Neuroscience, Criminology and the issue of the cause of criminal behaviour

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Abstract
The significant innovations in the study of how the brain makes possible mental phenomena and human behaviours facilitate the understanding of even the most complex processes, thus affecting the way of conceiving the mind, behaviour and, more generally, human nature. The debate reveals its greatest importance when it refers to consciousness and the human beings' freedom.
Studies and research in the neuroscientific field, however, present many important implications in ethical, philosophical and social fields as well. Neuroscience has progressively increased our knowledge of the human brain and it's functioning, providing us with an overview of the mental processes underlying human behaviour.

Keywords: *criminology, neuroscience, neurocriminology, free will, conciousness.*

1. The neuroscientific revolution

Modern neuroscientific technologies allow us to understand how the brain makes possible mental phenomena and human behaviours, even the most complex ones. Electroencephalography (EEG), magnetoencephalography (MEG), positron emission tomography (PET), single photon emission- computed tomography (SPECT), structural and functional magnetic resonance imaging (MRI and fMRI respectively) are the most important instruments through which the so-called "neuroscientific revolution" has been realized. They offer the chance of observing not only morphological and structural alterations in the brain mass, but also, and above all, the biochemical changes that occur in the stressed brain areas. These studies therefore affect the way of conceiving the mind, behaviour and, more generally, human nature. The debate reveals its greatest importance when it refers to consciousness and the human beings' freedom. According to Edelman, neuroscience aim to complete Darwin's program of fusion of the human and natural sciences through the development of a biological theory of consciousness (Edelman, 2004)

Studies and research in the neuroscientific field, however, present many important implications in ethical, philosophical and social fields as well. Neuroscience has progressively increased our knowledge of the human brain and his functioning, providing us with an overview of the mental processes underlying human behaviour.

2. Free will, determinism and moral responsibility

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Neuroscientific research has to do with two concepts related to each other: free will and moral responsibility. Libet found that brain "decides'" to initiate or, at least, prepare to initiate (certain actions) before there is any reportable subjective awareness that such a decision has taken place. In his famous experiment (Libet et al., 1983), it is concluded that cerebral initiation of a spontaneous, freely voluntary act can begin unconsciously, that is, before there is any (at least recallable) subjective awareness that a 'decision' to act has already been initiated cerebrally. Although Libet himself was mostly cautious about the relevance of this kind of investigations, it has certainly triggered an intense debate on freedom and free will.

The question of free will has been the subject of philosophical debate for centuries. It is a problematic concept, as there is no agreement if it concerns only the actions or even the will. Two conditions, however, presuppose it: the actor's choice between alternative courses of action and that the choice between these alternative courses of action does not happen by chance. The question is: how should the world be done so that these two conditions can be combined together? (De Caro, Lavazza, Sartori, 2010: p. IX). To answer this question, reference should be made to the important distinction between determinism and indeterminism. Determinism has been defined as the idea that every event is caused by an antecedent event and governed by the laws of nature. One of the crucial questions of the debate on free will is to establish the possible compatibility of free will with determinism or indeterminism.

The approaches to this problem can be classified as compatible or incompatible. The apparently indisputable incompatibility of freedom with determinism is not supported by those who endorse the thesis of compatibilism. This was the predominant concept for a long time, especially in the Anglo-Saxon countries. According to this perspective, the man's will would be determined, nevertheless the actions descend by will causally. Compatibilists believe that it is plausible for us to have a meaningful kind of free will in a deterministic universe. Incompatibilism can be divided into two approaches. The first one is libertarianism, according to which determinism is false and human beings have free will. Advance in neuroscience induce today many scholars to embrace the second approach. It's defined illusionism or hard determinism because it supports the idea that determinism is true and there's no chance for free acts. For instance, Libet's studies led Wegner (2002) to conclude that conscious will is an illusion. Consequently, the compatibilist has the burden of demonstrating how freedom and responsibility can exist in a deterministic universe. The incompatibility must instead show that freedom and responsibility can exist if our actions are random events.

Most people deny that we can be both free and determined. They are probably incompatibilists, because they have libertarian intuitions. Imaging scenarios of a person's wrongful actions in an explicitly deterministic world, people's judgments of freedom and responsibility appear to be compatibilist when given concrete. A little proportion of people do change their minds about moral culpability when they conceive of the world as deterministic rather than indeterministic: «It is enough to alter the outcome of a jury's decision in a criminal case where decisions have to be unanimous. It does seem to be a real possibility, then, that the number of convictions in criminal cases could be affected if there is widespread change in people's conception of the mind as part of the mechanistic fabric of the universe» (Roskies, 2006: p. 422).

The main criticism made against compatibilists by their adversaries concerns the construction of a concept of freedom ad hoc, different from the ordinary one, distorted on the basis of their thesis. In fact, its definition is per se problematic: traditionally there is no

agreement if this concept is applied only to acting or even to the will. Supporters of incompatibility solve the problem in two ways. Some scientists support the reasons for free will to the detriment of the determinism. Historically this is a thesis supported by the Catholic Church, which in fact contributed significantly to the descendant parable of the Italian school of positivist criminology. According to the opposite theory, not only freedom is impossible, but freedom is even an illusion. A position that seem backed by neuroscientific research findings. According to Nobel prize Francis Crick: «You, your joys and your sorrows, your memories and ambitions, your sense of personal identity and free will, are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules» (Crick, 1995).

3. From Neuroscience to Neurolaw

Until a few years ago, brain's study was limited to pathological aspects, while today it's possible to study how human beings think and act in normal conditions. For over a century scientists have been aware of the cognitive and behavioural consequences caused by the damage to certain areas of the brain, as taught by the famous case of Phineas Gage. However, the Italian physiologist Angelo Mosso deserves the credit for having observed and measured the blood pressure in the brain at the end of the nineteenth century. Mosso verified that every single action entails a greater flow of blood in the affected area of the brain. Today we know that the synaptic activity of neurons requires energy (glucose and oxygen) so resulting in changes in blood flow. The time of intuitions was beginning to leave the field to scientific evidence. Many years before Mosso, the French neurologist Paul Broca was convinced that different functions could be located in different parts of the brain.

"Neuroscientific revolution" of recent years has many important implications for the field of criminological studies, in relation to the issues of criminal responsibility, prevention and criminal sanctions. After many years of oblivion, the debate on free will and determinism has flared up again, thanks to the possibilities of brain observation offered by the neuroimaging techniques. Neuroscience has dramatically increased understanding of how mental states and processes are realized by the brain, thus opening doors for treating the multitude of ways in which minds become dysfunctional.

The appeal of the neuroscientific approach in the legal field lies in the possibility of providing objective and quantifiable data of pathological brain processes connected to a given behavior. In order to evaluate the mental capacity, the traditional psychiatric approach based on the clinical interview and the examination of the anamnestic information appears less objective and effective (Sartori, Gnoato, 2010: p. 182). Sammicheli and Sartori (2009: p. 17) define forensic neuroscience as the field that concerns the suitability of neuroscientific theories and methodologies to constitute scientific proof in criminal proceedings.

In Italy there have already been some cases in which some neuroimaging instruments have been used to verify the imputability. The first concerns an accused Algerian author of a murder that the Assize Court of Appeal of Trieste in 2009 recognized semi-spasm of mind due to a genetic predisposition. In 2011, a woman accused of murdering her sister and attempted murder of her parents was sentenced to twenty years in prison. A court in Como has recognized the existence of a partial mental defect due to the presence of "alterations in an area of the brain that has the function of regulating aggressive actions" and, from a genetic point of view, due to the presence of factors

"significantly associated with a greater risk of impulsive, aggressive and violent behaviour".

Forensic neuroscience does not exhaust the framework of research with a legal application. According to Sammicheli and Sartori (2009), neurolaw include normative neuroscience, such as the study of neural basis of moral reasoning, and criminological neuroscience. The latter is an emerging field that studies the application of neuroscientific, biological, genetic and psychological research to the criminological field. It seeks to apply neuroscientific techniques and principles to better understand, predict, and ultimately prevent crime.

4. Controversial matters in neurocriminology

Neurocriminology, therefore, specifically studies criminals from a neuroscientific point of view. Some researches explain the antisocial behaviour in reference to structural brain abnormalities, such as a decrease of grey matter in the prefrontal cortex, others in reference to dysfunctional aspects, for example in the prefrontal cortex and the anterior cingulate cortex of the frontal lobe and in the amygdala. The prefrontal cortex is considered to exert modulatory control over aggressive behaviours. The amygdala is a region critical to the generation, expression and experience of negative emotions. The prefrontal cortex is considered to exert modulatory control over aggressive behaviours. Magnetic resonance imaging (MRI), for example, has been employed to produce detailed images of brain, where voxel based morphometry (VBM) is increasingly employed to measure associations between body weight and regional brain alterations.

Several neuroimaging techniques are now available to explore brain dynamics in humans: electroencephalography (EEG), magnetoencephalography (MEG), near infrared spectroscopy (NIRS), single photon emission tomography (SPECT), positron emission tomography (PET) and functional magnetic resonance imaging (fMRI). Each of these techniques is based on a particular signal and has its own advantages and disadvantages, in terms of spatial and temporal resolution, safety and cost.

One might therefore say that criminological neuroscience is looking for the "new neurological stigmata of the criminal" (Baima Bollone, 2003), awakening the "Lombrosian ghosts", re-proposing all the questions related to the biological determinism of criminality (Gulotta, 2011, p. 85). "While modern technologies open new horizons of understanding the criminal phenomenon, on the other hand the consequences they project in terms of law and criminology are far from unpublished" (Sammicheli, Sartori, 2009, p. 30). However, Lombroso talked about atavism and determinism with regards to criminals, and not for all of them, while for non-criminals free will was not in question. Following the decline of the Italian school of positivist criminology, with the affirmation of a perspective focused above all on the research into the social causes of deviance, the problems of responsibility, free will and determinism had remained in the background of the scientific debate.

According to Stephen Morse (2004), it can affirm: "New neuroscience, old problems", because it will not justify any fundamental change in the law's approach to responsibility. Responsibility is not be confused with free will: it is a "fundamental psycho-legal error": «All behaviour may be caused in a physical universe, but not all behaviour is excused, because causation per se has nothing to do with responsibility» (Morse, 2004). New neuroscience may have fewer implications for law and society than popular imagination and even many scientists believe. A person may not be aware of all the causes of forming and acting on an intention, but this is not to say she did not form an intention and was not a fully conscious agent.

The concept of free will relevant to our moral and legal, personal and social practices is much more complex than that captured by the experiments (Lavazza, 2016). This is also true for criminal behaviour. A simple gesture performed in a laboratory can not be compared to the set of actions committed by the author of a crime, which conceal a universe of principles, values and opportunities. Moving a hand during an experiment is not equivalent to moving a hand to hit an individual during an assault or delivering money to babe a public official. In these cases social and cultural aspects come into play, interacting with the biological and functional aspects. Neuroimaging techniques can offer clear representations of neuronal problems affecting the brain, while causative factors of another nature can not provide an equal representation. Even if multifactorial thesis denies the idea of a deterministic cause in the morphological and functional alterations of certain areas of the brain, it could be argued that in itself it does not solve the problem of free will. Thus, free will is not put into crisis, because none of the multiple risk factors presents itself as a necessary and sufficient cause so preventing a choice between different alternative courses of action.

Biological and functional aspects may represent risk factors but not deterministic causes, except in specific cases. The risk is to slip into the dangerous equation between medical concepts, such as those of illness and predisposition, and the legal concept of criminality. It would be not only a serious methodological error, but would also have dangerous consequences in terms of preventing deviant behaviour.

The influence of biological, genetic and neurological components is always directly or indirectly mediated, moderated, accentuated or attenuated by psychological, emotional, relational, family, historical and situational components. Social environment can interact with genetics and biological risk factors for antisocial behaviour. Environmental influences in the early stages of development could directly change gene expression, altering the functioning of the brain and determining antisocial behaviour.

According to Raine (2008), criminal and violent behaviour is exponentially increased when social and biological risk factors combine. He argues that the structural impairments in antisocial individuals have a significant genetic basis. Raine observes that genes are not fixed, static, and immutable, so psychosocial processes cannot be ruled out. They can result in structural modifications to DNA that have profound influences on neuronal functioning, and hence antisocial behavioural outcome.

The frontal, prefrontal, and limbic system anatomical and functional lesions can contribute to altering both specific cognitive functions and the ability to regulate behaviour, but can not alone explain the complexity of psychopathology or determine behaviour (Zara, 2013). The problem can also be reversed: brain abnormalities may not be an independent variable, but rather they be caused by an environmental factor. It is not the high hormonal level that causes a greater inclination to violence, but it is the opposite. The culture of honour in southern Italy, for example, means that a provocation can be perceived as an offense, which produces the emission of hormones and the consequent aggressive response (Merzagora Betsos, 2012, p. 59).

Bianchi writes: «Neurosciences are constantly accused of annihilating the notion of personal responsibility. While contribution of environmental conditioning is peacefully accepted, contribution of properly biological factors is usually considered with suspicion and in any case is circumscribed to the presence of possible pathological impediments» (Bianchi, 2009, p. XVII). This means that (also) in a criminological perspective, the morphological and functional alterations in certain brain areas should not be looked at "with suspicion". They must be evaluated from time to time in the same way as other

possible factors. We do not fall into the error of attributing a priori to them the function of necessary and sufficient cause to realize an antisocial behaviour. Not all those who present such neuronal anomalies are consequently involved in antisocial behaviours. Not all those who are engaged in antisocial behaviour present neuronal alterations or dysfunctions. This observation supports a non-deterministic conception.

Neuroscientific research leads to the question of whether people who have damage in such regions should be excused for their behaviour. According to Green and Cohen, free will as we ordinarily understand it is an illusion generated by our cognitive architecture: «Retributivism notions of criminal responsibility ultimately depend on this illusion, and, if we are lucky, they will give way to consequentialist ones, thus radically transforming our approach to criminal justice» (Green, Cohen, 2004, p. 1778). Greene and Cohen suggest that neuroscience will lead to the rejection of desert, and thus retributivism. Consequentialism will thus gain ascendancy, not just in theory, but, eventually, in practice. It is the reductionist option whereby the mind is as a secondary phenomenon of the brain, against which, however, it can be argued that we are not "just" our brain (Merzagora Betsos, 2012). Greene and Cohen, as Merzagora Betsos notes, ignore the fundamental distinction between statements of fact and value judgments. Science must cover the facts. Neuroscience can show us a particular activation of some areas of the brain when certain decisions are made, but it can not pretend to indicate what are the implications of what has been observed (Merzagora Betsos, 2011).

5. Conclusions: the future challenges for criminology

"It is no longer the question of whether neurosciences can contribute to the understanding of criminal behavior and its evaluation, but how their contribution can support psychiatry and clinical psychopathology in the assessment of aspects of forensic and criminological relevance, such as imputability, the ability to rationally participate in a court process, the criminal and social danger, the prediction of the risk of violence, the compatibility of the individual with the prison life" (Zara, 2013, p. 19).

Advance in neuroscience research can provide new techniques for the evaluation of some criminal phenomena, such as impetus crimes. A crime committed without a clear will, which is apparently without explanation and which could be investigated with regard to its neurobiological bases. «Neuroscientific techniques provide neither the fineness of grain nor the breadth of information that would be needed to answer the question of determinism» (Roskies, 2010). "Neurodeterminism" has gained significant traction in recent years. According to Gazzaniga, in neuroscience hard determinism "still reigns" (Gazzaniga, 2011, 127). However, neuroscience can never provide total information and thus it cannot provide a definitive answer to the question of determinism. The philosophical problem of free will would not dissolve with either a positive or negative answer to this question. "It is becoming increasingly harder to argue that biological factors do not predispose some individuals to adult crime. This conclusion neither diminishes nor replaces social and environmental perspectives on crime causation" (Glenn, Raine, 2014)

The future scientific and neuroethical challenges for the emerging field of neurocriminology can best be met by integrative cross-disciplinary research that bridges traditional macrosocial theories (emphasizing broad social constructs) with new perspectives from clinical and social neuroscience to better understand, and ultimately prevent, antisocial behavior children and crime in adults (Raine, 2008). By avoiding any form of reductionism, criminology can only continue to study criminals and criminals with

an integrated approach, both social and biological. As philosopher Noë wrote, «You are not your brain. The brain, rather, is part of what you are» (Noë, 2009, p. 7).

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