

At the Origin of Crime - Current Developments in Neuroscience

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Abstract

A recent experiment on the human brain has aroused the interest of the scientific world, showing that, despite the fact that the brain knows the boundary between right and wrong, good and evil, every individual can easily get used to commit criminal acts. For this reason, in a civil society, a system that continuously reinforces the awareness of the boundary between good and evil that already exists in each of us is indispensable. According to some philosophers, every member of society acquires the habit of behaving in accordance with what is imposed by social morals and prescribed by law in order to enjoy individual freedom in a peaceful coexistence. But for such coexistence to be possible, all members of society, without distinction, must be subject to the rules of the legal order, respecting the laws issued by the state authorities that have a duty to fight crime for the protection of communities. However, although the law induces people to behave correctly, it is not possible to definitively change selfish human nature and - as some neuroscientists have recently discovered - free it from the influence of certain anomalous tendencies or real brain diseases.

Keywords: Fighting crime, Legal order, Brain Disease, Neuroscience, Neurolaw

1. Introduction

An interesting topic to reflect on today is a comparison between the latest developments in neuroscience and its influence on law, and what has been predicted by some great philosophers on issues fundamental to the life of human society. The link between neuroscience and law is analyzed by several currents of thought, especially since the project “Law and Neuroscience” of 2007 which provides relevant evidence on how neuroscience may be able to change the law. This new field of study has attracted the interest of several universities, including the Baylor College of Medicine in Houston and the Center of Excellence at CAS-Penn University of Pennsylvania. The Center for Neuroscience and Society of the University of Pennsylvania began in July 2009 and is working to address the social, legal and ethical inferences of neuroscience (Roskies 2002)³. Meanwhile, in the Italian legal system, neuroscience has received increasing recognition in recent years⁴. The opinions of neurologists and the analyses they carry out on the human brain and on possible neurogenetic pathologies are now taken into great consideration in judicial circles. The first Italian judicial case that saw the introduction in the criminal trial of new methods of scientific investigation, in particular neuroscientific techniques of behavioral genetics, is the Bay out case of 2009.

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³ The term “Neurolaw” was used by neuroscientist and lawyer J. Sherrod Taylor in 1991. J.S. Taylor’s book, *Neurolaw: Brain and Spinal Cord Negligence*, Clark Boardman Callaghan, New York, 1997, was used by lawyers to correctly introduce medical jargon into the classroom and to develop the implications of neuroscience on litigation. The term “Neuroethics”, on the other hand, was first used at the 2002 conference “Neuroethics: Mapping the Field”.

⁴ For an exploration of the ethical and legal aspects of neuroscience, genomics and converging technologies, see Cavalla 2014; Viola 2014; Palazzani 2019.

This is a judgment of the Trieste Court of Appeal, which granted a reduction of sentence to an accused, Abdelmalek Bayout, who had already been convicted of murder at first instance. According to the court, the defendant could not be held liable because he was in a state of partial mental infirmity at the time of the crime and because he was genetically predisposed to the crime. Just two years after the Bayout case, on 20 May 2011, neurosciences made their way back into Italian trials. The Criminal Court of Como sentenced to just twenty years in prison a 28-year-old girl who had brutally killed her sister and tried to kill her parents, because it recognized her in a state of partial mental infirmity. The sentence caused a great stir because the judge issued his sentence on the basis of an evaluation that used neuroscientific techniques. Therefore, the Italian courts have issued sentences of acquittal of defendants for mental defect, mental defect ascertained through the analysis of neuroscience. Even the Court of Cassation, judge of legitimacy, which first considered neuroscience as not usable (Criminal Court of Cassation, no. 43021/2012), then, with the progress of technology and neuroimaging, has recognized neuroscience as valid arguments of evidence (Criminal Court of Cassation, no. 11897/2018)⁵.

1.1. The experiment on dishonesty

Recently, a cognitive neuroscientist at the Princeton Neuroscience Institute, Neil Garrett, said that honesty - as well as any quality aimed at the good - is a moral quality that we often take for granted because it is based on what we have learned as right or wrong since childhood (Finnis 1991). But the human being, despite being aware of himself, is basically an animal often dominated by selfish instincts that, in the most critical moments, is not always able to choose between right or wrong, good or evil. In a recent study on dishonesty, Garrett did a very interesting experiment for the original way it was conducted. Garrett's experiment has shown that the human brain realizes when it does something wrong and strives to oppose it. This surprising discovery has aroused the interest of the scientific world. The neuroscientist had simulated a situation of buying and selling shares on the stock exchange where the honesty of the participants was tested with a game based on a real situation, which took for example a financial broker with the possibility of earning money by giving investment advice not entirely honest (Cain, Loewenstein, Moore 2005). After the test, Garrett studied the brains of the individuals examined with an MRI to see if there was a physical reaction to the decisions taken. The result was surprising. In fact, the brains of the game participants who had not cheated showed nothing special, but in the brain of the cheater, there was a super excited area of the brain: the amygdala. The amygdala is a very ancient structure of the brain and is activated with emotions, especially with negative ones such as fear and danger. Somehow, the brain of the person who implemented a dishonest tactic had kept a trace of this dishonesty by sending a clear signal of discomfort (Abe, *et. al.* 2007). But the biggest surprise, continuing the experiment - as Garret observes - is that it was discovered that the activity of the amygdala vanishes over time until it disappears. If we are given the chance to be repeatedly dishonest, the amygdala's excitement signal disappears, and we become more and more inclined to make wrong choices. Our brain, by adapting to negative impulses, can tolerate dishonesty without rebelling anymore. It is therefore normal for human beings to be able to cheat (Welsh, *et al.* 2015). Just like when we are in a restaurant: at first we intensely smell the scent of the kitchen, but after a while we stop paying attention because the neurons have adapted (Denny, *et al.* 2014). This study shows for the first time that the brain also adapts to its negative actions. Unfortunately, we adapt to anything, including crime and violence against our fellow human beings: this is "neural adaptation" (Makin 2017). For the first time, then, today we know that our conscious choices shape brain activity and not the other way around, and for this reason - concludes Garrett after his experiment - it is essential, in a civil society, a system that continuously strengthens the boundary between good and evil that exists at the base in each of us.

⁵ With the Criminal Court of Cassation, no. 43021/2012, the Supreme Court confirmed the judgment of the Court of Assizes of Appeal of Reggio Calabria that condemned a defendant for triple homicide, considering, among other reasons, that neuroscience could not explain the relapse of a trauma suffered by the defendant in adolescence on his ability to understand and want. With the Criminal Court of Cassation no. 11897/2018, the Court of Cassation confirms the judgment of the Court of Assizes of Appeal of Rome which, reforming a sentence of the Court of Cassino declaring the responsibility of an accused of the crimes of kidnapping, murder and contempt of corpse, ordered the reopening of the trial investigation to carry out a psychiatric report on the subject's imputability, and at the end, finding in the accused the pathology of post-traumatic epilepsy justifying incomprehensible conduct, ordered a reduction in the sentence from 30 to 20 years of imprisonment, with the exclusion of the disputed aggravating circumstances.

2. Men commit crimes because their brains get used to evil

Although the originality of Garrett's research is indisputable, it would seem that there is a contradiction between the premises of the experiment and its conclusions. First, it is argued that the human being is ultimately an animal dominated by selfish interests, so his choice between good and evil is not taken for granted. After the result of the experiment, which shows the over excitation of the amygdala as a consequence of the wrong action, it is claimed that the brain has an innate boundary between good and evil. Therefore, the choice between good and evil by men in social interactions should be guaranteed (Abe, *et al.* 2007). However, continuing the test, it emerges that men commit bad deeds because the brain - although brought to good initially, reacts negatively to them - then seems to get used to crime. So, what can prevent the evil from taking over? This is the real question that needs to be asked (Costa, Zolo 2002)⁶.

2.1. The reflections of Hobbes and Machiavelli on human nature

Wise conclusions about humanity, without the use of sophisticated scientific experiments, were already formulated a few centuries ago by Machiavelli and Hobbes, who tried to explain human nature by breaking the medieval visions of religious consciousness and morality, as well as those of classical idealism. Machiavelli defines man as a living being naturally brought to evil, guided by nature to express this evil. The Prince's task is to see how and when the people plot and to stop them by any means; in fact, the means to be used in politics must be suitable to achieve the only purpose that it is appropriate to pursue: the maintenance of the State (Machiavelli 1532). Hobbes, for his part, also perceived deeply the negativity of human reality and the difficulty of managing it rationally, finally extending this distrust of man himself, in particular of his ability to understand things correctly. The only true rationality that the individual can put into practice - according to Hobbes - is that of being governed by an absolute power, under the influence of which justice or the injustice of actions becomes an entirely secondary problem, since an action is all the more just the more it is imposed (Hobbes 1886).

According to the two philosophers, every member of society must become accustomed to correct behaviour in order to enjoy social security and freedom in a peaceful coexistence. Therefore, they must be subject to the rules of a moral and legal order (as invoked, but not specified, by the neuroscientist Garret after his experiment) which is the only way to strengthen the boundary between good and evil (Greene, Cohen 2004). Morality and law, in fact, are the only systems that limit the human inclination towards evil and allow man to live in society. These systems repress the instincts and impulses that flow freely from the selfish character of man. In particular, the law issued by the state authority for the protection of human communities - which will become, according to Kelsen, the object of a "pure doctrine", that is, a science of law liberated from all elements that are foreign to it (Kelsen 1934: 48)⁷ -, since the earliest times, had the task of affirming and consolidating in human consciences, still in a violent and ferocious state, the moral sense contrary to transgression to favor the other fundamental instinct of man: that of social aggregation.

It would seem that the social aggregation of men, in addition to being the only way to protect their lives and assert themselves - as Machiavelli and Hobbes maintain - is ultimately the result of a completely natural instinct, stronger than the evil of the human soul and the problems that result from coexistence⁸. Therefore, it must be noted that, despite the serious risks to which humanity is exposed, social life is perceived as a source of well-being. To support the validity of this statement, it would seem sufficient to remember the birth of social networks and their great development and success. The progress of technology has given us an extraordinary and immediate way to live in society by exchanging in real time news, feelings and thoughts with our fellow human beings, which most people use today. Each of us realizes that daily life is not only enriched, but does not have the same meaning and value if it is not shared with others.

⁶ On the subject, among others, see Pastore, Zaccaria, Viola 2017; Schiavello 2017: 65-85.

⁷ For an exhaustive analysis of Kelsen's theses, and their interpretations in Italian legal philosophical thought, see Riccobono 1989, 2017.

⁸ But can we really welcome this reversal of the Hobbes aphorism? It doesn't seem so. Under the eyes of all are the fires of war and guerrilla warfare that ignite here and there the planet with carnage of poor humanity always guilty even if essentially innocent. Some say that the uninterrupted massacre perpetrated, in different places, belongs to the pathology and not to the physiology of human coexistence. But the justification is not persuasive. Although conflicts jump from one end of the earth's axis to the other and are supported by the use of conventional weapons and the prohibition of nuclear weapons, they are no less deadly and tears and blood are raining. One cannot even ignore the cynicism of the Great Powers, who in words speak of peace and show themselves committed to extinguishing the fires of war, but with their actions they support the belligerents both for the guarantee of their spheres of influence and hegemony, and for the enrichment that arms trafficking brings.

The use of the term “socius” would then overturn the famous saying of Hobbes, *homo homini lupus*, which would turn so positively into *homo homini socius* (avoiding the perhaps excessive formula of Spinoza, which speaks of *homo homini deus*).

3. On the Hobbes aphorism

In the difficult and contradictory context of the world, law is a discipline that, from the beginning of time, governs the relationship between men in their common lives. In particular, law is an art or technique of human “doing” with which we can resolve the causes of conflict, proving to be an indispensable component in the functioning of social forces (Luzzati 1993; Manzin 2012). This discipline - also warns Lon Fuller (1986)⁹ - implies a negative essence (which consists in commanding the behaviors indispensable to civil life) such as, for example, *not* to kill, *not* to deceive, *not* to damage, *not* to defame. It is therefore inevitable, according to Hobbes, that in the “state of nature”, before the establishment of the law, men manifest their “right over everything” (*ius omnium in omnia*) with substantially similar forces, so that everyone runs the risk of being overwhelmed by the other, since all are equally endowed with sufficient power to cause damage to their own species (Fassò 1966-70). Hobbes’ description of fear and mistrust in relationships with others is exemplary and unsurpassed. What the philosopher calls “time of war” - using a metaphor not only limited to war episodes - is generated by a general state of “*bellum omnium contra omnes*”, an initial condition that, without the imposition of law, would affect the entire context of human existence. In this state of exasperated rivalry and hoarding of the goods necessary for survival, in which everyone is the enemy of everyone, no one can be sure of not incurring the greatest evils, that is, of losing the “supreme good” that is life, with a violent death. For this danger, every man must abandon the primitive state of nature, obeying his utilitarian reason, to reach the ultimate end of himself through the establishment of the state and the law (Dworkin 2000; Gardner 2015). The ultimate goal, or design of men, is to achieve, in this way, their preservation and a more comfortable life. Hume (1739/40: 261ff) supports the idea that humanity could not survive the dangers and destruction if individuals were not associated with each other: and the association between men could not take place except through law and justice (Rawls 1971)¹⁰, with which it is possible to preserve the life of the community with an agreement between the possession of individual goods and the achievement of the common good, thus satisfying the desire for survival that characterizes all living beings (Hughes 2012, 77-99).

4. The effects of brain disease on free will: the introduction of neuroscience findings into court battles

It seems, therefore, that it is precisely the law - through moral customs and family education in which we were born - the system that, since our childhood, directs our brain towards good and honesty. In fact, good and honest behavior is more easily ignored by those born in family contexts or in groups accustomed to living against the law (see Bickle 2009). The law therefore seems to be the system that really allows us to live peacefully in society: however, while pushing every man to behave properly, it cannot definitively change his selfish nature and the opportunity that he, always and anyway, can take the wrong path and choose morally wrong things. These different possibilities of choice could be attributed, ultimately, to the irrepressible exercise of freedom, considered by many thinkers as the main characteristic of every man, but can also be attributed, as recently discovered, even to some natural tendencies, or real pathologies, of the human brain.

Garret’s study on dishonesty, for example, should take into account other recent studies on the influence that some malformations or brain diseases may have on the choice that every man makes between good and evil. From this point of view, the so-called neuro-law advances inexorably, influencing more and more often the decisions of judges in court.

It is well known that the high technological progress of the last decades has allowed science in general, but especially scholars of the nervous system, to have access to increasingly sophisticated tools to examine the functioning of the brain. Today, neuroscientists who believe that there is a link between criminal behaviour and the genetic map, enter the court with innovative techniques trying to influence the decisions of judges by formulating possible solutions on issues that have always been at the center of legal and philosophical reflection, such as the existence of free will, imputability, moral responsibility (Minda 1996)¹¹. They ask what happens to the human brain affected by congenital diseases, and how brain diseases contracted during life can affect the behavior of the individual (Rizzolatti, Sinigaglia 2006; Pustilnik 2008, 2015).

⁹ On Lon Fuller’s theories, see Porciello 2017.

¹⁰ For more on the reasoning of law and justice, see Pariotti 2008; Avitabile 2017: 29-46.

¹¹ On the subject compare: Amato Mangiameli 1989, 2004; Pannarale 1998, 2006; Zanetti, Luberto 2008; Incampo, Scalfati 2017.

As Lombroso proposed more than a century ago, neuroscientists are convinced that there is a genetic predisposition to crime. There are, in fact, many court cases that cause a stir because of the increasingly specific and important role that neuroscientists play in trials.

The advancement of neuroscience in the courts, even in Italy - as we have seen - leads us to reflect on the issue of detention of persons who have committed a crime, whose genetic tests exclude the possession and ability to choose with a healthy mind. The same methods of investigation have significant consequences both in terms of ethical beliefs and procedural law (Jones, Marois 2009)¹². In fact, evidence of abnormal brain activity is introduced as an indicator of reduced responsibility and guilt of the defendant, due to a mental disorder from which he is affected (Mobbs *et al.* 2007). The arguments are that the defendant has come to commit a crime because his abnormal brain has imposed it on him. In this regard, it is interesting to analyze a recent study by Professor Deborah W. Denno that provides important information on how neuroscience is affecting court decisions in the United States. The subject of Denno's study was the analysis of all criminal cases in which neuroscientific evidence played an important role from 1992 to 2012. From the analysis of the data, the study concluded that the neuroscientific evidence in the 800 cases analyzed was mainly used for the mitigation of penalties accompanied by a complex range of defense strategies. Denno's analysis also shows that many courts not only expect lawyers to use neuroscience evidence, but also to penalize lawyers who neglect to use it. However, it has been argued that the introduction of such neuroscience findings into court battles is a double-edged sword (Gurley, Marcus 2008). In fact, although such results may mitigate the sentence of an accused with the argument that the criminal is not held responsible for his biological conformation, and therefore his guilt and his legal responsibility could be reduced, they could also lead to aggravate the sentence with the argument that the biological composition will commit further crimes in the future (Aspinwall, *et al.* 2012).

4.1. Alarming theory of early signs of deviance in prenatal and infant age

According to other recent studies, the crime gene can be found in the prefrontal cortex, an area of the body where it can be verified whether a person is destined to become a criminal future. This alarming theory was formulated after extensive studies on children, in which, according to some researchers, the first signs of deviance could be identified. Adrian Raine, a neuroscientist and professor of criminology at the University of Philadelphia, after carrying out several brain scanning tests on inmates, discovered that their prefrontal cortex - an organ delegated in the human body to regulate impulses, decisions and feelings - does not work and leads them more easily to bad instincts (Raine 1993)¹³.

All men have bad instincts, and the prefrontal cortex should serve to keep them under control, unless it's broken. Raine would have discovered that some criminals suffer from a lack of emotional capacity. Rather than not distinguishing good from evil, they do not understand good or evil because of a reduced function of the amygdala. According to Raine, therefore, it would be appropriate to control the brain until childhood to prevent dishonesty and criminal instincts, because the brain of children is fortunately malleable and therefore, for a certain period of time, retains the ability to change and develop appropriately.

5. The Neurolaw and the Impact on the Traditional Legal System

Finally, the question we need to think about is whether it is still permissible for the criminal to be fully liable when he commits his crime (Palombella 1985; Amato Mangiameli 1986; Pannarale 1998). If until a few years ago, in the Anglo-Saxon countries, the topic of neuroimaging techniques and genetic testing began to be discussed at - because it was considered essential to help the judge decide on the criminal responsibility of the criminal - today, in a legal system that is changing with the use of biotechnology (Montanari 1999; Scerbo 2000), we talk about neuroscientific techniques from America that are also crossing the Italian borders (Yarkoni, *et al.*, Wager 2011). Neurocriminology studies the composition of the brain and investigates how certain mental processes can work by looking for correlations between brain characteristics and criminal behaviour, and by making a valuable contribution to the study of the cause of crime (Petoff 2015).

¹² The crime scene and its technical reproducibility are analyzed by Sarzotti 2015.

¹³ Most of the problems are already present during pregnancy, then the research was carried out on Danish prisoners, with mothers who smoked or drank during pregnancy, some born in forced mode or with lack of oxygen, others abandoned. Another factor found, always of biological origin, is the total absence of fear in the thought process, which can sometimes help (as in the case of athletes), but, along with other factors, it may become another serious threat to the release of criminal instincts.

Rapid developments in brain imaging science are creating a new approach to our concepts of responsibility and punishment on the one hand, and understanding and forgiveness on the other (Ross 2008), documenting structural and functional impairments of the brain not only in antisocial, violent and psychopathic individuals, but also in those who act violently against their spouses and so-called white-collar criminals.

From neurocriminology research, it is clear that brain circuits have been altered in transgressors in parallel with brain circuits found at the basis of moral decision-making, outlining implications not only for the field of criminology, but also for the concepts of legal and moral responsibility, free will and punishment. Neuroscience has explored the functions and structures of the brain, shedding light on a better understanding of human behavior (Bickle 2009). The fusion of these two subjects (neuroscience and law) paved the way for neurolaw in the 1990s. There are two main methods in neurolaw: theoretical and practical. Until now, most neurolawyers have worked on brain functions and neuroscientific data to have a more accurate and fairer justice system. Due to the enormous differences between the brains of individuals, however, there is no direct mapping of mental function to specific areas of it (Poldrack 2010; Mohr, Nagel 2010). This is a fundamental challenge in the field of law: the scientists of Neurolaw try to translate the results of neuroscience with rules and legal systems, review standards, norms and legal behaviour to arrive at better solutions.

Understanding responsibility, free will and punishment and their relationship are the basis of the profound discussion produced in neurocriminology; if the neural circuit underlying human behavior and the ability to choose between good and evil is compromised in transgressors, it is morally and legally wrong for us to punish them. Free will is the often unspoken core of criminal law, which assumes that human beings are responsible agents, that is, free to choose to comply with social norms or to violate them. Many neuroscientific texts speak of forensic implications referring to cases where brain damage - such as that caused by a surgical resection, an accident or a tumor - is related to alleged criminal behaviour. The hypothesis is that almost all criminal, antisocial, sociopathic or psychopathic behaviour is linked to focal brain injuries that prevent correct behaviour from being chosen (Schleim 2012). In the future, it will certainly be interesting to examine to what extent increasingly elaborate analysis tools on the human brain can be used to convict or acquit defendants; and how such neuroscientific tools can influence the judgment on the assessment of criminal liability in criminal events (Horn 2003, Greely 2008). There are two different ways in which the neurolaw can be understood. From an initial point of view, the neurolaw represents the branch of neuroscience that studies the brain and its ability to shape and organize the basic legal concepts (Amato 2014). From a second perspective, the neurolaw seeks to explore the boundaries within which neuroscience can act in the field of law. Picozza (2016, 21-40) shows “how difficult it is today to deal with the issue of interpretation which - together with the efficiency of the legal system - is still today at the centre of the legal world and in particular in the fields of philosophy of law, general theory and so-called legal dogmatics” (cfr. Krueger, *et al.* 2014). In any case, the impact of neuroscience on the traditional legal system will be inevitable and will cover all aspects, from the concept of imputability and free will to that of responsibility in determining judgments.

6. Conclusion

The fundamental question between neuroscientists and jurists is the possibility of establishing a stable and fruitful relationship between law and neuroscience. While the law is a humanistic science based on the qualifying scheme of obligation, deriving from social morality and from the abstract meaning of the law of typing, and of the legal cases, neuroscience is a natural science based on experiments and assertions to be verified. However, some thinkers believe the opposite, namely that in reality the law is a phenomenon based on the social contract and on only relative propositions, while neuroscience is based on absolute statements.

This brings our minds to a real challenge. In fact, the law is man-made to regulate the members of a community by enabling them to live in a safe and excellent society (Hart 2012; Cohler, *et al.* 1989), as opposed to what happens to individuals in the natural state where there are no recognized rules and powers, and people do what they want by constantly putting at risk the “ultimate good” of their lives (Ost, *et al.* 2005)¹⁴. The ultimate goal of the law, therefore, is respect for human dignity and the fundamental rights of every person¹⁵. In this way, it attempts to achieve a “just” coexistence; a goal attainable only if society is governed by “good” and accurate laws, in other words, if there is a fair legal system (Sartor 2018). Neuroscientific statements, with an open eye on the neurological phenomenon, should help the law to have more precise rules in this regard.

¹⁴ On Ost’s thought and the questions of methodological pluralism of law, see Puppo 2013: 35-52.

¹⁵ On the issue of fundamental rights, among others, compare, Zolo 2009; Pino 2013.

From research in neurocriminology, it has been made clear that the brain circuits of offenders are altered in parallel with the brain circuits that underlie moral decision-making. Recent research in neurocriminology is outlining implications not only for the field of criminology, but also for the concepts of legal and moral responsibility, free will and punishment. To this end, the legal implications of brain research, free will and the neural bases of antisocial or criminal behaviour are of central importance. Drawing on neuroscience, neurolawyers seek to understand human behavior and potentially shape future aspects of legal processes.

In practice, they deliberate by having a comprehensive view of the image of the human brain and nervous system by scanning medical technologies such as radiology, psychiatry, neurology and clinical neuropsychology (Bigler 1991). With these new imaging techniques, researchers interested in the function of the human brain have the opportunity to examine the neurobiological correlates of human behavior (Baskin, *et al.* 2007; Tovino 2007; Takahashi 2012)¹⁶. So, although there is still uncertainty about Neurolaw, scientists are discovering that neuroscientific findings can help the law to achieve more reliable decisions and rules, and this has been shown in the field of procedural law, particularly in the area of civil and criminal liability. Neurolaw seeks to shed light on the path to justice at a time when legislators are about to rule on a specific act, which concerns the punishment of offenders, or when judges are about to give their verdict and decide the fate of an accused (Troper 2007). The results of neuroscience thus give lawyers a precise perspective, a more complete view of the crime and its perpetrator. Consequently, it is recurrently thought that Neurolaw, although still a critical event in our law firms, will help us in the future, more and more often, to apply medical knowledge and technology in the area of law to achieve a fairer punitive system.

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¹⁶ Today we are witnessing the development of neuroscientific considerations in various areas of law; such as intellectual property law, illicit law, consumer law, health law, labour law, constitutional law and criminal law. Neurolaws also serve the purpose of other related sciences; such as psychiatry, sociology, political science, behavioral ecology, and economics which primarily emphasize criminology.

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