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NEUROSCIENTIFIC EVIDENCE AND ITS EFFECTS ON THE PRINCIPLES OF EQUALITY OF ARMS AND *INTIME CONVICTION* IN CRIMINAL PROCEEDINGS*

LA PRUEBA NEUROCIENTIFICA Y SUS EFECTOS SOBRE LOS PRINCIPIOS DE IGUALDAD DE ARMAS E ÍNTIMA CONVICCIÓN EN EL PROCESO PENAL

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ABSTRACT

Neuroscientific evidence has an increasing impact on fact-finding in criminal proceedings. Yet, the reliability of neuroscientific knowledge cannot be entrusted entirely to the experts but must be inspected within the trial, according to its principles, rules, and epistemological canons. Legal scholarship has mainly focused on the decision-making powers of the judge who must admit neuroscientific techniques at trial as being able, for example, to provide a useful contribution to the ascertainment of facts. In this perspective, we should also look at the parties in the proceedings, asking ourselves if they have a right – which in turn complements the judge's duties – to have specific issues ascertained through the contribution of the neuroscience.

RESUMEN

La evidencia neurocientífica tiene un impacto cada vez mayor en la determinación de los hechos en los procesos penales. Sin embargo, la confiabilidad del conocimiento neurocientífico no puede confiarse enteramente a los expertos, sino que debe inspeccionarse dentro del juicio, de acuerdo con sus principios, reglas y cánones epistemológicos. Los estudios jurídicos se han centrado principalmente en los poderes

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de decisión del juez, que debe admitir técnicas neurocientíficas en el juicio como capaces, por ejemplo, de proporcionar una contribución útil a la determinación de los hechos. En esta perspectiva, también deberíamos mirar a las partes en el proceso, preguntándonos si tienen derecho –lo que a su vez complementa los deberes del juez– a que determinadas cuestiones se averigüen mediante el aporte de la neurociencia.

KEYWORDS

Neuroscientific Evidence, Criminal Proceedings, Equality of Arms, Intime Conviction, *Contradictoire*

PALABRAS CLAVE

Evidencia neurocientífica, Proceso penal, Igualdad de armas, Íntima convicción, Contradicción

SUMMARY

RESUMEN

1. INTRODUCTION

In the last years, we have witnessed an increasing recourse to neuroscientific evidence in criminal proceedings. Since it has been demonstrated that neurological disorders can affect human actions, any real understanding of human beings cannot prescind from an in-depth analysis of the neurobiological basis of their behaviours[1].

Today, neuroscience in criminal proceedings is used not only to establish diminished capacity, insanity, and plead for mitigation but also to predict the social dangerousness of the offender, to prove the ability of the defendant to personally stand at trial[2] and the sincerity of statements rendered during the criminal proceedings[3]. Nevertheless, the widespread use of neurodata in a criminal trial has raised several concerns about its impact on legal decision-makers. On one hand, judges and juries may not have the neuroscientific knowledge to evaluate highly specialised evidence; on the other hand, assigning to neuroscience what fact-finders cannot decide according to legal instruments may be problematic. Indeed, overreliance on neuroscience does not only place the judges in a position of dependence on the results of science but also affects the private individual's right to challenge (neuro)scientific evidence[4]. Conversely, the reliability of neuroscientific experience cannot entirely be based on expertise, and it must be rather inspected according to principles, rules, and epistemological canons governing the trial.

Legal scholarship has mainly focused on the decision-making powers of the judges who are called upon to select neuroscientific techniques which can be admitted as evidence, being able, for example, to take a practical contribution to the ascertainment of facts and liability of the perpetrator[5]. The most significant studies have thus investigated the ways neuroscientific data are assessed by judges and, above all, the methodologies used to analyse the results obtained[6]. From this view, we should also look at the formal participants involved in the proceedings, asking ourselves if they have

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[1] T. Vukasović, D. Bratko, *Heritability of personality: A meta-analysis of behavior genetic studies,* in *Psychological Bulletin*, vol. 141, no. 4, 2015, pp. 769-785; A. M. Johnson, P.A. Vernon, A.R. Feiler, *Behavioral genetic studies of personality: An introduction and review of the results of 50+ years of research*. In G. J. Boyle, G. Matthews, D. H. Saklofske (eds.), *The Sage handbook of personality theory and assessment*, *Vol. 1: Personality theories and models*, Sage, London, 2008, pp. 145-173.

[2] M. Chiavario, *Diritto processuale penale*, IX ed., Torino, Utet, 2022, p. 228 f.

[3] D. Aono, G. Yaffe, H. Kober, *Neuroscientific evidence in the courtroom Cognitive Research: Principles and Implications*, vol. 4, no. 40, 2019, p. 1 ff.

[4] On this topic, A. Scalfati, *La deriva scientista dell'accertamento penale*, in *Processo penale e giustizia*, no. 5, 2011, pp. 144-150. C. Orlando, *Automated evidence, and participatory rights in criminal proceedings*. In C. Parrinello, S. Tanner (eds.), *Environment, technologies and protection of rights: the challenge of the third millenium in the light of the Agenda 2030*, Napoli, Edizioni Scientifiche Italiane, currently being published.

[5] A. Bradley, *The Disruptive Neuroscience of Judicial Choice,* in *UC Irvine Law Review*, vol. 9, issue 1, article 1, 2018, pp. 1-52.

[6] See, among the others, Y. Du, *The Application of Neuroscience Evidence on Court Sentencing Decisions: Suggesting a Guideline for Neuro-Evidence,* in *Seattle Journal for Social Justice*, vol. 18, issue 2, article 19, 2020, pp. 493-524; V. G. Hardcastle, M. K. Kitzmiller, S. Lahey, *The Impact of Neuroscience Data in Criminal Cases: Female Defendants and the Double-Edged Sword*, in *New Criminal Law Review*, vol. 21, no. 2, 2018, pp. 291-315.

a right – which in turn complements the judge's duties – to have specific issues addressed and resolved with the aid of neuroscience, in full respect of all the procedural safeguards, especially those of defendants.

Starting with this assumption, this study examines these issues from two main perspectives. The first one relates to the principle of equality of arms, which requires formal participants, at a minimum, to always know in advance the criteria based on which they can exercise their right to introduce evidence, thereby avoiding unfair exclusions of relevant pieces of evidence and ensuring equal treatment. The second one focuses on the parties' right to *contradictoire* in light of the principle of *intime conviction*, according to which the judge is called upon to assess the conditions on which neuroscientific evidence can prove the facts at issue.

While, moreover, it is true that fact-finding must be guided by rules of logic and experience, question also arises about whether and to what extent bias, emotion, and empathy – which are key elements in every human decision-making – can play a role when judges must deal with the neuroscientific data[7].

2. NEUROSCIENTIFIC TECHNIQUES IN THE COURTROOM: A BRIEF OVERVIEW

Before discussing the main topics, it is important to provide an overview of the current state of knowledge in neuroscience. As is well known, criminology has already demonstrated the significant role of social, economic, and cultural factors in shaping criminal behaviour and the limitations that can prevent individuals from making alternative choices[8]. In addition, over the last decades, a whole range of brain imaging methods (so- called structural techniques) has confirmed that offenders' behaviours are often associated with the existence of neurobiological features, such as a biological vulnerability or a morpho-structural alteration of the brain areas (e.g., loss of cerebral matter, alteration in the organic structure, excessive spinal fluid, etc...)[9]. The most used tools are CT (computed tomography) and MRI (magnetic resonance imaging) techniques. Other neuro-practices make the activities' brain accessible, and they consist of the so-called functional methods such as electroencephalography (EEG), positron emission tomography (PET), single-photon emission computed tomography (SPECT), and functional magnetic resonance imaging (fMRI). The contribution of brain exploration techniques has also proved to be extremely useful to test the accuracy of the statements rendered during criminal trials, thus helping judges to discern the truth from the false. These outcomes are practically important if one considers that the credibility of witnesses is critical to both the defence and the prosecution, and in general to the persons who have an interest to prove the truth of their statements – such as

[7] A. Bradley, *The Disruptive Neuroscience of Judicial Choice*, cit., p. 40 ff.

[8] G.D. Caruso, *Public health and safety: The social determinants of health and criminal behavior,* UK: Researchers Links Books, 2017, pp. 1-38. Y. Otsu, C.Y. K. Yuen, *Health, crime, and the labor market: Theory and policy analysis*, in *Journal of Economic Dynamics and Control*, vol. 144, 2022, https://www.sciencedirect.com/science/article/abs/pii/S0165188922002330.

[9] R. Adolphs, J. Gläscher, D. Traneld, *Searching for the neural causes of criminal behavior*, in *PNAS*, 2018, vol. 115, no. 3, 451-452.

victims – especially if the testimonial evidence is the only evidentiary source. According to neuroscientific investigations, for instance, the truthfulness of memories presupposes the normal function of the limbic system, as being responsible for the behavioural and emotional reactions to stimuli[10].

Against this background, neurosciences have challenged the Cartesian dualistic conception of mind-brain and increasingly influenced the legal thought regarding definitions of guilt, criminal responsibility, and personhood in criminal proceedings[11]. Above all, they led criminal scholars to rethink the function of the punishment – traditionally intended in terms of retribution, prevention, or a mixture of both – towards an effective humanisation of the penalties, based on the concept that "to know all means to forgive all"[12].

Furthermore, as it has been noted, neurosciences, far from distorting the notion of trial accusation, are able to give it a meaning and scope that are new within systems marked by a strongly authoritative conception of criminal ascertainment[13].

3. NEUROINVESTIGATIONS, EVIDENTIARY PROCESS AND EQUAL TREATMENT OF PARTICIPANTS IN CRIMINAL PROCEEDINGS

Despite these several advantages, the contribution of neurosciences in criminal proceedings is highly controversial. Some scholars consider that neuroinvestigations can have limited use in the courtroom as only aiming to support other evidence of brain

[10] V. Rajmohan, E. Mohandas, *The limbic system*, in *Indian J Psychiatry*, vol. 49, no. 2, 2007, pp. 132–139.

[11] This study does not address the usage of neuroscience to assess competence or treatment issues, nor questions related to criminal policy. For the sake of completeness, however, we should remind that over the last decades, several concerns have arisen about the existence of free will and consciousness as categories that not only justify the personal responsibility of the offender but also their punishment. Some questions, for instance, have considered the possibility that free will is more than an illusion, since actions and words that we believe are freely chosen are, conversely, the predetermined outcome of a series of neurological, sociological, and economic factors. On this topic, see among the others, O. Di Giovine, *Ripensare il diritto penale attraverso le (neuro)scienze?* Giappichelli, Torino, 2019, pp. 1-96. See E.D. Crespo, *Libertad de voluntad, investigación sobre el cerebro y responsabilidad penal*, *Aproximación a los fundamentos del moderno debate sobre Neurociencias y Derecho penal*, in *InDret,* no. 2, 2011, pp. 2-38; E. D. Crespo (ed.), M. Maroto Calatayud (coord.), *Neurociencias y derecho penal. Nuevas perspectivas en el ámbito de la culpabilidad y tratamiento jurídico-penal de la peligrosidad*, Madrid (Edisofer), Buenos Aires (Euros Editores), Montevideo (B de F), 2013, p. 17 ss. Cf., more recently, E. D. Crespo (ed.), M. de la Cuerda Martín, F. García de la Torre García (coord.), *Derecho penal y comportamiento humano. Avances desde la neurociencia y la inteligencia artificial*, Valencia, Tirant lo Blanch, 2022. In particular, Professor Demetrio Crespo has proposed a compatibilist conception between determinism and freedom that makes it theoretically possible to strike a balance between the outcomes of neuroinvestigations and the puroposes of criminal law. This approach implies a refusal of both mechanistic materialism and metaphysical indeterminism, and enhances the existence of a minimum concept of freedom in terms of "intersubjective self-determination". See E. D. Crespo, *"Compatibilismo umanista": una proposta per conciliare le neuroscienze e il diritto penale*, in *Rivista italiana di diritto e procedura penale*, no. 2, 2022, p. 645 ff.

[12] J. Green, J. Cohen, *For the law, neuroscience changes nothing and everything*, in *Philosophical Transaction of the Royal Society Lond*, 2004, p. 1783.

[13] See S. Ruggeri, *Neuroscienze, tutela penale e garanzie della persona*, p. 10 ff.

impairments. Other, while acknowledging the questionable nature of neuroscientific evidence, believe it can lead to excuse or at least mitigate criminal conduct[14].

There is, however, little doubt that whenever new neuroscientific evidence is introduced by parties in criminal proceedings, its reliability and admissibility must be conditioned.

The fulfilment of this task demands a diagnostic ascertainment and a normative one. The former is carried out by experts and focuses on the diagnosis of the neuropathology, psychosis, or mere vulnerability of an offender. The latter is conducted by the judge, serving as a 'gatekeeper' of new evidence, in order to prevent the introduction of 'junk science' in the proceedings[15].

This normative assessment raises questions about the judges' discretion. One might think about the use of Implicit Association Test (IAT) in criminal trial[16]. Can a judge rely on IAT results to support arguments presented by the prosecution or the defense?[17] For example, if defendants claim that they were treated unfairly by law enforcement due to their race, the fallouts of an IAT measuring implicit biases related to race may be used to support this argument?

These questions are closely connected to the identification of the standards that should guide the admission or rejection of this highly specialised evidence. Judges normally accomplish the above-mentioned normative judgment according to objective criteria appointed by law. Requirements such as relevance, probative suitability, and validity of evidence, which refer to the facts that need to be proven, are commonly found in criminal procedural codes (e.g., Articles 189-190 of the Italian Code of Criminal Procedure), although, given their features, they are not meant to promote the admission of the science of good quality at trial. They also turn out not to be fit the variety provided by the neuroinvestigations[18].

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[14] Cf. C. Slobogin, *Neuroscience nuance: dissecting the relevance of neuroscience in adjudicating criminal culpability*, p. 578.

[15] P. P. Rivello, *La necessità di evitare l'ingresso della* junk science *nelle aule giudiziarie: un ripensamento circa alcune ricorrenti affermazioni*, in *Diritto Penale Contemporaneo,* no. 11, 2017, pp. 19-30.

[16] The Implicit Association Test (IAT) is an instrument used to assess implicit biases or attitudes that people unconsciously hold. The test works by measuring the speed at which individuals categorise stimuli (such as words or images) into different categories, and it is based on the idea that people associate certain concepts more easily with certain categories than with others. The results of the IAT have been used to investigate implicit biases related to race, gender, sexual orientation, and other social groups. However, it should be noted that the IAT is just one measure of implicit bias, and its validity and reliability have been long debated among researchers.

[17] G. Gennaro, *Oscillazioni neuro…scientifiche: test a-IAT e macchina della verità*, in *SP*, https://www.sistemapenale.it/it/scheda/corte-appello-brescia-test-a-iat-macchina-verita, 10.12.2020.

[18] See, C. Slobogin, *Neuroscience nuance: dissecting the relevance of neuroscience in adjudicating criminal culpability*, in *Journal of Law and the Biosciences*, 2017, p. 578, who classifies it into five types: evidence of abnormality showing that the defendant has neurological impairment (e.g. frontal lobe disorder); cause-of-an-effect evidence revealing the link between the defendant's neurological impairment and anti-social behaviour; effect-of-a-cause evidence proving that the defendant's neurological impairment predisposed him or her to commit the crime; individualised neuropsychological findings (such as psychoneurological tests about the defendant impulsivity or inability to conceptualise) highlighting the defendant behavioural impairments that are legally relevant; and "evidence showing that the defendant's impairments are similar to impairments the law has recognised as exculpatory or mitigating".

In light of the complexity of this area, caselaw has provided significant suggestions over the years by attaching great importance to the method governing the validity of scientific evidence.

Nobody could ignore the landmark decision issued by the US Supreme Court in 1993, *Daubert v. Merrell Dow Pharmaceuticals*[19], which has served as a useful guide for judges and jurors in evaluating the admissibility of scientific evidence in criminal trials, including expert testimonies[20]. These guidelines consist of the testability, the peer review and publication, the rate of error and standards for operation and general acceptance. It is worth noting that this checklist was acknowledged in 2010 in the well-known case *Cozzini* by the Italian Supreme Court of Cassation which, however, went further by requiring independence and reliability of the expertise, as well as the breadth and accuracy of the critical discussions surrounding the scientific research, the underlying studies and purposes, and the explanatory capacity of the theoretical framework[21].

A detailed analysis of these and other decisions about this topic falls beyond the scope of this essay. Nonetheless, we must observe that the standard afforded by *Daubert* and *Cozzini* judgments requires an assessment of the scientific method rather than of the merit of the (neuro)evidence itself[22]. This is a major issue, as judges may not have sufficient knowledge to distinguish between 'merit' and 'method'[23]. They also tend to ascertain the outcomes of neuroinvestigations carelessly, without determining whether the scientific theories can provide reliable outcomes. Moreover, there is the risk that they undervalue the above-mentioned criteria or, conversely, delimit their scope or ratify the expert's opinions uncritically.

Additionally, the US Supreme Court in the *Daubert* case also held that "scientific validity for one purpose is not necessarily scientific validity for other, unrelated purposes". We will try to shed light on this statement. There is little doubt that it refers to the interests of the participants in criminal trial. Nonetheless, this approach seems to impinge upon the equal treatment of parties demanding that (at least) they must always know in advance the criteria based on which they can exercise their right to introduce evidence. This understanding, indeed, is set up to avoid unjustified exclusions of relevant pieces of (neuro)evidence and threaten the evidentiary aims of parties. Despite the cogency pursued by the principle of equality of arms, one cannot deny that public prosecutors and offenders have very different burdens and interests associated with their roles within the criminal proceedings. The prosecutor aims at proving the defendant' blameworthiness and relevant facts concerned with the charges proffered. Things are quite different from the perspective of the accused, who do not have to demonstrate their innocence, even if they certainly have a right to introduce evidence

[19] *Daubert v. Merrell Dow Pharmaceuticals*, Inc., 509 US 579, 1993.

[20] *Kumho Tire Co. v. Carmichael, 526 US 137,* 1998.

[21] Cass. pen., Sez. 4, 13 December 2010, no. 43786, *Cozzini*.

[22] C. Conti, *Scienza controversa e processo penale: la Cassazione e il "discorso sul metodo",* in *Diritto penale e processo*, no. 6, 2019, p. 848 ff.

[23] According to Professor Ruggeri, *Neuroscienze, tutela penale e garanzie della persona*, cit. p. 15, criminal judgement cannot be given the scope of testing and falsifying the accuracy of a theory or a scientific method.

that might exonerate them from blameworthiness. This asymmetric position is a consequence of the principle *in dubio pro reo* and, in turn, influences the standards of scientific validity that must be met by the prosecution, on the one hand, and by the defendant, on the other hand. Therefore, in those jurisdictions in which preparators have been proved to be guilt 'beyond any reasonable doubt', defendants must be granted the right to introduce evidence whose scientific reliability appears weak in order to raise doubt in the judge or jury. According to this criterion, the same weak evidence, however, can turn out to be 'inadmissible' for prosecution purposes.

Should this conclusion be accepted in absolute terms? To answer this question, one must examine the objective of criminal proceedings. In this regard, suffice it to say that the unequal evidentiary standards in criminal trials serve a purpose unrelated to securing a conviction or uncovering the "truth" at all costs. Instead, the criminal trial should aim to uphold infringed social norms and values[24], as well as to treat those accused of crime humanely, regardless of its adversarial or inquisitorial nature. Yet, this approach is aligned with that theory according to which in difficult cases criminal responsibility-related issues must be solved in favour of the offender[25].

However, what cannot be acknowledged at all is a disparity in resources between the prosecution and the defendant as it results in an imbalance of power and breach the defendant's right to a fair defense, particularly if the prosecution has access to special neuroinvestigations which are conversely barred to the defendant, being these too expensive. Therefore, should the judge declare evidence submitted by the prosecution to be inadmissible and exclude it when the accused do not have equal evidentiary means to prove their innocence?

Against this framework, two further considerations must be drawn.

Firstly, the analysis conducted calls into question the nature of the criteria that should guide the fact-finder during the evidentiary process. If the evidence is based on unreliable scientific standards, the unreliability would operate as an exclusionary rule; whereas, if the reliability of the evidence is in doubt, it may still be admitted. In this case, it is hard to speak of an exclusionary rule. Additionally, evidence that has been admitted at the first stage may later be excluded if it is assessed to have little or no probative value regarding the issue at hand. Thus, the capacity to prove guilt determines the strength or weakness of scientific evidence.

Secondly, although the use of 'flexible' criteria can satisfy the evidentiary needs of the parties, there is still a risk that "bad science" could become good evidence, while completely unfounded and unreliable scientific knowledge should remain such whether the doubt must be overcome or, rather, it must simply be raised. In other words, what is not reliable enough for scientists can be sufficiently consistent from the legal viewpoint.

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[24] S. Satta, *Il mistero del processo*, in *Riv. dir. proc.*, 1949, p. 280 f.

[25] See E.D. Crespo who, without ignoring the risks of the deterministic approach, has recently proposed a new theory to attribute criminal culpability. This theory focuses on the humanity of the penalty and is articulated in three methodological pillars: the refusal of retribution as the purpose of the penalty, a permeable model of criminal science, and the search for unitary answers to scientific problems. See also S. Ruggeri, *Neuroscienze, tutela penale e garanzie della persona*, in *Processo penale e giustizia*, no. 1, 2023, pp. 3 and 13, who has highlighted the need to enhance a dialogue between the legal and scientific knowledges.

4. THE PARTIES' RIGHT TO *CONTRADICTOIRE* LINKED TO THE JUDGE'S *INTIME CONVICTION* PRINCIPLE

The selection of evidence for the decision has a particular impact on the judge's decision-making powers. Besides, the way on which evidentiary processes – from the admission to the assessment of evidence – are generally carried out does not represent a mere formalism. The method deployed, indeed, can constrain or broaden the content of the decision and restrict or extend judicial discretion. This matter is strictly related to the judges' free assessment of evidence.

Based on these premises, we should therefore consider the link between the judge's *intime conviction* and (neuro)scientific contributions[26]. To properly tackle this issue, we should first look at the complex relationship between scientific and legal knowledge[27].

Judges are not required to check science and are not bound by the conclusions of appointed expertise; they may decide to ignore them or use their own knowledge to reach different purposes. However, judges cannot be considered omniscient and cannot employ knowledge outside of their expertise to incorporate highly specialised techniques in criminal proceedings or use them as a basis for their verdicts[28]. In light of this and considering the ongoing scientific development, fact-finder represents no longer a *peritus peritorum*[29].

Historically, in the civil law countries, the beginning of the modern civilisation of law is marked by the *intime conviction* principle, according to which reliability of evidence is left to the discretionary assessment of judges. On the contrary, the fMRI, PET, CAT and other neuroinvestigation techniques seem to lead us back to the system of legal evidence since the inference between the neuro-evidence and the fact to be proved is not carried out from time to time by the judge but established by neuroscientists previously. Besides, when the neuro techniques go deep into the human being, it is arguable that the decision-maker can gain autonomy.

Moreover, as is well known, the facts are usually ascertained under the rules of experience and logic, which constitute the repertoire of empirical knowledge of the average man, in a given historical and cultural context. The scope of their application, however, will probably become increasingly reduced, because the judge may use them insofar as they do not result in suppositions or mere intuitions and are not even in

[26] This issue has been also addressed by Professor Nobili with regard to scientific evidence. See M. Nobili, *Il principio del libero convincimento del giudice*, Giuffrè, Milano, 1974 pp. 384-389

[27] O. Dominioni, *L'esperienza italiana di impiego della prova scientifica nel processo penale*. In: M. Bertolino, G. Ubertis (eds.) *Prova scientifica, ragionamento probatorio e decisione giudiziale*, Jovene, 2015, pp. 37-54.

[28] M. Taruffo, *La prova scientifica. Cenni generali*, in *Ragion Pratica*, no. 2, 2016, pp. 335-354.

[29] G. Carlizzi, Iudex peritus peritorum, in *Diritto Penale Contemporaneo*, no. 2, 2017, pp. 27-47; G. Carlizzi, *Giudice 2.0 e uso del sapere specialistico nel processo penale*, in *Processo penale e giustizia*, no. 2017, 732-754.

conflict with recognised and uncontroversial (neuro)scientific knowledge and methods[30].

Despite the undeniable importance of the principle of *intime conviction*, it is apparent that the choice of ascertaining neuroscientific evidence is not completely free and any deviation from the scientific findings requires a specific judicial reasoning[31].

Against this background, the role of judge as *peritus peritorum* is not justified by trust in the judge's knowledge but by the judge's decision-making function in a criminal trial.

Moreover, in this study particular attention must be paid to the *contradictoire* which we understand as a confrontation between parties about the neuroscientific evidence in order to overcome one-sided interests and provide the judge with a realistic description of facts and, above all, persons.

This principle deserves our attention for two reasons. Firstly, insofar as it brings together the interests of participants, it endorses the adversarial method enabling checking errors, and solving the problems related to the validity of the neuroinvestigations. Secondly, acknowledging more space for the technical-argumentative *contradictoire* can decrease the risk of the arbitrariness of the judges, on one hand, and their excessive trust in the scientific contribution, on the other hand. This principle should therefore guarantee the right of the participants, or at least increase the 'chance', to have their issues properly ascertained throughout the recourse to neuroscience.

However, one might wonder whether and how an effective confrontation in an area that require specialised knowledge can materialise the adversarial method and grant the accused a fair opportunity to challenge the validity of neurodata. In particular, the right to confrontation must be shaped in a way that allows private parties, especially the defendant, to benefit from the scientific support of the expert counsel during the examination[32].

5. THE "SEDUCTIVE ALLURE" OF NEUROSCIENCE AND THE RELIANCE ON BIAS, EMOTIONS, AND EMPATHY IN DECISION-MAKING PROCESSES

Another concern regards the influence of neuroscientific evidence on decision-making process. We refer to a "seductive allure" that descends from images connected to the defendant or witness' s brain but also from non-imaging results.

Some researchers have focused on the link between the glittering colours of the computer-generated fMRI pictures indicating the differential blood flow in the examined brain areas (so-called "Christmas tree phenomenon") and the verdicts and sentencing recommendations[33]. Although neuroimaging-based evidence does not hold

[30] G. Canzio, *La valutazione della prova scientifica fra verità e ragionevole dubbio*, in *Archivio penale*, 2012, p. 891.

[31] P. Tonini, *La Cassazione accoglie i criteri Daubert sulla prova scientifica. Riflessi sulla verifica delle massime di esperienza*, in *Dir. pen. proc*., 2011, p. 1346, who fosters the need to falsify the maxims of experience.

[32] S. Ruggeri, *Neuroscienze, tutela penale e garanzie della persona*, cit. p. 21.

[33], M. J. Saks, N. Schweitzer, E. Aharoni, K.A. Kiehl, *The impact of neuroimages in the sentencing phase of capital trials*, in *Journal of Empirical Legal Studies*, vol. 11, no. 1, 2019, pp., 105-131.

any special persuasive power, they have found that neuroscientific evidence has some mitigating effects on legal decisions. This phenomenon is also deemed as the "rhetorical relevance" of the neuroscientific evidence, that is, the potential for convincing a judge or jury in the defendant's (or prosecution's) favour[34].

Moreover, differentiating the applicable standards of validity according to the parties who demand the evidence may not receive approval from those who warn that implicit bias (especially racial ones), emotional, and empathy can play a role when judges must deal with neuroscientific contribution. It has been demonstrated that the neural activity in the brain related to decision-making can be closely linked with activity involved in bias, emotions, and empathy. Furthermore, the intricate nature of neural connections allows multiple brain regions and circuits to take part simultaneously or consecutively in forming thoughts we understand as decisions. These regions and networks may also activate when a person experiences emotions, bias, or empathy. Additionally, people are subjected to implicit cognition when making choices[35]. Therefore, can judges be seen as rational actors capable of putting bias and emotion aside in order to provide decisions on the basis of law and facts?

These concerns are not new, although they are growing in light of the increasing use of neuroscientific evidence in legal proceedings. We should remind that the ways in which judges and jurors interpret signs as evidence of truthfulness or deceit are, indeed, not based on objective scientific standards and are, therefore, less reliable than evidence from fMRI or lie detection machines[36].

These considerations shed light on new problematic issues concerning the judicial function and its essential features, impartiality, and neutrality of the judge. There is little doubt that all this ends up affecting the balance not only between parties but also between participants and the judge, who is and must remain the guarantor of *par condicio*[37].

In light of these issues, can the judicial authority run the risk of losing authority and prestige from the viewpoint of public opinion?

6. CONCLUSION

It has been noted that the fact-finding process can falsificate or confirm the statements of the prosecution and demands a rigorous comparison between the prosecutorial hypothesis and the facts as they emerged from the assessment of the evidentiary information, including the contribution afforded by ever-newer sciences.

The use of neuroscientific evidence in criminal proceedings entails several relevant implications on various principles: not only the adversarial and dispositive principles, but also the equal treatment and reasonable doubt principles, and the judge's

[34] C. Slobogin, *Neuroscience nuance: dissecting the relevance of neuroscience in adjudicating criminal culpability*, cit., p. 579. R. Merkel, *Neuroimaging and Criminal Law*. In: J. Clausen, N. Levy (eds.) *Handbook of Neuroethics*, Springer, Cham, 2015, pp. 1335-1362

[35] *Id.*

[36] D.P. McCabe, A. D. Castel, M. G. Rhodes, *The influence of fMRI lies detection evidence on juror decision-mak*ing, in *Behavioral Sciences & the Law*, vol. 29, no. 4, 2011, pp. 566-577.

[37] S. *Neuroscienze, tutela penale e garanzie della persona*, cit. p. 10.

intime conviction. Remarkably, the scientific criteria of relevance, reliability, and validity of a neuro technique diverge depending on the parties' perspectives, that is, on the fact that the reasonable doubt must be raised by the defendant or overcome by the prosecutor. They may also lead to challenges in the admission and assessment of such an evidence. Against this framework, the admission, and the assessment of neuro-evidence, – which normally are well-distinguished phases within the evidentiary process – turn out to be tangled with each other.

Furthermore, evidentiary processes are intended to ensure equal treatment and the right to defense, but it may also result in subjective and uncontrolled methods of assessment due to potential biases, emotions, and empathy of the judge. Based on this, on one hand, this evidentiary process seems to fulfil the *par conditio* requirement and the right of defence, as being responsive to the parties' interests; on the other hand, it could give space for lawless methods of assessing the neuro-evidence because of external or internal influences on the judge's free conviction.

Moreover, extremely important is to prevent the entry and use into the criminal proceedings of 'junk science'. We have also reminded the necessity to avoid both the improper use of neuroscientific knowledge by judges and jurors and the danger of the persuasive power of the neuroinvestigations. Science remains 'fallible', and its fallibility must always be considered. As any inference is probabilistic in nature, even the most advanced technology and scientific method or one with less error margins, can only provide answers with a degree of probability, which can range from low to high.

To achieve these aims, good solutions can be those of educating law students and judges on (neuro)science matters; establishing collaborations between scientific and legal institutions, and, above all, instructing the fact-finders to properly interpret the neuroscientific results, such as images' brain.

A further step to be taken can be that of drafting guidelines aimed at reducing the risks of misinterpretation in the use of the data offered by brain exploration techniques. These recommendations, for example, might adopt the combination of behavioural diagnosis and neuroimaging findings thus endorsing the role of the latter in relation to the traditional method of assessment.

In other words, given the above-raised concerns, steps must be taken to train judges and jurors about what neuroscientific evidence does mean in a criminal legal context.

Against this framework, enhancing the principle of *contradictoire* can prevent the negative impacts of both intuitive irrationality and mechanistic rationality that have dominated the field of epistemology for centuries. The former excessively relies on the irrational intuition of decision-makers, leading to an unclear ascertainment of facts, while the latter ignores the difference between 'law' and 'justice' by not allowing for a free evaluation of evidence. As it has been stated by Greene and Cohen in 2004, the use of neuroscientific evidence raises questions about what remains unchanged and what has been changed. This statement highlights the ongoing complexity of the relationship between the law and neuroscience, and the need to further analysis on this topic[38].

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