



The contribution of neuroscience on ascertaining individual responsibility in anti-social and anti-legal behaviour

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Abstract

Lately, neuroscience studies on deviant and criminal behaviours have been intensified, with particular reference to the implications on the field of law and the criminal process. By analysing the origin of behaviour, these emerging sciences, would be able to identify possible biological or genetic causes that may have affected the will and awareness of anti-social and anti-law acts committed. It is obvious that the debate shifts to the 'question' of liability. The re-founding of the criminal law on a scientific basis, as the probative reconstruction of criminal facts is increasingly entrusted to the results of technical-scientific evidence, raises concerns regarding their relevance and reliability, while being used together with the traditionally known instruments. This study intends, therefore, to investigate both the results achieved so far by neuroscience for the explanation and interpretation of deviant (or criminal) conduct on scientific grounds, and to understand its possible contribution at a legal level, without any prejudice to the guarantees of a fair and free criminal trial for the individual and the principle of human free will. In any case, neuroscience has opened a window towards a new approach to the criminal law, since knowing man better and understanding his behaviour will inevitably lead to both an adaptation and a renewal of the law and its types.

Keywords: *deviance; crime; justice; neuroscience; law; anti-social; anti-law; individual responsibility.*

1. Introduction

Neuroscience studies are fairly new, while having a purely clinical application over the years, has increasingly established itself on the legal scene. Before analysing the controversy over the relationship between 'neuroscience and law', it is appropriate to

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introduce this topic by starting with the definition of neuroscience provided by recent studies and dictionaries. The Oxford learner's dictionaries explains it as "the science that deals with the structure and function of the brain and the nervous system" (Oxford Learner's Dictionaries 2023), while the Cambridge dictionary as "the scientific study of the nervous system and the" (Cambridge Dictionary 2023). Collins dictionary explains neuroscience as "the study of the anatomy, physiology, biochemistry, and pharmacology of the nervous system" (Collins Dictionary 2023).

According to Kandel, Schwartz and Jessell, neuroscience is a mix of neurophysiology, cognitive psychology, developmental biology, cellular and molecular biology, anatomy and it is cognitive (Kandel, Schwartz and Jessell 2003: p.1165).

For Ciro Grandi the term "neuroscience indicates a heterogeneous group of scientific disciplines, united by the objective of explaining how neuronal connections superintend the performance of all human activities, not only those extrinsic in simple bodily movements, but also the more complex ones (volition, emotions, even the formulation of moral judgments, the choice to deviate and delinquency), traditionally attributed to the domain of the mind and considered inaccessible to experimental investigation" (Grandi 2016: p. XI). Indeed, this new scientific evidence allows for a more precise appreciation and understanding of "the functioning of the central and peripheral nervous system, through advanced research guided by computer simulators and new molecular technologies applied to optical techniques" (Balconi 2020). In particular, neuroscientists investigate "the links between the brain and a given mental activity, analysing how the mind emerges from its biological substrate" (Benini 2022; Posa and Losa 2016). Neuroscientific studies therefore aim to "identify the relationship between these neural connections and human behaviour that can identify genetic particulars. In the past, these investigations had the sole purpose of qualifying such behaviour as pathological or deviant, today the research carried out by neuroscientists aims to understand 'how human beings think, make decisions and act in the normal course of their activities'" (Presti 2019).

The growth of this new discipline developed more in the 2000s, in fact, it was during these years that the first scientific papers were published in the journal "Philosophical Transactions of the Royal Society of London" in 2004, which was then resumed and updated in 2006, while in 2004 was published the volume "Neuroscience and the Law. Brain, Mind, and the Scales of Justice" by Garland et al. (Garland et al. 2004). All the dates of these publications follow the important conference entitled "Neuroethics: Mapping the Field" (Chapman and Soares 2010: p. 481), which took place on 13 and 14 June 2002 in San Francisco, thanks to the initiative of Stanford University and the University of California, where the "term neuroethics was given a new meaning, namely: the study of the ethical, legal and social issues that arise when scientific discoveries about the brain are brought into medical practice, legal interpretations and health and social policy" (Figueroa 2013: pp. 259-268). These discoveries are taking place in the "field of genetics, brain imaging and in the diagnosis and prediction of diseases. Neuroethics has the task of examining how doctors, judges and lawyers, insurers and politicians as well as the public deal with these issues" (Figueroa 2013: pp. 259-268).

The 2002 conference "developed the awareness of the need for the study that would for the first time closely relate neuroscience to law, a topic that involves concepts such as 'free will' and the 'monist' or 'dualist' conception of the individual, which

inevitably touch upon the world of social norms and thus law” (Felten and O'Banion 2022). Many scholars over the years have analysed, with reference to their own legal system, this new field of science (neuroscience), expressing doubt but confidence that it is indeed capable of studying the human brain as never before. The first two researchers to relate neuroscience to law were the Americans Greene and Cohen in their famous article “For the law, Neuroscience will change everything and nothing”, published in the special issue of “Philosophical Transaction of the Royal Society of London”, in which they focused on the mind, in biological terms, and the brain in all its functions (Green and Cohen 2004: pp. 1775-1785).

2. The problem of human 'free will'

A fundamental point for the analysis of “the relationship between 'neuroscience and criminal law' can only concern the defendant, the causes of his behaviour that constitute the crime and consequently the issue of responsibility” (Bertolino 2020: pp. 1-22). Today, the applications of neuroscientific studies are also extended to (non-criminal) social deviance. In relation, however, to the perpetrator of criminal conduct, neuroscientific studies “come into conflict with both the recognition of the biological basis of human choices and actions and free will. The risk is that neuroscience will classify as biological neuronal defects the reasons that drive the subject to deviate socially and to commit crimes. In reality, on closer inspection, neuroscience discoveries do not conflict with the principle of man's freedom; on the contrary, they seek to improve knowledge of his decision-making processes, choice and controllability of conduct, so as to better interpret all his behaviour and verify or not his responsibility” (Posa 2019). This is not to say that “neuroscience can prove 'the impossibility of acting otherwise' and thus deny free will. On the contrary, they may be able to point to causes that exclude his or her responsibility, albeit by identifying the prospect of a biological determinism and related decision-making mechanisms and finding pathological neuronal forms in the offender” (Durisko et al. 2016: pp. 159-165). Even in cases in which “neuroscientific reflections equally lead towards determinism, there are those who do not rule out the possibility that it may nevertheless be compatible with free will (so-called compatibilist thesis), arguing that human freedom is absolutely reconcilable with the recognition of a universal and causal rule, except in cases in which there is actual physical coercion. These theories are confirmed by the fact that, according to cognitive neuroscience, our consciousness is influenced by a decision driven by intrapersonal and unconscious mechanisms. They find their explanation in so-called pre-consciousness, so that consciousness only takes responsibility for actions insofar as it retains control over them. From this perspective, the neuroscientific delineation of decision-making devices seems to be compatible with the definition of free will, understood as the ability to acquire power over the world around us and to influence the use of that power itself” (Watson and Breedlove 2014). This interpretation and vision is consistent with what is stated in the Rocco Code. It refers to “certain central norms that, precisely, regulate the relationship of causality” (Article 40 Italian Criminal Code), particularly in” cases of omissive and culpable offences. In short, neuroscience does not go against what are the foundations of modern penal thinking, nor does it deny the existence of a power of self-determination” (Di Florio 2021: pp.2-11). Studies on the relationship “between 'neuroscience and law' have also recently been extended to the principles of the Italian Constitution” (Errigo 2022) With regard to the developments that have taken place over

the years on the subject of “free will and consciousness of action”, mention must be made of the first scholar to carry out experiments and studies on the subject was Benjamin Libet. He stated that “the neuronal process underlying motor action would tend to occur before the subject's will to perform the action. In fact, he demonstrated through various experiments that voluntary actions begin first at the neural level and then the actual awareness of the movement comes into play. As a result of these findings, experts began to doubt the principle of 'free will', claiming that it is merely an illusion generated by common sense, just because the brain and its neural basis are unknown. Once the biological substratum of decisions was discovered, the brain increasingly became the centre of origin of all our behaviour, almost becoming the one and only true 'culprit' of our offences. On the basis of what has been said so far, neuroscience would be best placed to identify the 'when', 'where' and 'how' of the mechanistic process that causes action. Their aim is not to reform law, specifically criminal law, but rather to demonstrate the true illusory mechanisms of free will and to provide a new idea of justice” (Libet 1999: pp.47-57).

3. Law, imputability and neuroscience

Having clarified the role of neuroscience and its development over the years, it is necessary to shift the analysis to the relationship between “law and neuroscience”, with particular reference to the legal institution of imputability. The latter, made explicit by Article 85 of the Italian Criminal Code, “bases its elements on the 'presupposition of guilt' and thus on the reproachability for the evil committed, only when one is in the presence of subjects who at the time of the commission of the act constituting the crime are capable of 'intending' and 'willing'” (Garofoli 2022). The “‘capacity to intend’ is the person's ability to understand the social value of the act he or she intends to perform, being able to assess the consequences and determine the means and effects. In other words, through the use of knowledge processes and the reality principle, the individual is able to overcome difficulties in any situation. The 'capacity to will' is, on the other hand, the ability to determine oneself autonomously, selecting the right inputs to act or not to act, referring to the values of the culture one belongs to, the society one lives in and the demands of rationality, in order to be able to express one's actions in a socially appropriate and accepted manner” (Bianchi 2009: pp.327-330).

The infirmity of mind referred to by the Italian Penal Code, in Articles 88 and 89 (total and partial vice of mind), “must alter the two aptitudes of the person with a real pathological process, capable of interfering in the dynamics of will, widely compromising the capacity to understand and/or to want. The latter express that 'psychic normality' on which the so-called 'free will' is based; experts in courtrooms pursue the objective of understanding the possible causes that cause precisely this free will to fail” (Marchetti 2014: pp.20-26).

In essence, the expert has to “pronounce on the possibility that a subject had of not committing a given crime, which is not exactly an easy task given that he or she has to express an opinion that constitutes the 'presupposition of the presupposition' within the penal system. He must also establish a boundary between 'normality and pathology' that does not exist, is not formally determined as it is in other cases, so the expert witness is led to have to translate clinical categories into legal ones as best he can” (Pellegrino 2022). In reality, “a clear demarcation between 'mental health and mental illness' is not considered scientific; it varies according to the school of reference, the historical era and

the subjective inclinations of each expert in relation to the individual case. Imputability actually defines the psychic functions that circumscribe the boundary of meaning in the criminal justice system” (Brownsword and Harel 2019: pp.107-125). As neurosciences develop, imputability begins to lose certainty about its boundaries, even if one cannot speak of a “true crisis of imputability as the capacity to understand and will, which, as a 'capacity for guilt', remains entirely fundamental and, moreover, well established in the culture, construction and developments of modern criminal law” (Dova 2019). In (relative) crisis, on the other hand, is “the concept of mental illness, which creates considerable problems in the legal field” (Nappi 2019). In the medical field, reference is made to various interpretative models of mental illness.

Wanting to make a synthesis of those that are currently used in forensic psychiatry, it is inevitable to mention: “a) the 'integrated model', in which the mental disorder is classified according to explanatory hypotheses about its nature and origin. In the event of the rejection (in so far as it deresponsibilises) of any determinism (biological or social), the integrated multifactorial conception takes its place: 'here then are contextually interacting in the genesis of the mental disorder the biological and organic-constitutional components, which in turn are reflected on the psychological-psychodynamic ones, which integrate with the social-situational-environmental ones. The various factors integrate reciprocally in producing the effect, i.e. the mental disorder'; b) in response to an anti-psychiatric outlook, 'biological psychiatry' is developed, which does no more than rework the developments that have already taken place in the fields of neurology, psychopharmacology and genetic engineering, proposing a 'reduction of mental illness to a purely medical-biological situation of a biochemical and transmissive nature'; c) the "dynamic-structural" model is different, based on a radical psychologisation of the concept of mental illness understood as behaviour unrelated to the personality's directives; d) also relevant is the emergence of "nosographic psychiatry" in which nosographic classification is seen as a "conceptual platform" that allows the construction of a minimum defining substratum for the functioning of psychiatric science itself” (Vaccarino 2021; Hogg and Tindale 2001: pp. 56-86).

It should be noted, therefore, how between the legal concept of imputability and the psychological concept of mental illness there is a “plurality of heterogeneous conceptual categories in which legal and medico-psychological perspectives alternate, but clinical criteria are unsuitable, since they deal with completely different ideas and purposes, to be used in the legal sphere” (Jung 2000).

Neuroscience can also provide significant insight in favour of a review of Articles 94 and 95 of the Italian Criminal Code, relating respectively to habitual drunkenness or stupefaction and chronic intoxication by alcohol or drugs. With regard to these articles, the first (art. 94) is considered an “aggravating circumstance, while the second article (art. 95) a cause of exclusion of imputability, since, as reiterated by the Constitutional Court itself in Judgement No. 114 of 1998, it is a non-transitory alteration of the biochemical balance of the subject such as to determine a real and proper psychophysical pathological state of the defendant and, therefore, a corresponding and non-transitory alteration of the intellectual and volitional processes”(Grasso and Pascale 2020).

Chronic intoxication is equated with “mental defect, total or partial depending on the degree to which it affects the subject's capacities, because the irreversibility of the condition in which the toxic phenomena remain stable, even after the alcohol or substance consumed has been eliminated from the body, has been noted; consequently,

the previously mentioned provisions contained in Art. 88 and 89 Italian Criminal Code are applicable, and also that the “alcoholic psychoses that arise in the course of chronic intoxication (delirium tremens, hallucinosis, etc.) are susceptible to recovery even in a short period of time” (Fiandaca and Musco 2019). In this sense, the definition of chronic intoxication by alcohol or drugs cannot exist, as often a “pathology of somatic, psychological and psychiatric significance with characteristics of permanence, even after the cessation of the abuse, cannot be found. The Italian Court of Cassation, however, considered the question unfounded, affirming the reasonableness of the legislative discipline which, despite the fact that psychiatric and medico-legal doctrine cannot find certainty, means that the discrepancy can be considered plausible at least with reference to guilt. In truth, neuroscience further demonstrates that the criterion of irreversibility, which characterises chronic intoxication, has become rather anachronistic and lacks a reliable scientific basis, since it has been verified that, in the case of major substance or alcohol addiction problems, the capacity to understand can be excluded or diminished even in the absence of damage of an organic nature, even if neurobiological” (Flick 2014: pp.1-10). This leads to the conclusion that the neuroscientific evidence confirms that there is a need to revise the discipline (Imwinkelried 1983:pp. 554-571).

4. A possible collaboration between neuroscience and law

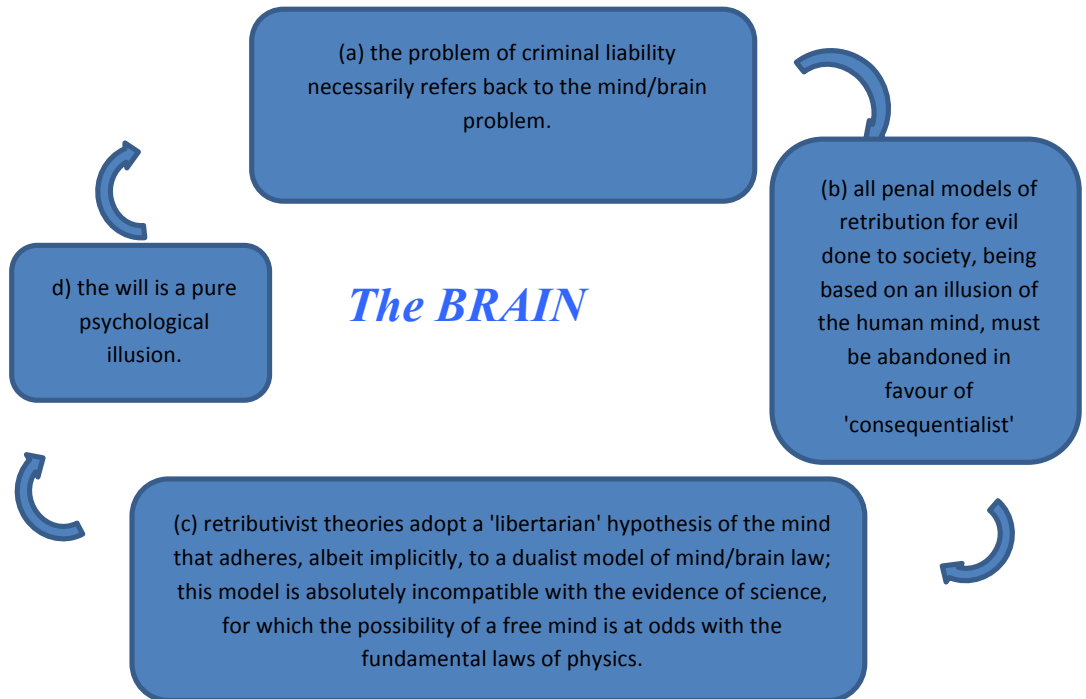
The debate on the extent to which neuroscience can have a concrete impact on law is wide open. A fundamental question animates national and international debates: is collaboration between neuroscience and law possible? To adequately answer this question, it is appropriate to analyse the question from two aspects, the theoretical and the practical (Grandi 2016: p. XI). From a theoretical point of view, the question has given rise to quite a few perplexities, which can be summarised in three critical configurations: 1) in the first hypothesis, neuroscience is “seen as one of many attempts over time to provide a uniquely causal explanation of crime. Previously, the focus had fallen on sociological or medico-biological factors such as poverty, race, culture, chromosomal characteristics, skull conformation, and so on; now the 'cause' of crime is intercepted in the neuronal interconnections and the subject's nervous system. This theory is countered by the most significant contributions in the criminological literature: many approaches, both sociological and medical-biological, have put themselves forward as unicausal theories (of crime), in the sense that they polarise their interest on a single factor, which is considered necessary and sufficient to account for the causes of criminal behaviour alone. This is an attitude that should be rejected, as it may appear dangerous due to the excessive one-sidedness of the premises and consequences; unicausal theories must be understood as particular contributions to be placed within a broader vision, which, at the same time, takes account of the entire constellation of factors, also considered causal, highlighted by the other individual theories. Inevitably, a unicausal criminological theory ends up neglecting those aspects that are not crucial from the point of view of that theory, emphasising instead a single condition. The unicausal theories, in short, do not take into account the set of motivations and other factors (such as family, school, environment, experience, education, etc.) that instead play a fundamental role in the development of the crime” (Gava 1994). 2) secondly, re-founding criminal law on the basis of scientific evidence from neuroscience would lead to a sort of “categorical error”, thus violating the epistemological principle according to which “each science is only able to understand the object of study to which its instruments give it access” (Gazzaniga

2005: p. 12). Because of this error, in fact, supporters of these proposals “risk misjudging the role that conceptual categories play in criminal law. This error could also cause a further misunderstanding: ‘the (erroneous) conviction that the penal discipline of imputability, culpability, retributive punishment slavishly follows the acquisitions provided by the so-called “hard” sciences on the subject of free will’, even if this is not the case” (Gazzaniga 2005: p. 12). 3) finally, “reinforcing the concepts that have just been reported, all the discoveries and developments made over the years by neuroscientists do not justify any change in criminal law, not least because the aim of neuroscience is not to change the law, but rather to make a contribution by providing methods and techniques to better assess legal concepts such as the imputability, responsibility and dangerousness of a subject. For all the reasons listed above, it certainly seems to be agreeable that it is not appropriate to refound criminal law on neuroscientific foundations, at least as far as the theoretical aspect is concerned; wanting to shift the question to a more pragmatic perspective, one should not exclude a priori any future possibility of collaboration between neuroscience and criminal law” (Greenwald et al. 1998: pp. 1464-1480). As Sartori and Zangossi (2016) state, “with the advent of modern forensic neuroscience, there are the prerequisites for a true innovation of the trial, not through a substitution, but through an enrichment of the traditional psychiatric-forensic assessment, in order to increase its objectivity and accuracy” (Sartori and Zangossi 2016: pp. 689-712). Neuroscientific data, in fact, allows for “the addition of essential information for understanding the case, not available with the traditional approach” (Hassemer 2011). It may, therefore, be useful to adopt neuroscience methodology. There are numerous fields of research where “neuroscience can make a significant contribution to the legal question of imputability: for instance, the now well-known research on frontal lobe pathologies” (Lanza et al. 2011) particularly affect an “individual's socio-moral capacities while maintaining general cognitive functioning substantially intact; they are relevant in the legal study of what is termed ‘insanity’. In cases where lesions occur in areas of the prefrontal cortex, there is a pathological dissociation between ‘cognitive faculties’ and ‘artificial intelligence’ (i.e. the ability to interact correctly in social contexts). Thus, patients who present conspicuous abnormalities in social behaviour may respond quite normally in intelligence tests” (Libet 1999). A further effect of this syndrome is a kind of inability to learn and benefit from experience, a deficit that can easily be deduced from “the Wisconsin Card Sorting Test, which analyses precisely the ability to interpret different problem-solving strategies by adapting them to each environmental demand. In the ‘frontal syndrome’, the faculty of free will is impaired and thus precisely the faculty that compromises imputability” (Lüderssen 2010).

From what has been proposed so far, it can be deduced that new technologies and new discoveries in the scientific field can certainly make an important contribution to the understanding of brain mechanisms and the resulting behavioural patterns, but from a theoretical point of view this is not yet sufficient for a re-foundation of criminal law on neuro-scientific grounds. Internationally, the scientific and doctrinaire positions on the possible contributions of neuroscience in law basically rest on two mass positions: the radicals and the moderates.

The ‘radicals’ strongly support a possible entry of “neuroscience into the cornerstones of law, believing that:

Tab. 1 The position of the 'radicals' in the neuroscientific landscape



To summarise, this thesis identifies mental phenomena with the physics of brain phenomena, thus solving the question of imputability upstream.

The 'moderates', on the other hand, while recognising neuroscience as being of great use, especially in subjects such as biology and neuropsychology, do not want to underestimate the risks of mismatch that could be created with law. In this second approach, two relatively independent points of view exist in parallel:

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| 1) The first purely scientific view involves an increasing study of the components that provoke violent and antisocial behaviour. | 2) The biological components of such behaviour are divided into two strands: behavioural genetics and neuroimaging. In the latter field, there are many developments, especially with regard to 'structural' and 'functional' neuroimages. | 3) Restricting ourselves to neuroimaging technologies, we noted: the problem of defining experimental and control populations, the problem of correctly comparing neuroimages and the problems relating to the correct and unambiguous interpretation of neuroimages. |
| 4) The second view, of a forensic-psychological nature, casts doubt on the concrete possibilities of transposing neuroscientific knowledge directly into the criminal courts. | 5) The problem concerns the method and the discourse between science and law, in fact, the controversy that could be created is precisely a misrepresentation between the answers given by science that are not suited to the questions posed by judges, in particular with regard to the more 'narrower' area of 'neuro' sciences. | 6) Neuroscience will not discover the brain equivalent of responsibility, because it is something we attribute to people and not to brains. Responsibility is a social construction, which is not found in the neuron structures of the brain. |

More recently, as well as in the international sphere, an open debate has been ignited in Italy on the two contrasting positions and on the possible collaboration between the

scientific and legal spheres, given that 'neuroethics' is being joined by the debate on 'neurolaw'" (Lavazzi 2022). Contrasting opinions have also emerged within the Italian cultural frontier: some are convinced of the revolutionary capacity of neuroscience on the world of law, while others have taken a cautious stance, especially when it comes to the application of neuroscience in the legal sphere. Leaving aside the actual debate, what is instead interesting with reference to the 'sociological' perspective, is to "rediscover that movement of 'reciprocal search for legitimization' between science and law that had previously been noted by psychiatry. From a historical point of view, it should be remembered that relations between legal doctrine and the sciences that study behaviour have, over time, alternated between phases of rapprochement and phases of rigorous assertion of their own boundaries: this has been especially beneficial for relations between 'law and psychiatry', in which the literature agrees in finding a path of 'mutual legitimisation' between the two knowledges" (Fuselli 2016). In doctrine, it is emphasised that the relationship "between 'justice and psychiatry' is historically determined by the 'state of development' of the latter. The weakness of the relationship between law and psychiatry, with their periodic crises, can be explained by the fact that the 'behavioural sciences' have always had a quite peculiar supporting role in relation to law. The purpose of these sciences is to investigate the functioning of our mind, but, often, they find themselves in a relationship of conflicting competences, especially when scientific 'labels' overlap with purely legal categories (the most classic hypothesis is being able to correctly categorise anti-social behaviour that, psychologically speaking, is defined as 'psychopathic', while for law it takes on the qualification of 'criminal')" (De Mari 2018). Nowadays, there seem to be important novelties and developments in the clinical field, marking the beginning of a new phase. In fact, if the "anti-psychiatry revolution had led to some crises in the relationship between psychiatry and law, with an escape from what has always been seen as a weak subject, now, the situation appears to be completely reversed, as judges increasingly seek the help of psychiatrists" (Fornari 2018). Today, the numerous studies and developments in the field of neuroscience have led to a rapprochement between the two worlds. Among the causes of this "rapprochement is the refinement of new techniques for the morphological and functional exploration of the brain, known by the Anglo-Saxon term neuroimaging or brain imaging, which have pushed the cognitive sciences beyond traditional topics, leading them to use an empirical approach to address issues that were normally reserved for philosophical speculation, such as free will" (Forsting and Jansen 2017). A further area for a possible collaboration between criminal law and neuroscience is the ascertainment of 'social dangerousness', the latter envisaged by Article 203 of the Italian Criminal Code as the probability that the perpetrator of an offence will commit new crimes in the future. If it is true that: "thanks to the techniques offered by neuroscience, it would probably be possible to provide the magistrate with an analysis of the risk of recidivism based on specific instruments capable of amplifying and integrating the clinical judgement, scientifically founded" then neuroscientific techniques could really be able to measure the capacity for self-control and therefore could have 'a certain usefulness also in relation to the assessment of the social dangerousness of the subject" (Popper 1996).

5. The obstacles to collaboration between criminal law and neuroscience

Having investigated the real and important contribution that neuroscience can make to law, it is now necessary to analyse to what extent it can be used in the courtroom. The path is certainly not easy because of many obstacles not only in the criminal law but also arising from the neuroscientific front itself. As for the criminal law obstacles, it is necessary to mention several prohibitions placed by the Italian criminal law and criminal procedure law: “the prohibition of expert opinions aimed at ascertaining the character and personality of the defendant and, in general, the psychic qualities independent of pathological causes (Art. 220, para. 2, Italian Code of Criminal Procedure) and other prohibitions placed by Articles 64, 188 and 189 (of the same Code) to protect the moral freedom of the declarant” (Della Ragione 2022). It has already happened in the past that these prohibitions barred access in “criminal proceedings to instruments such as the polygraph, better known as a lie detector (an instrument that detects changes in certain physiological parameters of the individual under examination such as blood pressure, respiratory rate, heartbeat and palmar sweating), narcoanalysis (performed by slow intravenous administration of barbiturates combined with amphetamine-type psychostimulants) and hypnosis” (Stephens-Davidowitz 2018). Assuming that these prohibitions turn out to be irrelevant or otherwise surmountable, “neuroscientific evidence should nevertheless be subject to the limits within which so-called 'scientific evidence' is admitted. In general, scientific evidence consists of 'evidentiary operations for which, at the moments of admission, assumption and evaluation, instruments of knowledge derived from science and technique are used, i.e. scientific principles and methodologies, technological methods, technical apparatus, the use of which requires expert skills’ (Sammicheli and Sartori 2015). It is essential for the judge in his assessment during admissibility to ascertain the reliability and trustworthiness of the evidence, hence its scientific validity. Obviously, not possessing the appropriate expertise, the judge can only check the scientific method used to ensure its quality. He must not “substitute himself for the expert but must ascertain 'how' he arrived at the result presented. The issue of evidence in criminal procedural law has always been full of theoretical and practical implications. Generally speaking, it can be observed that scientific evidence, like declarative evidence, must only be sought, admitted, taken, assessed and, therefore, then validated, if it admits verification and resists cross-examination. All this means that the judge, while having to ascertain *ex post* that the agent's conduct 'is' (not 'may be') a necessary condition of the single damaging event, is engaged in the hermeneutic operation in the light of the common canons of 'procedural certainty', leading, conclusively, at the outcome of the probative reasoning of a largely inductive type, to a judgement of liability characterised by a 'high degree of rational credibility' or 'confirmation' of the hypothesis formulated on the specific fact to be proved: a judgement also enunciated by jurisprudence in terms of 'high logical probability' or *probability bordering on certainty*” (Spanò and Tedeschi 2012). It follows that the level of “statistical probability must always be assessed with reference to the individual case, on the basis of the evidentiary findings since it is not permitted to deduce automatically (and proportionally) from the probability coefficient expressed by the law the confirmation of the hypothesis on the existence of the causal relationship” (Rossetti 2012). The obstacles, however, come not only from criminal law but from a more strictly technical perspective. For example, some perplexities fall on: “a) the risk of activation of circumvention strategies by the subject under examination with neuro-scientific techniques; b) the predisposition of some of the techniques to detect differences between

groups (e.g. bias analysis) and not to analyse the state of the individual; c) the inadequate maturity of other techniques. Some of these doubts can be remedied by comparing the data collected from the test subject with those of an adequate number of control subjects (at least one hundred). It is more difficult, on the other hand, in the case of comparison in the field of neuroimaging evidence, since data from healthy 'control' participants are essentially absent, not least because of the high cost involved in such investigations. Then there is the issue of the disproportionate persuasive power that brain images and explanations based on neuroscientific data might have, given their apparently simple reading, on judges and jurors" (De Luca 2021). Another major obstacle is that the neuropsychological investigation normally takes place under conditions that are nowhere near the 'natural' conditions in which the crime occurred. Finally, the big problem that all investigations that deal with the "mental capacity of the defendant have is that they can provide us with an analysis of the subject's behaviour and brain at the present time, not at the 'time when he allegedly committed the crime', which can be months or even years earlier. Only with a careful assessment developed on a case-by-case basis, taking into account the totality of the available clinical data, can one arrive at the conclusion, quite probabilistically, that the neurological and neuropsychological functioning at the time of the defendant's ascertainment can be considered similar to that at the time the crime was committed" (Barba and Geminiani 2021). As has been effectively noted, in fact, "the brain' changes. It is practically not feasible to continuously measure brain functioning in such a way that it is possible to relate brain activity recorded at a specific time to a later time. Thus, it may be difficult to know (before an expert opinion or scientific investigation) how the same brain functioned months ago, at the time when the legally relevant event occurred" (Sartori and Zangrossi 2016).

6. Neuroscientific evidence in criminal proceedings: the expert opinion

Neuroscientific evidence highlights the possibility that using scientific evidence or laws in the course of a trial requires specific expertise and knowledge that the judicial authority does not have. The term 'scientific expertise' is "quite broad and variable because it is certainly connected to the scientific progress that has developed over time but is also determined by the fact that less complex scientific laws are now part of common knowledge. The instrument that helps judges supplement their knowledge is the 'expert opinion', a means by which the legislator has shown an openness to science. It is well known that an expert's report is typical evidence expressly provided for by law (regulated by Articles 320 et seq. of the Italian Code of Criminal Procedure), which includes it among the means of evidence in which a 'party' request is not necessary for its admission, so it is admitted by the judge, as for all other evidence, only if not manifestly superfluous or irrelevant in relation to the subject of the evidence itself. The judge who orders the expert's report substantially limits his room for discretion in deciding, although he is not bound by the result of the report and may depart from or disregard altogether the conclusions reached by an individual expert. The Judge, however, according to Criminal Court of Cassation sentence No. 12026/2020 would not be *peritus peritorum* and could not disregard the results of an expert report solely on the basis of his own personal knowledge, based on uncertain and generic non-specialist elements" (Tonini and Conti 2022). It is necessary, at this point, to draw attention to what is termed "neuroscientifically oriented expertise. Essentially, it criticises the classical psychiatric approach, as psychiatric expertise is based exclusively on the clinical interview and thus

only on verbal interaction. Following these interviews, the appraiser compares the results of the latter with anamnestic, clinical data and court documentation to formulate hypotheses about the psychopathological state of the individual and the relationship to the behaviour/offence. The deficit of this diagnosis by means of an interview is that it is judged differently by different experts, so it has a very low concordance (e.g. with personality disorders, which are a frequent diagnosis in mental defect assessments, research shows low concordances of around 55%). Even lower is the estimated reliability in forensic evaluations that have to deal with opposing theses, which are also conditioned by different trial positions. Classical psychiatric diagnoses based only on the clinical interview and tests can certainly help. The technological progress that has developed over the last few decades has led to the emergence of new, increasingly sophisticated methodologies, which have made it possible to make important advances in the analysis of the relationship between cognitive processes and underlying neural mechanisms” (Algeri 2020). Thanks to these new advances, we are now able to obtain a great deal of information, as we can: “1) analyse brain activity by taking into account energy metabolism, neurotransmitter activity (e.g. Positron Emission Tomography, PET). The latter exploits the properties of certain radioactive isotopes with which substances of biological interest are marked, such as deoxyglucose, an analogue of glucose, the sugar that represents the main energy metabolism for the brain; 2) studying the fibres connecting different brain areas by means of Diffusion Tensor Imaging (DTI), which makes it possible to highlight anatomical connections between brain areas by measuring the speed of diffusion of water in the various directions; 3) studying the density of grey matter (neurons) and white matter (axons) in the brain by means of Voxel Based Morphometry (VBM), making it possible to show anatomical changes that escape visual appreciation. In addition to the improvement in brain investigation techniques, there has also been a singular development in the construction of neuro-cognitive tests that, with increasing precision, allow the psychological and cerebral mechanisms underlying the functions of interest to be analysed. The more in-depth study of cognitive domains has made it possible to address topics that were traditionally considered intractable by the sciences, such as empathy, moral values, feelings, emotional behaviour, etc. Functional imaging methodologies, in fact, make it possible to measure brain activity. To add to the difficulties previously discussed, there is another aspect that is little considered: the simulation of the psychic disorder. A depressive state, for example, can easily be simulated as the detection would be based solely on the patient/defendant's accounts. In the clinical context, the account of a symptom turns out to be more reliable because the patient has no interest in amplifying or distorting his symptoms as he himself would be penalised with an ineffective therapy; in the forensic context, on the other hand, the defendant gains great advantages in amplifying his symptoms, thus, his account turns out to be unreliable. In summary, neuroscience allows for increased objectivity in forensic psychiatric evaluations by introducing more certain data of the symptomatology and its neural and genetic correlates. Therefore, if in the traditional psychiatric assessment carried out by means of an interview the concordance of the opinions of different experts is low, then the scientific method that manages to be more objective and more reliable can undoubtedly give an important help in better assessing the subject” (Paige, 2017).

7. Neuroscience and testimony: mind-reading

In Italian and international criminal trials, 'testimony' is undoubtedly essential for the reconstruction of the fact being tried. Jurisprudence provides that the "witness is a 'third' subject with respect to the parties and is called upon to recount the facts of which he or she has become aware, if these are relevant or constitute the object of evidence in the trial" (Miucci 2011). Without dwelling too much on testimony in general, attention must be turned to the new techniques that neuroscience is developing in order to help the trial to interpret witness accounts more accurately. One of the most popular topics in the field of law and neuroscience is the possible the "use of the latter as 'mind-reading' tools. The subject has a certain popularity not only from a historical point of view, since it constitutes, together with the polygraph (lie detector), one of the first instruments applied to 'neuroscience' as an investigative technique, but also from a literary point of view, since the thought of being able to read the minds of others has always fascinated readers and writers. The goal of neuroscientific science is to try to investigate as much as possible the neural correlates of different mental functions (cognitive, emotional, behavioural); thanks to developments in recent years, this perspective has achieved a considerable increase through the development of neuroimaging technologies. In the example of 'lie detection', new neuroimaging techniques have brought about the development of neuropsychological models relating to 'the activity of lying', i.e. the study of all the parts of the mind that develop the cognitive activity of telling falsehoods (typical behaviour of deviants and criminals). Although the polygraph always used physiological indicators, considerable progress has been made: while the well-known polygraphic techniques measure peripheral correlates of the emotional state (variations in heart and respiratory rates, blood pressure, palmar conductance), in this case the observation from the periphery moves directly to the brain, in an attempt to identify a neuronal pattern that can be specifically associated with the mental activity of 'lying'. This would make it possible to overcome the limitations of polygraphic techniques, which measure generic parameters of emotional response and as such are neither sensitive nor specific; in the case of an instrument that can be traced back to memory detection, mention can also be made of the auto-biographical IAT. The latter is an indirect means of measurement that, based on the latency of responses, determines the possibility of association between concepts. It is essentially based on the compatibility effect, i.e. it compares compatible situations with incompatible situations; in simple terms, it simply checks response times, which, in the case of concepts associated with each other in the subject's mind, the times will be very fast; on the other hand, in the case of two non-associated concepts, the times will be slow, as testified by the numerous experiments carried out on the subject. In the autobiographical IAT, instead of investigating the association of concepts, the existence of a trace of the autobiographical memory is investigated in order to make it more suitable in the investigative and forensic sphere. The neuroscientific techniques briefly illustrated so far could constitute significantly relevant tools for the definition of the fact being judged, since with a certain objectivity they would be able to guarantee a minimum of perceived veracity of the statements collected during the trial" (Curci et al. 2015). Obviously, the question of the legal possibility for the application of these instruments remains somewhat complicated. It must be remembered, however, that "ascertaining the truth is not the sole objective of the criminal trial, but also has as its ultimate goal, if not above all, the protection of the fundamental rights of the defendant, the witness and those involved in the trial. Starting

from this assumption, Article 64 (2) of the Italian Code of Criminal Procedure, with regard to the interrogation of the person during the preliminary investigation, and Article 188 of the same Code for the trial phase, prohibit, with regard to the taking of declarative evidence, the use of methods or techniques suitable to affect the freedom of self-determination or to alter the ability to assess or remember facts, as they would be considered detrimental to individual guarantees” (Agosta et al. 2010). Hence the ban on the use of “techniques such as hypnosis, narcoanalysis, polygraphs or any other instrument that could manipulate the subject's psychophysical sphere, thus also affecting his or her freedom of self-determination. Much more complicated is the issue of neuroscience since neuroscientific tests, requiring interaction with the body of the person being examined in order to be carried out, are confronted above all with the limits set by the Italian Constitutional Charter: in Article 32 for physical integrity and in Article 13 for personal freedom. Neuroscientific techniques are minimally harmful to health, so much so that brain scanners or electrodes placed on the skull are used (methods also frequently used by doctors such as electroencephalograms or X-ray examinations). Even in matters of imputability, the taking of functional biological material samples to study the subject's genetic profile and identify possible genetic vulnerabilities would entail practically no health risk. Yet, since in criminal proceedings these techniques are carried out as part of expert investigations, the subject often finds himself being subjected to these examinations coercively or having to give his consent for them to be carried out. In this respect, in fact, neuroscientific testing could find a limit in the inviolable right to personal liberty under Article 13 of the Italian Constitutional Charter, since, tests such as magnetic resonance imaging, brain scans and even the administration of the IAT test would result in a restriction of the individual's liberty, since, for a certain period of time, he or she is detained at the site of the operations (sometimes immobilised in the case of scans or resonances). It is obvious that this is ruled out when the subject gives consent and voluntarily lends himself to acts restricting his freedom” (Canzio and Luparia 2022).

8. Conclusions

Summarising everything that has been illustrated up to this point and having already ruled out the hypothesis of a re-foundation of criminal law for all the reasons explained, the most plausible solution seems to be that of a possible collaboration between neuroscience and law that can develop in different sectors of the criminal process, each of which presents its own difficulties also in view of the instrument used and the specific peculiarities. However, the issue remains delicate and too broad to be able to find a single and unequivocal resolution to the debate, also because studies and research in this field are constantly evolving. Certainly, avoiding a dogmatic and 'prophetic' use of neuroscience can help to avoid dampening its very potential and to preserve the right guarantees for the process. There is no disputing the importance of neuroscience studies and the fundamental contribution they have made to research on social behaviour and how, indirectly, they are undoubtedly also useful for the legal world, albeit used with extreme caution and delicacy. As far as the strictly applied field is concerned, neuroscience should perhaps only be used as a means of circumstantial evidence, since the body data, in the application phase of the law, have a strong evidential value. What needs to be proven by judges is a 'pathological mental functioning'; the neural correlate turns out to be an effective proof of this. As soon as it is possible to establish with certainty an anatomo-functional correlation between a given mental function (which is

legally relevant) and the activation of a given brain region, it will be possible, with the help of neuro-imaging techniques, to introduce into the trial a possible proof of a mental dysfunctioning that must be judicially ascertained.

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