Angelini A, 'Neurotechnology in the research of evidence and in decision-making process: a dual perspective analysis' (2024) 2 EJPLT, 233 – 246.
DOI: https://doi.org/10.57230/EJPLT242AA

EJPLT
ISSN 2704-8012



Neurotechnology in the research of evidence and in decision-making process: a dual perspective analysis

Le neurotecnologie nella ricerca della prova e nei processi decisori: un'analisi a doppia prospettiva

ALICE ANGELINI
Ph.D. student in Criminal law
University of Insubria

Abstract

Neurotechnology in evidence collection and in decision-making must address the presumption of innocence and the prohibition of self-incrimination. The analysis adopts a dual approach: the philosophical perspective highlights the ethical dimension of free will, while the legal perspective addresses the technical aspect of protecting fundamental rights. Crucial safeguards include the inadmissibility of evidence obtained in violation of the self-incrimination prohibition and the evaluation of neurotechnological data as mere circumstantial evidence requiring corroboration.

L'uso delle neurotecnologie nella ricerca probatoria e nei processi decisori si scontra con la presunzione d'innocenza e il divieto di autoincriminazione. Il contributo affronta il tema da una duplice prospettiva: quella filosofica mette in luce la dimensione etica del libero arbitrio e quella legale la dimensione tecnica della tutela dei diritti fondamentali. Restano fondamentali le garanzie di inammissibilità delle prove ottenute in violazione del divieto di auto-incriminazione e la valutazione dei dati neurotecnologici come meri elementi di prova necessitanti corroboration.

© The author(s) 2024, published by Suor Orsola Benincasa Università Editrice.
This contribution is licensed under a Creative Common Attribution 4.0 International Licence CC-BY-NC-ND, all the details on the license are available at:
https://creativecommons.org/licenses/by-nc-nd/4.0/

Keywords: neurotechnology; criminal proceedings; research of evidence

Summary: 1. Introduction. – 2. Definitions. – 3. The philosophical perspective on free will. – 4. The legal perspective in the research of evidence. – 5. Neuroscientific tools and their Court admissibility. – 6. Constitutional principles and neurotechnologies. – 7. Neurotechnologies and sentencing disparity. – 8. Neurotechnology and human rights. – 9. Conclusions.

1. Introduction.

This paper pertains to the presentation of '*Neurotechnology in the research of evidence and in decision-making process: a dual perspective analysis*' at the Scuola Superiore S. Anna in Pisa during the conference '*Bridging the gap between neurorights and cyberights: introducing new ethical and legal safeguards for protecting humans in the digital era*'.

The discussion herein addresses the application of neurotechnology in legal proceedings for the collection of evidence, emphasizing the necessity of safeguarding the presumption of innocence and prohibiting self-incrimination. Additionally, it examines the role of neurotechnology as a tool within criminal policy.

The paper begins with definitions, in particular of the lexem 'criminal proceedings' and the term 'neurotechnology', exploring their interplay both in the evidence collection phase and the judicial decision-making process.

It then delves into the challenges posed by neurotechnology, particularly as it is increasingly used to assess 'mens rea'. This focus calls for a closer analysis of: a) the extent to which it can verify criminal intent, while evaluating the risks of infringing upon privacy and the right to self-defence and b) the potential for sentencing disparities between cases resolved with these tools and those adjudicated without them, particularly due to the economic constraints faced by defendants and issues related to the use of neurotechnological tools without respect for the right to counterproof.

The question described will be approached from a dual perspective: the philosophical perspective sheds light on the relationship with the ethical dimension of justice, while the legal perspective provides a bridge to its technical dimension. From the philosophical perspective, we will analyse the issue of free will to understand legal implications for the defendant's rights and moral freedom. The scientific literature presents a spectrum of positions, ranging from determinism to libertarian incompatibilism and compatibilism. Contemporary viewpoints, such as new compatibilism, underscore the importance of the perception of actions, positing that if persons perceive themselves to be acting freely and autonomously, they may be deemed responsible. These insights could facilitate ethical conclusions regarding the influence of neurotechnological elements on judicial decision-making, and the potential violations of defendants' rights by these tools. In essence, the inquiry revolves around how neurotechnology and legal proceedings may coexist while upholding human rights.

From the legal perspective, we will explore how neurotechnology can enhance evidence collection, in accordance with individual fundamental rights, and the implications for equity. This examination will involve analysing the procedural admissibility of neuroscientific evidence, using case law principles to provide additional insights. The criteria of reliability and falsifiability established by American jurisprudence in the Daubert standards are of paramount importance.

National Courts in Italy, from the lower Courts to the Court of Cassation, have scrutinized the advantages and disadvantages of neuroimaging and lie detection techniques as well as doctrinal studies focused on their impact on the principle of equity in decision-making. Nonetheless, uncertainties regarding the reliability of results, procedural risks, and potential overreliance on neuroscientific data during evidence collection persist. Additionally, the scientific challenge of reconciling emotional states with corresponding brain areas remains unresolved. On this field, the use of artificial intelligence in legal proceedings persists as an issue in background.

Finally, we will explore whether potential solutions could be identified through procedural safeguards, such as the inadmissibility of results or proceedings to obtain evidence that violate the prohibition against self-incrimination or the assessment of data as mere evidence requiring corroboration. However, the evolving nature of criminal law leaves the question open to further exploration.

2. Definitions.

Before examining how criminal procedure and neurotechnologies may intersect, it is crucial to define both concepts clearly.

It is essential, in fact, to clarify that the term 'proceedings' pertains specifically to the context of criminal procedure, with the purpose of analysing what kinds of intersections might exist between criminal proceedings and neurotechnologies.

Paolo Tonini defines *criminal procedure* as 'the legal process through which the state, acting through its judicial authorities, determines if a crime has been committed, identifies the person responsible, and applies the appropriate sanctions'.[1]

So, with the locution 'criminal proceedings', we intend a series of acts aimed at making a judicial decision, mainly based on the ascertainment of responsibility.

Neurotechnologies, according to Oliver Müller and Stefan Rotter, are an assembly of methods and instruments that enable a direct connection of technical components with the nervous system.[2] These technologies are utilized to enhance our understanding of brain function, treat neurological disorders, and improve human-machine interactions. Marcello Ienca

[1] P Tonini, *Manuale di procedura penale* (19th edn, Giuffrè 2018) 67.
[2] O Müller, S Rotter, 'Neurotechnology: current developments and ethical issues' (2017) 11(93) Frontiers in Systems Neuroscience, 1.

emphasizes that these technologies include brain-computer interfaces (BCIs), neuroprosthetics, and various forms of neural enhancement and stimulation.[3]

Neurotechnologies and legal proceedings come to represent links in the same chain when the former must enter the latter. This analysis will focus on the critical points of the intersection upon the introduction of neurotechnologies in the proceedings as evidence (i.e. admissibility of the evidence) and in the evaluative phase (i.e. as criminal policy tool).

In fact, the integration of neurotechnologies into the legal process raises significant philosophical, ethical, and legal issues, particularly concerning the determination of *mens rea* or criminal liability. These issues involve the protection of individual *moral freedom* and the principle of *equal treatment*.

In the following sections, we will examine the theoretical platforms of this problem from a philosophical perspective and from a legal perspective.

Philosophical and legal approaches are just some of the tools available to analyse the intersection between neurotechnology and process, as criminal law evolves in response to human evolution, technological innovation but must nevertheless preserve ethical and juridical safeguards and maintain and further promote the respect of human rights.

3. The philosophical perspective on free will.

In examining the philosophical perspectives regarding the existence or non-existence of free will, a debate has emerged within criminal law between those advocating for a rethinking of legal categories in light of neuroscientific contributions to the understanding of certain human behaviors,[4] and those who contend that philosophical inquiries can better explain some material phenomena without necessitating a radical overhaul of the criminal liability framework.[5] The latter, in fact, assert that criminal law categories constitute a shared linguistic code, pragmatically employed to provide a stable foundation for the entire criminal justice system, thereby ensuring a minimum level of equality and equal treatment.

The desire to redefine criminal law categories is primarily advocated by proponents of *philosophical determinism*. According to these scholars, [6] concepts like criminal liability and culpability, which presuppose that individuals act with full consciousness and volition, are untenable in light of the identity between mind and brain or at least the knowability of the mechanisms underpinning them. Consequently, this perspective negates the concept of free will, reducing freedom to a mere perception.

Conversely, *incompatibilist libertarians* assume that human action is based on metaphysical contra-causal freedom. A critique of the 'metaphysical' nature of their theories is articulated in a work by Mario Calderoni, who, as early as 1939, asserted that what matters is physical freedom, that is the ability of human

[3] M Ienca, 'Tra cervelli e macchine: riflessioni su neurotecnologie e su neurodiritti' (2019) Politeia, 60-61.
[4] L Santa Maria, 'Diritto penale sospeso tra neuroscienze ancor giovani e una metafisica troppo antica' [2017] DPC, 2.
[5] F Basile, G Vallar, 'Neuroscienze e diritto penale: le questioni sul tappeto' (2017) 4 DPC, 272-275.
[6] Santa Maria, 'Diritto penale' (n 4) 2.

beings to determine themselves and modify their actions based on foreseeable consequences.[7] In this regard, he was a precursor to compatibilist theses.

According to *compatibilist* doctrines, 'a person is free to do or not do what they want, but they are not free to will',[8] as individuals have no control over their mental states. Neuroimaging studies have shown that will emerges prior to the formation of consciousness, manifesting as an immediate reaction to impulses. From this, it follows that conscious will does not initiate actions but constitutes just one of the many links in the decision-making chain.

A more compelling theory appears to be that of the *new compatibilists*, who invoke the concept of perception.[9] They argue that the physical explanation of the extent to which human choices are free or constrained is irrelevant; what matters is human perception. If individuals perceive themselves to have acted freely, with consciousness and volition – regardless of whether these perceptions are merely illusory – then it becomes possible to attribute responsibility to them.

Although the theories of new compatibilism seem particularly acceptable even from a criminal law perspective, the issue of responsibility should remain entirely separate from the philosophical or scientific explanation surrounding the nature of will. *Responsibility* is a shared concept, essential for regulating behaviour at the social level, and should not be influenced by philosophical explanations regarding the degree to which will is shaped by genetic or environmental factors.[10]

These considerations, however, resurface when evaluating the admissibility of neuroscientific evidence, given its capacity to probe the human mind through techniques that profoundly penetrate its workings.

4. The legal perspective in the research of evidence.

Building upon this philosophical platform, we now turn to the legal perspective on neurotechnologies, which involves the interaction of neuroimaging tools in legal proceedings. The issue concerning the interaction between neurotechnologies and process arises from the assumption that human behaviour is, to some extent, predetermined and that the causes of actions are knowable if scientifically explained. This assumption has facilitated the introduction of neuroscience into the criminal process, albeit at an embryonic and sporadic level.

However, until the early 1990s, the use of neuroscience as a means of evidence was not regulated. Questions emerged regarding whether it represented a method for researching typical or atypical evidence and what procedural framework, as well as its implications, it should entail.

---

[7] M Calderoni, *I postulati della scienza positiva* (G Ramella e C 1901), 39-43.

[8] MB Magro, 'Le mille porte del libero arbitrio: compatibilismo e epifenomenalismo secondo le neuroscienze' (2020) 2 Riv It Med Leg, 717.

[9] Ibid 724-726.

[10] This is also based on Calderoni's teachings, which emphasize the need to keep the concept of responsibility separate from philosophical explanations of free will. For further reference, see M Calderoni, *I postulati della scienza positiva* (n 7) 43.

American jurisprudence has only recently solidified a response to this issue through the establishment of the *Daubert criteria* concerning the admissibility of scientific evidence in court, which superseded the 1923 *Frye ruling*.

While the Frye decision established that the criterion for admissibility of evidence was the 'general acceptance by the relevant scientific community', the Daubert ruling of 1993 must contend with a peculiar characteristic of neuroscientific evidence, namely the often-unsatisfactory levels of reliability of scientific data. Given that the methodologies were limited and rarely achieved the threshold of general acceptance, the Daubert criteria introduced additional requirements, including the testability and falsifiability of the method, subjecting the evidence to peer review, ensuring the independence of the expert, and explicitly stating the error rate.

These criteria were subsequently incorporated and further refined within the national context in 2010 by the *Cozzini ruling*,[11] which particularly emphasizes two aspects: the authority of the expert and the necessity for the expert to bear the burden of presenting to the judge a comprehensive range of opinions from the scientific theories pertaining to the methods in question. This approach seeks to provide the judge with a holistic overview of the available options. Consequently, judges are required to verify a minimum threshold of reliability of neuroscientific data for the purposes of admissibility.

Despite the established principles enshrined in the Daubert-Cozzini criteria, legal scholarship continues to scrutinize the procedural use of neuroscientific data as a tool for investigating the psychological element of the crime and the boundaries of procedural admissibility. This scrutiny arises particularly in light of skepticism expressed in certain case law decisions regarding the matter, as well as concerns about potential infringement upon the rights of the defence and the conflicts with the prohibition of self-incrimination that these tools may engender.

5. Neuroscientific tools and their Court admissibility.

At this stage, it is necessary to consider which forms of neuroscientific evidence are likely to be admitted in court and what the associated challenges may be.

The latest legal scholarship[12] distinguishes between two categories: a) instruments investigating *individuals as sources of real evidence*, providing scientifically verifiable data freely appreciated by the judge and b) instruments *validating declarative evidence*, aimed at assessing the truthfulness of statements made by the defendant, witnesses, or victims.

a) The first category includes techniques such as Functional Magnetic Resonance Imaging (fMRI), brain fingerprinting, Computerized Axial Tomography (CAT scans), as well as Physical Biometric Applications (PBA) and

[11] Cass sez IV pen, Sept 17, 2010, n 43786 (Cozzini et al.)

[12] MR Anglani, 'Neurolaw: l'incidenza delle neuroscienze sugli standard del processo penale e sulla «libertà morale della persona»' (2024) 6 federalismi.it, 57-58.

Behavioral Biometric Applications (BBA).[13] These instruments are used to determine whether the subjects exhibit brain damage or physically detectable pathologies, aiding in the evaluation of culpability.

b) The second category consists of lie and memory detection tools, such as fMRI, the Implicit Association Test (IAT), the Autobiographical Implicit Association Test (A-IAT), and the Timed Antagonistic Response Alethiometer (TARA). These instruments evaluate the truthfulness of statements by analysing physiological reactions, such as blood flow measurements, response times, and associative links.

While the first set of tools generally raises no concerns regarding moral autonomy – since they provide objective, scientifically measurable data and may be admissible even without the defendant's consent, given that dignity is respected in the collection of such data – the second set presents significant concerns in terms of potential conflict with the principle against self-incrimination.

However, several considerations must be taken into account.

1) Functional MRI, like others lie detection methods, detects increased blood flow in the brain during emotional responses. However, human *reactions vary widely*. Factors such as learned deception or neurological conditions can influence these responses, complicating their interpretation. The detection may also vary in the presence of childhood traumas or brain diseases, which alter the intensity of blood flow, adding another layer of complexity.[14]
2) Neurotechnologies run the risk of reducing individuals to *mere data points*, potentially undermining core elements of personal identity, awareness and self-determination.[15] Concerns about 'brain hacking' also arise,[16] though a detailed discussion on this matter is beyond the scope of this paper.
3) The use of neurotechnologies to assess subjective states may conflict with the principle of *moral freedom* in testimony, as culpability is typically tied to external, observable actions rather than internal mental states. In this regard, it is worth recalling the Raso ruling (2005), which included personality disorders within the legal concept of infirmity, as such disorders can affect the judgment of culpability.[17]

Another part of legal scholarship[18] distinguishes between *invasive methods* (such as DNA or genetic sampling, CAT scans, PET scans) and *non-invasive methods* (e.g. lie or memory detection).

With regard to invasive methods, legal scholars have stated that if neurotechnological assessments involve a *pati* (e.g., passively providing a

[13] GJ Sicignano, 'Brief reflections on the role of forensic evidence in the Italian criminal justice system' (2023) 1 *EJPLT*, 125-126.
[14] L Bain and others, *Neuroforensics. Exploring the legal implications of emerging neurotechnologies. Proceedings of a workshop* (The national academic press 2018), 13-14.
[15] G Gulotta, M Caponi Beltramo, 'Neurodiritti: tra tutela e responsabilità' [2021] Sistema Penale, 1.
[16] For further reference, please refer to G Gulotta, M Caponi Beltramo 'Neurodiritti' (n 15) 5.
[17] Cass pen, Sez Un, Jan 25, 2005, n 9163 (sentenza Raso); A Santosuosso, B Bottalico, 'Neuroscience and behavioral genetics in the italian criminal proceedings. Cases and perspectives' (2013) 1 Rassegna Italiana di Criminologia, 72-74.
[18] S Ruggeri, 'Neurosciences, criminal justice and individual safeguards' (2023) 2 Processo penale e giustizia, 287-288.

biological sample), they are permissible and do not violate the principle against self-incrimination.[19] However, if these assessments require active participation or communication without consent, they infringe upon the *nemo tenetur se detegere* principle, as involuntary statements breach the right to remain silent. Thus, the Court upholds the principle of the privilege against self-incrimination.

Similarly, if lie and memory detection tools were coercible, they would violate the principle of *nemo tenetur se detegere*.

In particular, the Implicit Association Test (IAT) raises concerns about self-determination, as it investigates memory, which is susceptible to alteration, rather than facts.[20] Therefore, results from the IAT must be corroborated through adversarial proceedings, as the test alone cannot constitute conclusive evidence but should be considered as a clue.

Finally, all neuroscientific tools elicit concerns about their reliability. Despite the Daubert criteria, which entrust judge as *peritum peritorum*, who must evaluate evidence according to their expertise, the overall reliability of scientific evidence remains relatively low.

This brings us to further challenges regarding the neurotechnological assessments on the functions of punishment. These tools potentially conflict with the principle of culpability and rehabilitation, since a conviction based on uncertain data does not allow the convict (possibly innocent) to understand the wrongdoing's disvalue.

6. Constitutional principles and neurotechnologies.

To address these issues, it is essential to rely on fundamental principles. In this paragraph, we will analyse how the challenges presented by neurotechnologies should be addressed in light of the Italian Constitution.

First and foremost, the question arises as to how these challenges can be reconciled with the right to defence, as enshrined in Article 24 of the Constitution, and the right to evidence under Article 111 of the Constitution.[21]

These two principles stand in contrast to the right to health, articulated in Article 32 of the Constitution, which states that 'no one can be obliged to undergo specific health treatment except by law' and to the principle of *nemo tenetur se detegere*, also contained in Article 24 and included in the Code of Criminal Procedure.

Secondly, it is necessary to clarify the legality and limitations of consent to neuroscientific assessments.

Our criminal justice system upholds the principle of freedom of self-determination, as outlined in Article 188 of the Code of Criminal Procedure, which prohibits methods or techniques that influence self-determination or alter the ability to recall or evaluate facts.

[19] S Ruggeri, 'Neurosciences' (n 18) 286.
[20] FR Dinacci, 'Neuroscience and criminal trial: probatory reasoning between evaluation chemistry and rational logic' (2016) 2 Processo penale e giustizia, 7.
[21] FG Pizzetti, 'La Costituzione e l'uso in sede giudiziaria delle neuroscienze (e dell'intelligenza artificiale): spunti di riflessione' (2019) 2 Biolaw journal, 702.

Two court rulings exemplify this balance:[22] the Court of Appeal of Salerno (2575/2016)[23] prohibited techniques that influence self-determination, even with consent, asserting that information must be collected externally; and the Court of Appeal of Brescia (1683/2020)[24] ruled that the IAT test contradicts Article 188, affirming that self-determination and moral freedom are indispensable rights.

There are diverging views on these matters. Some argue that this conflicts with the right to evidence under Article 111; while others maintain that neuroscientific tools should require counterevidence.[25] Some accept them but acknowledge critical issues.[26]

Some others, finally, argue that lie or memory detection tools are inadmissible only if imposed by the prosecutor or judge; however, if the defendant voluntarily submits to them, there is no violation, as no recognized right exists to 'not to be discovered of lying'.[27]

Nonetheless, the constitutional protection against self-incrimination and the right to moral freedom are broader in scope.

Assuming neurosciences as typical evidence with atypical content – though this aspect will not be elaborated here[28] – Article 189 of the Code of Criminal Procedure on atypical evidence mandates that evidence must be suitable for determining the facts and for protecting moral freedom. Corda suggests a 'variable intensity' for the criterion of suitability, which is more flexible when applied to the defence, with the aim of raising reasonable doubt rather than persuading. This preference supports admissibility.[29]

Based on this premise, it must be asserted that using techniques on the subject as evidence is permissible where it does not affect self-determination and results are used only *in favor rei* (not as incriminating evidence).

Indeed, the issue must be resolved through the principle of *favor rei* and the proper application of the beyond reasonable doubt (BARD) standard.

We need to address this issue on two levels.

a) When is it truly necessary to rely on neurotechnological tools?

Neurotechnological tools are certainly essential for assessing physical impairments, especially to prevent the conviction of individuals who are legally non-chargeable. However, there is no need to investigate the truthfulness of the defendant's statements (and their internal forum), as this would violate the prohibition against using methods that influence self-determination.

The real risk, however, arises when the defence voluntarily employs neuroscientific tools to seek favourable evidence, but obtains unfavourable results. In such cases, it is crucial to determine whether these results stem from the dishonesty of the defendant or from a flaw in the tool itself. If dishonesty

[22] F Cirillo, 'Neurodiritti: ambiguità della 'libertà cognitiva' e prospettive di tutela' (2023) II Consulta Online, 682-686.
[23] Court of Appeal of Salerno, Dec 16, 2016, n 2575.
[24] Court of Appeal of Brescia, July 15, 2020, n 1683.
[25] F Cirillo, 'Neurodiritti' (n 22) 683.
[26] O Di Giovine, 'Prove di dialogo tra neuroscienze e diritto penale' (2016) 4 Giornale italiano di psicologia, 336.
[27] S Ruggeri, 'Neurosciences' (n 18) 291.
[28] Reference is made in greater detail to A Corda, 'Neuroscienze forensi e giustizia penale tra diritto e prova (Disorientamenti giurisprudenziali e questioni aperte)' (2014) 3 Archivio penale, 27.
[29] ibid 27.

is involved, it must be determined whether the initial consent for the assessment also covers results that are against the defendant.

Conversely, if a defect in the tool is identified, its functionality should be evaluated through *expert comparisons* among individuals with technical expertise, such as doctors, psychologists, technicians who designed the tool, and legal counsel.

b) What is the solution if lie or memory detection tools are the only means to prove innocence?

In such cases, the necessity arises from a history of improper use of the *BARD standard*: a conviction should only be pronounced when there is unequivocal certainty, following the criterion that it is better for a guilty person to go free than for an innocent person to be wrongly convicted'. However, given the difficulty of refining the BARD standard without altering judicial practices potential solution could be to render lie or memory detection tools inadmissible when used *contra reum* and allowing their use solely *in favor rei*.

Thus, the cautious use of minimally invasive neuroscientific tools becomes compatible with the preservation of moral freedom, provided that the data obtained are considered inadmissible if used *contra reum*, both at the time of acquisition and at the time of judgment (where such evidence should not prevail).[30]

However, if moral freedom were elevated to an absolute principle, what would this affect the rights to health, defence and evidence?

The use of truth-finding measures is therefore permissible under the following conditions:

1) the defendant has given explicit consent;
2) the technique is minimally invasive;
3) the underlying theories are widely recognized and credible;[31]
4) it is the only available means for the defendant to prove his/her innocence;
5) the evidence is rendered inadmissible if it is unfavourable to the defendant.

On the other hand, sacrificing the defendant 'in the name of his moral freedom'[32] is not acceptable.

An additional observation must be made regarding the admissibility of neuroscientific evidence under the aforementioned conditions. It is indeed possible that evidence favorable to the defendant for the purpose of determining guilt may still prove decisive in an unfavourable sense, specifically in assessing dangerousness and, consequently, in the imposition of security measures. If, in fact, neuroscientific evidence was to demonstrate the subject's partial or total incapacity, it must also be considered that such data could be interpreted as an indicator of the subject's dangerousness and may, therefore, serves as basis for the imposition of a security measure.

In this regard, the procedural use of neurotechnologies could, in fact, consistently result in unfavorable outcomes for the defendant.

[30] AU Palma, 'Le "prove di verità" e la libertà morale del dichiarante' (2020) 1 Archivio Penale, 51.
[31] These first three conditions were identified by A U Palma in 'Le "prove di verità"' (n 30) 55.
[32] ibid 56.

7. Neurotechnologies and sentencing disparity.

Finally, it is necessary to reflect on the judge's evaluation of neurotechnologies as evidence and the potential for sentencing disparity.

The issue arises when considering the principle of equal treatment in two different concrete situations: a) between cases in which neuroscientific tools are employed and those in which they are not; b) in cases in which neuroscientific tools are employed exclusively on the victim of the crime.

a) Regarding the first issue, a pertinent example can be drawn from the case of Como (G.i.p. Como, 2011)[33]. In this case, the perpetrator not only killed her parents but also, during the investigation, her sister to secure the inheritance.

Her stated intention conflicted with her actual motive, which prompted a psychiatric evaluation during the trial, but the psychiatric assessment yielded conflicting results.

The defence then sought to conduct a functional MRI (fMRI) on the woman to demonstrate the presence of a mental disorder, which, when corroborated with other findings, led the court to recognize a partial mental incapacity. Based on the initial evaluation, a conviction would likely have been reached, but it was only with the use of neuroscience that partial incapacity established.

It is important to reflect on what might have occurred if the defence had not chosen to rely on neuroscientific tools.

In some cases, neuroscientific evidence can shift the balance *in favor rei*, leading to a declaration of partial or total incapacity (with the previously discussed limits).

It is therefore necessary to consider what happens in cases where these techniques are not utilized.

It can be argued that the defence's decision to use neuroscientific evidence becomes a determining factor, with the risk that neuroscientific tools, given their cost, are more accessible to wealthier individuals. This disparity calls into question the egalitarian nature of justice.[34]

b) Concerning the potential risks associated with employing neuroscientific tools on the injured party, the Cremona case (G.i.p. Cremona, 2011)[35] serves as useful reference. In this instance, the defendant was accused of sexual harassment with abuse of authority. Due to conflicting statements from both parties and witnesses during the trial, the judge ordered a neuroscientific examination to verify whether the victim had a memory of the alleged harassment.

The IAT test was utilized, confirming the allegation, and the defendant was convicted based on the neuroscientific expertise conducted solely on the statements of the victim, which represents a *privileged evidence*.[36]

In this scenario, the conviction was based on unfavourable neuroscientific evidence obtained without the defendant's consent and without granting them the right to present counterevidence.

---

[33] Trib Como, G.i.p., May 20, 2011.
[34] G Gulotta, M Caponi Beltramo, 'Neurodiritti' (n 15) 8.
[35] Trib Cremona, G.i.p., Jul 19, 2011, n 109.
[36] FR Dinacci, 'Neuroscience and criminal trial' (n 20) 8-9.

This case illustrates that the exclusive use of neuroscientific tools on the victim may entail a latent risk, as it could skew the judgment *contra reum*, relying solely on the victim's memories – or, more precisely, on what the victim believes to remember.

When employing neuroscientific tools on the victim, it is advisable for the neuroscientific evidence to be deemed valid only if acquired under the same conditions for the defendant as well. Otherwise, there exists a risk of infringing upon the defendant's right to defence – particularly the right to present counterevidence – as well as their right to self-determination.

From these two cases, it can be deduced that safeguards against such inequalities may lie in the principle of *adversarial proceedings*[37] and in the duty to *provide justification* for sentencing decisions.

Scientific evidence, in fact, must be subject to adversarial examination and evaluated alongside other forms of evidence, as affirmed in the *Franzese ruling*, [38] applying the criterion of logical probability. Judicial decisions, therefore, should take into account all the evidence gathered and cannot rely solely on neuroscientific data.

The duty to provide reasons for sentencing decisions requires judges to justify their conclusions based on all available evidence, articulating the logical reasoning behind their decisions. This justification must be particularly rigorous when largely based on neuroscientific data, emphasizing the unreliability of all exculpatory elements and clearly explaining the reasons for considering the neuroscientific evidence as credible, in order to avoid an over-reliance on such data.[39]

Di Chiara has issued a cautionary note regarding neurotechnologies, likening them to the sirens' songs or to the wax wings of Icarus and Daedalus in their attempt to escape the labyrinth.

Regarding the relationship between neurotechnologies and the judiciary, he observed that judges 'are not gods and yet they are equally dangerous like the ancient gods', in our view, particularly when they allow themselves to be swayed by neuroscientific data without critical examination.[40]

8. Neurotechnology and human rights.

Additional considerations could explore the use of artificial intelligence-based tools in both the research of evidence and the decision-making process,[41]

---

[37] ibid 9.

[38] F Fuscaldo, 'Il neuroimaging funzionale per l'analisi della prova dichiarativa' [2023] quotidianolegale.it.

[39] A common risk is the tendency to intuitively find reconstructions of facts based on neuroscientific information more convincing than those lacking such data, even when the neuroscientific evidence presented is irrelevant or incorrect, in DS Weisberg and others, 'The Seductive Allure of Neuroscience Explanations' (2008) 20(3) Journal of Cognitive Neuroscience, 470.

[40] G Di Chiara, 'Il canto delle sirene. Processo penale e modernità scientifico-tecnologica: prova dichiarativa e diagnostica della verità' [2007] Criminalia, 39.

[41] For an overview of the primary references, see S Quattrocolo, 'Equità del processo penale e automated evidence alla luce della convenzione europea dei diritti dell'uomo' (2019) 1 Revista Ítalo-Española de Derecho Procesal, 107-123; S Quattrocolo, 'Processo penale e rivoluzione digitale: da ossimoro a endiadi?' (2020) Media Laws, 121-135; V Manes, 'L'oracolo algoritmico e la giustizia penale: al bivio tra tecnologia e tecnocrazia' [2020] Discrimen; J Nieva Fenoll, *Intelligenza artificiale e processo* (Giappichelli 2019).

particularly as instruments grounded in a neurotechnological framework. However, such an analysis would open avenues that extend beyond the scope of this discussion.

An international overview on how human rights intersect with criminal proceedings is necessary.

Two main theories regarding human rights and neurotechnology can be identified.

According to the first theoretical approach, the existing legal framework is considered adequate to address the challenges posed by neurotechnologies in criminal proceedings.[42]

Conversely, the second approach advocates for the recognition of four new rights, collectively referred to as 'neurorights',[43] (right to cognitive liberty, right to mental privacy, right to mental integrity, right to psychological continuity).

In the context of criminal procedure, these rights serve specific purposes:

- the right to cognitive liberty ensures control over the application of neurocognitive technologies;
- the right to mental privacy protects against intrusive techniques, such as mental decoding, that could infringe upon a defendant's private sphere;
- the right to mental integrity prevents subjects from being exposed to invasive or harmful neurotechnological interventions without consent;
- the right to psychological continuity ensures that individuals' memory or identity is not unduly alterated during legal proceedings.

The challenge lies in reconciling these rights with the pursuit of procedural truth within judicial proceedings.

Alternatively, if we recognize that the creation of new rights is unnecessary, those already existent – such as physical or mental integrity, privacy and freedom of thought – might already provide sufficient protection against the coercive use of neurotechnologies, if they are adapted to the new challenges posed by these technologies.[44]

In light of these premises, memory and lie-detection tools present significant risks to the protection of these rights,[45] raising ethical concerns that also intersect with the application of artificial intelligence in legal contexts.[46]

---

[42] See C Bublitz, 'Neurotechnologies and human rights: restating and reaffirming the multi-layered protection of the person' (2024) 28(5) The international journal of human rights, 782-807, where the author argues that there is no need to establish new rights to address issues arising in criminal proceedings, as existing rights already provide protection against the misuse of neurotechnologies, though they would need to be further articulated to be applied to new scenarios.

[43] See M Ienca, R Andorno, 'Towards new human rights in the age of neuroscience and neurotechnology' (2017) 13(5) Life Sciences, Society and Policy.

[44] See C Bublitz, 'Neurotechnologies and human rights' (n 42) 783.

[45] An illustrative example of these risks, specifically related to the sentencing phase, is the *Wisconsin v. Eric L. Loomis* case, in which the defendant was evaluated using the COMPAS algorithm. It was later shown that the algorithm exhibited *racial bias*. Rather than establishing a direct causal link between the defendant's actions and the occurrence of the event, the algorithm, in cases of insufficient evidence, sought to base the determination of guilt on psychological assessments. See F Basile, 'Intelligenza artificiale e diritto penale: quattro possibili percorsi di indagine' (2019) 10 DPU.

[46] For a reflection on ethical implication in using AI tools, see JA Searle, *Intelligenza artificiale e Pensiero umano – Filosofia per un tempo nuovo* (Castelvecchi 2023); L Floridi, *Etica dell'intelligenza artificiale – Sviluppi, opportunità, sfide* (Raffaello Cortina Editore 2022).

The solution likely lies in striking a nuanced balance between procedural needs – such as the pursuit of trial truth – and the protection of human rights as a whole. This equilibrium can be upheld in criminal proceedings through established principles such as the right to self-defence, the right against self-incrimination and the principle of consent.

At this juncture, ensuring the adequate protection of human rights in the context of criminal proceedings remains an open question, demanding ongoing scrutiny, careful case-by-case adjudication and the evolving interpretation of case law.

9. Conclusions.

In light of the challenges posed by neurotechnologies as a source of evidence and their complex role in the decision-making process, we may conclude that, despite the criticisms, they represent a reality that cannot be ignored or underestimated, particularly given the increasingly pervasive nature of technological advancement.

New challenges also emerge with the development of Brain-Computer Interfaces (BCI), Deep Brain Stimulation (DBS) and closed-loop systems, commonly used as interfaces by individuals with disabilities. These technologies enable direct communication between the brain and an external device or allow external influence on the brain by using electrical impulses to stimulate specific areas once their characteristics have been mapped.

Such systems not only receive signals but also transmit them to the brain, with the potential to alter memories or, more broadly, the physical or psychological data may be investigated through the device itself, even though such techniques are currently restricted to therapeutic use.

The issue becomes more complex if these technologies are introduced in legal proceedings or if the individual undergoing the neuroscientific assessment is one who has been treated with such tools.

Finally, these tools test the boundaries of freedom of thought and pose significant questions about the ethical limits within which neuroscience may operate as a means of investigating the human mind.

As technology advances far more rapidly than the law, the key challenge lies in integrating these innovations while ensuring the protection of fundamental human rights.