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**The troubled relationship between neuroscience and
criminal responsibility: an overview and case study**

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Vita and Publications

Vita

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Publications

1. Zampieri, I., Pellegrini, S., & Pietrini, P. (2020). *Neurobiological Correlates of Antisocial Human Behavior*, in *Neuroscience and Law* (pp. 441-452). Springer, Cham.
2. Monaro, M., Zampieri, I., Sartori, G., Pietrini, P., & Orrù, G. (2020). *The detection of faked identity using unexpected questions and choice reaction times*, in *Psychological Research*, 1-9.
3. Scarpazza, C., Zampieri, I., Miolla, A., Melis, G., Pietrini, P., & Sartori, G. (2021). *A multidisciplinary approach to insanity assessment as a way to reduce cognitive biases*, in *Forensic science international*, 110652.

4. Scarpazza, C., Miolla, A., Zampieri, I., Melis, G., Sartori, G., Ferracuti, S., & Pietrini, P. (2021). *Translational Application of a Neuro-Scientific Multi-Modal Approach Into Forensic Psychiatric Evaluation: Why and How?* in *Frontiers in Psychiatry*, 12, 70.

Abstract

Criminal behavior and the assessment of legal insanity have always been topics of primary concern for the justice system and, at the same time, of great interest to mental health experts. Neuroscience has given mental health specialists an incredible tool to investigate the brain, but the use of neuroimaging techniques in criminal trials has been received with a significant degree of resistance. This thesis illustrates an overview of the techniques involved in the study of the brain that gave birth to modern neuroscience. Moreover, it highlights the philosophical consequences of some neuroscientific experiments that have alerted legal scholars to the problems of free will and criminal responsibility. This contribution goes in-depth in analyzing the normative components of criminal responsibility according to Italian law, and it presents some comparisons with Anglo-American law. Additionally, the present work focuses on the judgment of criminal responsibility in insanity defense cases and the controversies around the mental conditions that can be relevant for a *not guilty by reason of insanity* verdict. Some real forensic cases are illustrated and discussed. They concern the role of neuroscientific evidence and a debate on the relevance of a personality disorder for the insanity defense. This thesis addresses the problems of translation of legal terms into scientific concepts and, the other way around, of scientific findings into pieces of evidence that are meaningful for legal doctrine. In conclusion, the thesis aims to give an overall outlook on the relationship between law and contemporary forensic neuroscience.

Abbreviations

A.L.I. – American Law Institute

Art. – Articolo – Article

Cass. Pen. – Cassazione Penale – Italian Supreme Court

c.p. – Codice Penale – Italian criminal code

c.p.p. – Codice di Procedura Penale – Italian code of criminal procedure

M.P.C. – Model penal code

N.G.R.I. – Not guilty by reason of insanity

P.D./P.Ds – Personality Disorder/Personality Disorders

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Introduction

Justice has a troubled relationship with science. On the one hand, courtroom proceedings need to use scientific methods to reliably investigate what happened in the past to judge it in the present. The Yale law professor Mirjan Damaska argued, back in 1997, that the future of the trial would be that of the progressive adoption of scientific models in the evaluation of facts. Nowadays, the only way for Courts to demonstrate many legally relevant facts is using the scientific method and sophisticated techniques.¹ The law needs science to work correctly and ensure just and rational decisions.

On the other hand, scientists and jurists manifested, time and time again, serious troubles in communicating with each other. In Court, it has been argued that science can be a “bad teacher,” confusing more than informing judges and jurors about the fact under their scrutiny. A scientific approach is necessary, but translation errors between the scientist's language and the law's language (and vice-versa) can generate distortions of justice, with varying degrees of seriousness, which are more pronounced in the criminal trial.

These distortions can arise from many sources. For example, this can happen when the judge employs “bad” science. Judges and jurors, to no guilt of their own, are ill-equipped to recognize pseudo-science or understand the (ir-)relevance of instruments that do not guarantee the genuineness of their results. Another distortion happens when scientists incorrectly apply their expertise to a single case. Jurists are generally, once again, ill-equipped to recognize when otherwise “good” scientific knowledge is misused in their specific context. The last distortion can occur when the science is sound and correctly applied to the case, but its

¹ Damaska, M.R. (1997) *Evidence law adrift*, Yale University Press.

outcomes are incorrectly evaluated in the decision. Judges generally lack the scientific knowledge to recognize if they are inadvertently making a scientific mistake when drafting the final verdict.²

The abovementioned translation errors between science and law have been pervasive concerning mental health and criminal behavior. Psychology and law share the common element of dealing with people and relationships between social groups, and they aim to guarantee their wellness and resolve contrasts that may arise in everyday life. Legal and psychological disciplines provide complementary knowledge, especially in those areas concerning the person, identity and self-determination, and conflicts between individuals or between individuals and society.

Judges and lawyers have manifested a wavering relationship with more recent categories of mental health (starting from personality disorders). At the same time, forensic psychologists and psychiatrists sometimes demonstrated a poor understanding of the nuances offered by the Italian criminal code and its rules concerning *mens rea* and mental capacity.

Occasionally, incorrect translation of scientific concepts to the criminal trial does not appear to stem from diverging opinions about the relevance of scientific facts. Instead, it seems that confusion can arise from philosophical disagreement, between scientists and jurists, on fundamental concepts of human existence: first among them is the concept of free will and the role of the human brain in behavior, as pioneered by modern neuroscience.

Therefore, this thesis is an effort of translation, back and forth between neuroscience, psychology, philosophy, and law, trying to offer an

² Caprioli, F. (2008), *La scienza "cattiva maestra": le insidie della prova scientifica nel processo penale*, in *Cassazione Penale*, pg. 3520B.

analysis of the issues concerning mental capacity and criminal responsibility.

The first chapter of the present work will illustrate the advances in the techniques and methods used by neuroscientists to understand the brain, providing a historical outlook on the technological and clinical discoveries about the central nervous system.

The second chapter will start to analyze the deep-rooted philosophical issues of individual responsibility and neuroscience concerning the problems of free will and determinism, which could be at the bottom of many misconceptions between jurists and scientists.

The third chapter will give a systematic overview of the discipline of mental capacity and the insanity defense in the Italian criminal code and the evolution of its application by the Supreme Court, comparing it to the context of the development of mental health science and neuroscience.

The fourth chapter will provide the reader with a case study on applying neuroscientific data and evidence to some famous criminal trials in Italy. We will start from the two pioneering Italian cases, concluded in 2009 and 2011, and a more recent case (2018), in which we will try to apply what was argued in the previous chapters to real-case scenarios.

Chapter 1 – Neuroscience: a new discipline with ancient roots

Clinicians, scientists, and philosophers have always been interested in discovering what happens in the "black box" of the human brain. The brain can be considered the most mysterious and complex organ of the human body.

There is much evidence of brain surgical interventions in ancient societies of the Neolithic, dating up to 10.000 BC. Such operations consisted of trepanation and craniotomy, supposedly performed to treat head injuries and the subsequent intracranial pressure, chronic headaches, mental illness, evil spirits possession, or neurological disease, like seizures.¹ This kind of procedure was widespread, as demonstrated by the astounding number of drilled skulls found worldwide and relating to different Eras. Many of these crania show signs of healing, suggesting that the patients survived the rudimentary operation.

The history of brain surgery and, thus, the study of the human brain proceeded in a long journey, from Hippocrates and Galen, across the flourishing period of the Renaissance, to the World Wars.

Since the early years of the 16th Century, there has been a burst of neuroscientific studies, generally based on the investigation of brain anatomy through *post-mortem* examinations, to correlate each part of the

¹ Marino Jr, R., & Gonzales-Portillo, M. (2000). *Preconquest Peruvian neurosurgeons: a study of Inca and pre-Columbian trephination and the art of medicine in ancient Peru*, in *Neurosurgery*, 47(4), 940-950. See also: Nikova, A., & Birbilis, T. (2017). *The Basic Steps of Evolution of Brain Surgery*, in *Maedica*, 12(4), 297-305.

brain and its peculiar features to the neurological disease which affected the person during life. Different theories emerged from the scientific observations about the role of the ventricles, the membranes, the nerves, the pineal gland, and many other parts. The unsolved debate around the relationship between mind and brain was dominated by the dualistic theory. Indeed, the most influential standpoint was proposed by René Descartes (1596-1650), who postulated that a non-material mind controlled the physical body.²

While the interest of the time focused on the brain itself, the first organized attempt to relate brain shape to behavior was carried out by Franz Joseph Gall (1758-1828). In 1808 Gall proposed what is known as Phrenology, starting by observing people's more noticeable attitudes and the features of their skull. Gall believed that bumps and recesses of the skull were due to a larger (or smaller) volume of the underneath brain areas. Therefore, more significant development of an area indicated an enhancement of a specific cognitive function. Gall and his collaborator Johann Spurzheim (1776-1832) developed a map of the human head partitioned into 35 separate sections, indicating personality traits or cognitive abilities, complex behaviors, or even preferences.

Despite Phrenology being nowadays just a topic for the history of science at best, or a topic of humor at the worst, it represents a noticeable effort of a localizationist approach, which is still fundamental to modern neuroscience. On the other side, experiments on animals after small and discrete lesions to the brain showed little or no changes in the animals' behavior. These results promoted a *holistic* view of the brain. Moreover,

² Roche, R. A., Commins, S., & Dockree, P. M. (2009). *Cognitive neuroscience: Introduction and historical perspective*, in *Pioneering studies in cognitive neuroscience*, 1-18.

they allowed us to observe the brain's incredible capacity to recover from an injury and carry on the functions of the damaged regions.

Nonetheless, several case studies of human brain injuries appeared to tilt the balance favoring the localizationist view instead of the holistic view. Neuropsychology and neuroscience are rooted in studies about head traumas and brain disease. With the advent of experimental neuropsychology, these disciplines covered the investigation of brain functions in a healthy population alongside the study of impaired functions.

Since the beginning of the 19th Century, the studies and experiments aimed to associate a particular cortical area with a specific cognitive function, such as speech, vision, or motor abilities. At that time, the most relevant clinical observations relied on the clinicopathological method, which investigates a patient's signs and symptoms and the results of examining the involved tissues using biopsy, autopsy, or both.³

Some peculiar cases of brain injury were so extraordinary that every single one of them propelled neuroscience forward in time. Some are still studied even today. Among the most famous ones is the case of Phineas Gage, described below.

In 1848 Phineas Gage,⁴ an American railroad foreman, survived a traumatic brain injury caused by an iron rod that shot through his

³ Nikova, A., & Birbilis, T. (2017). The Basic Steps of Evolution of Brain Surgery. *Maedica*, 12(4), 297.

⁴ Damasio, H., Grabowski, T., Frank, R., Galaburda, A. M., & Damasio, A. R. (1994). *The return of Phineas Gage: clues about the brain from the skull of a famous patient*, in *Science*, 264(5162), 1102-1105.

Ratiu, P., Talos, I. F., Haker, S., Lieberman, D., & Everett, P. (2004). *The tale of Phineas Gage, digitally remastered*. in *Journal of neurotrauma*, 21(5), 637-643.

skull and destroyed most of his left frontal lobe. While his cognitive functions, like memory, motor, muscular strength, and speech abilities, recovered after a few months, his personality completely changed. As Dr. Harlow, his physician, observed, Gage was able to go back to work, but he could not cover the same head role he had before. In Harlow's words, he became "*fitful, irreverent, indulging at times in the grossest profanity.*"⁵ Moreover, he was barely able to self-inhibit, and he was incapable of keeping the focus on a task by rapidly abandoning a target in favor of a new one.

This clinical case indicated that the frontal lobe somehow housed what is commonly called personality, along with those aspects of reasoning at the base of rationality and social behavior.

During a remarkable 20-year period, from 1855 to 1875, the clinicopathological approach permitted several studies that are now regarded as scientific milestones.⁶ New famous case studies emerged, like the patient observed by Paul Broca (1824-1880), who was unable to generate an intelligible speech after a stroke in the left hemisphere.⁷ After the patient's death, the autopsy showed a lesion in the left frontal cortex, later referred to as Broca's Area. The complementary case study arrived almost 15 years later, described by Karl Wernicke (1848-1904). After a stroke, Wernicke's patient could not produce a meaningful talk even if

⁵ Harlow, J. M. (1868). *Recovery from passage of an iron bar through the head.* in Massachusetts Medical Society, 2, 3-20.

⁶ Bennett, M. R., Hatton, S., Hermens, D. F., & Lagopoulos, J. (2016). *Behavior, neuropsychology and fMRI*, in Progress in neurobiology, 145, 1-25.

⁷ Broca, P. (1861). *Remarques sur le siège de la faculté du langage articulé, suivies d'une observation d'aphémie (perte de la parole)* [Remarks on the location of articulated language, followed by an observation of aphemia (loss of speech)], in Bulletin et Memoires de la Societe anatomique de Paris, 6, 330-357.

he was still capable of generating a structured speech.⁸ The post-mortem examination revealed a lesion near the left temporal junction, later labeled Wernicke's Area.

These studies permitted building cognitive models of different brain functions by observing the alterations of such functions when brain damage in a specific area occurred.

In the 20th Century, a different approach emerged in the research of brain functions. Neurologists noticed no strict correspondence between a specific lesion site and the type of the consequent psychological deficits, as patients with the same injury showed substantially different symptoms. Because of this, most neuropsychologists adopted functional rather than anatomical models, building "box and arrow diagrams" to explain complex cognitive functions.⁹

The clinicopathological method represented a valuable, though an indirect, measure to infer what brain mechanisms underlie specific cognitive functions.

However, this approach presented several theoretical and practical limitations. For example, brain lesions were not always reliably localized, pre-morbid data about the patient were usually sparse, comorbid conditions practically always existed, and the clinical sample had huge demographic differences. All these aspects certainly affected neuropsychological studies. Moreover, the clinicopathological methodology confined the investigators to collecting naturally occurring

⁸ Wernicke, C. (1874). *Der aphasische Symptomencomplex: eine psychologische Studie auf anatomischer Basis* [The aphasic symptom complex: a psychological study on an anatomical basis]. Max Cohn & Weigert, Breslau, Poland.

⁹ Price, C.J. (2018). *The Evolution of Cognitive Models: From Neuropsychology to Neuroimaging and back*, in *Cortex*; 107: 37–49; doi: 10.1016/j.cortex.2017.12.020.

phenomena, thus precluding the possibility of experimentally manipulating the conditions of interest. The pathological examination reflected the endpoint of the evolution of the disease, but it was not possible to study the plastic reorganization of the brain after an injury. The actual revolution of the neuropathological techniques was discovering the possibility of measuring the physiological correlates of neural activity through non-invasive manners, including healthy subjects in the studies. This turning point will happen only with the advent of electroencephalogram (EEG), positron emission tomography (PET), and magnetic resonance imaging (MRI).

Towards the end of the 19th Century, in parallel with the clinical neurological observations, the branch of electrophysiology made advancements with discoveries in animal models. Scientists could record electrical potentials first through the activation of nerves and muscles and then from the cerebral cortex of animals¹⁰. The first recordings of the electrical potentials from a patient's scalp were performed in the 1920s by Hans Berger (1873-1941), a German neuropsychiatrist. In 1929 he published the results of his research in the famous paper *Über das Elektrenkephalogramm des Menschen*¹¹, which gave official birth to the electroencephalographic method to investigate human brain activity in real-time.

A few years later, in 1938, Isidor Isaac Rabi (1898-1988) discovered the nuclear magnetic resonance, which was applied to get an image of a

¹⁰ Stone, J. L., & Hughes, J. R. (2013). *Early history of electroencephalography and establishment of the American Clinical Neurophysiology Society*, in *Journal of Clinical Neurophysiology*, 30(1), 28-44. See also Brazier, M.A.B. (1988). *A history of neurophysiology in the 19th century*. Raven Press, New York, NY.

¹¹ Berger, H. (1929). *Über das Elektrenkephalogramm des Menschen* [About the human electroencephalogram], in *Arch Psychiatr Nervenkr.* 87, 527–570.

human body only in the early '80s. In the meantime, we need to wait until the '70s to see the birth of the first positron emission tomography (PET). For the first time, this method permitted the observation of visual information of the brain activity based on the cerebral metabolism of glucose analogs labeled with radioactive atoms.

At the end of the 19th Century, it was postulated that the activity of neurons demanded the consumption of oxygen; as a logical consequence, increased neural activity in specific brain areas entailed a heightened blood flow to supply the necessary oxygen.

In 1990, Seiji Ogawa developed the technique that lies at the basis of functional Magnetic Resonance Imaging (fMRI). He recognized the considerable importance of blood oxygen level as a correlate of detectable neural activity through functional magnetic resonance imaging.¹²

The fMRI has been primarily used to improve brain mapping studies¹³ and extend the understanding of brain development, monitor the clinical course of neurological and psychiatric patients, and plan brain surgery that may affect specific cognitive functions.¹⁴

¹² Ogawa, S., Lee, T.M., Nayak, A.S. and Glynn, P. (1990). *Oxygenation-sensitive contrast in magnetic resonance image of rodent brain at high magnetic fields*, in *Magnetic Resonance in Medicine*, 14(1): 68–78.

¹³ Berman M.G., Jonides J., Nee D.E. (2006). *Studying mind and brain with fMRI*, in *Social cognitive and affective neuroscience* 1(2):158–161.

See also Cabeza R., Nyberg L. (2000). *Imaging cognition II: An empirical review of 275 PET and fMRI studies*, in *Journal of cognitive neuroscience* 12(1):1–47.

¹⁴ Beisteiner, R. (2013). *Improving clinical fMRI: better paradigms or higher field strength?*, in *American Journal of Neuroradiology* 34(10):1972–1973.

Advances in brain imaging and electrophysiological techniques allowed both the metabolic and electrical brain activity to be observed at rest and while a conscious participant is engaged in a specific cognitive task.¹⁵ These methods, also used in a combination, permitted both the spatial and temporal recordings of cortical processing for the first time. In fact, the two methods rely on different strength points. While fMRI has a high spatial resolution (in the order of millimeters), it has a relatively poor temporal resolution (the hemodynamic response rises up to a peak over 4–5 seconds). The EEG directly measures the brain's electrical activity, providing high temporal (in the order of milliseconds) but low spatial resolution. Therefore, the two techniques can be considered complementary in addressing relevant questions within the field of cognitive neuroscience.¹⁶

Further advances in the neuroscientific methods, based on special MRI techniques, permitted to study of the connections of nerve tracts and thus, improved the understanding of the interconnections among the different brain areas.

The application of modern neuroscientific techniques covers the realm of complex human behaviors and mental processes that require multiple skills, like decision making, reasoning, and even moral judgment or social behavior. As some have already observed, the field of neuroscience nowadays is almost infinite, counting over twenty subcategories within it.¹⁷

¹⁵ Roche, R. A., Commins, S., & Dockree, P. M. (2009). op. cit.

¹⁶ *Ibidem*.

¹⁷ This observation comes from Giacomo Rizzolatti, in his foreword to the book D'Aloia, A., Errigo, M.C. (Eds.) (2020). *Neuroscience and Law*, Springer, Berlin, Germany.

As we will see, advancements in cognitive neuroscience helped us investigate issues traditionally in the sphere of philosophy, like free will and responsibility, using the tools given by science, approaching questions (and trying to provide answers) that are of interest to the law.

The first study of the brains of criminals with brain imaging techniques was conducted by Adrian Raine. He used the PET and fMRI to study the brain of forty-one murderers in prison and other people who had not committed any crime.¹⁸ Raine discovered that almost all murderers presented brain lesions, manifesting primarily in the frontal lobe, as demonstrated by their reduced glucose metabolism in the prefrontal cortex. This finding will be crucial, as we will see, because of the role assumed by the frontal lobes, which act as a brake for instinctive responses.

Most recent techniques have helped us overcome a dualistic vision of the brain and shifted the focus from understanding the relationship between mind and brain to unveiling how the mind emerges from its biological substrate, the brain. However, we can observe that the medical jargon still conveys the idea of the mind as a separate object, as demonstrated by terminology like "psychophysical," "psychosomatic," and even the very expression "mental illness." However, most neuroscientists today

¹⁸ Raine, A., Buchsbaum, M.S., Stanley, J., Lottenberg, S., Abel, L., Stoddard, J. (1994). *Selective reductions in prefrontal glucose metabolism in murderers*, in *Biological Psychiatry*, Vol. 36, Issue 6, 365-373. See also Raine, A., Buchsbaum, M.S., Lacasse, L. (1997). *Brain abnormalities in murderers indicated by positron emission tomography*, in *Biological Psychiatry*, Vol. 42, Issue 6, 495-508.

firmly believe that the mind is a process that derives from brain activity.
To put it simply: the mind is what the brain does.¹⁹

¹⁹ Bianchi, A. (2009). *Neuroscienze e diritto: spiegare di più per comprendere meglio*, in Bianchi, A., Gulotta, G., Sartori, G. (Eds.) *Manuale di neuroscienze forensi*, Giuffrè Editore, Milano.

Chapter 2 – Determinism, free will, and the brain: an ongoing debate

A child gleefully jumps into the sparkling blue waters of a Sardinian beach, splashing all around him, giggling happily with his friends. While imagining this scene, we instinctively believe that he *decided* to move his muscles immediately before the young man jumped and leap into the air and into the water below. In other words, the choice of jumping was taken of his own *free will*. To cite a century-old, concise explanation, we define *free will* as a will unimpeded by any compulsion.²⁰

However, there are many different definitions of free will in Philosophy, and many other scholars employ different meanings to describe the concept. Some free will skeptics define a free action as an action that must not be shaped by any cause²¹ or that a genuinely free act must be necessarily caused by a "soul" or another supernatural entity.²² On the

²⁰ Carus, P. (1910). *Person and personality*, in Hegeler, E. C. (ed.) *The Monist*, Open Court Publishing Company, Chicago, IL, page 369, available online at <https://archive.org/details/monist09instgoog/page/368/mode/2up>, last visited on 14th of January, 2022.

²¹ Bargh, J. A. (2008). *Free Will is Unnatural* in Baer J., Kaufman, C., Baumeister, R. F. (Eds.) *Are we free? Psychology and free will*. Oxford University Press, New York, NY.

²² Bargh, J. A., Earp, B. D. (2009). *The will is caused, not "free"*, in *Dialogue: The Official Newsletter of the Society for Personality and Social Psychology*, 24, 13-15.

other hand, many supporters of free will maintain that free will is just the "capacity to make uncoerced choices."²³

Significant studies from colleagues in the field of Social Psychology have tried to contribute to the debate, tackling the problem at its source. They argued that the definitional question about free will comprises two different, though related, questions: "What is the reality of free will?" and "What do people think free will is?"²⁴ Social psychologists have claimed that their science would be more suited to answer the latter question, analyzing the social concept of free will and how people "feel" the idea of their agency in their day-to-day lives. On the other hand, the psychological sciences appear to be ill-equipped to answer the bigger age-old question of the very existence of free will. We would say that neuroscientists, through the studies of brain functions even using brain imaging, are trying to answer mostly the first question with various degrees of success.²⁵

²³ Carus, P. op. cit.; Monroe, A.E., Malle, B.F. (2010). *From uncaused will to conscious choice: The need to study, not speculate about people's folk concept of free will* in *Review of Philosophy and Psychology*, 1, 211–224. <http://dx.doi.org/10.1007/s13164-009-0010-7>; Stillman, T. F., Baumeister, R. F., Mele, A. R. (2011). *Free will in everyday life: Autobiographical accounts of free and unfree actions* in *Philosophical Psychology*, 24, 381–394. <http://dx.doi.org/10.1080/09515089.2011.556607>.

²⁴ Baumeister, R.F., Monroe, A.E. (2014). *Recent Research on Free Will: Conceptualizations, Beliefs and Processes*, in *Advances in Experimental Social Psychology*, Vol. 50, page 4. ISSN 0065-2601 <http://dx.doi.org/10.1016/B978-0-12-800284-1.00001-1>.

²⁵ The pioneering study in the field of neuroscience of free will is the experiment that ended up denying the existence of free will using EEG, published by Benjamin Libet in 1983, see *infra*, chapter 2.2 - Neuroscience of free will.

Free will as a concept is often mentioned next to judgments that can apply only to actions that the individual freely chooses, concepts such as "responsibility," "sin," "praise," "guilt," "blame," or "credit." Only chosen and willed actions are seen as deserving of admiration or reprimand, whereas involuntary and uncontrolled movements are seen as neutral and cannot have a moral or legal value. It is only natural that the debate around free will became of great importance in the legal field, especially in criminal law, with the notions of criminal responsibility and intent.

The dilemma of free will and its repercussions in the legal field does not originate from the recent discoveries on the brain and its inner mechanisms. It looks like, instead, the latest findings in neuroscience rekindled the age-old debate on free will that was never really solved or even mitigated.²⁶

As it has been said, there is no universally shared definition of free will among philosophers or scientists. According to a general classification, three conditions describe free will.²⁷ The first one is *the ability to do otherwise*. To be free, an agent must have at least two alternative behavioral options between which they can choose. The second condition for free will is *control over one's choices*. This requisite implies that one must be the "owner" of one's choice, the author of the decision, and the act. That is what is called *agency*. The third condition is *the responsiveness to reasons*. A free-willed choice must be the outcome of rational reasoning rather than an arbitrary non-motivated decision.

²⁶ Grandi, C. (2016). *Neuroscienze e responsabilità penale. Nuove soluzioni per problemi antichi?* Giappichelli Editore, Torino.

²⁷ Walter, H. (2001). *Neurophilosophy of Free Will: From Libertarian Illusion to a Concept of Natural Autonomy*. The MIT Press, Cambridge, MA.

For instance, simple involuntary movements, like a motor or vocal tic, do not leave any space of choice for the person or respond to any reason. Thus, they happen beyond any possibility of voluntary control. On the other hand, more complex voluntary behavior appears to satisfy the requirements for a voluntary decision taken with free will: which path to choose when going to work, whether to jump or not to jump in the Sardinian sea, what to eat at a restaurant, whether to steal or rob someone to gain riches.

Traditionally, two different paradigms address the problem of free will, arising from their relationship with causal determinism: the first position is compatibilism or soft determinism, while the second, antithetic to the first, is incompatibilism.

Before delving into the definition of compatibilism and incompatibilism, a preliminary description of causal determinism is necessary to understand the two opposing schools of thought.

We define causal determinism as the idea that every event is *necessitated by antecedent events and conditions together with the laws of nature*.²⁸ More specifically, a broader all-encompassing definition is as follows: "*The world is governed by (or is under the sway of) determinism if and only if, given a specified way things are at a time T, the way things go thereafter is fixed as a matter of natural law.*"²⁹ In conclusion, philosophers have classified the universe as deterministic or indeterministic according to whether they believed or not in causal determinism.

²⁸ Hoefler, K. (2016). *Causal Determinism* in Zalta E. N. (Ed.), The Stanford Encyclopedia of Philosophy (Spring 2016 edition), available online at <https://plato.stanford.edu/archives/spr2016/entries/determinism-causal/>, last visited on 14th of January, 2022.

²⁹ *Ibidem*.

Chapter 2.1 – Determinism and free will: the schools of compatibilism and incompatibilism

Keeping in mind what causal determinism is, we can now analyze the two opposed schools about the existence of free will, compatibilism and incompatibilism. Incompatibilism is rooted in the assumption of causal determinism in any phenomena and, on this ground, radically denies the existence of anything akin to "free will." According to some incompatibilists, the perception of having free will is just an illusion of our mind, and we are not free to act differently from how we act.³⁰ Therefore, according to this school of thought, we cannot have free will because any action, determined only by preexistent conditions and natural laws, will inevitably lack the first requisites noted above, the *ability to do otherwise*.

Within incompatibilism, the feeling of exerting any conscious control on our decisions and actions is deemed as an *epiphenomenon* of pre-determined processes that take place out of our consciousness.³¹ The illusion of free will is a "kind concession" of a deterministic brain to let the person believe in their decisional power. Some neuroscientists have noted that when looking at individuals as physical systems, it is impossible to see human beings as more blameworthy or praiseworthy than bricks.³²

³⁰ Pereboom, D. (2002). *Living without free will: The case for hard incompatibilism* in The Oxford handbook of free will.

³¹ Wegner, D. M. (2002). *The Illusion of Conscious Will*, MIT Press, Cambridge, MA.

³² Greene, J., Cohen, J. (2004). *For the law, neuroscience changes nothing and everything*, in Philosophical Transactions of the Royal Society B, 359/1451.

However, one could distinguish two diverse sub-schools inside incompatibilism: the first one, described above, can be defined as *no-freedom theory* or *pessimism* about free will and moral responsibility. The other one is *metaphysical libertarianism*.³³

Metaphysical libertarians are one of the prominent philosophical positions on free will that, following the same premise as hard determinists (free will is incompatible with determinism), arrive at a decisively opposite conclusion. This position not only states that free will exists and that everyone is endowed with it but that free will may exist *only* in a non-deterministic context. Within the same universe, while all the other natural phenomena occur by a random combination of factors and circumstances that cannot be predicted, some facts result from people's choices. Therefore, we can distinguish two kinds of events: *chance events*, which arise from the natural randomness of our chaotic, non-deterministic universe, and *choice events*, which track their *source* in an individual's free will that are direct consequences of actions that an agent chooses. True *sourcehood*, the link between an action and its agent characterized by freedom and responsibility, requires that one's action not be causally determined by factors beyond one's control.³⁴

It is important to note that metaphysical libertarianism appears to be in accordance with some interpretations of physical indeterminism brought forth by the discoveries in quantum mechanics (i.e., *quantum indeterminacy*). It has been argued that the phenomena arising from quantum indeterminacy might affect brain activity. It could then allow

³³ Strawson, G. (1998). *Free will* in Craig, E. (Ed.), Routledge Encyclopedia of Philosophy, Routledge, London.

³⁴ O'Connor, T., Franklin, C. (2022). *Free will* in Zalta, E. N. (Ed.) The Stanford Encyclopedia of Philosophy (Spring 2022 Edition), available online at <https://plato.stanford.edu/entries/freewill/>, last visited on 14th of January, 2022.

for incompatibilist free will, so that brain activity underpinning human choices might be affected by such events. In other words, that quantum indeterminacy would provide an entry point for freedom of will that was not allowed by classical physics.³⁵ However, these conclusions have been met with justified criticism, even by prominent libertarians; it has been noted that physical events connected with quantum indeterminacy happen randomly and spontaneously, without any conscious control, and, thus, would be more likely to undermine freedom of will rather than enhance it.³⁶

On the other side of the argument, according to compatibilist theories, free will may exist even if causal determinism is true. In other words, human beings can still choose how to act even if they, more specifically their brains, obey the natural laws of physics. Furthermore, compatibilism believes causal determinism is necessary for the subsistence of free will and considers that indeterminism and free will are incompatible. An indeterministic universe entails that everything happens just by chance and chaos. Even human actions would originate from random events, which do not require the deliberate intervention of the person.³⁷ In a compatibilist view, we could say that people can

³⁵ *Inter alia*, Eddington, A. S. (1932). *The decline of determinism*, in *Mathematical Gazette*, 16, 66.

Jordan, P. (1944). *Physics of the 20th Century*, (translation by Oshry, E.), Philosophical Library, New York

Stapp, H.P. (1995). *Why Classical Mechanics Cannot Naturally Accommodate Consciousness but Quantum Mechanics Can*, in *Psyche*, 2(5), May 1995.

³⁶ Kane, R. (2007). *Libertarianism* in Fischer, J. M., Kane, R., Pereboom, D., Vargas, M. (Eds.) *Four Views on Free Will, Great debates in philosophy* series, Wiley-Blackwell, Hoboken, NJ.

³⁷ De Caro, M. (2004). *Il libero arbitrio: una introduzione*, Laterza, Roma.

modulate the output (the voluntary actions) but not the input (willing, needs, impulses, etc.) through their free will. Human beings, endowed with free will, are "output moderators," even if they cannot control the input's source and nature. As Schopenhauer quotes, "*A man can surely do what he wills to do, but cannot determine what he wills. You are free to do what you want, but you are not free to want what you want.*"³⁸

With these paradigms in mind, we can offer some thoughts that have animated the discourse around free will, the law, and neuroscience, without any presumption of completeness. These concepts coexist in most people's minds in complex ways: we all can have deterministic, indeterministic, and free-will-based explanations for events, depending on the context.

It has been observed that in ordinary folk psychology,³⁹ human beings employ two radically different explanations regarding mental phenomena and natural phenomena. Whereas natural phenomena are explained through physics and mechanics, for mental phenomena, we usually rely on a "mentalist" explanation, through which we explain actions not through natural laws but by using arguments based on the agent's will.⁴⁰

³⁸ Schopenhauer, A. (1839). *Über die Freiheit des menschlichen Willens* (On the Freedom of the Will, transl. 1960).

³⁹ "Roughly speaking, the law implicitly adopts the folk-psychological model of the person, which explains behavior in terms of desires, beliefs, and intentions". Morse, S. (2008). *Determinism and the Death of Folk Psychology: Two Challenges to Responsibility from Neuroscience*, in *Minnesota Journal of Law Science and Technology*, 9(1).

⁴⁰ Grandi, C. (2016). *op. cit.*

More specifically, these scholars have argued that adult human beings have a well-developed, specific idea of a special kind of "entity" in the world: an *acting entity*. For instance, we can recognize that a dog acts in ways that we interpret as guided not by simple physics or mechanics, but we see its actions within a teleological system characterized by a goal. Dogs often appear to move towards goals, even if not the brightest of goals, but goals nonetheless: we see them move towards things they want to eat or smell, and we see them move away from things we imagine they do not like (perhaps because they are threatening or noisy). Thus, most people imagine that a dog, much like a person, behaves like an *acting entity*.⁴¹

On the other hand, as it has been shown by experiments in social psychology, while current knowledge of science and scientific principles has caused most people to perceive the world as deterministic, this belief peacefully shares the space of our mind with the (self-)perception of individuals as agents separated from the laws of physics. We perceive *acting entities* as able to determine themselves to action toward autonomously defined goals, goals that are defined by their own free volition.⁴²

However, this dualistic attitude of our minds does not apply only to the shared folk-psychological concepts of *acting* and *non-acting entities*, but it also applies to the law, or more specifically, to the lawmaker. It has been argued that the lawmaker is in a position where it must axiomatically presume the existence of free will and, connected with this, the existence

⁴¹ Wegner, D.M. (2019). *L'illusione della volontà cosciente* in De Caro, M., Lavazza, A. and Sartori, G. (eds.) *Siamo davvero liberi?*, Codice Edizioni, Torino.

⁴² Grandi, C. (2016). op. cit.

of agency in human behavior.⁴³ This is opposed to an always more consistent part of the scientific consensus around neuroscience, which suggests that concepts like free will, self-determination, conscious will, and the like are nothing more than illusions. As we will see in the next section, these concepts are scientifically untenable, without any ontological consistency.⁴⁴

In conclusion, and for clarity, we will give a glossary of the philosophical positions relating to the debate around free will.⁴⁵

Agent causation: a type of causation due to an agent choice, not caused by physical events.

Compatibilism: free will is compatible with determinism. Compatibilism is also called *soft determinism*.

Determinism: the state of the universe is a product of physical laws and the universe's initial conditions.

Eliminativism: the belief that science will show the scientific unsustainability of concepts that are thought to be *folk-psychological*, such as "belief," "desire," and "free will." Therefore, these concepts should be discarded.

Epiphenomenalism: mental states are physically caused but have no physical effects.

⁴³ Lavazza, A., Sammiceli, L. (2019). *Se non siamo liberi possiamo essere puniti?* in De Caro, M., Lavazza, A. and Sartori, G. (eds.) *Siamo davvero liberi?*, op. cit.

⁴⁴ Morse, S. (2009). *The Neuroscience Challenges to Criminal Responsibility* in Santosuosso, A. (ed.) *Le Neuroscienze e il Diritto*, Ibis Edizioni, Como.

⁴⁵ Roskies, A. (2006). *Neuroscientific challenges to free will and responsibility* in Trends in cognitive sciences, 10(9), 419-423.

Hard determinism: also called "*pessimism*" or "*no-freedom theory*." Hard determinism is the belief that the universe is deterministic and free will does not exist; freedom is just an illusion.

Incompatibilism: free will is incompatible with determinism; incompatibilists that believe that determinism is true are called *hard determinists*, while incompatibilists that believe that determinism is false are called *metaphysical libertarians*.

Libertarianism: although the universe is indeterministic, we are endowed with free will. It distinguishes between two classes of events: *chance events* and *choice events*. Human choice is not subject to physical law but stems from the operation of the will and is causally efficacious.

Reductionism: mentalistic terms, such as "choice," will be shown to be entirely explicable in terms of physical mechanisms.

The figure below shows a map of the main philosophical paradigms on free will.

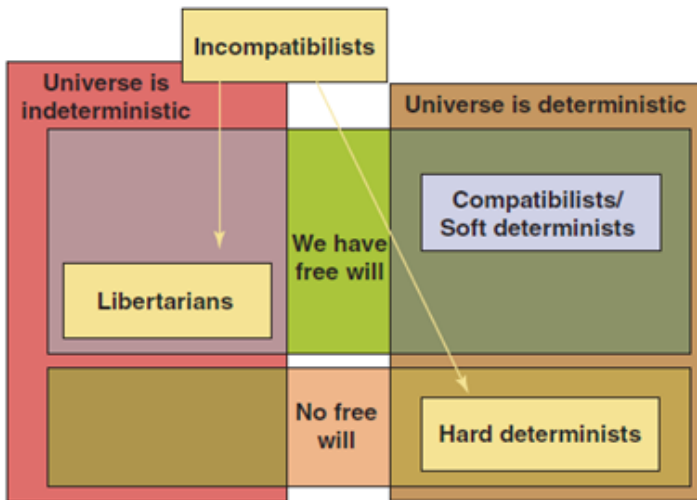


Figure 2 - Map of the main philosophical paradigms on free will.
From Roskies, A. (2006)

Chapter 2.2 – Neuroscience of free will

Since the 1980s, neuroscience has erupted in the conversation about free will with surprising force. The daring thought of investigating volition and agency using the tools of neuroscience has sprouted a field of research that is very much healthy and lively even today: the so-called *Neuroscience of Free Will*.

The neuroscience of free will investigates human agency, moral responsibility, and consciousness, studying the living brain and its decision-making processes. This approach tries to solve the irreconcilable positions about human free will that have existed for millennia in philosophy (summarized above) using biological processes and, most importantly, the experimental bases of neuroscience and psychology.

Before delving into an analysis of the neuroscience of free will, it is important to note that the idea at the base of the field, that is, using experiments to investigate if human beings have free will, implies accepting a link between brain functioning and a pre-existing theoretical construct. For example, when applying this concept to understanding if someone who engaged in violent behavior could have done otherwise in that specific circumstance, the definition of free will we use will significantly impact the results.⁴⁶

The contribution of neuroscience to the free will debate was pioneered by the study of Benjamin Libet in 1983.⁴⁷ Libet's experiment is probably the most debated and controversial in the field and was subjected to a plethora of criticism in the decades after it was published, not only towards its methods but also its conclusions. Libet based his experiment on previous research about the electric signal known as *bereitschaftspotential* discovered in 1965 (B.P., or Readiness Potential, R.P.),⁴⁸ a very faint electric signal known to precede a physical action. In particular, his study wanted to investigate how the Readiness Potential was related to the intention to move.

⁴⁶ Lavazza, A. (2016). *Free Will and Neuroscience: From Explaining Freedom Away to New Ways of Operationalizing and Measuring It*, in *Frontiers of Human Neuroscience*. 10:262, DOI: 10.3389/fnhum.2016.00262.

⁴⁷ Libet, B., Gleason, C.A., Wright, E.W., Pearl, D.K. (1983). *Time of Conscious Intention to Act in Relation to Onset of Cerebral Activity (Readiness-Potential): The Unconscious Initiation of a Freely Voluntary Act* in *Brain*, 106, 623-642.

⁴⁸ Kornhuber, H.H. and Deecke, L. (1965). *Hirnpotentialänderungen Bei Willkürbewegungen und Passiven Bewegungen Des Menschen: Bereitschaftspotential Und Reafferente Potentiale* [Changes in the Brain Potential in Voluntary Movements and Passive Movements in Men: Readiness Potential and Reafferent Potentials], in *Pflügers Archiv Gesamte Physiol Menschen Tiere*, 1965, German.

In the experiment, Libet asked the subjects to choose a random moment to make a simple movement (flicking their wrist) while measuring the brain's electrical activity with EEG, focusing on the occurrence of Readiness Potential. To determine the exact moment when subjects felt the intention to move, the researchers asked them to note the position of the second hand of a clock and report its place when they felt the conscious will to move.

This experiment showed that, on average, approximately two hundred milliseconds elapse between the first appearance of conscious will to execute the movement and the act of performing it. More surprisingly, by analyzing EEG recordings of the experiment, Libet noted that brain activity involved in the initiation of the action occurred, on average, five hundred milliseconds before the execution of the movement, therefore preceding the intention of the subject by three hundred milliseconds. Consequently, conscious decisions to act were preceded by an unconscious buildup of activity in the brain – more specifically, in the supplementary motor area – and this change in activity was called *Bereitschaftpotential* (or readiness potential).

Neuroscientists disagree on the implications of the results of Libet's experiment. Some scholars interpreted the results in the sense that, since the experiment shows without a doubt that the brain is the actual initiator of the action, free will must play no part in their initiation.⁴⁹ In this sense, if the brain's processes are the initiators of intentional acts and start before consciousness is even aware of any desire to act, consciousness must play no causal role in volition. Libet himself, on the contrary, concluded that the results of his experiment are entirely compatible with a notion of free will, provided that this notion is defined

⁴⁹ Wegner, D.M. (2019). *L'illusione della volontà cosciente*, *op.cit.*

as a capacity to refrain from the decision that the subject had taken before.

Indeed, in a subsequent study on readiness potential, Libet found evidence that his subjects could stop themselves from acting after showing readiness potential to commit an action. In particular, he discovered that individuals could block preparatory cerebral processes consciously before their execution. The evidence he provided was that, in a series of acts to be performed at prearranged times, subjects were instructed in advance to "veto" the developing intention/preparation to act and to do this about one to two hundred milliseconds before the prearranged clock time at which they were supposed to act. In this case, Libet and colleagues were able to record activations of readiness potential more than one second before the pre-set time, without any actual muscle activation, therefore suggesting that the subject intended to act but "aborted" his action before any movement.⁵⁰ This phenomenon is sometimes called "free won't."

Libet, well aware of the debate sparked by his research, underlined that his experiments "*do not exclude the potential for 'philosophically real' individual responsibility and free will*" and that his findings "*should therefore be taken not as being antagonistic to free will but rather as affecting the view of how free will might operate. Processes associated with individual responsibility and free will would 'operate' not to initiate a voluntary act, but to select and control volitional outcomes.*"⁵¹ The author speculates that motor execution of a deliberately preselected voluntary act may involve processes similar to spontaneously voluntary acts. Libet concludes that the concept of conscious veto of the motor action is aligned with particular "*religious*

⁵⁰ Libet, B. (1985). *Unconscious cerebral initiative and the role of conscious will in voluntary action*, in *The Behavioral and Brain Sciences*, 8, 529-566.

⁵¹ *Ibidem*.

and humanistic views of ethical behavior and individual responsibility." In contrast, self-control of one's urges or intentions is commonly regarded as a virtue. Hence, compatibly with Libet's findings, self-control would be nothing but the conscious control of an unconsciously initiated final volitional process.

More recently, John-Dylan Haynes and colleagues performed another experiment that soon became famous. They found that the outcome of a decision can be encoded in brain activity of the prefrontal and parietal cortex up to ten seconds before it enters awareness.⁵² First, the experimenters asked their subjects to fixate the center of a screen where a stream of letters was presented. At some point of the subject's choosing, they decided freely between one or two buttons and pressed the button immediately while remembering the letter presented when they consciously made their motor decision. After this, subjects were presented with a 'response mapping' screen with four choices where they would select the corresponding letter with a second button press. Haynes and colleagues recorded brain activity through fMRI and found that two regions in the frontal and parietal cortex showed considerable activity that predicted the outcome of the motor decision the subject had not yet consciously made. Such brain activity suggests that when the subject's decision reached awareness, it had already been influenced by unconscious brain activity for up to ten seconds before the subject acted. These results led them to conclude that the delay reflects the operations of a network of high-level control areas that begin to prepare the upcoming decision long before it enters awareness. This network is

⁵² Soon, C.S., Brass, M., Heinze, H.J., Haynes, J.D. (2008). *Unconscious determinants of free decisions in the human brain*, in *Nature Neuroscience*, Vol. 11, issue 5, 543-545.

explicitly situated in the frontopolar and parietal cortex, which has been shown to activate way before the sensorimotor area.

As already mentioned, the findings by Libet and Haynes encountered several criticisms. Critics argued against the conclusions about free will with different motivations. The first factor that must be considered is the timing of the first conscious will to move, which is mentally known by the subject. We can refer to this moment as the subject's "mental time."⁵³ The instant the subject signals his decision to act does not always coincide with the time measured by the physical devices.

In neuroscience, there have been situations and experiments where subjective time differed from objective, physically estimated time. One example of the difference between subjective and objective time is the temporal illusion of chronostasis, caused by a phenomenon called saccadic masking. Libet and Haynes's experiments should have considered phenomena like this, whereas subjective time was used to record intention. We will describe chronostasis briefly, as exploring the neuroscience of perception far exceeds the scope of the present work.

Chronostasis is the subjective feeling of perceiving an image for a longer time than what has been presented, and it has been detected for as long as two hundred milliseconds. Chronostasis has been recorded after a phenomenon called visual saccadic suppression, which is the phenomenon in perception where the brain selectively blocks visual processing during rapid eye movements (saccade) to avoid the viewer both the experience of motion blur and the experience of the gap in visual perception. Saccadic masking can elicit an overestimation of the

⁵³ For and overview, see Tempia, F. (2010) *Decisioni libere e giudizi morali: la mente conta*, in De Caro, M., Lavazza, A., Sartori, G. (Eds.) *Siamo davvero liberi? Le neuroscienze e il mistero del libero arbitrio*, Codice Edizioni, Torino.

temporal duration of a post-saccadic stimulus, extending it by up to two hundred milliseconds.⁵⁴ Indeed, the research done by Kielan Yarrow and colleagues has demonstrated that, during the brief period of "blindness" that accompanies any saccadic movement, we hold the image perceived at the end of the saccade, and subjectively we feel that we spent more time on that image than we really did. In Yarrow's study, to elicit the feeling of perceiving a picture for one full second, the image was presented for just 811 milliseconds after a 55° saccadic movement. Therefore, the brain gives the viewer the illusion of having perceived the image for longer than they did, as if the brain was filling the saccadic gap with the post-saccadic image.⁵⁵ We can easily reproduce the illusion ourselves through the so-called stopped clock illusion. When we look at the second hand of an analog clock for the first time after a saccadic movement, the clock appears to stay still for longer than expected due to chronostasis.

Therefore, our temporal mental experience does not always correspond to chronometric time but, instead, is distorted by our mind to create a perception of reality that is as coherent as possible.

Another factor that critics of Libet and Haynes have argued is the significance accorded to the activation of cerebral areas before a voluntary movement. It has been proven that the supplementary motor area can activate not only when preparing an action that will be performed but also by the mere thought of the movement, without any intention of enacting it. It was interpreted that the supplementary motor

⁵⁴ Yarrow, K., Whiteley, L., Rothwell, J.C., Haggard, P. (2006). *Spatial consequences of bridging the saccadic gap*, in *Vision Research*, Vol. 46, issue 4, 545-555.

⁵⁵ Yarrow, K., Haggard, P., Heal, R., Brown, P., Rothwell, J.C. (2001). *Illusory perceptions of space and time preserve cross-saccadic perceptual continuity*, in *Nature*, 414, 302-305.

area is where the brain computes the preparation of motor movements.⁵⁶ It is clear that some degree of preparation by the secondary motor cortex is always necessary for voluntary actions, even when we decide not to execute the movement. In Haynes' experiment, it is entirely reasonable to interpret the detected activation of the prefrontal areas as the subject pondering the two options. We can easily hypothesize that the activity is slightly different when considering left or right, even if the subject did not choose one or the other yet. If the subject thinks more at the left than at the right, they will most likely select left over right, and vice-versa. This interpretation differs significantly from Haynes' conclusions, where he claimed that the activation detected before the decision is a neural correlate of an unconscious decision and not the effect of ponderation of the options.⁵⁷

These considerations invite us to caution before accepting conclusions about free will and the timing of conscious actions. The meaning and importance of the readiness potential, to this day, are still unclear.⁵⁸

⁵⁶ Roland, P.E., Larsen, B., Lassen, N.A., Skinhøj, E. (1980). *Supplementary motor area and other cortical areas in organization of voluntary movements in man*, in *Journal of Neurophysiology*, Volume 41, issue 1, 118-136.

⁵⁷ Tempia, F. (2010). op. cit.

⁵⁸ As highlighted in the review by Shibasaki, H., Hallett, M. (2006) *What is Bereitschaftspotential?*, in *Clinical Neurophysiology*, 117/11, 2341-2356. For an insight into the manipulation of the amplitude of the readiness potential, see Verleger, R., Haake, M., Baur, A., Smigasiewicz, K. (2016) *Time to Move Again: Does the Bereitschaftspotential Covary with Demands on Internal Timing?* in *Frontiers in Human Neuroscience*, doi: 10.3389/fnhum.2016.00642, and also Verleger, R. (2021) *Measuring Free Will with the Bereitschaftspotential? New data on an Old Misunderstanding*, in Benetka, G., Werbik, H. (eds.) *Discussing Cognitive*

Chapter 2.3 – Criminal justice and free will: is there a need for reform?

Findings in the field of the neuroscience of free will have triggered a debate over the years that involves the fundamental concepts at the base of our criminal justice system. Some have even argued that progress in neuroscience will inevitably lead us to change our legal systems to accommodate new ideas about people and their actions.

The most cited scholars arguing for a neuroscience-based reformatory approach to criminal justice are Joshua Greene and Jonathan Cohen.⁵⁹ In their 2004 paper, Greene and Cohen argue that neuroscience promises to explain the operations of the mind in terms of the physical operations of the brain, with enormous consequences for the law. Neuroscience will bring us to understand the physical causes of human behavior, with a transformative effect on the law, in the sense that neuroscience can change people's moral intuitions about free will and responsibility that are at the base of legal doctrine.

Greene and Cohen describe the two fundamental justifications for legal punishment: retributivism on the one hand and consequentialism on the other. While consequentialism pursues punishment as an instrument for promoting future social welfare (in the author's terms, it is "forward-looking"), retributivism sets the aim of punishment in giving people what they deserve based on their past actions ("backward-looking"). The authors are particularly skeptical about retributivism. They distrust notions such as "deserving" and "free will" since they believe in a

Neuroscience, part of the Annals of Theoretical Psychology book series, Springer, Berlin, Germany.

⁵⁹ Greene, J., Cohen, J. (2004). op. cit.

deterministic and mechanistic universe. Greene and Cohen argue that the retributivist approach to punishment requires free will: assuming that one can deserve to be punished only for freely willed actions, hard determinism must entail that no one deserves to be punished. Using the categories we illustrated at the beginning of this chapter, the authors argue that retributivists can either be compatibilists or metaphysical libertarians. Greene and Cohen observe that most legal scholars appear to be compatibilists, believing that while the universe is deterministic, this still must leave space for free will and personal responsibility.⁶⁰

Moreover, the authors observe that the law is immune to threats that come from understanding the mechanisms of how the brain works: the law makes no assumption at all that can be changed by neuroscience or any science for that matter. Criminal law just assumes that people have a general capacity for rational choice. While new and better science can only help us understand who was or was not rational at the crime scene. So, neuroscience changes nothing, although it leaves the law on shakier ground than it might seem. The authors argue that the legitimacy of the law itself depends on how adequately legislation reflects the moral intuitions and commitments of society. If neuroscience can affect those moral intuitions, it can change the law. In particular, Greene and Cohen argue in favor of a consequentialist reform of punishment that does not need free will as a justification. In their view, we should punish not because the criminals deserve it but because punishing criminals has beneficial effects on society through deterrence and containment. Recently, other philosophers have put forward arguments in line with Greene and Cohen's view, reigniting a debate and arguing for

⁶⁰ See above, chapter 2 - Determinism, free will and the brain: an ongoing debate.

implementing a "medical model" in criminal justice, "*incapacitating the criminally dangerous individuals with the minimum harm required for adequate protection.*"⁶¹

The merely consequentialist position on punishment was met with some degree of resistance by legal scholars, especially in the United States, where the retributivist view of punishment is still largely dominant. Among others, the most prominent critic of neuroscience's consequences on criminal law is Stephen J. Morse. Morse radically rejects the importance of neuroscientific findings for the fundamental concepts in criminal law. Morse does not believe that neuroscience will prove that determinism is true, as determinism is metaphysical speculation about the ontology of the universe and is impossible to definitively prove it: "*there is simply no compelling reason to upend centuries of legal doctrine, theory and institutions based on an armchair metaphysical theory.*"⁶² Along with determinism, Morse argues against the concept of the no-freedom theory, according to which free will and consciousness are mere epiphenomena and, thus, people have no causal power. Morse observes that epiphenomenalism has no reasonable conceptual or empirical grounds. In addition, it also carries unjustifiable normative consequences that would follow from the mind as a mere epiphenomenon. Following an example made by Morse, if our mental states are simply epiphenomenal, what will happen to private/civil law?

⁶¹ Pereboom, D., Caruso, G.D. (2018). *Hard-Incompatibilist Existentialism: Neuroscience, Punishment, and Meaning in Life*, in Caruso, G.D., Flanagan, O. (eds.) *Neuroexistentialism: Meaning, Morals, and Purpose in the Age of Neuroscience*, Oxford University Press, Oxford, U.K.

⁶² Morse, S.J. (2020). *Neuroscience and Law: Conceptual and Practical Issues*, in D'Aloia, A., Errigo, M.C. (eds.) *Neuroscience and Law*, Springer Nature Switzerland, 415-440.

What will be the fate of a "*biological machine that was formerly called a person*" that claims that it should not be bound to a contract because the contract is just the outcome of various "*neuronal circumstances*"?⁶³

Morse explains that "*if our mental states, including our reasons, are epiphenomenal and doing no work, then reasons do not have force and no normative implications follow at all. [...] We are not helpless Pinocchios being dangled and manipulated by our Geppetto brains. Agency is secure, at least for now. Neuroscience will not radically transform the law's view of the person, legal doctrine and legal institutions for the foreseeable future and probably never.*"⁶⁴

Even putting apart the unsolvable dilemma of free will, the law has a surprisingly low bar for free will. Criminal law, generally, assumes that people behave as if they have free will and considers people as responsible agents for their actions. More specifically, criminal responsibility is based on three implicit assumptions that are hard to argue against (and, *a fortiori*, hard to falsify using neuroscience): 1) that we are creatures capable of acting consciously; 2) that our intentions and our reasons are causally explanatory; 3) that we are creatures capable of common-sense rationality. This is the presupposed folk psychological view of the person and behavior, and this psychological theory causally explains behavior using mental states such as desires, beliefs, intentions, wills, and plans. Folk psychology does not presuppose anything about free will, is in harmony with determinism, and does not hold that we have minds independent of our bodies. It allows for thoughtless, automatic, and habitual actions. It presupposes, on the other hand, that

⁶³ Morse, S.J. (2015). *Neuroscience, Free Will, and Criminal Responsibility*, in Faculty Scholarship at Penn Law, 1604.

⁶⁴ Morse, S.J. (2020). *Neuroscience and Law: Conceptual and Practical Issues*, cit.

human actions will be at least rationalizable through mental state explanations or that they will be responsive to reasons. As we will see, neuroscience can help criminal justice identify more accurately legally relevant mental states but will likely not have a revolutionary effect on fundamental categories of criminal law by itself.⁶⁵ On the other hand, as Greene and Cohen have argued, criminal law might be modified only by a political choice, even if fueled by a change in moral intuitions pushed by neuroscience.

⁶⁵ Morse, S.J. (2010). *Lost in Translation? An Essay on Law and Neuroscience*, in Freeman, M. (ed.) *Law and Neuroscience*, Current Legal Issues 2010, Volume 13, Oxford University Press, Oxford, U.K.

Chapter 3 – Mental capacity in criminal trials

The fascinating advances of cognitive neuroscience bring together the burden of putting under the bull's eye all those concepts, disciplines, and even entire systems based on the traditional knowledge about how the human mind works.

Every-day life concepts like merit, blame, guilt, praise, and punishment are firmly rooted in the conception of the human being as endowed with rationality, with the ability to act or refrain deliberately. Such a vision has not come from science, but rather it has somewhat naturally developed along with society, and it probably derives from the common subjective perception of having the power of self-control. This attitude towards mental states and behaviors is often called *folk psychology*.

Social norms would not make sense if people could not conform their behavior to the rules. Therefore, punishment would be meaningless if not directed at someone who deliberately chose to violate the law.

Law, and in particular criminal law, is based on a model of the individual as an active agent. In this scenario, any conviction requires the criminal action to be committed with a *mens rea*, that is, with the guilty mind of the defendant.⁶⁶ According to the Italian law (Art. 42.1 c.p.), no one can be punished for an action or an omission that constitutes a criminal offense according to the law if they did not commit it with awareness and deliberate purpose.⁶⁷

⁶⁶ Greene, J., Cohen, J. (2004). op. cit.

⁶⁷ Art. 42 states: “Nessuno può essere punito per un’azione od omissione preveduta dalla legge come reato, se non l’ha commessa con coscienza e volontà”.

The mental condition of being aware and acting on purpose is the foundation of criminal intent⁶⁸ or *mens rea*. An act is intentional or committed with a *guilty mind* if the agent is *aware* of his actions and their consequences and wants those specific consequences to occur. For instance, according to Italian law, causing the death of someone by shooting at them with a gun with the precise aim of killing them constitutes intentional homicide.⁶⁹

Nonetheless, a guilty mind is not enough to be responsible for one's criminal action. As it is known, an intentional criminal act not necessarily ends up with a guilty verdict: first of all, according to Italian criminal law, for a defendant to be considered criminally responsible, they must meet the criteria for *imputability*, which requires that individuals retain either a full or not completely suppressed "*capacità di intendere e volere*" (Art. 85)⁷⁰, that is the capacity to appreciate the nature of their conduct and its consequences, and ability to conform their behavior to the requirements of law.

According to Italian law, a person who intentionally commits an act of criminal relevance *will* be punished *unless* they are deemed not liable for it at the time of the crime. By default, one can be criminally liable only if

⁶⁸ Italian: *dolo*.

⁶⁹ Italian: *omicidio volontario* (Art. 575 c.p.).

⁷⁰ Art. 85 states: "*Nessuno può essere punito per un fatto preveduto dalla legge come reato, se, al momento in cui lo ha commesso, non era imputabile. È imputabile chi ha la capacità d'intendere e di volere*".

they are over the age of 18 and endowed with full or partially impaired mental capacity.⁷¹

The abovementioned Art. 85 implies considering two distinct aspects when assessing mental capacity.⁷² The first one concerns the relation between the defendant's mental capacity and a precise fact: the alleged crime they committed. A defendant might be found responsible for criminal action but not for another one, given that the final judgment of "not guilty by reason of insanity" (N.G.R.I.) in one case does not limit the possibility of getting a different verdict in a different trial charged against the same person. The second intrinsic aspect of Art. 85 refers to the temporal dimension: mental capacity must be evaluated with regard to the time of the commission of the criminal behavior. An insanity condition has no effect on criminal responsibility if it has occurred after the fact or even if it was present in a time not related to the criminal act.

So far, we presented two conditions to be evaluated during a criminal trial, which are both referred to the agent who committed a crime and not to the classification of the fact itself. These two aspects are criminal intent and mental capacity. Although the more subtle differences between criminal intent and mental capacity are still debated among experts, one can define the main difference between the two conditions. Mental capacity is referred to the mental condition of the defendant at the time of the crime, with a particular focus, even if not exclusive, on the effect that a mental disorder may have on the natural capacity. On the other hand, criminal intent more specifically regards the agent's mental participation in the occurrence of a specific fact, regardless of the

⁷¹ With some exceptions for adolescents between 14 and 18 years of age in the Italian Penal code – see Arts. 97-98 c.p.

⁷² Garofoli, R. (2016). *Compendio di diritto penale – parte generale*, NelDiritto Editore, Roma.

presence of a mental disorder. In other words, mental capacity concerns the perpetrator's mental state, whereas criminal intent regards the mere relationship between the perpetrator and the occurrence of the criminal act, leaving the evaluation of the *quality* of the mind to a later step.

There is no doubt that mental capacity and *mens rea* are independent of each other since each of them can exist even if the other one is considered missing. What is more complex is the debate around the hierarchy of criminal intent and legal capacity or, more specifically, if mental capacity is a prerequisite of criminal intent and *mens rea* in general.

Among legal scholars, we can distinguish two prominent positions on the topic. According to the traditional interpretation,⁷³ which has some precedent among jurisprudence,⁷⁴ mental capacity and intent lie on two different and independent levels: mental capacity is meant as a general capacity to receive punishment. This means that, even if the defendant is found not guilty by reason of insanity, this does not (legally and ontologically) eliminate the crime, which is still a criminal act committed against the law with *mens rea*, thus, intentionally. This interpretation maintains that criminal intent, and *mens rea* in general, is to be interpreted as the "psychological connection" between the author and the fact, a connection that can be found even in the mind of the minor or of the mentally insane adult perpetrator.

This interpretation rests on its coherence with other rules stated by the Italian criminal code: for example, while regulating the case of the

⁷³ Among others, Antolisei F. (2003). *Manuale di diritto penale – parte generale*, 16th edition, Giuffrè, Milano and Gallo M. (2020). *Diritto penale italiano – appunti di parte generale*, 3rd edition, Giappichelli, Torino.

⁷⁴ Cass. Pen., Sez. I, n. 40808, 14/10/2010

"mediated offender," that is, the case of someone using a minor or an insane individual as a "tool" to commit a crime, Art. 86 and 111 state that the criminal acts committed by someone lacking mental capacity are explicitly "criminal offenses."⁷⁵

According to a more recent and shared among many scholars interpretation,⁷⁶ mental capacity is definitely a prerequisite of *mens rea* itself. These authors state that one cannot be judged for their mental participation in the crime without intact legal sanity. Thus, insane perpetrators are unable to commit criminal offenses since they cannot have a *mens rea*. These scholars adhere to the so-called "normative design" of *mens rea*, which means that the psychological component of the crime carries in itself reprimand and blame towards the subject for committing an act that they should have abstained from committing.⁷⁷ Without this psychological component, there cannot be any *mens rea*. This reprimand and blame cannot be aimed toward a perpetrator who was deprived of the possibility of differently acting because they lacked mental capacity.

⁷⁵ Art. 86 states: "*Se taluno mette altri nello stato d'incapacità d'intendere o di volere, al fine di fargli commettere un reato, del reato commesso dalla persona resa incapace risponde chi ha cagionato lo stato di incapacità*"; Art. 111 states: "*Chi ha determinato a commettere un reato una persona non imputabile, ovvero non punibile a cagione di una condizione o qualità personale, risponde del reato da questa commesso, e la pena è aumentata. [...]*"

⁷⁶ Among others, Mantovani F. (2020). *Diritto Penale – Parte generale*, 11th edition, CEDAM, Padova and Padovani T. (2019). *Diritto Penale*, 12th edition, Giuffrè, Milano.

⁷⁷ Original italian: "*rimprovero o disapprovazione del soggetto per aver commesso un fatto che si sarebbe dovuto astenere dal commettere*" in Garofoli R. op. cit.

Adhering to the first or the second interpretation can have significant consequences when applying the law, especially when enacting a security measure on the defendant. A security measure is usually adopted in the case of *not guilty by reason of insanity* acquittals. In most cases, it consists of committing to mental health facilities the mentally ill perpetrator who is deemed dangerous to society.⁷⁸ When applying a security measure, the judge must decide its duration based on the offender's dangerousness, which is determined, among other criteria, also by their mental participation in the act (*mens rea*). Therefore, if one adheres to the "normative design," whenever there is no mental capacity, there is no *mens rea* and, thus, there is no criminal intent to evaluate for a security measure.

Either in the case of considering mental capacity independent of *mens rea* or in the case of placing mental capacity as a prerequisite of criminal intent, it seems fundamental to deepen the meaning of mental capacity and legal insanity in order to have a better understanding of what the experts are asked to assess and to implement more objective techniques for *measuring* the multifaceted capacity.

The analysis of the assessment of mental capacity in the Italian system raises quite a few questions for neuroscientists: the person who committed a crime is criminally responsible if they have the ability to "appreciate and control," but legal doctrine does not refer to any

⁷⁸ According to the Italian system there are different types of institutions, differentiated by having either high or low therapeutical intensity. The high therapeutical intensity structures in Italy are facilities for the execution of security measures (italian acronym *REMS* – *residenza per l'esecuzione delle misure di sicurezza*). Low intensity structures consisted in therapeutical communities, daycare mental health services, and outpatient clinical assistance.

scientifically viable definition of these two concepts, all the while asking experts (typically from the medical or psychological field) to assess their presence or absence. While the Anglo-American term (mental capacity) indicates that a more general unitarian ability is required to be considered responsible for one's actions, the Italian law articulates that capacity in two components, "*intendere e volere*." We will investigate both paradigms in detail.

Chapter 3.1 – Multiple definitions of mental (in-)capacity according to the law

The Italian criminal code was written by the jurist and Minister of Justice Alfredo Rocco in 1930, under the dictatorship of Benito Mussolini. The first draft of the penal code was characterized by an explicit fascist ideology which was modified only after World War II with the advent of the Constitution of the newly formed Italian Republic. As already mentioned above, the Art. 85 of the so-called *Codice Rocco* requires that the defendant does not lack mental capacity in order to be considered responsible for their criminal actions and, thus, to receive a guilty verdict. The subsequent articles of the Italian criminal code regulate the legal course that follows a positive result of the assessment of mental insanity. If the defendant shows a completely abolished mental capacity by reason of insanity (Art. 88), they are acquitted because they are not *imputabile*.⁷⁹ If the other case is assessed, the defendant's mental capacity is significantly impaired by reason of insanity but not entirely suppressed (Art. 89). The defendant is found guilty in this case, but their

⁷⁹ Art. 88 states: "*Non è imputabile chi, nel momento in cui ha commesso il fatto, era, per infermità, in tale stato di mente da escludere la capacità d'intendere o di volere*".

sentence will be reduced.⁸⁰ As regulated by Art. 65 of the Italian penal code, this reduction can be up to one-third of the base conviction and can commute a life sentence to 20-24 years of prison.⁸¹

The *formula* of the Art. 85 summarizes in concise terms what the lawmaker meant as indicators of a condition of "normality" thought to be sufficient for a person to be judged responsible for the criminal action and deserving of punishment. This condition of "legal normality" has two components:

- a) *capacità di intendere* is defined by legal doctrine as the capacity to appreciate the unlawfulness and wrongfulness of the action, with reference to the culture and the social environment in which the (criminal) behavior is performed.⁸² This capacity appears to correspond to the *M'Naghten test* for legal insanity in the U.S. legal system. According to the *M'Naghten* rule, a defendant should be relieved of criminal responsibility only if they were affected by a defect of reason or mental disease that

⁸⁰ Art. 89 states: "*Chi, nel momento in cui ha commesso il fatto, era, per infermità, in tale stato di mente da scemare grandemente, senza escluderla, la capacità d'intendere o di volere, risponde del reato commesso; ma la pena è diminuita*".

⁸¹ Art. 65 states: "*Quando ricorre una circostanza attenuante, e non è dalla legge determinata la diminuzione di pena, si osservano le norme seguenti: [...]*

2) *alla pena dell'ergastolo è sostituita la reclusione da venti a ventiquattro anni*

3) *le altre pene sono diminuite in misura non eccedente un terzo*"

⁸² Garofoli, R. (2016). op. cit.

precluded them from appreciating the nature, quality, and wrongfulness of their actions at the time of the crime.⁸³

- b) *capacità di volere* is defined as the capacity of the individual to control their conduct to conform to the requirements of law. The control is exerted if the subject can modulate their impulses, that is, through inhibitory mechanisms applied to their behavior according to social and legal norms.⁸⁴ This ability appears to be very similar to the *Irresistible impulse test* adopted in the U.S. to integrate the already existing *M'Naghten* rule.⁸⁵ This test is also known as the *policeman at the elbow test*. It argues that the agent committed the crime under the urge of an irresistible impulse if they would have done it even in the presence of a policeman or whenever a policeman had appeared while the criminal act was about to be carried out. According to this doctrine, a perpetrator should be acquitted if they were affected by a mental disease or

⁸³ M'Naghten's case [1843] UKHL J16 (19 June 1843). "In 1843, Daniel M'Naghten attempted to assassinate the British Prime Minister. Given that M'Naghten claimed that he committed the crime while in a state of mental incapacity, the House of Lords came up with a set of rules for determining when a defendant should be acquitted as a result of insanity. The rules put forth by the House of Lords in the case, which have come to be known as the M'Naghten test for legal insanity, hold that a defendant should be relieved of criminal liability only if at the time of the crime he suffered from a defect of reason or mental disease that prevented him from appreciating the nature, quality or wrongfulness of his act", from Chiesa, L. E. (2011) *Punishing without free will*, in *Utah Law Review*, 1403.

⁸⁴ Garofoli, R. (2016). op. cit.

⁸⁵ The *irresistible impulse test* can be traced back to *Parsons v. State*, 81 Ala. 577 (1887)

condition that prevented them from modulating their behavior at the time of the crime.

Similar to the Italian criminal code, in which the two components of the legal capacity are independent of each other (*capacità di intendere* and *capacità di volere*), the American system ended up combining the *M'Naghten* and *irresistible impulse* tests in the Model Penal Code.⁸⁶

This condition of normality that we can refer to as mental capacity is subjected to legal presumption and is considered to exist if the defendant has reached physical and psychological maturity, conventionally at the eighteenth year of age.⁸⁷ This threshold is standard across most European legal systems. However, in Italy, there is precedent about reasonable doubt favoring the defendant when applied to the defendant's mental capacity: imputability, states the Supreme Court in a 2016 ruling, is an integral part of the crime according to article 85 of the penal code and, thus, if imputability is doubted (totally, or even partially), the burden of proof about its occurrence inevitably falls on the prosecution.⁸⁸

⁸⁶ The Model Penal Code (MPC) is a model act designed to stimulate and assist U.S. State legislatures to update and standardize the penal law of the United States of America. The MPC was a project of the American Law Institute and was published in 1962 after a ten-year drafting period.

For an early, critical review of the MPC from a Prosecutor's perspective, see Kuh, R.H. (1963) *A Prosecutor considers the Model Penal Code*, in *Columbia Law Review*. For a more in-depth look at the MPC, see Dubber, M.C. (2015). *An introduction to the model penal code*, Oxford University Press.

⁸⁷ Precisely, mental capacity is subject to a *iuris tantum* presumption, that means "until proven otherwise".

⁸⁸ Cass. Pen., Sez. I, n. 9738, 25/05/2016.

According to Italian law and most other countries' criminal law, few conditions are eligible to acquit a perpetrator from punishment. Frequent conditions of excuse are lack of perpetrator's mental capacity by reasons of insanity or minor age. The following section will focus on those mental disorders that, according to the most influential Italian jurisprudence, are eligible for an insanity defense. Moreover, a focus on the evolution of the concept of mental insanity is presented.

Chapter 3.2 – Mental conditions for the insanity defense

Many mental disorders, illnesses, and syndromes can influence mental capacity in the legal setting. Moreover, according to the Italian jurisprudence,⁸⁹ also physical diseases may potentially affect mental capacity, like feverish conditions that cause delusional states,⁹⁰ besides minor age and mental disorders. Still, there is an ongoing debate among legal scholars and forensic experts about which mental disorders significantly impact imputability and to what extent. Trying to estimate the effect of different mental diseases on mental capacity presents several issues both from a clinical and normative perspective.

The history of mental health shows an unavoidable degree of subjectivity, which causes pluralism among experts in defining and explaining mental disorders⁹¹. Far from being confined in a long-gone

⁸⁹ Cass. Pen., Sez. V, n. 8282, 08/03/2006

⁹⁰ Garofoli, R. (2016). *op. cit.*

⁹¹ Regier D.A., et al. (2013). *DSM-5 field trials in the United States and Canada, Part II: test-retest reliability of selected categorical diagnoses.*, in *American Journal of Psychiatry*, 170:59–70. doi: 10.1176/appi.ajp.2012.12070999. See also Miller P.R., et al. (2001). *Inpatient diagnostic assessments: 1. Accuracy of structured vs.*

history, this subjectivity still characterizes mental health science today.⁹² In recent years we have seen a proliferation of different theoretical and technical applications of mental disease, each more or less improvised or autonomous of each other, and their correspondent contributions to defend their validity. This pluralism occurred in forensic medicine, psychiatry itself, and psychology, including the ever-growing branch of forensic psychology.⁹³

The clinical challenge the experts have to deal with in a forensic setting is mainly related to a translational operation. First of all, the mental capacity assessment passes through the clinical-diagnostic phase. This first step must rely on clinical criteria in compliance with the references most shared by the scientific community, the *International Classification of Diseases (ICD-11)*,⁹⁴ and the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR)*.⁹⁵ After the experts have identified the clinical condition of the defendant, they must explain, for each actual case, if and how the examinee's mental disorder may have impaired those abilities included in the broad concept of mental capacity. The abovementioned diagnostic manuals belong exclusively to the clinical domain. Thus, they do not describe the effect of the different mental disorders on the ability to appreciate the nature and the unlawfulness of one's misconduct and

unstructured interviews, in *Psychiatry Research*, 105:255–64. doi: 10.1016/S0165-1781(01)00317-1

⁹² Bertolino, M. (2020). *L'imputabilità secondo il codice penale*, in *Sistema Penale*

⁹³ Fornari, U. (2018). op. cit., pg. 1339.

⁹⁴ *International Statistical Classification of Diseases and Related Health Problems* (11th ed.; ICD-11; World Health Organization, 2019)

⁹⁵ *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition, Text Revision (DSM-5-TR; American Psychiatric Association; Washington, March 18, 2022)

refrain from acting it. They could not even give such an indication, if not merely in abstract. Assessing the impact of a particular mental state on mental capacity is a further step. The psychopathological-forensic reasoning is one of the most challenging commitments in charge of the experts. In other words, the professionals' most complex work consists of translating descriptive medical categories into the meanings of normative categories. In this sense, the experts operate a translation by providing the Judge with dialogic reasoning between science and law. Such a dialogue aims to answer the crucial question, "did the defendant's mental condition impair their mental capacity?"

On the medical side, forensic experts should overcome the problem of the plurality of psychopathological approaches by referring to the most updated and shared scientific literature. Experts, indeed, shall explain to the Court the scientific knowledge to which the assessment relates, providing the state of the scientific debate and the degree of reliability of the assertions based on the scientific and technological expertise available at the time of the assessment. The judge is also allowed to decide based only on the scientific explanations given by an expert appointed by one of the parties, provided that the judge adequately motivates their refusal to use a court-appointed expert's report.⁹⁶ As the Italian Supreme Court finally clarified, no scientific method can prove the truth of any scientific law, and this is due to science's intrinsic fallibility. It follows that not even the expert evaluation can be

⁹⁶ Cass. pen., Sez. IV, n. 28102 del 21/03/2019: *"La sentenza di condanna che si fonda sulla sola consulenza tecnica di parte civile deve dare adeguata spiegazione delle ragioni per le quali, a fronte della richiesta dell'imputato di perizia, gli esiti di detta consulenza vengano ritenuti esaustivi e incontrovertibili giacché la regola di giudizio dell'"aldilà ogni ragionevole dubbio" impone al giudice l'adozione di un metodo dialettico di verifica dell'ipotesi accusatoria."*

considered the bearer of absolute truth, especially when the expert is the proponent of a specific scientific approach rather than another.⁹⁷

On the normative side, the position about a defendant's mental capacity varied quite a bit during the past ninety years of applicability of the Rocco code. By examining the preparatory work of the penal code, it is possible to appreciate how the lawmaker intended the concept of mental insanity. Indeed, only clinically proven psychiatric or physical illnesses could lead to a mental insanity defense. Thus, such illnesses represented a pathologically and clinically ascertainable form of mental insanity.⁹⁸ The normative conception of mental insanity included an explicit need to prove the connection between a mental illness and the correspondent organic substrate. According to psychiatry's state of the Art in the years of the drafting of the Italian penal code, just a limited number of mental illnesses, such as psychoses, had a correlate in an organic substrate. This limitation implied that only a few psychiatric disorders could breach the courtrooms, and the concept of mental insanity perfectly overlapped with the narrow borders of organic-based psychiatric illnesses.⁹⁹

The non-unitarian psychopathological science produced, as a consequence, a disoriented jurisprudence about mental insanity. The analysis of the rulings of the Italian Supreme Court involving the insanity defense shows that many approaches followed one another,

⁹⁷ Cass. pen., 2 aprile 2019, n. 14426: "*La dichiarazione resa dal perito nel corso del dibattimento costituisce una prova dichiarativa. Di conseguenza, ove risulti decisiva, il giudice di appello ha l'obbligo di procedere alla rinnovazione dibattimentale, nel caso di riforma della sentenza di assoluzione sulla base di un diverso apprezzamento di essa*"

⁹⁸ About the preparatory work for the Italian criminal code: *Relazione ministeriale sul progetto di codice penale* (1929). Roma, vol. V, p. 143.

⁹⁹ Bertolino, M. (2020). *L'imputabilità secondo il codice penale*, cit.

sometimes coexisting at the same time and, thus, magnifying the uncertainty about the decision on mental insanity. Among the main criteria that the legal doctrine adopted, the oldest one is the medical-organicist model, based on *organic* correlates of psychiatric diseases. Later, the nosographic paradigm was adopted, allowing many other mental disorders to enter the realm of mental insanity only under the condition of being among well-defined and acknowledged psychiatric illnesses. Around the 90s, there have been some attempts to broaden the concept of mental insanity. Some rulings of the Italian Supreme Court demonstrate that they have accepted psychological and multifactorial approaches to define mental illness. Therefore, a new attitude emerged about the insanity defense, besides the traditional ones (organicist and nosographic), as presented in Table 1. According to the innovative approach, not only psychosis and well-defined psychiatric diseases were eligible causes for mental insanity, but also other forms of mental disorder/alteration as long as they are proven to be relevant in impairing mental capacity.¹⁰⁰ The abovementioned doctrinal approach anticipated what the Italian Supreme Court in Plenary Session would have claimed in 2005, in the famous ruling n. 9163, known by the name of *Raso ruling*, from the defendant's surname.

As a brief overview, the evolution of the mental insanity concept moved from medical-organicist to nosographic paradigm first. In the meantime, a few attempts to broaden the mental insanity concept appeared around the 90s even if, just in 2005, the Italian Supreme Court put a benchmark. At its core, the ruling accepts any abnormal condition as a potential cause of insanity, even when not coincident with a specific diagnosis, as

¹⁰⁰ Cass. Pen., 13/01/1986; Cass. Pen., 10/02/1986; Cass. Pen., 29/09/1986; Cass. Pen., Sez. I, n. 5336, 04/03/1997.

long as that *mental condition* is proven to have partially affected or completely impaired the defendant's mental capacity when the crime occurred.

On the doctrinal side, there have been strong hesitations in aligning normative contents to the advancements in the psychopathological field. Nonetheless, an evolutionary process is unavoidable in criminal law. The Judge cannot abstain from considering the progress of medical and psychiatric science. They must adopt the most updated and shared positions, which increasingly embrace a multifactorial view of mental illness. The famous *Raso ruling* of 2005 strongly asserts that, when ruling about mental incapacity and insanity, the Judge must refer to a scientific theory that, on the one hand, must be as up-to-date as possible and, on the other hand, must be a shared practice within the scientific community.¹⁰¹ The decision process should be done without the involvement of any scientific or philosophical debate over the so-called exact sciences. The Judge indeed is under no obligation to decide based on a specific scientific theory; therefore, the Judge should proceed using the instruments at their disposal in the acquired evidence, just making sure that they are up-to-date and sufficiently shared within the scientific community.¹⁰²

¹⁰¹ Cass., Sez. Un., n. 9163, 08/03/2005.

¹⁰² *Ivi*, section 11.0.

Table 1 - Evolution of the accepted conditions for mental insanity in some Italian Supreme Court rulings

Ruling ¹⁰³	Argument
Cass. Pen., 13/01/1986 "Spanò"	<p><i>"Qualunque condizione morbosa, anche se difficilmente caratterizzabile sul piano clinico, può integrare il vizio di mente sempre che presenti connotazioni tali da escludere o diminuire le normali capacità intellettive e volitive."</i></p> <p>Even if hard to define from a clinical point of view, any mental disorder can constitute a cause for legal insanity, as long as its features can abolish or diminish the defendant's normal intellectual and volitional abilities.</p>
Cass. Pen., 10/02/1986, "Capoccini"	<p><i>"L'infermità mentale che esclude o diminuisce l'imputabilità, pur dovendo essere intesa come stato patologico non necessariamente permanente e comprendendo le anomalie psichiche che rifiutino una precisa classificazione nosografica, deve essere tale, per intensità, da escludere o diminuire grandemente la capacità di intendere e di volere del soggetto agente; il carattere labile ed impulsivo indipendente da cause patologiche o carenze congenite non può incidere sulle capacità intellettive e volitive."</i></p> <p>Mental conditions, even if not permanent or nosographically defined, can be relevant for the insanity defense, provided that they are severe enough to diminish or abolish the mental capacity of the agent. Therefore, a weak and impulsive temperament of the defendant cannot affect their</p>

¹⁰³ Older rulings are indexed in the Supreme Court database without section and number, but with the surname of the defendant.

Ruling ¹⁰³	Argument
	cognitive and volitional capacity if it is not derived from a pathological condition.
Cass. Pen., 29/09/1986 "Corbatto"	<p><i>"La nozione giuridica di infermità rilevante ai fini dell'imputabilità, può in concreto essere integrata, oltre che da quelle alterazioni psichiche per le quali la scienza medico-legale utilizza la definizione di malattia di mente (e che la scienza psichiatrica definisce psicosi organiche od endogene ovvero ad esse assimila), anche da altre anomalie che la scienza psichiatrica riconduce nella categoria dell'abnormalità psichica ed i cui soggetti sono per lo più designati con le espressioni di nevrotici (se la sindrome è caratterizzata da un particolare tipo di sofferenza, con senso di malattia, che si esplica con svariati sintomi e meccanismi) e di psicopatici (se la sindrome è caratterizzata da quadri e comportamenti dannosi non solo per il soggetto, ma anche per gli altri) – le quali non integrano il concetto medico-legale specifico di malattia, ma costituendo varianti anomale dell'essere psichico, sono ricondotte nella categoria medico-legale generica delle infermità di mente."</i></p> <p>Alongside traditional psychiatric illnesses, already included in the concept of mental insanity, other mental abnormalities labeled as 'neuroses' or 'psychopathies' can fulfill the notion of mental insanity, even if they do not meet the criteria for proper diseases from a medicolegal point of view.</p>
Cass. Pen., Sez. I, n. 5336, 04/03/1997, "Chiatti"	<p><i>"Il concetto di infermità mentale recepito dal nostro codice penale è più ampio rispetto a quello di malattia mentale, di guisa che non essendo tutte le malattie di mente inquadrare nella classificazione scientifica delle infermità, nella categoria dei malati di mente potrebbero rientrare anche dei soggetti affetti da nevrosi e psicopatie, nel caso che queste si manifestino con elevato grado di intensità e con forme più</i></p>

Ruling ¹⁰³	Argument
	<p><i>complesse tanto da integrare gli estremi di una vera e propria psicosi. In tal caso – al fine della esclusione o della riduzione della imputabilità – è comunque necessario accertare l'esistenza di un effettivo rapporto tra il complesso delle anomalie psichiche effettivamente riscontrate nel singolo soggetto e il determinismo dell'azione delittuosa da lui commessa, chiarendo se tale complesso di anomalie psichiche, al quale viene riconosciuto valore di malattia, abbia avuto un rapporto motivante con il fatto delittuoso commesso.”</i></p> <p>The notion of mental insanity in the Italian Criminal Code is broader than the notion of mental illness. Since not all mental diseases are considered insanity conditions, there are some cases in which people affected by neuroses or psychopathies can be deemed mentally insane, provided that such abnormalities result in being as severe and complex as real psychoses. In any case, there must be a causal link between the mental condition and the criminal act.</p>
<p>Cass. Pen., Sez. I, n. 5885, 22/04/1997</p>	<p><i>“Le cosiddette ‘anormalità psichiche,’ quali le nevrosi o le psicopatie, non indicative di uno stato morboso a differenza delle psicosi acute o criniche non sono annoverabili tra le infermità mentali anzidette e non sono rilevanti ai fini dell’applicazione degli artt. 88 e 89 cod. pen.”</i></p> <p>Mental abnormalities like neurosis or psychopathy are not expressions of a pathological condition, differently from acute and chronic psychoses. They are excluded</p>

Ruling ¹⁰³	Argument
	from the group of admitted conditions for an insanity defense. ¹⁰⁴
Cass. Pen., Sez. VI, n. 26614, 07/04/2003	<p><i>“In tema di imputabilità le anomalie che influiscono sulla capacità di intendere e di volere sono solo le malattie mentali in senso stretto, cioè le insufficienze cerebrali originali o quelle derivanti da conseguenze stabilizzate di danni cerebrali di varia natura, nonché le psicosi acute o croniche, contraddistinte queste ultime, da un complesso di fenomeni psichici che differiscono da quelli tipici di uno stato di normalità per qualità e non per quantità, sicché esula dalla nozione di infermità mentale il gruppo delle cosiddette abnormità psichiche, come le nevrosi e le psicopatie, che non sono indicative di uno stato morboso e si sostanziano in anomalie del carattere non rilevanti ai fini dell’applicabilità degli artt. 88 e 89 c.p., in quanto hanno natura transeunte, si riferiscono alla sfera psico-intellettuale e volitiva e costituiscono il naturale portato di stati emotivi e passionali.”</i></p> <p>Only proper mental illnesses due to an organic substrate, both congenital and acquired, and chronic or acute psychoses, can be relevant for legal insanity. Psychopathy represents a personality abnormality, and it is not a pathology, even if it affects the determination or the inhibition of one's volition.</p>

¹⁰⁴ This ruling has been recently cited in two Italian Supreme Court rulings: Cass. Pen., Sez. I, n. 52951, 25/06/2014 and Cass. Pen., Sez. IV, n. 2318, 19/01/2018. The Italian Supreme Court used the ruling from 1997 to reject the insanity defense proposed by the defendant’s attorney based on a diagnosis of antisocial personality disorder. This is an example of the Italian Supreme Court completely scotomizing the *Raso ruling* of 2005.

Ruling ¹⁰³	Argument
	Therefore, psychopathy cannot represent a cause of impaired or suppressed mental capacity.
Cass. Pen., Sez. I, n. 19532, 24/04/2003	<p><i>“il concetto di infermità mentale recepito dal nostro codice penale è più ampio rispetto a quello di malattia mentale, di guisa che, non essendo tutte le malattie di mente inquadrare nella classificazione scientifica delle infermità, nella categoria dei malati di mente potrebbero rientrare anche dei soggetti affetti da nevrosi e psicopatie, nel caso che queste si manifestino con elevato grado di intensità e con forme più complesse tanto da integrare gli estremi di una vera e propria psicosi. In tal caso – al fine della esclusione o della riduzione della imputabilità – è, comunque, necessario accertare l’esistenza di un effettivo rapporto tra il complesso delle anomalie psichiche effettivamente riscontrate nel singolo soggetto e il determinismo dell’azione delittuosa da lui commessa, chiarendo se tale complesso di anomalie psichiche, al quale viene riconosciuto il valore di malattia, abbia avuto un rapporto motivante con il fatto delittuoso commesso”</i></p> <p>The concept of mental insanity is broader than the realm of mental disorders. Neurosis and psychopathy of high intensity and complexity, such that they overlap into an authentic psychosis, might represent a cause of exclusion of mental capacity. In other words, this ruling requires that a mental condition, to be considered a mental insanity condition, must have the features of psychosis.</p>
Cass. Pen., Sez. VI, n. 22765, 22/05/2003	<i>“In tema di imputabilità, gli articoli 88 e 89 c.p. – che disciplinano rispettivamente l’infermità totale e parziale di mente, quali cause che escludono o diminuiscono la capacità di intendere e di volere – postulano l’esistenza di una vera e propria malattia mentale, ossia di uno stato patologico che</i>

Ruling ¹⁰³	Argument
	<p><i>incide sui processi volitivi e intellettivi della persona oppure di anomalie psichiche che, seppure non classificabili secondo precisi schemi nosografici, perché sprovviste di una sicura base organica, siano tali, per la loro intensità, da escludere totalmente o scemare grandemente la capacità di intendere e di volere del colpevole. Ne consegue che una condizione di perturbamento psichico transitoria, di natura non patologica, dovuta ad una sindrome ansiosa depressiva, non essendo destinata ad incidere sulla capacità di intendere e di volere, non è in grado di compromettere l'imputabilità dell'imputato."</i></p> <p>Proper mental disorders that affect mental capacity, and mental abnormalities without a precise nosographic classification or a well-defined organic substrate, can affect mental capacity and, thus, are possible causes of mental insanity. Therefore, a temporary disturbance without a pathological base, due to an anxious-depressed syndrome, does not affect mental capacity.</p>
Cass. Pen., Sez. I, n. 24255, 04/05/2004	<p><i>"Il vizio totale o parziale di mente che escluda o scemi grandemente senza escluderla la capacità di intendere e di volere deve essere dovuto ad uno stato patologico che, seppure non comprensivo delle sole malattie fisiche e mentali nosograficamente classificate, sia comunque riconducibile ad una "infermità", ancorché non classificabile o non insediata stabilmente nel soggetto, che incida in modo rilevante sui processi intellettivi e volitivi di quest'ultimo, rendendolo incapace di rendersi conto del valore delle proprie azioni e di determinarsi in modo coerente con le rappresentazioni apprese."</i></p> <p>A pathological condition does not need to coincide with organic or psychiatric disorders; it also includes</p>

Ruling ¹⁰³	Argument
	physical abnormalities, even without an organic substrate, as long as their expression is of high intensity and suppresses or significantly reduces mental capacity.
Cass. Pen., Sez. Un., n. 9163, 08/03/2005	<p><i>"[...] ai fini del riconoscimento del vizio totale o parziale di mente, rientrano nel concetto di "infermità" anche i "gravi disturbi della personalità", a condizione che il giudice ne accerti la gravità e l'intensità, tali da escludere o scemare grandemente la capacità di intendere o di volere, e il nesso eziologico con la specifica azione criminosa."</i></p> <p>Severe personality disorders are included among the possible causes of mental insanity, provided that the judge assesses its severity and intensity, which must diminish or abolish mental capacity. Moreover, the judge must assess the causal link between the disorder and the criminal act.</p>
Cass. Pen., Sez. V, n. 8282, 08/03/2006	<p><i>"Del pari e per lo stesso motivo non sono sufficienti a legittimare il riconoscimento di infermità mentale neppure parziale, le manifestazioni di tipo nevrotico, le "personalità psicotiche o psicopatiche", le alterazioni comportamentali prive di substrato organico, ancor più se a carattere episodico o sporadico. Non lo è neppure la insufficienza mentale, specie di grado lieve e che non giunga alla oligofrenia né alla frenastenia, perché l'"ipovoluzione intellettuale, l'immaturità, non sono sufficienti a sorreggere l'ipotesi di una alterazione patologica clinicamente accertata e provocante uno stato morboso quando non sia di grado tale da non permettere al reo di comprendere i limiti di un'azione lecita né il disvalore di un comportamento antiggiuridico."</i></p>

Ruling ¹⁰³	Argument
	Neurotic expressions, psychotic and psychopathic personalities, and behavioral alterations not due to an "organic" substrate are not sufficient to be causes of mental insanity.

As the listed rulings show, the *Raso ruling* by the Italian Supreme Court in Plenary Session shifted the focus of the forensic assessment from the clinical defect of the mind itself to the second level of the imputability judgment: the psychological-normative one. In other words, rather than the diagnostic classification, the judge requires the experts to verify the actual effects that the psychological disorder played on the defendant's mental capacity.

Some jurisprudence after the *Raso ruling* still excludes temperamental abnormalities from the group of potential relevant causes for mental insanity. Although the influence of these abnormalities on thought and behavior is acknowledged, in some cases, they have not been considered real illnesses for an insanity defense since they do not originate from a pathological condition.¹⁰⁵

3.2.1 The problem of applying the *Raso ruling* in the practice

The *Raso ruling* claims much more clearly than previous rulings – and with more authoritativeness – that personality disorders (or abnormal personalities) may be relevant for insanity defense if some conditions are present. Nonetheless, in practice, the rulings after 2005, while acknowledging the *Raso ruling's* principles, concluded that several

¹⁰⁵ Cass. Pen., n. 8282, 08/03/2006 cit.

personality disorders were not severe enough to have affected mental capacity. The motivations they presented were logical but not resolute about the issue of personality disorders. Somehow, it seems that since 2005, the Supreme Court has admitted very few cases of personality disorders or abnormal personalities worthy of being excuses for an insanity defense.

In the post-*Raso* jurisprudence, the principle of the Italian Supreme Court seems to be applied in a very flexible way so that in front of a similar (or identical) clinical condition, sometimes it is invoked to recognize mental insanity, some others to deny it.¹⁰⁶

While many Judges are skeptical about personality disorders as insanity-relevant illnesses, there are contradictory interpretations of the provision expressed by the *Raso* ruling among experts for different reasons. These discrepancies remark the great challenge of the communication between science and law. This ruling sets the focus on the impact of a mental condition on mental capacity instead of the disorder's etiology and nosographic classification. Some experts affirm that it is necessary to determine the severity of personality disorder within the clinical setting to establish whether that disorder is relevant for the insanity defense. Some others argue that there is a *clinical* severity and a *forensic* severity of the diseases, that they do not always coincide, and that they must be evaluated separately. While clinical severity is assessed based on the impairment in personal life, including school, work, and social

¹⁰⁶ Bertolino, M. (2020). *L'imputabilità secondo il codice penale*, cit. See also Cass. Pen., Sez. V, n. 8282, 08/03/2006 cit.; Cass. Pen., Sez. VI, n. 43285, 12/11/2009; Cass. Pen., Sez. V, n. 44045, 25/11/2008; Cass. Pen., Sez. III, n. 1161, 14/01/2014; Cass. Pen., Sez. I, n. 40286, 27/09/2013; Cass. Pen., Sez. V, n. 9843, 01/03/2013; Cass. Pen., Sez. I, n. 35842, 08/08/2019; Cass. Pen., Sez. II, n. 13959, 10/04/2020.

relationships, the forensic severity must refer to the individual's ability to understand the nature of the misconduct and modulating impulses.

Debates about the forensic and clinical severity of the disease often arise in the courtroom when discussing personality disorders (PDs). Indeed, personality disorders and other mental disorders are classified according to a descriptive-phenomenological model. This model presents diagnostic criteria, expressed as descriptions of symptoms and behaviors for each clinical condition, with an intrinsic low degree of objectivity in the clinical assessment. The diagnostic category of Personality Disorders includes pathologies that are very different from each other. Diagnostic criteria for distinct personality disorders often overlap. Moreover, each personality disorder can present multifaceted and atypical features. Such conditions are frequently comorbid with other diseases (like alcohol or substance addiction). Given these issues in the clinical setting, it is easy to understand how the same challenge is even more problematic in a forensic evaluation. This low degree of objectivity drags and amplifies in the forensic context.

A multidimensional neuroscientific approach appears to be promising in increasing the objectivity of forensic assessment. The strength of this integrated approach comes from the consideration of interacting features of the defendant, like neural, biological, and environmental components from which deviant behaviors possibly emerge.

Chapter 4 – The contribution of neuroscience to criminal trials

In the previous chapter, we presented some current issues of mental insanity assessment in a criminal trial, focusing on the challenging relationship between criminal law and mental health medical disciplines. The following section goes into a more detailed analysis of the tools available to forensic experts. In particular, we will discuss the application of neuroscientific evidence in insanity evaluation as a valuable method to improve clinical and forensic accuracy. In addition, we will present and discuss some real cases of insanity assessment in Italian courts, in which neuroscience has played a relevant role.

The recent sprouting of behavioral neuroscience provides solid clues supporting the existence of multiple modulating factors of human behavior. It is common to think of human beings as rational creatures. This insight is partially motivated by the indisputable evolution of the human brain in volume and complexity compared to other animal species' brains, particularly regarding the prefrontal cortex.¹⁰⁷ The prefrontal cortex is involved in a wide array of social, cognitive, and affective functions, including decision-making processes.¹⁰⁸ A defect in this cortical area is often associated with significant disruption in one or more abilities listed above. Impaired affective and cognitive frontal

¹⁰⁷ Fuster, J. (2015). *The prefrontal cortex*, 5th Edition, Academic press, Cambridge, MA.

¹⁰⁸ Dixon, M. L., Thiruchselvam, R., Todd, R., Christoff, K. (2017). *Emotion and the prefrontal cortex: An integrative review*, in *Psychological bulletin*, 143(10), 1033.

Hiser, J., & Koenigs, M. (2018). *The multifaceted role of the ventromedial prefrontal cortex in emotion, decision making, social cognition, and psychopathology*, in *Biological Psychiatry*, 83(8), 638-647.

functions are typically present in mental and neurological diseases or brain lesions involving the most anterior regions.¹⁰⁹

Brain modifications, both pathological and physiological, are due to a combination of stimuli coming from different sources. Indeed, albeit any experience must go through the brain, some factors are innate, like genetics, while others derive from external influences, such as the social and cultural background. This distinction is historically known as the "*nature and nurture*" debate.¹¹⁰ However, genetic and environmental elements influence each other reciprocally all life long. The individual genetic pool modulates the behavioral, cognitive, and affective outcomes and many other aspects of one's life. The other way round, social experiences and educational background – in its broader meaning – affect the expression of the genetic asset.¹¹¹ Thus, as for any behavior, the dynamic interaction of neural, genetic, and environmental components

¹⁰⁹ Xu, P., Chen, A., Li, Y., Xing, X., & Lu, H. (2019). *Medial prefrontal cortex in neurological diseases*, in *Physiological genomics*, 51(9), 432-442.

Bechara, A. (2004). *The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage*, in *Brain and cognition*, 55(1), 30-40.

¹¹⁰ The first mention of the *nature and nurture* dichotomy is attributable to Galton, F., (1869). *Hereditary Genius: An Inquiry into its Laws and Consequences*, Macmillan, London. See also Galton, F., (1874). *English Men of Science: Their Nature and Nurture*, Macmillan, London.

¹¹¹ Robinson, G. E., Fernald, R. D., & Clayton, D. F. (2008). *Genes and social behavior*, in *Science*, 322(5903), 896-900.

Palumbo, S., Mariotti, V., Iofrida, C., Pellegrini, S. (2018). *Genes and Aggressive behavior: epigenetic mechanisms underlying individual susceptibility to aversive environments*, in *Frontiers in Behavioral Neuroscience*. 12:117. doi: 10.3389/fnbeh.2018.00117.

contributes to the modulation of criminal conduct.¹¹² Of course, deviant and criminal behavior share these underlying interacting mechanisms.

Diving back into the forensic setting, it becomes more and more evident how the traditional approach to mental insanity assessment is weaker than a multidisciplinary method that embraces the defendant's mental condition and criminal behavior from different and complementary points of view. Undoubtedly, the neuroscientific findings of physiological and pathological correlates of human behavior challenge

¹¹² For a review see Romero-Martinez, A, Gonzalez M, Lila M, Gracia E, Marti-Bonmati L, Alberich-Bayarri A, et al. (2019). *The brain resting-state functional connectivity underlying violence proneness: is it a reliable marker for neurocriminology? A systematic review*, in Behavioral Science. 9:11. doi: 10.3390/bs9010011.

Sajous-Turner, A., Anderson, N.E., Widdows, M., Nyalakanti, P., Harenski, K., Harenski, C., et al. (2019). *Aberrant brain gray matter in murderers*, in Brain Imaging and Behavior, 14:2050–61. doi: 10.1007/s11682-019-00155-y.

Iofrida, C., Palumbo, S., Pellegrini, S. (2014). *Molecular genetics and antisocial behavior: where do we stand?* In Experimental Biology and Medicine. 239:1514–23. doi: 10.1177/1535370214529508.

Rigoni, D., Pellegrini, S., Mariotti, V., Cozza, A., Mechelli, A., Ferrara, S.D., et al. (2010). *How neuroscience and behavioral genetics improve psychiatric assessment: report on a violent murder case*, in Frontiers in Behavioral Neuroscience 4:160. doi: 10.3389/fnbeh.2010.00160.

Raine, A., Yang, Y. (2006). *Neural foundations to moral reasoning and antisocial behavior*, in Social Cognitive and Affective Neuroscience, 1, 203–213.

Pietrini, P., Guazzelli, M., Basso, G., Jaffe, K., Grafman J. (2000). *Neural correlates of imaginal aggressive behavior assessed by positron emission tomography in healthy subjects*. American Journal of Psychiatry, 157:1772–81. doi: 10.1176/appi.ajp.157.11.1772.

the clinical method traditionally used in criminal trials.¹¹³ This technique consists of a set of unstructured or semi-structured clinical interviews. Most of the time – although not always – the administration of neuropsychological and psychopathological tests follows.

The most significant limitation that characterizes both types of interviews is their reliance on the defendant's verbal report.¹¹⁴ The unstructured interview is still widely used because it has the advantage of being flexible, allowing the experts to adapt the progression of the examination for each specific case. However, a longer-lasting and flexible interview does not correspond to a more accurate evaluation, especially in the absence of other pieces of clinical evidence.

Thus, even accepting the fundamental role of the clinical interview, experts' (un)conscious biases and the subjective perspective intervene independently of the specialists' expertise.¹¹⁵ The neuroscientific multimodal methodology may considerably reduce the subjectivity in the insanity assessment. For example, brain alterations highlighted by neuroimaging are fundamental for supporting the clinical observation and possibly changing the initial hypothesis. In conclusion, combining

¹¹³ Scarpazza, C., et al. (2021). *Translational Application of a Neuro-Scientific Multimodal Approach Into Forensic Psychiatric Evaluation: Why and How?*, in *Frontiers in Psychiatry*, 12:597918. doi: 10.3389/fpsy.2021.597918.

¹¹⁴ Meynen, G. (2020). *Neuroscience-based psychiatric assessments of criminal responsibility: beyond self-report?*, in *Cambridge Quarterly of Healthcare Ethics*, 29:446–58. doi: 10.1017/S0963180120000195

¹¹⁵ Rosen, J., Mulsant, B. H., Bruce, M. L., Mittal, V., & Fox, D. (2004). *Actors' portrayals of depression to test interrater reliability in clinical trials*, in *American Journal of Psychiatry*, 161(10), 1909-1911. The most famous experiment is described in Rosenhan, D. L. (1973). *On being sane in insane places*, in *Science*, 179(4070), 250-258.

the clinical interview with neuroscientific methods is a promising strategy for overcoming subjectivity and divergences among experts and, finally, providing the Judge with more robust reliability of an insanity evaluation.¹¹⁶

Chapter 4.1 – Case studies

In the following sections, we present two famous Italian cases that pioneered the neurobiological evidence in courtrooms. Then, we describe a recent case in which the insanity assessment has been performed through a multimodal approach. The neurobiological evidence collected ignited a stimulating debate among experts.

Chapter 4.1.1 – "*Lighter sentence for murderer with 'bad genes.'*"¹¹⁷

Case 1 – Court of Appeal of Trieste, the 18th of September, 2009

In 2007, A.B., an Algerian citizen, stabbed to death a young Colombian man who had rudely accused him of being a homosexual because he was wearing kajal make-up. A few hours before the murder, A.B. argued with a group of people after reciprocal provocations. The dispute ended in a physical altercation that left A.B. with injuries after being hit with kicks and punches and beaten with a belt. A.B. went back to an Islamic center and changed his clothes. Then, he went to a shop, bought a knife, looked for the man who had insulted him, and stabbed him to death.

¹¹⁶ Scarpazza, C. et al. (2021). op. cit.

¹¹⁷ Feresin, E. (2009). *Lighter sentence for murderer with 'bad genes'*, in Nature News, <https://doi.org/10.1038/news.2009.1050>

However, A.B. murdered the wrong man, believing he caught the author of the insult.

During the first-instance trial at the Court of Udine, the Judge appointed an expert to assess A.B.'s mental capacity at the time of the crime. The perpetrator had a psychiatric history of delusions treated with antipsychotic drugs that he self-suspended the year before the murder. The expert diagnosed the defendant with a psychotic disorder characterized by delusions and a comorbid personality disorder with impulsive-antisocial components. Moreover, the defendant's cognitive performance corresponded to the lowest range of normality. In conclusion, the Judge's expert stated that A.B.'s mental capacity was wholly lacking when he committed the crime. The Judge disagreed with such a conclusion. In particular, the antecedent and the murder-subsequent behavior indicated his awareness of the unlawfulness of his actions. However, the Judge deemed the psychotic disorder that affected A.B. as relevant in determining a partial impairment of his mental capacity. The Judge convicted A.B. to 9 years and two months in prison. The Appeal trial followed, elicited by the defense.¹¹⁸

The Court of Appeal of Trieste ordered a new psychiatric assessment and appointed Prof. Giuseppe Sartori and Prof. Pietro Pietrini. The two experts described a dependent-negativistic personality comorbid with an anxious-depressive disorder. Moreover, A.B. presented a delusional psychotic disorder and weak cognitive abilities. These elements prevented him from appropriately understanding and acting in social and interpersonal situations.

The innovative element of the insanity assessment was the genetic exam. The experts analyzed a saliva sample of A.B. to investigate the presence

¹¹⁸ Corte d'Assise d'Appello di Trieste, 01/10/2009, n. 5

on his D.N.A. of particular genes that regulate some neurotransmitters that are crucial for modulating impulsive and aggressive behavior. In particular, the carriers of peculiar allelic variants of some genes are at higher risk of developing aggressive behaviors towards others if they grew up in a hostile social environment. A negative background includes traumatic experiences, neglecting family, affectively deprived relationships, dysfunctional parental interaction, and many other situations that may significantly impact an individual.

The genetic results showed that A.B.'s profile included allelic variants of most polymorphisms associated with aggressive and impulsive behavior. Of particular relevance, he was a carrier of the low activity allele for the gene MAOA (MAOA-l). The experts explained in their report that this allelic variant, coupled with the defendant's negative social background, could make the subject more prone to manifest aggressiveness if provoked or socially excluded. In conclusion, the experts stated that A.B.'s mental capacity was significantly impaired, even if not completely suppressed when he committed the crime.

After analyzing the probatory elements and the second expert assessment, the Court of Appeal of Trieste convicted A.B. to 8 years and two months in prison. The Court, thus, weighted the mental insanity excuse as more relevant than the first-instance verdict. The genetic evidence played a crucial role in the final decision of this case. Indeed, the Court of Appeal welcomed the evidence that specific genes present in the accused made him exceptionally susceptible to aggressive reactions, especially in stressful situations, and considered this finding a corroborative sign of A.B.'s deficit. Because of these reasons, The Court

applied the maximum reduction for the partial insanity cases.¹¹⁹ The case of A.B. is the first occurrence of an Italian court basing the insanity defense's motivation on genetic evidence.

Case 2 – Court of Como, the 20th of May, 2011

In 2009, S.A., a 26 years-old woman living in Cirimido (province of Como – Italy), segregated her older sister inside the house and forced her to intake a lethal dose of psychiatric drugs, causing her death. Later, she set the sister's body on fire and hid it clumsily in the yard. In the subsequent months, S.A. carried out multiple actions to manipulate the suspicious circumstances of her sister's disappearance by making up fake stories, accompanied by letters and other evidence she deceitfully created herself. In the meantime, S.A. administered psychotropic drugs to her father, provoking him severe damage and hospitalization.¹²⁰ Moreover, she attempted on her parents' life on various occasions, once by trying to blow up their car and, eventually, by strangling the mother with a belt and making her faint. S.A. failed in this last aggression because, being under surveillance after her sister went missing, she was interrupted by the Police breaking into the house and taken into custody.

¹¹⁹ Ivi: "Proprio la circostanza emersa nel corso dell'ultima perizia psichiatrica e, vale a dire, che determinati "geni" presenti nel patrimonio cromosomico dell'imputato lo renderebbero particolarmente reattivo in termini di aggressività – e, conseguentemente vulnerabile – in presenza di situazioni di stress induce la Corte a rivalutare la decisione del G.U.P. di non applicare nel massimo la riduzione di pena possibile per il difetto parziale di imputabilità. Proprio l'importanza del deficit riscontrato dai periti con queste nuovissime risultanze frutto dell'indagine genetica portano a ritenere che la riduzione possa essere effettivamente operata nella misura massima di un terzo. "

¹²⁰ Grandi, C. (2016) op. cit.

Even though S.A.'s manipulative behavior appeared clever at first glance, her deceptive plan before and after her sister's killing was quickly unmaskable and irrational.¹²¹

The Judge ordered to proceed with a psychiatric assessment for mental insanity. The experts diagnosed S.A. with dissociative syndrome, pathological lying, and *pseudologia fantastica*.¹²²

The defendant's attorney asked for a neuroimaging and genetic examination, in addition to the psychiatric assessment. The consultancy team of S.A.'s defense, led by Prof. Sartori and Prof. Pietrini, highlighted relevant morphological alteration in the woman's brain, which involved crucial areas for impulse control (lying included), moral sense, and reasoning abilities. Furthermore, the genetic profile of S.A. carried three allelic variations of specific genes, which are associated with an incremented vulnerability to commit impulsive and aggressive actions, especially in stressful situations. The Court of Como acknowledged the relevance of neuroimaging and genetic results provided by the defense and convicted S.A. to 20 years of prison for partial mental insanity. This case is the Italian milestone for accepting the neuroscientific evidence in the decision about criminal responsibility.

¹²¹ Gulotta, G. *Il ruolo delle neuroscienze nel caso di Como: la prospettiva del difensore di Albertani*, in *Filodiritto*, 27/05/2020; available online at <https://www.filodiritto.com/print/pdf/node/39881> last visited on 21st of April, 2022,

¹²² Collica, M.T. (2018). *Gli sviluppi delle neuroscienze sul giudizio di imputabilità*, in *Diritto Penale Contemporaneo*.

Chapter 4.1.2 – A debated multidisciplinary insanity defense in a recent Italian murder case

1) The fact and the first-instance trial.¹²³

In the first days of March 2016, two young men, M.P. and M.F., gathered in the apartment of M.F. and consumed cocaine and alcohol for two consecutive days. They invited a few people to reach them during this time range, mainly to buy more cocaine. On the morning of the third day, the two men drove around the city searching for anyone with the intent to bring them home and harm or even kill them. Since the search was vain, one of the perpetrators contacted the victim, a 23 years-old man, asking for his availability for sexual services in exchange for money, to which the victim agreed. Once the victim was in the apartment and complied with the request to get undressed, M.P. and M.F. offered him an alcoholic beverage, to which they added a massive quantity of an anesthetic drug (GHB, possibly Alcover). GHB is also known as a "date-rape drug" for its dazing and narcotic effect. As soon as the victim started feeling the effects of the drug, he ran off to the bathroom, where the two perpetrators assaulted him, restrained him, and took him to the bedroom. The victim was strangled, stabbed with different knives, and hit over the head with a hammer, sustaining serious wounds. Along with the more severe wounds, the perpetrators appeared to have inflicted injuries only to cause the victim more pain. The victim died after a considerable time had passed since the initial assault, which convinced the prosecution to charge M.P. and M.F. with premeditated murder, further aggravated because of the torture the perpetrators enacted upon their victim.

¹²³ 1° Corte d'Assise d'Appello di Roma, n. 34, 25/09/2018.

M.F.'s defense asked the Judge for an insanity assessment by providing defensive expert reports on multiple areas.

The defendant claimed to be affected by neurological damages due to habitual overuse of alcohol and psychotropic substances, which started during adolescence.

The MRI showed significant morphological alterations, such as reduced total grey matter volume, an abnormal volumetric difference between the amygdalae, and reduced volume of the bilateral orbitofrontal cortex, with significant asymmetry between the two.

PET-CT exam excluded any alteration in brain perfusion or metabolism.

The psychiatric consultant diagnosed a Bipolar Disorder with psychotic episodes induced by the early abuse of cocaine and alcohol. The expert stated that M.F.'s mental capacity was severely impaired and possibly entirely suppressed during the criminal action.

The toxicological examination of different biological samples confirmed that M.F. chronically used cocaine and alcohol.

Finally, the genetic results revealed the presence of allelic variants of some genes related to impulse control and aggressive behavior modulation: homozygosis for 5-HTTLPR (fragment 44 bp-SS genotype) and COMT (Leu136Leu).¹²⁴

In the first-instance trial, the Judge deemed the configuration of the above-listed elements not relevant for reducing M.F.'s capacity to understand the nature of his actions and control his behavior in conformity with the law. The verdict (21/02/2017) convicted M.F. to 30

¹²⁴ Oliva, A., Grassi, S., Zedda, M., Molinari, M., & Ferracuti, S. (2021). *Forensic value of genetic variants associated with anti-social behavior*, in *Diagnostics*, 11(12), 2386.

years in prison. In June 2017, the other defendant, M.P., committed suicide in jail before the conclusion of the trial against him.

2) The Appeal trial.¹²⁵

The defendant appealed the conviction because of the lacking of the *ex-officio* insanity evaluation, despite the results provided by the defense's experts. Thus, the Court of Appeal of Rome accepted the defendant's grievance and appointed a team of forensic experts to undergo M.F. to a psychiatric and neuro-biological examination. The team was composed of Prof. Stefano Ferracuti, Prof. Marco Molinari, and Dr. Antonio Oliva. They examined all the elements collected in the previous trial stage, conducted clinical interviews with M.F., and administered a battery of neuropsychological and psychopathological tests.

The experts diagnosed M.F. with an Unspecified personality disorder of moderate severity, comorbid with a history of alcohol and substance abuse, and an alleged parasomnia. Considering all the elements, the Court's experts excluded the presence of sufficient cause of mental insanity in M.F. when he committed the crime.

Leaving aside for a while the neurobiological pieces of evidence, we will describe the controversy among experts on the personality disorder's relevance in affecting M.F.'s life and mental capacity.

Although each party's experts agreed on the diagnosis of personality disorder, a stimulating discussion took place during the hearings, focusing on the severity of the disorder. Moreover, the same set of elements was used by counterposed parties either to demonstrate or to deny the disorder's severity.

¹²⁵ 1° Corte d'Assise d'Appello di Roma, *ibidem*.

Indeed, the impact of the pathological personality on the defendant's life was subjectively interpreted. For example, according to M.F.'s psychosocial and educational history, he was attending university, was employed in different jobs, had sentimental relationships, and was perfectly capable of refraining from using alcohol or substances when necessary for the circumstances, like the driver's license periodical checks.

However, looking deeper at the same story, a completely different existential situation showed up. M.F. did attend university for a while, but it consisted of a private telematic university, and he took just a couple of exams before dropping out. In his work life, the defendant appeared unwilling to do any job, so his father tried to hire him in his family restaurant. M.F. ended up just stealing money and alcohol from the restaurant, and thus he was fired. After this, he started a small business, but it went bad very fast, and M.F. obtained no results except for almost bankrupting his company.

The sentimental relationships of the defendant resulted in being just occasional or a few-weeks lasting. Furthermore, it emerged that M.F. engaged in violent sexual behavior toward a girl during one of their first dates. During a sexual encounter, he went very close to suffocating her without the girl's consent to practice erotic suffocation. Immediately after this event, the defendant entered the bedroom wearing a wig and a swimming suit in a mental state described as irrational and confused by that girl.

The defendant's consultants, Prof. Pietro Pietrini and Prof. Stefano Zago claimed that a severe personality disorder affected the offender, basing their expert opinion on this enormously dysfunctional interpersonal functioning. The psychiatric disorder represented just a piece of the forensic assessment of the accused. It matched, indeed, with the genetic and brain morphology abnormalities, the history of alcohol and

substance chronic abuse, and the borderline IQ of the defendant (83 points). Pietrini and Zago argued that the complex configuration of all clinical elements greatly impacted M.F.'s mental capacity at the time of the crime by preventing him from acting with rationality.

Based on the same anamnestic elements, the victim's family consultant stated that M.F. had such a weak personality disorder that anybody can be considered affected by it. The prosecutor agreed on a low severity of the personality disorder, defining it as just a *blurred* personality disorder. Interestingly, the prosecutor affirmed this right after highlighting the dysfunctionality of M.F.'s behavior in his entire life.

The results of the neurobiological examination have been unanimously deemed not relevant or, at best, noticeable but independent of each other. None of the elements have been considered to play a significant causal role in the perpetrator's criminal behavior. M.F. was definitively convicted to 30 years in prison, his insanity defense rejected, and he was considered fully responsible for the crime.

This trial is fascinating because it put on stage the controversies on the burning issues in insanity assessment. As described in chapter 3, multiple issues are still debated about the relevance of personality disorders in affecting mental capacity. Moreover, our knowledge of neurobiological correlates of criminal behavior is promising but still at an early stage. This case demonstrates how far we are from unanimity in applying the results from genetics and neuroimaging to the forensic field.

Conclusions

As we have seen, interpretations and opinions can dramatically collide when dealing with criminal behavior and insane perpetrators. Divergent opinions and uncertainty in the courtroom can lead to mistakes and confusion in the legal doctrine that studies and interprets the law and in trials, where legal criteria must be applied to criminal cases. Uncertainty is certainly the name of the game in the field of forensic psychopathology: in daily proceedings, we observe a low level of agreement among experts in definitions, criteria, and techniques, which often lead to controversial outcomes.

We have shown that the methods employed when evaluating the mental condition of perpetrators derived *tout-court* from the clinical practice. However, although a certain degree of uncertainty and subjectivity can still be tolerable in the clinical setting of mental health, the same should not be accepted in forensics, where the decision must be taken “beyond a reasonable doubt.” Instead, it appears that the methods and criteria commonly used in forensic psychopathology are, most of the time, not objective enough and can leave many doubts, some of them “reasonable.”

A possible solution could imply tackling the problem at its source: analyzing the brain. Neuroscientific evidence can provide a useful tool that supports the expert's evaluation in the setting of an insanity assessment. The use of neuroscientific data in criminal trials could provide experts with an objective, common ground about the defendant's brain, therefore limiting the extent of uncertainty. However, this would not be entirely resolute and will lead to at least three issues, which will need to be addressed if we choose to follow the path of neuroscientific evidence.

The first one is that, even with the common ground offered by brain imaging and behavioral genetics, there still can be some space for subjectivity and opinions. Whereas one cannot argue about the structure of the defendant's brain after seeing the images, it is very common to find different interpretations about the impact that specific brain alterations may have on thought and behavior. In other words, interpretative pluralism can still find a way of influencing evaluations about the potential causal link between neuroscientific evidence and criminal conduct. Some have already proposed to limit the usage of structural neuroimaging only to those cases that already show some neuropsychological suspect results. The purpose of such limitation is to avoid using brain imaging in cases that have not collected any clue about potential brain dysfunction and, thus, to prevent the defendant from undergoing an MRI examination just with the aim of finding anything somewhere in the brain. MRI should therefore be used only to confirm and corroborate, not to explore.¹²⁶

A further problem can arise from the fear, somewhat unjustified, of the abolition of criminal responsibility as a consequence of the application of neuroscience. Some scholars, especially from the legal field, consider the advent of neuroscientific evidence in the courtrooms as the carrier of the most extreme reductionism, which entails the risk of undermining the criminal system at its basis. As expressed in Chapter 2 of the present work, some philosophers, neuroscientists, and even legal scholars have argued for a world devoid of personal responsibility due to the actions being predetermined by the human brain. However, this scenario is far from being adopted by the legal system and society, and there is still

¹²⁶ Scarpazza, C., Ferracuti, S., Miolla, A., Sartori, G. (2018) *The charm of structural neuroimaging in insanity evaluations: guidelines to avoid misinterpretation of the findings*, in *Translational Psychiatry*

plenty of space for determinism and responsibility to coexist. The fear expressed by traditional legal doctrine appears unjustified even with regard to the most extreme of positions. Some proponents of a deterministic worldview ended up supporting a more humanitarian view of punishment,¹²⁷ which is strongly welcomed and shared with scholars in criminal law, especially in Italy, where reeducation through punishment is engraved in Art. 27 of the Italian Constitution.

A third issue, rarely discussed, concerns the monetary and time resources needed to perform neuroimaging examinations. MRI exams are very costly, and their use cannot be justified if not in the more critical, high-profile criminal cases. The matter of expenses is problematic for the justice system, especially in Italy. Indeed, the Italian justice system is notoriously underfunded and understaffed, and arguing for wider use of neuroscientific evidence without considering the systemic costs has the potential for being just wishful thinking. However, one can argue that the defendants can gather neuroimaging data on their own, if needed, without weighing on the justice system's budget at all. In this case, there would inevitably be the risk of leaving neuroimaging and neurobiological data out of the reach of the thousands of defendants that do not have the financial means to hire experts willing to gather the MRI and genetic evidence. The low financial capacity is possibly even more emphasized in minor crimes, where the expenses for sophisticated examinations would end up being higher than those for the trial and attorney.

Forensic neuroscience and forensic psychopathology are still ridden with many open questions that require further study. A considerable issue stems from the ambiguous application of the *Raso ruling* regarding the relevance of personality disorders for the insanity defense. The 2005

¹²⁷ Greene, J., Cohen, J. (2004). op. cit.

ruling by the Plenary Sessions seems to have provoked more issues than it tried to solve: not only it broadened the concept of criminal insanity, but it also intensified a debate among experts on its exact content. Further research in psychopathological and psychiatric disciplines, also performed with the help of neuroscience and neurobiology, may contribute to improving the communication between lawmakers and forensic scientists. The other way around, judges (and lawyers in general) might assist with the translation effort by gathering more scientific information and resources, both during their formative years at University or during their professional career. Recently, prominent scholars of evidence law have argued in favor of a shift in the approach to *de facto* evaluations, moving away from the concept of “scientific evidence” and towards “evidence science.” More specifically, it has been argued that the judge must embrace the scientific method as the leading way for gaining knowledge and making their decision.¹²⁸ Some scholars previously claimed that shifting the focus from the object to the method of the scientific evidence and back should be maintained to preserve the adversarial nature of the trial.¹²⁹

Another open question concerns the usage of neuroimaging to infer proof of personality disorders in insane perpetrators. While it is clear that neuroimaging can highlight the biological underpinnings of some personality disorders in the clinical setting,¹³⁰ using such techniques in

¹²⁸ Conti, C. (2020) *Il BARD paradigma di metodo: legalizzare il convincimento senza riduzionismi aritmetici*, in *Diritto Penale e Processo*, 6, 829.

¹²⁹ Padovani, T. (1999) *Il crepuscolo della legalità nel processo penale. Riflessioni antistoriche sulle dimensioni processuali della legalità penale*, in *Indice penale*, 535.

¹³⁰ For the case of BPD, see Schmahl, C., Bremner, J.D. (2006) *Neuroimaging in borderline personality disorder*, in *Journal of Psychiatric Research*, 40(5), 419-427.

forensics would allow for bridging the gap between law and science with peculiar efficacy. In fact, using neuroimaging to support a claim of personality disorder-based insanity would, on the one hand, further depict neuroimaging as a valuable tool in the courtroom and, on the other hand, clarify in a surprisingly effective fashion how personality disorders are not mere alterations of a generic way of being or temperament, but actual mental disorders with a biological substrate, as it was deemed necessary by Italian jurisprudence until not so long ago.

The promising advancements in the study of the human brain can bring an enormous contribution to explaining how multiple factors influence cognitive and behavioral outcomes, both in healthy and mentally ill people. The bidirectional enrichment between law and neuroscience within the forensic realm must be kept thriving and aimed at shared goals. Adopting a scientific-based criminal justice will lead to more accurate and fair decisions on the defendants' criminal responsibility. In addition, scientific-based verdicts could even influence the lawmaker to overcome traditional categories of mental insanity, which are mostly still grounded on mere societal protection policies rather than on the effect of the perpetrator's mental state on the criminal act.

For a recent meta-analysis of neuroimaging data in BPD, see Degasperi, G., Cristea, I.A., Di Rosa, E., Costa, C., Gentili, C. (2021) *Parsing variability in borderline personality disorder: a meta-analysis of neuroimaging studies*, in *Translational Psychiatry*, 11, 314. With a broader scope, see Mc Closkey, M.S., Phan, K.L., Coccaro, E.F. (2005) *Neuroimaging and personality disorders*, in *Current Psychiatry Reports*, 7, 65-72.

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