, 2 *BRIT. MED. J.* 710 (1946); WILLIAM G. H. COOK, *INSANITY AND MENTAL DEFICIENCY IN RELATION TO LEGAL RESPONSIBILITY: A STUDY IN PSYCHOLOGICAL JURISPRUDENCE* (1921), at 118-126 & 152-164.

standing the brain. Henceforward, a debate about the neuropsychiatric fundamentals of madness⁵⁵ has become widespread. Insanity is an uncontrolled state mentally or neurologically eventuated in thought and will, predominantly, in terms of the late 19th century medical law.⁵⁶ In addition to difficulty of proof, a main problem with law was the ambiguity and indetermination of “insanity”. The law has held that “mental disease” is an indeterminate and vague term (including conditions varying from mild indisposition to delirious and confusional states). Another problem was the differences between literatures and approaches of medicine and law. The form of insanity was a question of mental pathology that was not of particular interest to law (nor the causes of insanity). Actually, law was concerned in the legal consequences resulting from insanity. To fill this gap, medico-legal discourses have scrutinized any degree of madness, especially in the context of irresistible impulse and criminal responsibility as mentioned earlier. This was momentous in legal doctrine of criminal responsibility⁵⁷ due to the large number of important criminal prosecutions were accompanied by the plea of insanity or situations in which madness connected with criminal acts;⁵⁸ in view of the fact that “insanity in some form has always been regarded as an excuse for the commission of crime”.⁵⁹ However, owing to the dissimilar definitional propositions (of the insanity), as Shen pointed, nowadays, despite the advances in neuroscience, there is no explicit “line between a criminal defendant who had the capacity to do otherwise versus a defendant who (due to his “insanity”) did not really make a ‘choice’ in the way that criminal law requires for culpability”.⁶⁰ Nowadays, the doctrine of irresistible impulse has been chiefly considering in the context of brain-damaged cases (mainly a disorder in the frontal lobes) by “control” tests; it seems that in many cases, defendants’ criminal behavior appears to be the product of their extremely poor judgment and self-control. Modern neurolaw tries to substantively assess the responsibility of defendants

⁵⁵ SWAIN STELLA, *THE USES OF MADNESS IN NINETEENTH- AND TWENTIETH-CENTURY FICTION* (1992), at 129-138; NORMAN DAIN, *CONCEPTS OF INSANITY IN THE UNITED STATES* (1964).

⁵⁶ Algernon Bristow, *Medico-Legal Inspections and Post-Mortem Examinations*, A SYSTEM OF LEGAL MEDICINE (Allan McLane Hamilton Ed., 1894).

⁵⁷ Edwin R. Keedy, *Insanity and Criminal Responsibility*, 7 J. CRIM. L. CRIMINOLOGY & POLICE SCI. 484 (1917).

⁵⁸ Forbes Winslow, *The Legal Doctrine of Responsibility in Cases of Insanity, Connected with Alleged Criminal Acts*, 11 J. PSYCHOL. MED. MENT. PATHOL. 214 (1858).

⁵⁹ P. Holmes Reed, *Insanity as a Defence in Criminal Law*, 68 HIS. DISSERTATIONS & THESIS COLL. 1 (1895).

⁶⁰ Shen, *supra* note 5, at 674.

with any type of insanity. It is Neurocriminologists' commitment to resist ascribing immoral behavior to an uncontrollable brain dysfunction while they holds individuals accountable for their criminal conduct.⁶¹ Several criminal cases, have currently been confronting with a variety of pre-trial, adjudicatory, and dispositional issues that includes evidence of frontal lobe dysfunction; and this will increasingly continue in future litigations. "This trend is likely to accelerate, as the technologies available for diagnosing frontal lobe dysfunction improve, and as attorneys and courts become more familiar with, and receptive to, neuroscience evidence."⁶²

Due to some new experiences in medicine, a discourse concerning the concept of 'Life' along with the 'Death' has held forth in legal arguments by analyzing the brain and mind in the state of death and its legal implications.⁶³ Noticeably, the biological components of the matter were taken into consideration for ascertaining an individual's legal status. Despite some existing scientific indicator of cell death and inactive state of mind (considerably unconsciousness) or body (such as cessation of cardio-pulmonary function), there was concern about the medical definition of death, since science was somewhat unable to diagnose it.⁶⁴ A conceptual obscurity at that time was the state of brain and mind in some unknown conditions including coma and the vegetative state, which was followed by a great deal of complexity in explaining the human consciousness and life. These subjects are still controversial in

⁶¹ Jessie A. Seiden, *Comment, The Criminal Brain: Frontal Lobe Dysfunction Evidence in Capital Proceedings*, 16 CAP. DEF. J. 395, 419 (2004). As seiden said, "there is an important difference between being immoral and acting immoral. A defendant who acts immorally as a result of [brain dysfunction] is arguably not as culpable as a defendant who simply is immoral."

⁶² Redding, Richard E., *The Brain-Disordered Defendant: Neuroscience and Legal Insanity in the Twenty-First Century*, 56 AMER. UNI. LAW REV. 51 (2006).

⁶³ In spite of substantial inconsistencies in the concept of life, the definition of death was more consenting. Actually, a process-based medical definition of life, as what Allan Hamilton has described in his work entitled *Identity of Living in A SYSTEM OF LEGAL MEDICINE* (Allan McLane Hamilton Ed., 1894), was not ideal in the legal setting. Howsoever, life and death have generally presumed to be inter-related processes, as it clear in some works, such as Francis Harris' *Death in its Medico-Legal Aspects* in the book mentioned above. This attitude was likewise reflected in the 1980s thoughts; pursuant to what Green said "death commences with the very beginnings of life as the body constantly sloughs off and replaces dead cellular material". See: Ronald M. Green, *Toward a Copernican Revolution in Our Thinking about Life's Beginning and Life's End*, 66 SOUNDINGS 152 (1983).

⁶⁴ A neurological investigation of the matter was considered trivial; hence, it was assigned to the middle of 20th century. During that, there was advances in neuropsychology to define the death more precise in light of brain death and technological capabilities that allowed successful organ transplants. See: Alexander Morgan Capron and Leon Kass, *A Statutory Definition of the Standards for Determining Human Death: An Appraisal and a Proposal*, 121 U. Pa. L. Rev. 87 (1973); De Georgia MA, *History of brain death as death: 1968 to the present*, 4 J. CRIT. CARE. 673 (2014).

current neurolaw deliberations. To demonstrate the brain function in a vegetative state, neuro-psychologists, based on new discoveries in neuroscience,⁶⁵ have recently figured out that some patients are conscious and there is a way to directly communicate with his/her brain in a great surprise. This leads to a novel concept of life (somehow the death), of which an underlying assumption might be that the brain responses to stimuli could be considered as an assessment factor. Nowadays, current neuroscience comes to the conclusion that consciousness is directly related to the brain cognitive functions and can be scientifically evaluated with some techniques such as fMRI.⁶⁶ These findings undermine the traditional arguments in the medico-legal discourses, in addition to repelling the necessity of some alleged indicators (such as ability to talk) by replacing unprecedented factors (such as the brain neurofeedback and cognitive functioning) to redefine the concept of life and death.

Moreover, there was an argument about inducement of abnormalities in as much as cultural normative differences in the context of criminology such as what Durkheim⁶⁷ has theorized, as a matter of fact, in the light of socio-psychological discourses. In his book, *Conflits de Culture et Criminalité* (1938), Sellin also explained the relationship between cultural conflicts and delinquency in similar fashion. He emphasized on the psychological element of social norm acceptance regarding customary values and traditions, which are strictly influenced by a set of legal rules; and if these rules do not conform to the pattern of cultural norms, then some kind of cultural conflicts would arise by which contraventions are successively outcropped at the core of society.⁶⁸ If truth be told, Sellin and his sympathizers put confidence in psychological dependency of individuals' intellectual perspectives on cultural values as a part of their identity, which more often fashions the personality to a considerable extent; it is therefore deniable in criminology. As a result, paying attention to socio-psychological factors – of course not merely – has given rise to 'Élément dangereux (dangerous element)' doctrine. According to the doctrine, in subordination to social norms, there are individuals who are psycho-

⁶⁵ Lorina Naci et al., *The Brain's Silent Messenger: Using Selective Attention to Decode Human Thought for Brain-Based Communication*, 33 J. OF NEUROS. 9385 (2013).

⁶⁶ Adrian M. Owen, M. R. Coleman, *Detecting awareness in the vegetative state*, 1129 ANN. N. Y. ACAD. SCI. 130 (2008).

⁶⁷ See: Walter A. Lunden, *Pioneers in Criminology XVI-Emile Durkheim (1858-1917)*, 49 J. CRIM. L. & CRIMINOLOGY & POLICE SCI. 2 (1958); Thorolfur Thorlindsson and Jón Gunnar Bernburg, *Durkheim's Theory of Social Order and Deviance: a Multi-level Test*, 20 EURO. SOCIOLOGICAL REV. 271 (2004); Philip Smith, *Durkheim and Criminology: Reconstructing the Legacy*, 41 AUS. & NEW ZEALAND J. CRIMINOLOGY 333 (2008).

⁶⁸ THORSTEN SELLIN, *CONFLITS DE CULTURE ET CRIMINALITÉ* (1984), at 21-67.

logically recusant, potentially maladaptive, and have a high probability of committing a crime; therefore, recognition and identification of these probable malicious elements might be considered as a prerequisite for crime prevention. Based on the severity of their social abnormalities, they are frequently supposed to be categorized in the dangerous classes of society.⁶⁹ As Raffaele Garofalo has put forward about the potential criminality of individuals, *Temibilità* (dangerousness) depends on possible antagonism, normative hostility, and incongruousness with self-relative social life.⁷⁰ The underlying distinction that some scholars have analytically placed among criminals with mental disorder and social abnormality might be rooted in the thought of Philippe Pinel at the beginning of the nineteenth century, who has differentiated between delinquency out of mental illness (*manie avec délire*) and misdemeanor without any psychopathy (*manie sans délire*).⁷¹ Jean Pinatel also referred to the social incompatibility of some people, in terms of normative repugnance at what the society traditionally postulated (negation of society) and the psychological pressure on them, as the mutual factors to furnish a house for dangerous classes.⁷²

Eventually, by focusing on a comprehensive approach to biological, psychological, and sociological factors, the 19th and early 20th centuries spread out medico-legal discourses, for the most part, in explaining criminality. The maturity of this discursal link is more perspicuous in the middle of the twentieth century under the root causes of crime. These causes are mostly the existential and life-sustaining elements of a criminal phenomenon arising from physiological impairment, psychological disorderliness or antisocial conditions. The ideas of Stefani and Kinberg on the factors of crime realization, for example, can be pointed out.⁷³ Pursuant to them, in keeping with proportionate conditions, as long as the factors are not matchable, they will not engender a crime by a potential violator in the context of a particular society. As a matter of fact, they particularly believed that the deterministic influence of the brain physiologic factor could not be ignored in a criminological analysis (considering its impact on individuals' will and cognizance), such as a severe reaction (anger, exasperation, wrath, etc.), TBI, intellectual disability, alco-

⁶⁹ A. R. Gillis, *Crime and State Surveillance in Nineteenth-Century France*, 95 AM. J. SOCIOL. 307 (1989).

⁷⁰ GREGG BARAK, *BATTLEGROUND: CRIMINAL JUSTICE* (2007), at 162.

⁷¹ PHILIPPE PINEL, *A TREATISE ON INSANITY* (Trans. D. Davis, 1962, Original Book: 1806).

⁷² JEAN PINATEL, *LE PROBLÈME DE L'ÉTAT DANGEREUX* (1954).

⁷³ GASTON STEFANI, *DROIT PENAL GÉNÉRAL ET CRIMINOLOGIE* (1959); OLOF KINBERG, *LES PROBLÈMES FONDAMENTAUX DE LA CRIMINOLOGIE* (1959).

holism, epilepsy, and insanity.⁷⁴ Hence, the meticulous and evidence-based investigation into the brain, which was deemed as a newly proposed factor in medico-legal discourses, remained for the next era of law and neuroscience in order to ponder the human behavior more precisely with the neuroscientific approach, peculiarly in light of EEG evidences.

The Modern Era: EEG Evidences and Psychosurgery

Electrical activity in the brain was discovered more than a century ago by Richard Caton, a British physician and professor at University of Liverpool School of Medicine, who discovered electrical signals through direct communication with the animals' brain.⁷⁵ Following his findings, after about forty years (in the 1920s), Hans Burger used the scalp to record the electric current of the human brain.⁷⁶ Berger's discoveries are typically one of the most important neurobiological developments that revolutionized the medical history of neurology⁷⁷ and, of course, 'Law and Neuroscience' gradually. With the advent of the EEG technique, over the time, law also took advantage of its beneficial findings. Since the middle of the 20th century, EEG was considered by practitioners as a technique for instrumental usage at first light;⁷⁸ and after some new neuroscience discoveries about the human brain, within a couple of decades, that the analytical platform of neurocognitive functions has typically preponderated over its pathless antecedent background, it found a way for legal normative implementation by some well-nigh concrete facts for legal decisions.

⁷⁴ Stefani and Kinberg generally divided the root causes of crime into the biological, mental and social propellants (separate but under the interaction). On account of the diversity of statuses and characters, however, impression rates among individuals are different. Yet, there were some sociologists, such as Lemert and Becker, who only emphasized on the sociological factor. For a detailed description, see: Michael J. Rosenberg, *Lemert Primary and Secondary Deviance*, in *ENCYCLOPEDIA OF CRIMINOLOGICAL THEORY* (Francis T. Cullen & Pamela Wilcox, Eds., 2010); also see: Julius Debro and Howard S. Becker, *Dialogue with Howard S. Becker*, 5 *ISSUES IN CRIMINOLOGY* 159 (1970).

⁷⁵ In 1875, for the first time, he published his examinations' results by a paper entitled: *The Electric Currents of the Brain* in the *British Medical Journal*. Caton utilized the galvanometer, a device which is invented by Lord Kelvin in 1858, and reported at the Ninth International Conference on Medicine in Washington (1887) about the electrical activity of the brain. See: R. Caton, *Researches on electrical phenomena of cerebral grey matter*, 3 *NINTH INTERNATIONAL MEDICAL CONGRESS PROCEEDINGS* 246.

⁷⁶ He named this device, "Electroencephalogram (EEG)". See: H. Berger, *Über das Elektrenkephalogramm des Menschen*, 87 *ARCHIV FÜR PSYCHIATRIE UND NERVENKRANKHEITEN* 527 (1929).

⁷⁷ L. Holmes Gregory, *Epilepsy*, *LANDMARK PAPERS IN NEUROLOGY* (Martin R. Turner and Matthew C. Kiernan, Eds. 2015).

⁷⁸ E.g., application of EEG recording for the psychological assessment of the accused's insanity in the hospital; see: *Downs v. State*, 330 S.W.2d 281, 284 (Ark. 1959).

Following new EEG findings on the brain in the 1950s, by the positive-pressure ventilators device, the concept of “Brain Death” was put into words for the first time. In 1956, according to an experimental study on six patients with inactive neurological reflexes (based on EEG data), hypotension, polyuria, and hypothermia, through angiography, it was concluded that in all of them, the brain blood flow was stopped and no neurocognitive function has been seen somehow the brains were dead as the patients hereto.⁷⁹ Subsequent to this study, a number of physicians worked on the state of coma.⁸⁰ Certainly, it was significantly important for legal practitioners who have confronted with some controversial ethical and legal issues in such unknown brain states. Here, consciousness was a key factor. After Berger’s encephalographic investigations, piecemeal, works to explain the physical roots of consciousness have begun to emerge. Experimental reports⁸¹ suggested that the feeling states are associated with relative preponderance of alpha activity over EEG responses; impactful enhancement of the activity affiliated with pleasant thoughts or feelings. However, neural mechanisms effecting enhancement of this alpha activity were unknown. The results indicated the discrimination between experimental and rest periods. A voluntary control, which signifies the awareness in biologic activity (e.g., feeling state), can be exerted exclusively with respect to the subconscious activity. Scholars have proposed that activated EEG patterns possibly might be resulted from the attention required while individuals are trying to perceive a phenomenon. The type or quality of the attention employed functions.

In light of intellectual activity experiments,⁸² the EEG was supposed to relatively assess mental activity in various levels (subconscious, the conscious, and

⁷⁹ E. F. Wijdicks, *The diagnosis of brain death*, 16 N. ENGL. J. MED. 1215 (2001).

⁸⁰ For example, see: P. Wertheimer et al., *Diagnosis of death of the nervous system in comas with respiratory arrest treated by artificial respiration*, 67 PRESSE. MED. 87 (1959). In 1959, under a momentous study on 23 patients with coma at the Paris Hospital, the researchers found that the brain pulses of those in absolute coma were inactive in EEG since the brains’ tissue were completely necrotic by some means were deemed in a brain death state (irretrievable coma). See: P. Mollaret and M. Goulon, *The depassed coma (preliminary memoir)*, 101 REV. NEUROL. (PARIS) 3 (1959).

⁸¹ For example, see: Barbara B. Brown, *Recognition of aspects of consciousness through association with EEG alpha activity represented by a light signal*, 6 PSYCHOPHYSIOLOGY 442 (1970); J. P. Banquet, *Spectral analysis of the EEG in meditation*, 35 ELECTROENCEPHALOGR. CLIN. NEUROPHYSIOL. 143 (1973).

⁸² Barbara B. Brown, *Awareness of EEG-subjective activity relationships detected within a closed feedback system*, 7 PSYCHOPHYSIOLOGY 451 (1970); Erik Peper, *Feedback regulation of the alpha electroencephalogram activity through control of the internal and external parameters*, 7 BIOLOGICAL CYBERNETICS 107 (1970).

the superconscious)⁸³ or the states of consciousness (sleep,⁸⁴ drunkenness, drug use,⁸⁵ etc.). Consciousness was typically defined as human knowledge about himself and his visual environment. The neurological events in consciousness have perceived as the events processed by the language system of the brain. Consciousness has a communicative essence that creates the ability of imaginary dialogue with oneself making self-consciousness. A relatively small part of the neocortex is its living substrate; it is mostly formed by neurodynamical activity of the left-hemisphere neocortex, where discrete fragments of imprinted reality are designated by symbols or words; hence, speech is an external manifestation of conscious thinking. Superconsciousness is a mysterious manifestation of mental activity of the entire brain with a dynamic awareness; in such a state of consciousness multidimensional imagery and huge complexity in perception are occurred in cognitive functions associated with higher potential, creativity, intuition, quantum reality and spiritual awareness. In subconsciousness, every mental activity is automatically realized (or can be) under certain conditions with no conscious skills. "Along with earlier realized experience filling consciousness with particular external content, there is a direct channel of influence on the subconsciousness in the form of imitative behavior. Thus, routine but important responses can be fixed and further carried out by column systems of lower (pre-verbal) levels, without being realized."⁸⁶ Based on psychological, metabolic, physiological and pharmacologic indicators, it was found that the brain's activities are disparate in consciousness raising or disturbance. Physicians like Donald Hebb mainly believed that the upper brainstem, thalamus, and basal forebrain play a crucial role in this regard; he argued that there is a set of neural cells which, in the state of consciousness, temporarily acts as a coherent system with neural communica-

⁸³ WILLIAM WALKER ATKINSON, *THE SUBCONSCIOUS & THE SUPERCONSCIOUS PLANES OF MIND* (2016). As Tindall alluded, "The normal state of consciousness comprises either the state of wakefulness, awareness, or alertness... The abnormal state of consciousness is more difficult to define and characterize, as evidenced by the many terms applied to altered states of consciousness by various observers. Among such terms are: clouding of consciousness, confusional state, delirium, lethargy, obtundation, stupor, dementia, hypersomnia, vegetative state, akinetic mutism, locked-in syndrome, coma, and brain death". See: Suzie C. Tindall, *Level of Consciousness*, CLINICAL METHODS: THE HISTORY, PHYSICAL, AND LABORATORY EXAMINATIONS (Walker HK et al., Eds., 1990).

⁸⁴ K. TaniN Yoshii, *Efficiency of verbal learning during sleep as related to the EEG pattern*, 17 BRAIN RESEARCH 277 (1970).

⁸⁵ Ijaz Haider and Ian Oswald, *Late Brain Recovery Processes after Drug Overdose*, 2 BRITISH MED. J. 318 (1970).

⁸⁶ L.E. Popov et al., *The phenomena of superconsciousness, consciousness and subconsciousness*, NATURAL RESOURCES AND TECHNOLOGIES IN EDUCATIONAL ACTIVITIES 57 (2015).

tion network for facilitation of other systems at a given time in order to bring about cognitive capacities; however, it is still in controversy.⁸⁷ Neuroscience experiments consider the type of “consciousness accessibility” by focusing on the central nervous system and the electrical properties of neurons (particularly in the cerebral cortex). Neuroscientists linked access-conscious to “rational control” of behavior, which contrasts with a broader conception of “intentional access”.⁸⁸ The latter takes a mental state to be access-conscious if it can inform goal-directed or intentional behavior (whether irrational or reasonable). As modern neuroscience experiments go, “Neural Correlates of Consciousness” (NCC)⁸⁹ is a first step for neurolaw in understanding consciousness. “An NCC is a minimal neural system N such that there is a mapping from states of N to states of consciousness, where a given state of N is sufficient under conditions C, for the corresponding state of consciousness.”⁹⁰ Yet, there are many objections to the neuroscientific concept of consciousness on the grounds that it would be too superficial if we try to elucidate substantive components of mental experiments by the positive patterns of NCC displaying in fMRI. A plausible objection might be derived from the fact that mental activity of the brain follows a complex, diverse, and multilateral perception of any phenomenon.

Beyond, there were corroborated contemplations on the use of EEG in criminal justice systems. This has incorporated law cases bearing on the question of insanity and mental illness that have a potent effect on individual criminal responsibility; including what was strictly noted in the famous case of *Durham*.⁹¹ For the juries, a specific rule (known as the *Durham rule*) was recognized to find a defendant is not guilty due to insanity: “an accused is not criminally responsible if his unlawful act was the product of mental disease or mental defect”.⁹² Given that the EEG technique was recently introduced to the legal community and its efficiency was largely defensible for psychiatrics, criminologists have become increasingly familiar with it; involving what scholars

⁸⁷ See: Zeman Adam and J. A. Coebergh, *The nature of consciousness*, HANDBOOK OF CLINICAL NEUROLOGY (J.L. Bernat and R. Beresford, Eds., 2013).

⁸⁸ Ned Block, *On a Confusion about a Function of Consciousness*, 18 BEHAVIORAL AND BRAIN SCIENCES 227 (1995).

⁸⁹ Francis Crick and Christof Koch, *Consciousness and Neuroscience*, 8 CEREBRAL CORTEX 97 (1998).

⁹⁰ David J. Chalmers, *What Is a Neural Correlate of Consciousness*, NEURAL CORRELATES OF CONSCIOUSNESS: EMPIRICAL AND CONCEPTUAL QUESTIONS 17 (Thomas Metzinger, ed., 2000).

⁹¹ *Durham v. United States*, 214 F.2d 862 (D.C. Cir. 1954)

⁹² *Durham*, 214 F.2d at 874-75.

learned by EEG experiences about the abnormal brain of individuals⁹³ with epilepsy,⁹⁴ tumors,⁹⁵ and neurological diseases⁹⁶ and behavioral responses to them. The clear example of this was Bennett's neuropsychological explanation for violence, social abnormalities and emotional disturbances in patients with epilepsy;⁹⁷ according to him, epilepsy causes some neurological responses by which atypical and violent behaviors become apparent. Such spontaneous reactions can lead to anomalous consequences in the social context; providing therapeutic measures in this regard, therefore, is an inevitable measure. It is mainly propounded in light of the right to treatment; as it is well articulated in *Rouse v. Cameron*.⁹⁸ Relying on Durham rule, the court decided to hold the accused not guilty with regard to his madness and upheld its decision to confine him in a hospital for several years. In fact, lawyers believed that the mere subjection of confinement would not be in line with criminal justice and individual fundamental rights, but the community is responsible for providing appropriate therapeutic measures to them by developed medical sciences (especially psychiatry and neurology); indeed, scientists were somewhat expected to control and eradicate violence in human.⁹⁹ The use of neuroscientific evidence in criminal justice system will be further discussed in the post-modern era. "Violence" was the key factor in the new criminology. Beside the psychological and neurological effects in emerging aggressions, some scholars recognized the term of 'dysfunctional society' as one of the main causes of pugnaciousness.¹⁰⁰ This led to a dialectic discourse between medicalization, socialization, and individualization of crime. As Mark and Ervin suggested, "that poverty, unemployment and substandard housing have a major role in provo-

⁹³ Denis Williams, *The Significance of an Abnormal Electroencephalogram*, 4 J. NEURO. & PSY. 257 (1941).

⁹⁴ J. H. Margerison et al., *Epilepsy and the temporal lobes. A clinical, electroencephalographical study of the brain in epilepsy, with particular reference to the temporal lobes*, 89 BRAIN 499 (1966).

⁹⁵ M. F. Williams et al., *clinico-eeeg study of 128 gliomas and 50 intracranial metastatic tumours*, 85 BRAIN 1 (1962).

⁹⁶ M. F. Williams et al., *Clinico-EEG correlation with arterial and jugular venous biochemical studies in acute neurological disorder*, 87 BRAIN 281 (1964).

⁹⁷ A. E. Bennett, *Psychiatric aspects of psychomotor epilepsy*, 6 CALIF. MED. 346 (1962).

⁹⁸ *Rouse v. Cameron* 373 F.2d 451 (D.C. Cir. 1966).

⁹⁹ Largely, because of an experience gained in imprisonment system whereby offenders who were mentally ill, compared to others (With no mental disorder), spent more time in prison and it was not consistent with the requirements of criminal justice; psychopathic offender should be distinguished from common delinquents and be treated as a sick. See: HENRY J. STEADMAN AND JOSEPH JOHN COCOZZA, *CAREERS OF THE CRIMINALLY INSANE: EXCESSIVE SOCIAL CONTROL OF DEVIANCE* (1974); J. McGarry, *The Fate of Psychotic Offenders Referred for Trial*, 127 AM. J.-PSYCHIAT. 1181 (1971).

¹⁰⁰ Anon, *Psychosurgery: A Political Weapon*, CHICAGO METRO NEWS (21 December 1974).

king social protest and urban riots is obvious to an increasingly concerned and crowded American society. The more subtle, but equally important role of brain dysfunction, however, is often overlooked by sociologists and physicians who are prejudiced by the either environment or brain dysfunction dichotomy in explaining aberrant human behavior”.¹⁰¹ Indeed, the core of this discourse is to find the roots of crime in the environmental context, neuropsychological grounds or essentially individuals themselves. Critics of the biology of violence-propensity described it merely as a myth that did not have a well-founded scientific rationalization and was the same Lombroso’s criminal man theory.¹⁰² Based on this critique, thus, the biological theory of “Violence-Prone” is just a return to the classic biocriminology (19th century) that has formerly followed a seductive path. For the most part, sociological criminologists believed that the technological method for controlling behavioral violence is typically a pretext for turning a blind eye to the social injustice.¹⁰³ Nevertheless, medics have pointed out that the method could be a viable solution for social problems.¹⁰⁴

Some neurosurgeons drew attention to the biological causes of mental illness in some delinquent patients; but on the contrary, a group of psychiatrists was more willing to explain it by taking into account the environmental causes.¹⁰⁵ The National Institute of Mental Health of the United States (NIMH) investigated both the biological (specifically neuropsychological) and sociological dimensions of mental illness;¹⁰⁶ in its basic biological research, the institute advanced the medicalization of behavioral violence.¹⁰⁷ However, the NIMH

¹⁰¹ V. H. Mark and F. Ervin, *Role of Brain Disease in Riots and Urban Violence*, 201 J. AMER. MED. ASSOC. 895 (1967).

¹⁰² Frank Dougherty, *Psychosurgery: Carte blanche?*, 111 SCIENCE NEWS 387 (1977); Lee Coleman, *Perspectives on the Medical Research of Violence*, 44 AMER. J. ORTHOPSYCHIATRY 675 (1974).

¹⁰³ Peter Conrad, *The Discovery of Hyperkinesis: Notes on the Medicalization of Deviant Behavior*, 23 SOCIAL PROBLEMS 12 (1975); PETER CONRAD AND JOSEPH SCHNEIDER, *DEVIANCE AND MEDICALIZATION: FROM BADNESS TO SICKNESS* (1980).

¹⁰⁴ Elliot Valenstein, *The Prefrontal Area and Psychosurgery*, 85 PROGRESS IN BRAIN RESEARCH 539 (1990).

¹⁰⁵ Lee Edson, *The Psyche and the Surgeon: For the Mentally Ill, a Court of Last Resort*, NEW YORK TIMES (30 September 1973).

¹⁰⁶ For some detailed descriptions, see: Luigi Valzelli, *Reflections on Experimental and Human Pathology of Aggression*, 8 PROG. NEUROPSYCHOPHARMACOL. BIOL. PSYCHIATRY 311 (1984); A. Nassi and S. Abramowitz, *From Phrenology to Psychosurgery and Back Again: Biological Studies of Criminality*, 46 AMER. J. ORTHOPSYCHIATRY 591 (1976).

¹⁰⁷ For instance, the genetic research showed that keeping juveniles in detention, due to the presence of additional Y chromosomes in their bodies, typically makes them more aggressive; in the pharmacological research about the hormonal imbalance and aggression, it is also found that some offenders at least are more susceptible to commit a crime.

also alluded to some non-physical factors of violation among individuals. The research projects under the category of “Individual Violation” illustrated that despite the unbreakable link between violence and the brain, other factors (such as social, environmental, and educational) are also playing a significant role in this regard.¹⁰⁸ Anyhow, taking an one-dimensional approach obviously cannot depict a clear image of the violence roots; as Borogaonkar and Shah remarked,¹⁰⁹ putting social factors under scrutiny cannot merely ascertain the individuals’ willingness to contravene the norms.¹¹⁰ In the 1970s, for example, there were abundant works to explain the violent states of those who suffered from neurological and psychological disorders, as well as epilepsy¹¹¹ with which abnormal behaviors are always associated.¹¹² Moreover, some EEG studies on the brain of prisoners showed that high rates of criminals suffered from mental illnesses.¹¹³ By investigating into the human brain, likewise, a tremendous amount of works strived to find the neuropsychological causes of behavioral violence.¹¹⁴ Biologists, neurophysiologists, biochemists, and geneticists, each with their own contribution, portrayed the anatomy of human violence.¹¹⁵ Like what scientists found about the violence in individual with alcoholism. Skeleton was among the medics who examined the effects of alcohol on the brain and explicated the results by EEG data.¹¹⁶ Following such fin-

¹⁰⁸ Brian P. Casey, *The Surgical Elimination of Violence? Conflicting Attitudes towards Technology and Science during the Psychosurgery Controversy of the 1970s*, 28 SCIENCE IN CONTEXT 99 (2015).

¹⁰⁹ D. Borogaonkar and S. Shah, *Advances in Human Genetics and Their Impact on Society*, 170 SCIENCE NEW SERIES 347 (1970).

¹¹⁰ That is why developed neurocriminology reaffirmed a neuro-sociopsychological approach. See generally: Arian Petoft, *Neurolaw: A brief introduction*, 14 IRAN. J. NEUROL. 53 (2015); Arian Petoft and Ahmed momeni-Rad, *Toward Human Behavior Sciences from the Perspective of Neurolaw*, 2 INT. J. PUB. MEN. HEAL. & NEUROSCI. 29 (2015).

¹¹¹ F. R. Ervin et al., *Focal cerebral disease, temporal lobe epilepsy and violent behavior*, 94 TRANS. AM. NEUROL. ASSOC. 253 (1969); M. Goldstein, *Brain research and violent behavior*, 30 Arch. Neurol. 26 (1974).

¹¹² Including severe physical reactions in the ictal and post-ictal states due to the frontal lobe epilepsy, antisocial behaviors by some psychiatric disorders in temporal lobe epilepsy, aggressive comportment in individuals with personality disorder and the like. See: G. Rita et al., *Episodic dyscontrol: a study of 130 violent patients*, 127 AM. J. PSYCHIATRY 1473 (1971); T. L. Riley, *The electroencephalogram in patients with rage attacks or episodic violent behavior*, 144 MIL. MED. 515 (1979).

¹¹³ I. Adrian, *Violent crime and the E.E.G.*, 2 BR. MED. J. 193 (1970).

¹¹⁴ See: V. H. MARK AND F. R. ERVIN, *VIOLENCE AND THE BRAIN* (1970); ADRIAN RAINE, *THE ANATOMY OF VIOLENCE: THE BIOLOGICAL ROOTS OF CRIME* (2014); Bruce D. Bartholow, *The Aggressive Brain*, *AGGRESSION AND VIOLENCE: A SOCIAL PSYCHOLOGICAL PERSPECTIVE* (Brad J. Bushman, Ed., 2015); JAN VOLAVKA, *NEUROBIOLOGY OF VIOLENCE* (2008).

¹¹⁵ GENE BYLINSKY, *NEW CLUES TO THE CAUSES OF VIOLENCE* (1973).

¹¹⁶ He assessed the state of drunkenness and complete disturbance in attention and awareness to explain

dings, scholars has also proposed the question on the feasibility of detecting potential violent elements through the investigation on the offenders' brain¹¹⁷ in order to provide convenient therapies or confinement. In fact, the possible use of neuroscience techniques in crime prevention has given an incentive for such efforts.¹¹⁸ In spite of the neuroscience development, however, scholars have not yet been able to provide a convincing answer.

In order to prevent behavioral violence or treat some kinds of mental disorder, psychosurgery method has become an enormous movement in the 1970s.¹¹⁹ Efforts to discover the neural or mental roots of violence and provide a suitable method for cure, actually, were robustly made to prevent crime as a potential threat in individuals who are neuro-psychologically violent or abusive. Despite the criticisms of psychosurgery,¹²⁰ some scholars like Edson defended the use of its techniques even in cases where there is a deficient understanding of the correlation between human brain and behavioral violence. In his viewpoint, we should employ the psychosurgery techniques at least for untreatable psychiatric disorders (e.g., lack of improvement through pharmacotherapy, psychotherapy, and other methods).¹²¹ Psychosurgeons expressed their hope that this would be a potential solution for preventing the growing illegality¹²² at least towards the offenders who suffering from serious mental

the extent to which cognitive or psychological perturbations were detected. See: W. D. Skelton, *Alcohol, violent behavior, and the electroencephalogram*, 63 SOUTH. MED. J. 465, (1970).

¹¹⁷ Anonymous author, *Are violent criminals recognizable on the EEG?*, 112 MUNCH. MED. WOCHENSCHR. 3 (1970).

¹¹⁸ Pharmacotherapy (exceedingly psychiatric medication) and psychosurgery were the most known methods in this regard. For example, pharmacotherapy of aggression in some patients with central brain disorders; see: R. R. Monroe, *Anticonvulsants in the treatment of aggression*, 160 J. NERV. MENT. DIS. 1 (1975); or the treatment of epilepsy with carbamazepine; see: E. R. Tunks and S. W. Dermer, *Carbamazepine in the dyscontrol syndrome associated with limbic system dysfunction*, 164 J. NERV. MENT. DIS. 56 (1977).

¹¹⁹ *Supra* note 103, p.20; L. G. Kiloh and J. S. Smith, *The neural basis of aggression and its treatment by psychosurgery*, 12 AUST. N. Z. J. PSYCHIATRY 21 (1978).

¹²⁰ E.g., see: Steven Jay Greenblatt, *The Ethics and Legality of Psychosurgery*, 22 N.Y.L. SCH. L. REV., 961 (1977); Bernard L. Diamond, *The Psychiatric Prediction of Dangerousness*, 123 UNIV. PA. LAW REV., 439 (1974). The controversy over the use of psychosurgery techniques has culminated with the sponsored mental health program: a two-year contract with a half million dollars fund between the US government and three physicians at the NMHI for the diagnosis, therapy and investigation of brain disease and violence. See: NA - File RES 9-19-E. Neuro-Research Foundation, Inc. No Date. "Organic Brain Disease and Violent Behavior: A Demonstration Program for Diagnosis, Treatment and Research." C.V. Mosby Company.

¹²¹ Lee Edson, *For the Mentally Ill, a Court of Last Resort*, NEW YORK TIMES (Sept. 30, 1973).

¹²² Albert Rosenfeld, *The Psycho-Biology of Violence*, 21 LIFE 67 (1968); Joel Meister, *Violence and the Safe Society*, 4 HASTINGS CENTER REPORT 4 (1974). Among the concerns was the rapid deterioration of thuggery and murder status; from the mid-1960s until the mid-1970s, the homicide

illnesses. According to judge Bazelon, “in the 1930’s and 1940’s atomic scientists stood on the threshold of unlocking the secrets of the atom, ushering in the nuclear era. Today, the bio-behavioral scientist stands on the threshold of unlocking many of the secrets of the brain.”¹²³ Inspired by Hippocrates,¹²⁴ Mark and Erwin, called forth the “Violence Surgery” due to some successful and effective treatment for epilepsy and temporal lobe disorders.¹²⁵ In applying psychosurgery, hence, several programs were implemented to abate and eliminate the heroin-related crimes, and even to rehabilitate prisoners;¹²⁶ including a pilot study on 12 offenders in California who were subjected to aggressive behavior and temporal lobe epilepsy, or a study on 24 prisoners who are convicted of rape in Michigan, to appraise Mark and Erwin’s hypothesis.¹²⁷ Contrary to what was expected,¹²⁸ the results showed that the invasive psychosurgery method jeopardize their health, therefore it does not meet the requirements of criminal justice. Although the practices were diverse¹²⁹ and merit of such techniques or their effectiveness were slightly unevaluable. The controversy among scholars was intensified to the extent that critics condemned psychosurgery as a misleading, worthless and even hazardous medical method.¹³⁰ Albeit, some psychiatrists contrarily referred to the lucrative function of psy-

statistics was almost doubled. See: Sourcebook of Criminal Justice Statistics Online. Table 3.106.2011, available at <http://www.albany.edu/sourcebook/pdf/t31062011.pdf>

¹²³ Chief Judge Bazelon, *The Perils of Wizardry*, Annual Meeting of the American Psychiatric Association, Detroit, Michigan, May 7, 1974, at 1.

¹²⁴ “For extreme diseases, extreme methods of cure, as to restriction, are most suitable.” F. ADAMS, *THE GENUINE WORKS OF HIPPOCRATES* (1972), at 293.

¹²⁵ ERVIN, *supra* note 114, Chapter 6.

¹²⁶ Murray Goldstein, *Brain Research and Violent Behavior*, 30 *ARCHIVES OF NEUROLOGY* 1 (1974).

¹²⁷ Ronald Gass, *Kaimowitz v. Department of Mental Health: the Detroit Psychosurgery Case*, *OPERATING ON THE MIND* (Williard Gaylin, Joel Meister, and Robert Neville, Eds., 1975); Anon, *Publicity Kills Brain Surgery Planned as Test on Inmate*, *LOS ANGELES TIMES* (14 March 1973).

¹²⁸ NA - NIH Director’s File class Res 9-19-E 1970, *The Violent Offender; the Development of Diagnostic Procedures*.

¹²⁹ There was a great deal of variation amongst practitioners due to several classes of patients with neuropsychological disorders (epilepsy, schizophrenia, autistic spectrum, encephalopathy, spinal cord injury, paraneoplastic syndrome, functional neurological symptom, alcoholism, confusion, insanity, etc.), differences in surgical procedures (amygdala, posterior hypothalamus, etc.) and various invasive techniques (oil wax, lobotomy, stereo-encephalotomy, etc.). See: Hirotar Narabayashi, *Stereencephalotomy in Japan*, 24 *CONFINIA NEUROLOGICA* 314 (1964); Larry Gostin and Paul Bridges, *Ethical Considerations of Psychosurgery: The Unhappy Legacy of the Pre-Frontal Lobotomy*, 6 *J. MED. ETHICS* 149 (1980).

¹³⁰ They believed that psychosurgery is based on the inappropriate invasive method. Afterward, civil libertarians, a large number of practitioners, and political activists got indignant about the allegation. See: Peter Breggin, *Psychosurgery for Political Purposes*, 13 *DUQUESNE LAW REVIEW* 841 (1975).

chosurgery in a legal system¹³¹ and the need to modernize its techniques. Anyway, the use of traditional techniques (such as lobotomy) has been significantly reduced since the late 1970s and new procedures were developed in neurosurgery, mainly the minimal surgery, and more specifically stereotactic surgery¹³² with the use of radiographic imaging.¹³³ At the present time, psychosurgeons used these modern techniques also as the last solution for the treatment of severe mental disorders that cannot be cured in any other ways.

Meanwhile, a patient consent to psychosurgery was an argumentative ethical-legal question. In addition to be fully aware of the procedure details (including the necessary medical information and possible complications), a patient should voluntarily decide on performing the surgery. Psychosurgeons, thus, considered the processes entailing a “Voluntary Consent” of any subject. According to some critics,¹³⁴ however, psychosurgery sometimes has indeterminate and unpredictable consequences due to lack of sufficient knowledge about the human brain and make it somehow impossible to inform the subjected patient precisely. Additionally, in psychopathic cases that a chronic mental disorder typically impairs or substantially destroys patients’ wise decision-making, the decision remains with a legally appointed guardian; and in any case, if the surgical procedures are experimental or innovative, there is no way to consent.¹³⁵ *Kaimowitz*¹³⁶ is a clear example of this. A Circuit Court sentenced John Doe to confine as a criminal sexual psychopath. He had been charged with the murder and subsequent rape of a nurse at a hospital while he was confined there as a mental patient. After more than 17 years, he was transferred to a clinic as a suitable subject for the research-project entitled

¹³¹ J. Guedon, *Comments on Foucault’s ‘About the Concept of the Dangerous Individual in 19th Century Legal Psychiatry*, LAW AND PSYCHIATRY (D. Weisstub, Ed., 1978).

¹³² By emerging new neuroscience techniques, such as MRI in the 1980s, which gives more details of the brain anatomy, and PET (Positron-emission tomography) that detects changes in the brain metabolism and blood flow, physicians are able to operate stereotactic treatment for mental illnesses such as schizophrenia, severe depression, obsessive-compulsive disorder (OCD) and even antisocial personality disorder (ASPD) in order to frustrate the progress in which potential violence get objectivity. See: Miguel A. Faria, *Violence, Mental illness, and the brain - A brief history of psychosurgery: Part 3*, 4 SURG. NEUROL. INT. 91 (2013).

¹³³ R. A. Robison et al., *Surgery of the mind, mood, and conscious state: an idea in evolution*, 77 WORLD NEUROSURG. 662 (2012).

¹³⁴ Phil Zakowski, *Psychosurgery*, 4 J. LEGAL MED 26 (1976); William Stevens, *Psychosurgery Curbed by Court*, NEW YORK TIMES (11 July 1973).

¹³⁵ L. Alex Swan, *Physical Manipulation of the Brain*, 8 SOCIAL POLICY 52 (1977).

¹³⁶ *Kaimowitz v. Department of Mental Health*, 2 PRISON L. REP. 433 (Mich. Cir. Ct., Wayne County, 1973).

“Treatment of Uncontrollable Aggression”.¹³⁷ He and his parents signed an informed consent form to perform the experimental and innovative surgical procedures on his brain. The main question was about “whether legally adequate consent could be obtained from adults involuntarily confined in the state mental health system for experimental or innovative procedures on the brain to ameliorate behavior, and, if it could be, whether the State should allow such experimentation on human subjects to proceed”. The court did not pass on whether such a procedure is unconstitutional (cruel and unusual punishment) because of “that the involuntarily detained mental patient may not give an informed and valid consent to experimental psychosurgery.” The court held that “when the state of medical knowledge develops to the extent that the type of psychosurgical intervention proposed here becomes an accepted neurosurgical procedure and is no longer experimental, it is possible, with appropriate review mechanisms that involuntarily detained mental patients could consent to such an operation.” Due to the advancement of psychosurgery and the legality of voluntary expression of consent to an appropriate procedure as a last means, however, some scholars¹³⁸ and judges¹³⁹ criticized this decision.

The effectiveness of modern psychosurgery techniques in the treatment of mental disorders for controlling violent behaviors on the one hand, and the need to provide a proper legal mechanism for authorization of implementing them through determined formal procedures on the other hand, launched a movement to ‘neurolegislation’ in this regard. In 1973, Oregon approved the first comprehensive psychosurgery statutory law.¹⁴⁰ The statute provides that psychosurgery may be performed only under the Review Board¹⁴¹ approval. For this purpose, first of all, a respected psychosurgeon must file a petition with the board including the patient (or legal guardian¹⁴²) consent proof, the requisiteness of the proposed treatment, and its legitimacy (appropriateness of

¹³⁷ The experiment was to compare the effectiveness of psychosurgery (specifically on the amygdala of the limbic system) with the effect of the drug cyproterone acetate on the 24 criminal sexual psychopaths’ hormone flow.

¹³⁸ E.g. Jeffrie Murphy, *Total Institutions and the Possibility of Consent to Organic Therapies*, 5 HUMAN RIGHTS 25 (1975).

¹³⁹ E.g. *Aden v. Younger*, Civ. No. 14407. Court of Appeals of California, Fourth Appellate District, Division One. April 23, 1976.

¹⁴⁰ 35 Ore. Rev. Stat. § 426.700 et seq.

¹⁴¹ The Board is composed of “...nine members appointed by the governor from specified medical, psychological, neuroscientific and lay backgrounds.”

¹⁴² If the patient is believed to lack the capacity for voluntary and informed consent, and there is no legal guardian, the Board must request that one be appointed.

therapy,¹⁴³ legality and clinical merit). The board determines whether a “Voluntary and Informed” consent is given. But California has adopted a different approach to the act¹⁴⁴ in 1976; it provided the availability of treatments to have involuntarily confine pursuant to the penal code, wherever institutionalized.¹⁴⁵ The act requires a petition with a review committee¹⁴⁶ in order to assess the consent and the merits. There were also non-invasive treatments that had the analogous way of regulation. Among the most well-known was Electroconvulsive Therapy¹⁴⁷ (ECT), in which, a patient’s brain, will be shocked by exposure to electric current to relieve the symptoms of some mental health problem (chiefly epileptic seizure,¹⁴⁸ severe depression,¹⁴⁹ and schizophrenia¹⁵⁰). The U.S. case law¹⁵¹ and legislations¹⁵² recognized the right to refuse such shock treatments and also provide the requirements for obtaining the consent.¹⁵³

¹⁴³ To this end, several requirements must be met before an operation:

“(1) All conventional therapies must have been attempted;
(2) Criteria for selection of the patient must have been met;
(3) The operation must offer hope of saving life, reestablishing health or alleviating suffering;
(4) All other viable alternative methods of treatment must have been tried and have failed to produce satisfactory results.” See: Department of Health, Education and Welfare, *Use of psychosurgery in practice and research*, 42 FEDERAL REGISTER 26318 (1977).

¹⁴⁴ Cal. Penal Code § 2670 et seq.

¹⁴⁵ The essential distinction between the Oregon and California legislation is that under the latter, legal representative or guardian consent is not recognized. Hence, the performance upon individuals who lack the capacity is absolutely prohibited in California; its legislation presumed that minors under the age of 18 years have not such a capacity.

¹⁴⁶ Dissimilar to the board, the committee is decentralized and composed only of physicians: one appointed by the facility (in which the psychosurgery will be operated) and two appointed by the local mental health director (must include two psychiatrists or neurosurgeons who are board-certified or eligible).

¹⁴⁷ Formerly known as Electroshock Therapy. For general descriptions of ECT treatment, see: Kalinowsky, *The Convulsive Therapies*, COMPREHENSIVE TEXTBOOK OF PSYCHIATRY (A. Freedman & H. Kaplan, Eds., 1967).

¹⁴⁸ M. E. Lunde, *Electroconvulsive therapy in patients with epilepsy*, 9 EPILEPSY BEHAV. 355 (2006).

¹⁴⁹ E. ROSEN et al., ABNORMAL PSYCHOLOGY (1972), at 433.

¹⁵⁰ M. Sullivan, *Treatment of Acute Schizophrenia: The Place of ECT*, 35 DISEASES OF THE NERVOUS SYSTEM 467 (1974).

¹⁵¹ E.g., *Aden v. Younger*, 57 Cal. App. 3d 662, 129 Cal. Rptr. 535 (1976); *Wyatt v. Aderholt*, 503 F.2d 1305 (5th Cir. 1974); *Davis v. Watkins*, 384 F. Supp. 1196, 1206 (N.D. Ohio 1973).

¹⁵² Such as the statutes that provided the requirement of patient voluntarily informed consent to electroshock therapy: MICH. COMP. LAWS ANN. § 330.1716 (1974); N.Y. MENTAL HYGIENE LAW § 15.03(b)(4) (McKinney Supp. 1976). Also the acts that recognized the right to refuse shock treatment for patients: MASS. ANN. LAWS ch. 123 § 23 (Supp. 1974); WASH. REV. CODE § 71.05.370(7) (1974).

¹⁵³ For a detailed discussion, see: Anonymous author, *Regulation of Electroconvulsive Therapy*, 75 Michigan L. Rev. 363 (1976).

This era encompasses the grounds for lawyers to be more familiar with the brain. EEG, as a correlation factor in the relation between law and neuroscience in the modern era, acquainted medico-legal discourses with the brain evidences representing new facts, principally, behind the behavioral violence. Indeed, this was an introduction to a motivation for the violence treatment by psychosurgical procedures predominantly. Since copious amount of criminal cases covered mental disorders, courts felt the robust need to EEG evidences of the individuals' brain, especially, following the novel findings in neurocriminology. But this required an expertise in the both fields of law and neuroscience in addition to neurolitigation proficiency qualification (neuroscience evidences in criminal procedure, to a large extent). Taylor was among neuro-lawyers who outstandingly investigated the connection between the fields and shared his neuro-procedure experiences¹⁵⁴ with lawyers. A new collaborative literature¹⁵⁵ actually was indispensable. He therefore coined the term "Neuro-law" as a distinct interdisciplinary field of study in 1991.¹⁵⁶ By exploring the effects of neuroscience findings on legal systems, neurolaw makes an effort to shed light on the relation between law and brain by taking into account a neuro-sociopsychological approach. Concurrent with the birth of neurolaw, the post-modern era is begun.

The Post-modern Era: fMRI Evidences and Advancement of Neurolaw

From the beginning of the 1990s, neuropsychology and law were in the course of convergence.¹⁵⁷ The focus of the neuropsychologists was the human brain imaging and the presentation of medico-legal interpretations of its data in a courtroom.¹⁵⁸ Due to some critics on the reliability of neuroscience evidences in the context of legal system, however, some jurists refused to accept such data and the role of neuropsychology was supposed to be diminished in legal proceedings; but contrary to what was expected, now in the 21st century, we are witnessing an increasing number of neuroscientific evidences in courtrooms and the development of neurolitigations. The emergence of neurolaw

¹⁵⁴ He has presented numerous lectures on the subject in the US and England, and in 1989, by one of his prominent works entitled "Neuropsychological Evidence on Appeal", propounded his substantive and procedural methods of formulating neuroproceeding.

¹⁵⁵ Neuroscience and law are very different disciplines in nature from laboratory to the courtroom. Discrepancy of language was a critical issue with which neurolaw scholars are faced. Neurolawyers were being accosted with many concepts have slightly distinct meanings in the both sciences.

¹⁵⁶ Sherrod J. Taylor et al., *Neuropsychologists and neurolawyers*, 5 NEUROPSYCHOLOGY 293 (1991).

¹⁵⁷ *Ibid.*, p. 293.

¹⁵⁸ Francis X. Shen., *Neuroscientific Evidence as Instant Replay*, 3 J. L. & BIOSCIENCES 343 (2016).

coincided with the first successful experiment of fMRI in 1991.¹⁵⁹ By the combination of the MRI, PET and SPECT techniques, scientists were able to create another technique called fMRI, which virtually displays the brain functions. The fMRI technique was successful in the path of progress¹⁶⁰ because of desirable access of countries to MRI scanners, the development of computer technology, and the medical advances in brain physiology. Nowadays, along with EEG evidences, fMRI data are also being examined to provide a more accurate understanding of activities and cognitive functions of the brain. FMRI has had significant scientific implications for other biomedical discoveries. More than clinical applications, it is used in neuroscience researches, especially in the field of cognitive studies,¹⁶¹ in order to identify the brain and redefine human behavior in the context of legal approach. For example, fMRI considerably helps us to understand the memory status of individuals (especially for presenting witnesses in a court), abnormal behavior, violence, bias, feelings, emotions, and so on; despite the use of fMRI in diagnosis of neurological diseases and mental disorders, howbeit, it still does not play a main role in the pathology.¹⁶² Neurolaw studies on the brain by fMRI have extended to complex moral and philosophical issues in the field of legal phenomena,¹⁶³ including the concept and states of consciousness, awareness, free will and legal responsibility. A dramatic increase in neuroscience findings that have affected social sciences unexpectedly extended the realm of neurolaw to the new subfields of study such as ‘neuro-economic law’,¹⁶⁴ ‘neuro-constitutional law’,¹⁶⁵ and ‘neuro-human rights’.¹⁶⁶ Thus, by providing a novel

¹⁵⁹ P. A. Bandettini, *Twenty years of functional MRI: the science and the stories*, 62 NEUROIMAGE 575 (2012).

¹⁶⁰ *Ibid.*

¹⁶¹ E. Bullmore, *The future of functional MRI in clinical medicine*, 62 NEUROIMAGE 1267 (2012).

¹⁶² B. R. Rosen, and R. L. Savoy, *fMRI at 20: has it changed the world?*, 62 NEUROIMAGE 1316 (2012).

¹⁶³ J. D. Greene et al., *The neural bases of cognitive conflict and control in moral judgment*, 44 NEURON. 389 (2004); A. M. Owen et al., *Detecting awareness in the vegetative state*, 313 SCIENCE 1402 (2006); C. S. Soon et al., *Unconscious determinants of free decisions in the human brain*, 11 NAT. NEUROSCI. 543 (2008).

¹⁶⁴ Remarkably, Neuroeconomics and Neuromarketing issues that could outstandingly be important in the context of post-regulatory states. This leads to a multidisciplinary study encompassing public economic law, neuroscience, business and economics. See generally: D. Ariely, and G. S. Berns, *Neuro-marketing: the hope and hype of neuroimaging in business*, 11 NAT. REV. NEUROSCI. 284 (2010); Paul W. Glimcher et al., *A Brief History of Neuroeconomics*, NEUROECONOMICS: DECISION MAKING AND THE BRAIN (Paul W. Glimcher, Ernst Fehr, Eds., 2013). To study about the post-regulatory state, see: Colin Scott, *Regulation in the Age of Governance: The Rise of the Post-Regulatory State*, NATIONAL EUROPE CENTRE PAPER, No. 100: 6 June 2003.

¹⁶⁵ Including some issues in neuropolitics and neurolegislation; see: Francis X. Shen, *Neurolegislation:*

perspective and new distinct interdisciplinary field of study, neurolaw strikingly outstretched the realm of 'law and neuroscience' to the extent that all legal issues could be subjected to modernization or reconsideration by neurolaw novel scholarly perspective in connection with new neuroscience discoveries. Clearly, behavior is the most core factor in a legal analysis of phenomena and, drawing from neuroscience, neurolaw scholars try to understand human behavior in a more deep deliberation; therefore, it will potentially shape future aspects of legal perspective (subjective transition) and issues (objective transition).

Efficiency of neuroscience findings in legal systems took the path to an ever-increasing presence of neuroscientific evidences in judiciary, legislature, and legal community.¹⁶⁷ Perhaps the most important effect that neuroscience has on the post-modern law is the mind reading and direct communication with the brain, largely, by the fMRI and EEG techniques. Investigation on the brain to clarify what goes on the mind caused many concerns about violation of right to privacy and cognitive liberty.¹⁶⁸ For the courts, in the current proceedings, resorting to neuroscience techniques in discovering the facts and issuing the appropriate verdict is a legitimate and virtuous matter, but the extent and limits of such an access to the individuals' mind and the maintenance of their fundamental rights are the controversial questions. Critics believe that the content of individuals' thought should be inviolable¹⁶⁹ and governments should respect the privacy of their mind.¹⁷⁰ Obviously, some primary conditions, in light of the rule of law requirements should be considered in this regard: such as effective judicial review, formal authorization, legality, taking non-punitive measures and health maintaining. Meantime, the concerns are not limited to these issues, but some recent findings also tag along with new challenges. Among the most notable ones is nootropics as the new smart

How U.S. legislators are using brain science, 29 Harv. J.L. & Tech. 495 (2016); K. M. Knutson et al., *Politics on the brain: an fMRI investigation*, 1 SOC. NEUROSCI. 25 (2006).

¹⁶⁶ Arian Petroft et al., *Controversial Brain Imaging as a Terrorism Emergency Measure in Neurolaw Discourse*, 2 INT. J. NEUROL. NEUROTH. 1 (2017).

¹⁶⁷ Francis X. Shen, *The Law and Neuroscience Bibliography: Navigating the Emerging Field of Neurolaw*, 38 INT. J. LEGAL INF. 352 (2010).

¹⁶⁸ *Supra* note 166.

¹⁶⁹ Their argument accentuates the new modern rights in the age of neurolaw: the right to cognitive liberty, the right to mental privacy, the right to mental integrity, and the right to psychological continuity. See: Marcello Ienca and Roberto Andorno, *Towards new human rights in the age of neuroscience and neurotechnology*, 13 LIFE SCI. SOC. POLICY 5 (2017).

¹⁷⁰ Calvin J. Kraft and James Giordano, *Integrating Brain Science and Law: Neuroscientific Evidence and Legal Perspectives on Protecting Individual Liberties*, 11 FRONT. NEUROSCI. 621 (2017).

drugs and cognitive enhancers to have an advanced mind. Neuropharmacologists developed these drugs for improving cognitive function of the brain and increasing learning ability and memory, with minimal side effects.¹⁷¹ Although nootropic is advantageous in the rehabilitation and cognitive enhancement, but it could threaten some fundamental rights.¹⁷² Hereupon, it gives rise to some legal and moral questions about equality of people, distributive justice, and fair competition in a society in which people are increasingly taking nootropics.¹⁷³

By the new neuropsychological findings about the human brain and the nature of mental phenomena, neurolaw scholars strive to put forward new definition of human behavior and subsequently redefine the fundamental concepts in law¹⁷⁴ including free will, crime, adulthood, maturity and responsibility. Therefore, it seems that law is in transition. The concept and components of free will and criminal responsibility is a pivotal discussion of modern criminology in the 21st century that brings forth an argumentative debate regarding determinism discourse.¹⁷⁵ It seems that new discoveries in neuroscience ambiguously demonstrate that our behavior is determined by physical events in the brain; for that reason, we cannot be responsible for our actions. As Morse in criticizing this argument said “the challenge to free will from neurophysical determinism is familiar to similar challenges in the past, but it fails for three reasons. First, free will is not a criterion for the application of any legal rule.

¹⁷¹ Nootropics are non-psychotropic drugs that extremely have low levels of toxicity. For more detailed explanation, see: R. Dejongh et al., *Botox for the brain: enhancement of cognition, mood and pro-social behavior and blunting of unwanted memories*, 32 **NEUROSCI. BIOBEHAV. R.** 760 (2008); Wolfgang Froestl et al., *Cognitive Enhancers (Nootropics). Part 1: Drugs Interacting with Receptors*, 32 **J. ALZHEIMER'S DIS.** 793 (2012); C. Mondadori, *The pharmacology of the nootropics; new insights and new questions*, 59 **BEHAV. BRAIN RES.** 1 (1993).

¹⁷² Every day, pharmaceutical companies introduce new types of nootropics that people can buy most of them without any prescription. The demand for this kind of drugs creates a situation whereby supply arises from a black market. In addition, the widespread tendency in nootropic consumption to get a more advanced mind undermines the purpose of medicine. Therefore, there is a need for legal requirements by which a doctor can control over a patient's usage of a nootropic. See: Emma Thorley et al., *Varsity Medical Ethics Debate 2015: should nootropic drugs be available under prescription on the NHS?*, 11 **PHILOS. ETHICS. HUMANIT. MED.** 6 (2016).

¹⁷³ Lilly Pham, *Nootropics: an ethical discussion*, DUKE UNIVERSITY ONLINE ARCHIVE (November 5, 2012).

¹⁷⁴ Among multitude worthy works, see: A. Kolber, *Free will as a matter of law*, **PHILOSOPHICAL FOUNDATIONS OF LAW AND NEUROSCIENCE**, (M. Pardo and Patterson D., Eds., 2015); S. J. Morse, *Neuroscience, free will, and criminal responsibility*, **FREE WILL AND THE BRAIN: NEUROSCIENTIFIC, PHILOSOPHICAL, AND LEGAL PERSPECTIVES** (Glannon W., Ed., 2015).

¹⁷⁵ Stephen J. Morse, *Criminal Law and Common Sense: An Essay on the Perils and Promise of Neuroscience*, 99 **MARQ. L. REV.** 40 (2015); Joshua Greene and Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 **PHIL. TRANS. R. SOC. A.** 1785 (2004).

Second, free will is not foundational for criminal responsibility. Third, there is a philosophically plausible response to those who claim that determinism and responsibility are incompatible.”¹⁷⁶ He even considers some arguments based on excessive reliance on neuropsychological findings and brain overclaim.¹⁷⁷ Nevertheless, many neuropsychologists speak of new findings based on neuroscience evidences of abnormalities and behavioral violence that may somehow change the nature and assessment of criminal responsibility. For example, Fields recently noted, “we are on the brink of a new understanding of the neuroscience of violence.”¹⁷⁸ “Violence, like all behaviors, is controlled by the brain. New research in neuroscience is identifying the brain circuits of rage and aggression in ways that have not been possible before. Research to understand and cure disease is widely appreciated, but there is a larger unmet need to understand the neuroscience of violence.”¹⁷⁹

The spirit of radical determinism thought¹⁸⁰ might be similar to what Marc and Erwin have brought up in the context of psychosurgery, which is typically a recurrence of the twentieth century criminology. As it clear, there is a long way of neurolaw advancement that might gradually change our view of the concept of criminal responsibility. According to Greely, “certainly modern neuroscience works on the premise that our minds, our thoughts, our perceptions, our emotions, our beliefs, our actions, are all generated by our brains... This is important today because we are in the middle of a revolution in neuroscience. Compared to 30 years ago, we know almost infinitely more about how the human brain works.”¹⁸¹ Due to worthwhile application of neuroscience in the context of legal system including rehabilitation, mind advancement, violence prediction, and developing a more accurate approach to human be-

¹⁷⁶ Stephen J. Morse, *Determinism and the Death of Folk Psychology: Two Challenges to Responsibility from Neuroscience*, 9 MINN. J.L. SCI. & TECH. 1 (2008).

¹⁷⁷ Stephen J. Morse, *Brain Overclaim Redux*, 31 LAW & INEQ. 509 (2013).

¹⁷⁸ Fields, Douglas, *The Neuroscience of Violence*, BRAINFACETS (Apr. 29, 2016).

¹⁷⁹ Fields, Douglas, *The Neuroscience of Violence, again*, BRAINFACETS (Jul. 12, 2016).

¹⁸⁰ It suggests argue that “no one person is more or less responsible than any other for actions. We are all part of a deterministic system that someday, in theory, we will completely understand.” See: BRENT GARLAND, *NEUROSCIENCE AND THE LAW: BRAIN, MIND AND THE SCALES OF JUSTICE* (2004). For example, some studies concluded that the brain signals our body to act before we become consciously aware of it. Indeed, our actions are automatic responses to stimuli; therefore, if we consciously decide to act, it is merely *ex post* determinations. See: Daniel Dennett, *The Self as Responding - and Responsible - Artefact*, 1001 ANN. N.Y. ACAD. SCI. 39 (2003). Eventually, radical determinists come to the conclusion that we have, at best, “free won’t” rather than “free will.” GARLAND, at 56.

¹⁸¹ Henry T. Greely, *Law and the Revolution in Neuroscience: An Early Look at the Field*, 42 AKRON L. REV. 687 (2009).

havior, it seems that neurocriminology has a bright future¹⁸² in the conceptualization of free will and criminal responsibility. However, we should avoid engaging in paradoxical discourses that have led us to a deadlock in the historical path of 'law and neuroscience'. Exaggerating neuroscience findings in the context of neurocriminological determinism may deviate law from its correct path. Every human behavior is deeply rooted in the brain functions but it does not mean that we have no will. There are some philosophical explanations¹⁸³ and psychological experiments¹⁸⁴ to plausibly ascertain that human mind can control the brain and is not under its dictatorship. Neurological effects could encompass the elements of will, or even in some cases put it under absolute brain control, but human authority and voluntarily deciding to act are undeniable in essence. As Opderbeck stated, "... some versions of reductive neurolaw are, to put it bluntly, redolent of fascism... They propose, not a concept of the 'rule of law,' but instead a dictatorship of the brain, or of some model of the brain, with 'neural reeducation camps' for those whose brains don't quite fall in line."¹⁸⁵ Lyashenko dialectically suggests some responses to a general critique of reductive neurolaw by emphasizing on nebulousness of "Uniqueness" and "Transcendence"¹⁸⁶ as the core concepts in the critique; furthermore, she alluded to some of the research projects, including the use of neuroimaging to predict recidivism rates and real-time brain feedback during drug rehabilitation, that reductive neurolaw offer us.¹⁸⁷ Notwithstanding, this argument does not demonstrate positivistic approach to the brain full control over the mind. New findings in modern neuroscience about the brain control over our habits, emotions, and thoughts do not necessarily assert mind subordination. As it seems, there is actually a mutual impact between the brain and mind. The mind is also able to control over our habits, emotions, and thoughts. Hereupon, an individual's will could be undermined by

¹⁸² Francis X. Shen, *Law and Neuroscience*, 48 *ARIZ. ST. U. L. REV.* 1043 (2017).

¹⁸³ See: WILLIAM R. UTTAL, *MIND AND BRAIN: A CRITICAL APPRAISAL OF COGNITIVE NEUROSCIENCE* (2011); ANTONIO R. DAMASIO, *SELF COMES TO MIND: CONSTRUCTING THE CONSCIOUS BRAIN* (2012).

¹⁸⁴ See: JEFFREY M. SCHWARTZ, REBECCA GLADDING, *YOU ARE NOT YOUR BRAIN* (2012).

¹⁸⁵ David W. Opderbeck, *The Problem with Neurolaw*, SETON HALL PUBLIC LAW (Research Paper No. 2214601, 2013). On the basis of reductive neuroscience, "the brain is a physical entity governed by the principles and rules of the physical world. In addition, it is increasingly clear that the brain determines the mind." GARLAND, *supra* note 182, at 8.

¹⁸⁶ In theorizing the concept of "Self", "Being", "Soul" and "God".

¹⁸⁷ E. Lyashenko, *The Problem with Fearing the Unknown: A Response to David Opderbeck's The Problem With NeuroLaw*, 59 *SAINT LOUIS UNIVERSITY L.J.* 11 (2014).

the brain malfunctioning as well as out of an abnormality of the mind. This new route to reconceptualization of the core legal concepts, has found its practical way to criminal procedures. As it is clear in progressive implementation of the neuroscience techniques¹⁸⁸ in British,¹⁸⁹ Dutch,¹⁹⁰ Canadian,¹⁹¹ and the U.S.¹⁹² criminal proceedings, in order to assess criminal liability before a court. The extent to which neuroscience evidences are admissible is a controversial issue, anyhow.¹⁹³ In Canada, these evidences have usually been provided in sentencing decisions or dangerousness designations (an dangerous or long-term offender).¹⁹⁴ Neuropsychological or psychiatric assessments of the dangerousness and risk to the public from offenders is also addressed in England and Wales, particularly in the context of sexual offending.¹⁹⁵ Dutch courts admitted neuroscientific data as demonstrative facts in mitigating the punishment for the most part.¹⁹⁶ Generally, in the United States neuroscientific evidences are often used to evaluate the defendant's consciousness and free will in committing a crime, but they have been considerably less helpful for a judge in finding him/her guilty or not guilty.¹⁹⁷ Therefore, "if neuroscience matters, it is more likely to be at the sentencing as opposed to the guilt phase."¹⁹⁸ In the post-modern era, neuroscience evidences as expert testimonies have come up with a growing number of court cases.¹⁹⁹ These cases predominantly involve the death penalty and murder.²⁰⁰ Today, 'neuro-criminal

¹⁸⁸ *Supra* note 158, at 344.

¹⁸⁹ Paul Catley1 and Lisa Claydon, *The Use of Neuroscientific Evidence in the Courtroom by Those Accused of Criminal Offenses in England and Wales*, 2J. L. & BIOSCIENCES 510 (2015).

¹⁹⁰ C.H. de Kogel and E.J.M.C. Westgeest, *Neuroscientific and behavioral genetic information in criminal cases in the Netherlands*, 2J. L. & BIOSCIENCES 580 (2015).

¹⁹¹ Jennifer A. Chandler, *The Use of Neuroscientific Evidence in Canadian Criminal Proceedings*, 2J. L. & BIOSCIENCES 550 (2015).

¹⁹² Nita A. Farahany, *Neuroscience and Behavioral Genetics in US Criminal Law: An Empirical Analysis*, 2J. L. & BIOSCIENCES 485 (2015).

¹⁹³ *Supra* note 190, at 564.

¹⁹⁴ *Ibid.*, at 559.

¹⁹⁵ *Supra* note 189, at 539.

¹⁹⁶ *Ibid.*, at 600. In most of cases, the defendant was presumed a person with mental disorder or who has a defective development; hereupon, these presumptions have mitigated his/her criminal responsibility.

¹⁹⁷ *Supra* note 191, at 501.

¹⁹⁸ *Supra* note 158, at 347.

¹⁹⁹ Neuroscientific evidences are presented in courts in many legal context, such as murder, dangerousness, drug usage, criminal mental states, competency, assault, robbery, fraud, etc.

²⁰⁰ DEBORAH W. DENNO, *CHANGING LAW'S MIND: HOW NEUROSCIENCE CAN HELP US PUNISH CRIMINALS MORE FAIRLY AND EFFECTIVELY* (2016).

law' provides comparative systematic data and statistics on the status of neuroscience evidences in the context of cases, their reliability in judicial precedent, and procedures of 'neuro-criminal litigations'. fMRI evidences have admitted by the U.S. courts²⁰¹ in many cases for mitigating criminal responsibility²⁰² or determining the brain injury,²⁰³ mental capacity,²⁰⁴ and the brain death.²⁰⁵ In the *Semrau* first instance trial (2010), also, fMRI data from the accused's brain was filed based on a lie detection technique;²⁰⁶ results of the fMRI lie detector test indicated that Dr. Semrau was generally truthful when, during the test, he said his billing decisions were made in good faith and without an intent to defraud. However, the court of appeals did not admit the fMRI evidence:

"The admissibility of fMRI lie detection testing in a criminal case is an issue of first impression for any jurisdiction in the country, state and federal. After carefully reviewing the scientific and factual evidence, we conclude that ... the technology had not been fully examined in 'real world' settings and the testing administered to Dr. Semrau was not consistent with tests done in research studies. We also hold that the testimony was independently inadmissible ... because the prosecution did not know about the test before it was conducted, constitutional concerns caution against admitting lie detection tests to bolster witness credibility, and the test results do not purport to indicate whether Dr. Semrau was truthful about any single statement."

Some fMRI findings offer us new facts on legal reasoning, i.e., the substantive interpretation of legal rules. A clear example is *Roper v. Simmons*,²⁰⁷ in which, relying on new fMRI findings about the differences between adolescents' and

²⁰¹ However, the admissibility of fMRI image as a *substantive* or *demonstrative* evidence is still controversial. See: Neal Feigenson, *Brain Imaging and Courtroom Evidence: On the Admissibility and Persuasiveness of fMRI*, 2 INT. J. LAW CONTEXT 233 (2006).

²⁰² For example, an accused's brain abnormalities as a mitigating factor that decreased his level of culpability and ability to commit a murder; e.g., *United States v. McCluskey*, 893 F. Supp. 2d 1117 (2012) (No. 10-cr-02734). As the U.S. Supreme Court has made it clear, for mitigating criminal responsibility, a neuroscientific evidence could be presented in court to "any aspect of defendant's character or record and any of the circumstances of the offense that the defendant proffers as a basis for a sentence less than death." *Kansas v. Marsh* :: 548 U.S. 163 (2006), at 174.

²⁰³ Including possible causes of brain injury and trauma. See: *Green Leaf Nursery, Inc. v. Kmart Corp.*, 485 F. Supp. 2d 815 - Dist. Court, ED Michigan 2007, Civil Case No. 05-40162. Also see: *Penney v. Praxair, Inc.*, 116 F. 3d 330 - Court of Appeals, 8th Circuit 1997, Nos. 96-3312, 96-3247.

²⁰⁴ Including *mens rea* (e.g. *People v. Williams*, Supreme Court of California S110377, 2004), competency to stand trial (e.g. *United States v. Gigante*, 982 F. Supp. 140 - 1997) or to receive the death penalty (state of delaware v. red dog, 1993), and the insanity (e.g. *People v. Weinstein* 156 Misc.2d 34 - 1992).

²⁰⁵ E.g. *In Re Guardianship of Schiavo*, 916 So. 2d 814 - Fla. Dist. Ct. 2005.

²⁰⁶ See: *U.S. v. Semrau*. U.S. District Court for the Western District of Tennessee, No. 07-10074 (2010).

²⁰⁷ 543 U.S. 551 (2005)

adults' brain activity, the U.S. Supreme Court held that it is unconstitutional to impose capital punishment for crimes committed while under the age of eighteen. Moreover, in 2010, for the first time in Florida, the court ruled the qEEG evidence admissible in issuing the verdict.²⁰⁸ Some scholars consider a neuroscientific evidence as a "double-edged sword" can act to promote a defendant's blameworthiness even as it is used to decrease judge's sentencing.²⁰⁹ However, some studies show that such an evidence is commonly offered to mitigate punishments in a way that traditional criminal law has always allowed, especially in the penalty phase of death penalty trials.²¹⁰ In addition to mitigating the level of criminal responsibility, neuroscientific evidence may imply the probability of rehabilitation. Sometimes, there is a probable therapeutic activity for TBI treatment and recovery. Hence, a judge may hope for adopting therapeutic measures to reform a criminal offender. For instance, functional brain imaging data that provides objective evidence of brain injury in mild blunt head trauma patients with persistent post-concussive somatic or cognitive symptoms may be considered important for crafting sentences with "the greatest hope for success in rehabilitation". On the contrary, a TBI diagnosis is occasionally cited to explain why a more serious confinement is required to protect "the public safety". This confrontation is evident in Canadian criminal proceedings.²¹¹ Therefore, evidence of brain damage may put a judicial decision in a path that a judge should decide whether rehabilitation measure or a more onerous sentence is required. Furthermore, neuropsychological evidences may illustrate developmental immaturity, which is considered as a mitigating factor when sentencing takes place. An offender who has a moderate to severe learning disability, which derived from a low IQ and cognitive weakness, may be subjected for the mitigation of punishment by the jury when assessing the *mens rea* required for the offense. Such evidences

²⁰⁸ *State v. Nelson*, 11th F] Cir. Ct., F05-846 (2010).

²⁰⁹ See: Valerie Gray Hardcastle et al., "The Impact of Neuroscience Data in Criminal Cases Female Defendants and the Double-Edged Sword", 21 NEW CRIM. L. REV. 291 (2018); Lisa G. Aspinwall et al., *The Double-edged Sword: Does Biomechanism Increase or Decrease Judges' Sentencing of Psychopaths?* 337 SCIENCE 846, 849 (2012).

²¹⁰ E.g., Deborah W. Denno, "The Myth of the Double-Edged Sword: An Empirical Study of Neuroscience Evidence in Criminal Cases" 56 B.C. L. REV. Vol. 498 (2015).

²¹¹ As Chandler alluded, in *R. v. Harper* (2009 YKTC 18) "the judge sentenced a man for the sexual assault of a 13-year-old girl. He had severe FASD [Fetal Alcohol Spectrum Disorder] and a lengthy criminal history including four other convictions for sexual assault." On the contrary, in *R. v. Becker* (2009 ABPC 227) "the judge refused the defense request for a conditional sentence to be served in the community and incarcerated an offender with FASD, possible brain injury, ADHD [Attention Deficit Hyperactivity Disorder], and substance abuse." *Supra* note 190, at 569-570.

have being used in the British criminal proceedings in many contexts including racially aggravated harassment, manslaughter, robbery, etc.²¹² The increasing importance of neuroscience findings in the legal theories and practices has led to the establishment of expert exclusive research institutes²¹³ and the extensive development of neurolaw works in the vast majority of countries.²¹⁴ Over the past couple of decades, a large number of conferences, seminars and symposiums of law and neuroscience have been held at universities all over the world,²¹⁵ including Iran.²¹⁶ There are currently more than 20 world-class universities that provide fellowship in postgraduate education or research-study programs²¹⁷ inviting scholars to join in the neurolaw researches. The dramatic effects of neuroscience findings on legal systems in the way of neurolaw advancement conduce to the evolutionary transition of law. In developing new norms and regulations, consequently, novel neuropolicy and neurolegislative movements were made in light of advanced neurolaw. France's prime minister unprecedentedly adopted a neuropsychological public policy program entitled "Neuropolicy" in Ministry of Social Affairs to take advantage of the potential opportunities arising from advanced neuroscience in public policy, in accordance with specific mechanisms.²¹⁸ In the U.S., there are also a number of state legislatures that have drafted laws or regulations on the neurolaw issues.²¹⁹

A more-or-less progression of medico-legal discourses in line with history of

²¹² *Supra* note 189, at 536-539.

²¹³ E.g., The MacArthur Foundation Research Network on Law and Neuroscience; Shen Neurolaw Lab; Fordham University Center of Neuroscience and Law.

²¹⁴ *Supra* note 5, at 670. You can find the bibliography of neurolaw and the statistics of researches in this new interdisciplinary field of study, on: <http://www.lawneuro.org/bibliography.php>; also see: *Supra* note 167, at 353.

²¹⁵ To read about some major events from 2003 to present, see: <http://www.lawneuro.org/conferences.php>.

²¹⁶ In Iran, neurolaw was presented at Tehran University of Medical Sciences (Department of Neurology) for the first time in 2015. See: *Supra* note 110. Since then, many neurolaw symposiums have been held in Tehran. E.g., "Toward Human Behavior Sciences from the Perspective of Neurolaw", Tehran University of Medical Sciences, 2015; "Modern Criminology in the Light of Neurocriminology" University of Judicial Sciences and Administrative Services, 2016; "Neuroscientific Techniques in Law: Opportunities and Challenges" Iran University of Medical Sciences (Brain & Cognition Clinic), 2017.

²¹⁷ Since 2006, courses in 'Law and Neuroscience' have been offered by many schools including: Harvard University; Yale Law School; William & Mary Law School; Stanford Law School; University of Pennsylvania; Vanderbilt Law School; University of Minnesota Law School; Fordham Law School; University of Kent (UK); Macquarie University (Australia); etc.

²¹⁸ <https://mindhacks.com/2010/05/31/french-government-begins-neuropolicy>.

²¹⁹ E.g., An act to amend the criminal procedure law, in relation to admissibility of magnetic resonance imaging (MRI) brain scans in criminal proceedings, Bill No. A9154 (State of New York); for more detailed explanation, see: Shen, *supra* note 165.

law and neuroscience shows the connection between the advancement of the brain sciences and neurolaw development. Mind and brain sciences have tremendously advanced and certainly continue to do so; however, it seems that there is no symmetrical development in the connective discourses of law and neuroscience during the 19th and 20th centuries. This is because of the traditional segregated way of the social sciences from medical sciences. Notwithstanding, we believe that the advancement of law and neuroscience might be in a linear fashion in the age of neurolaw, which gives rise to a mutually consolidated way of science; indeed, the development of medico-legal discourses was a motivation for the sake of convergence and eventually integration into this newly born knowledge. Neurolaw provides us a common literature of law and neuroscience (that was not existed heretofore) by which the discourses reach maturity in line with scientific advances. Before the post-modern era there was no progressive interdependence between law and neuroscience owing to some restrictive factors such as scientific segregation, heterogeneous literature, legal conservatism towards evidence reliability, etc.; but the emergence of neurolaw dramatically changed the matter. Neurolaw somehow puts forward discourses in an integrated autonomous field of study by which a new scholarly perspective to phenomena is being presented. A great number of scholarly contributions and academic scholarships in the field of neurolaw during the last couple of decades simply demonstrates the interdependency between law and neuroscience in the advancement; however, this is particularly true for their common discourses in the context of neurolaw, and not for the pure disciplinary matters. This is why present-day law traces back the most modern neuroscience discoveries. Much inclination for using the brain evidences in legal practices or referring to their modern findings in legal argumentation in order to reshape the linked discourses, in the current life of neurolaw, is a motivation to keep up this interdependency and modernization of law.

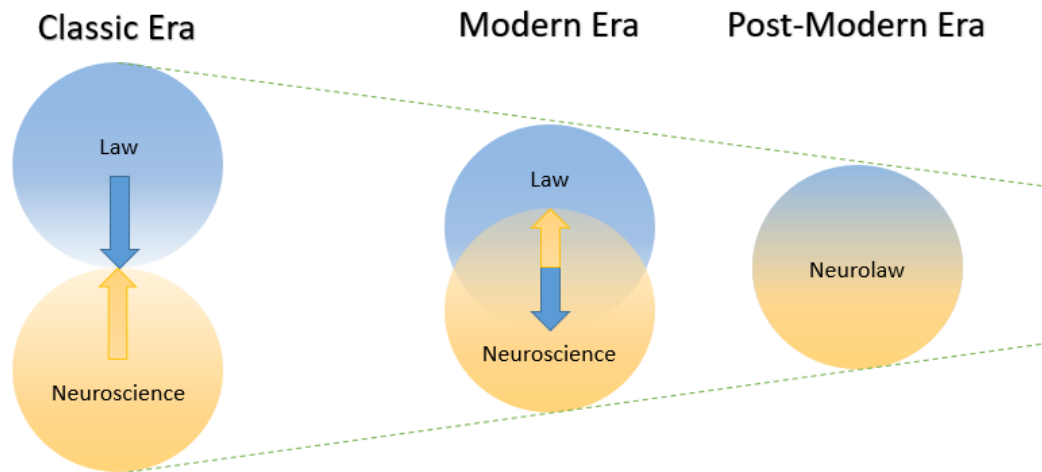
Conclusion

The classic era of law and neuroscience was the platform for medico-legal discourses were remarkably initiated with physio-psychological thoughts inspired by which some controversial criminal doctrines including bio-legal analysis of crime in the context of determinism have emerged. This has led to a multidimensional analysis of legal phenomena that 'biocriminology' was conventionally in the core of it. By a primary understanding of the brain and its impact on human behavior, scholars became more familiar with neurological disorders and characterized some essential concepts including "Death", "Li-

fe” and “Consciousness”. In this timeframe, by taking a comprehensive approach to biological, psychological, and sociological factors in human behavior, medico-legal discourses have been developed, particularly in explaining criminality. However, the meticulous and evidence-based investigation into the brain remained for the modern era. Almost at the commencement of the modern era, EEG technique was introduced in legal systems. Subsequent to some new neuroscience discoveries based on EEG evidences of the brain, this technique found a way for legal normative implementation by some well-nigh concrete facts for legal decisions. Physicians have coined the concept of “Brain Death” that the consciousness was at the core of it in medico-legal conceptualization. EEG evidences gradually found their way into courtrooms, mostly in the context of cases bearing on the question of insanity and mental illness that have a potent effect on individual criminal responsibility. Violence was the key factor in the criminology of the modern era. In order to call a dialectic discourse between medicalization, socialization, and individualization of crime in this new criminology, psychological, neurological, and dysfunctional society factors were considered in the anatomy of violence. For preventing behavioral aggressiveness or providing an effective treatment for a mental disorder, psychosurgery techniques have been remarkably used as a violence-surgery method in respect of employing modern scientific techniques for controlling violence. Meanwhile, the patient voluntarily informed consent to psychosurgery was regulated by neurolegislations. EEG acquainted medico-legal discourses with the brain evidences representing new facts that were important for courts, especially due to the novel findings in neurocriminology. This robust need to expertise in the both fields of law and neuroscience, and the advancement of neurolitigation led to the emergence of “Neurolaw” as a distinct interdisciplinary field of study in the next era. From the beginning of the post-modern era, neuropsychology and law were in the course of convergence. Nowadays, modern neuroscience, especially by FMRI evidences, provides us a more accurate understanding of activities and cognitive function of the brain; this includes the mind reading and direct communication with the brain. Discovering the secrets of the brain and the manifestation of mind accompanied by new post-modern rights including the right to cognitive liberty, the right to mental privacy, etc. The modern neuroscience findings fertilize the ground for the reconceptualization of legal concepts including free will, crime, competency and criminal responsibility in the context of neurolaw. A dramatic development of ‘law and neuroscience’ unexpectedly outstretched the realm of neurolaw to the new subfields of study to the extent that all legal

issues could be subjected to modernization or reconsideration in connection with new neuroscience discoveries. Therefore, it seems that law is in transition. In 21st neuroscience evidences took the path to an ever-increasing presence in courtrooms. In the post-modern era we are witnessing the extensive use of neuroscientific evidences in British, Dutch, Canadian, and the U.S. criminal proceedings in many legal contexts, such as murder, dangerousness, drug usage, criminal mental states, competency, assault, robbery, fraud, etc. These evidences are also used for mitigating criminal responsibility or determining the brain injury, mental capacity, the brain death, and the probability of rehabilitation. Besides, some fMRI findings offer us new facts on legal reasoning, i.e., the substantive interpretation of legal rules. Furthermore, in developing new norms and regulations, novel neuropolicy and neurolegislative movements were made in light of advanced neurolaw. Consequently, the post-modern law is currently employing the modern neuroscience findings by which neurolaw is increasingly encompassing litigations, legislations, and legal thoughts.

In conclusion, it seems that medico-legal discourses took their path to the realm of neurolaw as a distinct field of study to revise the law by transition of the perspective from a pure legal to a specialized neurolaw approach. In 19th and 20th centuries, the path has mainly sought out the reconceptualization of the core concepts in criminology, but in the post-modern era, coincident with the emergence of neurolaw, it penetrated the entire body of law. Hence, there is a distinct medico-legal analysis of phenomena in the current life of law from the traditional one; though this new neuroscientific evidence-based perspective has root in the history, as seen above, but it is clearly revolutionized in the context of neurolaw and evolving by the advancement of this newly born field. Somehow the convergence made this perspective novel and distinct. As a result, our hypothesis about the repetition is unreliable.



This historical study showed that medico-legal discourses took three steps in the three time frames relatively: development of multidimensional approach, discovering the brain facts, and brain decoding. By the first step, legal scholars found out they should substantively scrutinize the human behavior by a *de facto* approach in which biological, psychological, and sociological involved factors are considered. The multidimensional approach has encouraged scholars to explicate criminality and find a way to countervail it. The second step illustrated that in the realm of biological factors, there are brain facts that lead us to the neuroscience discoveries by which theoretical and practical aspect of law could be mutated. By taking into account the neurological factors, scholars have mainly strived to depict the anatomy of violence and develop violence-surgery. And the last one is the way to find the brain secrets in order to take advantage of neurolaw perspective for transition of law. In this era, scholars try to directly communicate with brain and look for some effective techniques in mind reading.

	Classic Era	Modern Era	Post-modern Era
Steps	Development of multidimensional approach	Discovering the brain facts	Brain decoding
Perspective	Bio-sociopsychological	Neuro-sociopsychological	Neurolaw approach
Key factor	Criminality	Violence	Mind reading
Subordinate factor	Countervailing	Surgery	Direct communication with the

			brain
Most known emerged neuroscientific evidence	-	EEG	fMRI
Practical impact in the legal context	-	The rise of neuroscientific evidence in courtrooms	Neurolitigation and neurolegislation advancement