Entre el derecho penal y la neurociencia: la culpabilidad en las nuevas fronteras del estudio del cerebro y sus mecanismos (y patologías)

Between Criminal Law And Neuroscience : Culpability In The New Frontiers Of The Study Of The Brain And Its Mechanisms (and Pathologies)

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Resumen: Las investigaciones recientes en el campo de la neurociencia han revelado una profunda dinámica en los procesos que subyacen a la voluntad, la conciencia y la percepción de la acción humana. Estos procesos, descritos hasta mediados del siglo pasado según la «lógica empírica», revelan hoy realidades mucho más complejas. El mismo principio fundamental de la imputabilidad de una persona subyace al concepto de «capacidad de comprender y querer», una capacidad que los sistemas jurídicos consideran inicialmente «supuesta», pero que debe «demostrarse de manera concreta» en el juicio: de manera concreta en el momento del hecho y de manera concreta en la persona acusada. Esta contribución, lejos de pretender ser concluyente, quiere servir de «puente» entre disciplinas muy distantes entre sí, pero que a menudo se encuentran en las salas de los tribunales, donde, sin embargo, ha ocurrido con frecuencia que el propósito de las intervenciones (principalmente de médicos, neurólogos, psicólogos, psiquiatras) era finalista: lejos de explicar el fenómeno, se exigía al médico que sustituyera casi en la función de juzgar la culpabilidad. Un papel que no solo va más allá de la competencia médica propiamente dicha, sino que también impone al médico una responsabilidad muy alejada de su propia función y de su vocación: velar por el bienestar de la persona, lo que a menudo pasa por la omisión científica de juicios (para los que,

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además, el médico en los procedimientos penales carece de formación especializada y de lenguaje técnico).

Abstract: *Recent research in the field of neuroscience has revealed profound dynamics in the processes underlying the will, consciousness, and awareness of human action. These processes –until the middle of the last century described according to 'empirical logic'– today show profoundly more complex realities. The same cardinal principle of a person's imputability underlies the concept of 'capacity to understand and to want', a capacity that the legal systems initially consider as 'assumed' but which must, at the trial, be 'demonstrated in concrete terms': in concrete terms at the moment of the fact and in concrete terms in the person accused. This contribution, far from wishing to be conclusive, wants to act as a 'bridge' between disciplines that are very distant from each other, but which often meet in the courtrooms, where however it has often happened that the purpose of the interventions (mainly by doctors, neurologists, psychologists, psychiatrists) was finalistic: far from being explanatory of the phenomenon, the doctor was required to substitute himself almost in the function of judging guilt. A role that not only goes beyond the medical competence per se but also places on the doctor a responsibility far removed from his own function, and from his vocation: to take care of the person's well-being, which often passes through the scientific omission of judgements (for which, moreover, the doctor in criminal proceedings also lacks specialist training and technical language).*

Palabras clave: neurociencias, derecho penal, delito, culpabilidad, imputabilidad, intención.

Keywords: *neurosciences, criminal law, offence, culpability, imputability, intent.*

1. INTRODUCTION

Recent research in the field of neuroscience has revealed profound dynamics in the processes underlying the will, consciousness, and awareness of human action. These processes –until the middle of the last century described according to 'empirical logic'– today show profoundly more complex realities. The same cardinal principle of a person's imputability underlies the concept of 'capacity to understand and to want', a capacity that the legal systems initially consider as 'assumed' but which must, at the trial, be 'demonstrated in concrete terms': in concrete terms at the moment of the fact and in concrete terms in the person accused.

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interventions (mainly by doctors, neurologists, psychologists, psychiatrists) was finalistic: far from being explanatory of the phenomenon, the doctor was required to substitute himself almost in the function of judging guilt. A role that not only goes beyond the medical competence per se but also places on the doctor a responsibility far removed from his own function, and from his vocation: to take care of the person's wellbeing, which often passes through the scientific omission of judgements (for which, moreover, the doctor in criminal proceedings also lacks specialist training and technical language).

Giovanni Fiandaca writes in Prima Lezione di Diritto Penale (2017)

On the one hand, judges have even less than in the past sufficiently homogeneous scientific judgments at their disposal when assessing the empirical assumptions of capacity. On the other hand, the experts (psychiatrists and psychologists) have, since the end of the 1960s, developed a conception of their own role that has led them to reject the traditional position of being subordinate to the criminal justice system, in the name of a claimed therapeutic 'purity' of psychiatric activity: in other words, by reaffirming their autonomous role as doctors, they have shirked the responsibility of sharing with the magistrates the tasks of social control and management of the punitive function. Hence the tendency to return to the magistrate the ultimate task of establishing whether the pathology eventually diagnosed in the defendant (by the doctor) also affects his actual capacity to understand the meaning of the sentence and punishment.

Basaglia (1971) states

"... the psychiatrist always acts in his double delegation of man of science and guardian of order. But the two roles are in obvious mutual contradiction, since the man of science should tend to safeguard the sick man, while the guardian of order tends to safeguard and defend the healthy man".

Obviously for jurists, and especially for specialists in criminal law, some clarifications will appear superfluous, certainly laconic and sometimes pleonastic. Exactly the same applies to neuroscientists to a large extent. But it is precisely the bridging purpose of this work that makes it necessary for jurists to enter the world of neuroscience in a 'soft' manner, and likewise for those who deal with neuroscience to be able to enter this universe light years away from their own, trying to understand the dynamics and concrete implications of their work.

As Jean-Pierre Changeux (1983) said over forty years ago

Let the rigorous spirits view the enterprise with indulgence and put the gaps, inaccuracies, and imprecisions they detect squarely on the bill for the 'pedagogical' concern of conveying to a non-specialist audience the salient and characteristic aspects of a research in motion. ...Throwing a footbridge over the ditch that separates the Humanities from the Sciences of the nervous system will constitute for some an arbitrary, even illegitimate encroachment.

In this sense, at least two elements bring the two branches together. The first is that they have as their subject man, human action, people's decision-making and behavioural processes. The second is that both fields aim to (or should aim to) improve the quality of life of the individual and the society in which he or she lives.

If it is true that neuroscience often finds its object of study in pathology, criminal law, too, lives –and it cannot be otherwise (unlike civil justice)– in the courts, i.e. in the pathological moment to which the justice-system is called to account and respond.

In a beautiful research (2008) Sammicheli and Sartori stated

"the criteria by which a distinction is made between normality and pathology in the clinic (and thus by which the concept of illness is constructed) cannot be used to tout court to delimit imputability from non-imputability in the legal field. They arise from completely different premises, and with completely different purposes. The dangers in the operation of 'translation' are such as to distort the very sense of the expert mandate."

True, one cannot translate and transpose, nor can one delegate to the psychiatrist the moment and the burden of the judicial decision.

And yet it is necessary precisely to translate –and first of all to understand– in order to prevent the events of the penal dimension (and not only of imputability) from letting deviances locked outside the door of psychiatric hospitals (understood as totalising institutions) back in through the window of prison. Recovering common premises and goals can help in this process.

2. OFFENCE AND CULPABILITY

In order to be able to integrate a criminal offence –in any legal system, whether civil law or common law– the 'fact' must conform to an abstract case of offence and must be carried out *contra ius*: the contrast between the typical fact and the legal system is summarised in a judgement of unlawfulness.

A further prerequisite for punishability is that the act is attributable to the responsibility of a person, who is therefore the author of it: the conditions of this attributability are summarised in the judgment of guilt.

To be a crime, a human act must be typical, unlawful and culpable.

This is what the classical 'tripartite' theory of crime outlines. In the bipartite theory, on the other hand, a clear distinction of unlawfulness is lacking, arguing that the causes of justification would ab origine annul the unlawfulness of a conduct, an unlawfulness of which, if anything, the typicality (conformity to the typical fact) is merely indicative. In other words, the judgement of unlawfulness is structurally resolved in the verification of the coverage of a cause of justification.

Culpability thus summarises the psychological conditions that allow the personal imputation of an offence to the perpetrator. This judgement includes the assessment of the psychological bond, of whether the fact belongs to the perpetrator, as well as the assessment of the circumstances (personal and otherwise) that affect the person's capacity for self-determination.

The judgement of guilt therefore implies that there is *at least* a possibility of acting differently, and from this evolution of penal thinking it follows that today what until the first decades of the twentieth century was defined as 'guilt by character'

or 'lifestyle' is excluded: that is to say, that guilt which –not without scientific basis at the time!– was based on a disapproval (often more moral than legal) of previous choices (the criminal record of the subject) or of living conditions (social and economic conditions).

The 'guilty verdict' is generally based on four prerequisites: imputability, wilful misconduct or guilt, cognizability of the criminal prohibition, and absence of exculpatory grounds.

These four assumptions –abundantly described and dissected in the criminal law literature and immediately analysable from the descriptions in the criminal law manuals– are all influenced, in a differentially incisive manner, by neuroscience.

3. IMPUTABILITY

Imputability –in the sense of the offender's psychological maturity– is the first issue on which the medico-legal debate has always focused.

Sometimes simplifying the assumption on the basis of age, historically oriented on a census, scholastic, gender basis, imputability presupposes in certain circumstances (but must be proven in concrete terms) the capacity to understand: a personal quality of the perpetrator.

It is different from the 'consciousness and will' of the action, which are conditions of the psychic tracing of an action (or omission) back to the perpetrator.

Capacity is both normative and scientific, and the legal system merely provides parameters such as age, absence of insanity, and other conditions that may affect personal determination.

All these normative parameters are neuroscientifically questionable from the ground up. Both on the basis of educational and behavioural sciences (e.g. with regard to age), which can also distinguish different 'capacities' on the basis not of the objective fact, but with regard to the act acted upon fact (a 16-year-old may be capable of understanding some things and not others, being for instance in a transitional moment of cognitive development, especially taking into account one's individual culture, interests education, social environment, affective environment, heritage of values, sociological and even linguistic substratum), and on the basis of the assessment of the conditions that may affect personal determination (which, since they must be determined in concrete terms, are anything but a parameter that can be extended as a rule), right down to the very definition of the concept of the cause of 'insanity'.

In the latter case, many questions are open, first and foremost taxonomic ones.

Are we referring only to recognised pathologies (some such as DPS are very recent)? To those that can be diagnosed with absolute certainty (in some cases, certain pathologies can only be confirmed at autopsy with brain dissection)? In the case of disagreeable diagnoses, what are we leaning towards? Is insanity sufficient that it exists, or must it also be decisive in the concrete case, in the concrete action,

in the performance of the typical act? What if this incidence is not direct, but derivative (e.g. a side effect not universally recognised as such by medicine)?

Let us briefly consider Post-Traumatic Stress Disorder.

It is known that a 'reaction to trauma', a mild traumatic syndrome, will remain stored deep inside, in the form of a traumatic memory that, under certain conditions, can be reactivated.

Much deeper trauma, and the resulting post-traumatic disorder, can affect anyone who has experienced violent accidents, natural catastrophes, wars, rape, abuse, torture or abandonment: any experience that produces a very strong fear for one's own safety or that of others. All these situations can generate immediate reactions but can also give rise to syndromes of a malignant and often persistent nature, sometimes even years later.

Typical of these syndromes (in addition to a differentially modulated general state of anxiety, depression and vegetative disorders) is an 'obsessive rumination' focused on the horrors experienced or suffered, even with sudden flashbacks in which the trauma is relived in the sensory and emotional fullness of the original trauma; spontaneous flashbacks, but more often evoked by objects, sounds, smells associated with the original trauma.

In this disorder the expression flashback does not refer to the mere 're-emergence of memory' but takes the form of sometimes dangerous delusional states often accompanied by hallucinations: the sense of the present is completely lost or confused in states of hallucination and delirium. During a flashback, for instance, a veteran may be convinced (in a state of sensory reality for him that has no room for interpretation as a hallucinatory state) that the people inside a supermarket are enemy soldiers and, if armed, may –consequently and logically– shoot.

Bennet Omalu (et al. 2011) working with Iraq war veterans, has shown that repeated concussive trauma can result in chronic encephalopathy, of traumatic origin, causing impaired memory and cognitive function, which can exacerbate depressive tendencies, flashbacks, hallucinations and psychosis. DPS may also have biological as well as psychological determinants, and the treatment of such conditions requires both pharmacological intervention and psychological therapy, although it is not excluded that in the most severe and profound cases this disorder may be almost incurable.

The concept of dissociation is crucial for understanding not only hysterical conditions or personality disorders (multiple or bipolar), but also post-traumatic stress syndromes. When experiencing situations that constitute a threat or danger, an 'instantaneous dissociation' can occur, observing the scene 'as a bystander'.

For the image to push its boundaries and be replaced by the hallucination, something has to happen in the mind and/or brain, which has to give rise to some dissociation or disconnection: the mechanisms that normally allow us to recognise our thoughts and images and take responsibility for them, to see them as our own and not externally originated, have to fail.

Brewin and Hellawell (2004) believe that there is a radical distinction between autobiographical memories, which are verbally accessible, and flashback memories, which are not verbally or voluntarily accessible, but which may erupt automatically in the presence of any reference to the traumatic event or to something (image, even partial or mere recall such as a shape or colour, sound, smell) associated with it.

Whereas autobiographical memories are not isolated and are embedded in a context of life and perspective and can be corrected in relation to different contexts and perspectives, traumatic memories are isolated pieces, fragments from which it is not possible to achieve the typical detachment that allows retrospection and re-enactment, and thus potentially a re-contextualisation (a process typical of psychotherapeutic intervention).

The jurisprudential debate has accepted a conceptual declination according to which the 'disturbance' must have the aptitude to impair (according to some even 'severely') the capacity, in concrete terms, both to perceive the 'disvalue' of the act committed (or omitted, for example by standing by and failing to render assistance) and to grasp the meaning of the punitive treatment (thus in concrete terms to be aware of deserving the punishment and to consider it appropriate and proportionate).

According to a strictly medical model, on the other hand, only the 'psychic disturbance with an organic basis' (biological? physiological?) or which possesses pathological features such that it can be traced back to a precise (pre-established?) nosographic-clinical framework, falls within the concept of mental illness.

Both the first and the second orientation show how precise definitions in the neuroscientific field can –to use a strictly legal term– supplement not only the jurisprudential orientation, but even the legal norm.

There are also those who leave a greater margin of autonomy to the legal assessment than to the nosographic classification in the strict sense, allowing pathological significance to be attributed even to atypical mental alterations (defined in the legal sphere as psychopathies) and to phenomena defined as 'short-circuit reactions'.

In most criminal legal systems, emotional and passionate states are not (any longer) recognised as excluding imputability: they do not exclude it or even diminish it. This rigour is, in criminal law, mitigated by two extremely subjective elements: a weak/fragile personality and that this emotional/passionate state assumes the characteristics (even momentary) of an albeit transitory 'real' infirmity (explosive reactions, panic reactions, raptus... which clinically are more symptoms than autonomous pathological states).

The judge is faced with having to choose between scientific models and orientations, sometimes in stark contrast with each other: a very subjective choice, with enormous margins of discretion that are difficult to reconcile with the principle of certainty that should underpin criminal law (and its application with profound repercussions on people's lives and freedom).

If emotional and passionate states do not exclude imputability (in the sense that the person can still be considered sane and capable of understanding and want-

ing) a more detailed reflection on the subject (far from ever being conclusive) I would like to stimulate it with some purely chemical-clinical reflections on the 'utmost feeling' that we often abuse to discuss: love.

According to some authors (Liebowitz, 1983) infatuation has its origin in a molecule: phenylethylamine (FEA), an amphetamine naturally produced by the body responsible for feelings of joy, hilarity and euphoria. One becomes infatuated when the neurons of the limbic system are saturated or sensitised by FEA (or by norepinephrine and dopamine). Nerve endings become accustomed to the stimulation or levels of the hormone drop.

According to Silvia Corrent's (2017) 'step-by-step' description

attraction fades and attachment becomes more important, a new chemical balance is established: endorphins calm the mind and reduce anxiety. One tends to feel security and stability. Oxytocin remains present, which urges us to physical contact and hugs... From a symptomatological point of view, attraction is characterised by an altered mental state with a rise in mood (very reminiscent of the hypomanic phases of bipolar disorder –this could imply the functioning of similar neurophysiological modifications: increased functioning of the dopaminergic and noradrenergic systems)... Other behaviours related to attraction are narrowing of interests and intrusive thoughts concerning the partner, similar to obsessive compulsive disorder, this is due to a serotonergic dysfunction. In the early stages of a relationship serotonin levels are lowered (serotonin is the feel-good neurotransmitter, involved in mood regulation)... High cortisol levels occur (creating social bonds induces stress), stimulation of the adrenal glands causes testosterone to increase in women and decrease in men. Testosterone is an androgenic hormone that plays a role in sexual desire, in women it peaks just before ovulation. The heart beats faster due to a rush of adrenaline caused by the exception neurotransmitters epinephrine and norepinephrine, which are produced by the adrenal glands in the spinal cord and brain. Attachment is characterised by the need for closeness and gives signs of malaise and agitation when separation from the object of attachment occurs and by a reduction of these signs after rapprochement; it also takes a certain amount of time to develop. The data emphasised the key role of neuro-peptides such as oxytocin and vasopressin in this phase. Vasopressin would be linked to the regulation of sexual persistence, assertiveness and dominance. Oxytocin, in humans, appears to reduce stress responses. It is a peptide hormone, produced by the hypothalamic nuclei and produced by the posterior pituitary gland and plays a central role during labour and delivery and later in the lactation process. More recently, it has also been indicated as a key element in social interactions and in our sentimental reactions, hence its nickname 'love hormone': it increases pro-social behaviour such as altruism, generosity and empathy and leads us to be more inclined to trust others... These socio-cognitive effects emerge as a consequence of the suppression of the action of the prefontal and cortico-limbic circuits, resulting in the lowering of social inhibitors such as fear, anxiety and stress. It is linked to intimacy; it sensitises the skin, encouraging physical contact; it activates dopaminergic pathways and dopaminergic pleasure centres."

The defect of will is also often graduated, ranging from a 'total defect' of mind, where the defect is such as to completely exclude the capacity to intend, or a partial one, dissecting and declining different gradations of that capacity.

An interesting examination from a neuroscientific point of view –again in the field of criminal law– focuses on the aetiological relationship between the offence committed and the specific 'mental sector' of the disorder, i.e. whether this (immediate?) relationship may –even or possibly– be lacking.

Neuroscientists might have a typical skin rash characterised by the appearance of pinkish or white pomphi of various sizes and generally causing itching, discomfort or pain (paraphrasing Sammicheli and thus 'translating' for penalists: a hives).

An academic example of a typical fact in question is something like this: a person suffering from persecution mania kills the person of the alleged persecutor (immediate aetiological relationship) and a person suffering from persecution mania commits a theft against a person outside the context of such mania (non-immediate aetiological relationship).

Jurisprudence in favour rei considers the exemption to be literal, and therefore incapacity is detected in the subject at the time of the commission of the act (persecution mania from which he suffered regardless at that time) and not in relation to the specific act committed (theft, murder, etc.).

The most rigorous jurisprudence considers the exemption in its immediate aetiological relationship and tends to justify the murder of the immediate aetiological relationship and not the theft, as it is not immediately related to the state of the mental disorder.

In between there is the person, suffering from persecution mania, whose real mental state cannot be probed except through years of analysis that –for example– might bring to light elements of criminal relevance. In the previous example, the persecution mania might have induced the theft of an object mistaken for a weapon, either in one's own defence or in order to take it away from one's persecutor. In this case –freely speaking– one would undoubtedly have returned to a direct (albeit mediated) aetiological relationship, and without entering (yet) into the actual dynamics of the brain (or rather the dynamics of the biochemistry of the brain and the mind-brain relationship in which consciousness would reside, the one that –after all– the criminal law judgement of imputability aims to ascertain). Leaving aside the fact that even today neurosciences still do not know its origin, dynamics, localisation and –then– biochemistry and functional dynamics (Edelman had predicted that we would come to terms with it by 2030, but everything suggests that the prediction was consistent with Edelmanian optimism).

On the subject of epilepsy, then, there is an inclination towards a possible assertion of liability in 'intervals of lucidity': in other words, epilepsy would (almost) be a pathology in itself (and not, as is often the case, a symptom or effect of complex pathologies). In fact, in legal literature there is often confusion between epilepsy and epileptic seizures (admitting that during an epileptic seizure a criminal act can be committed).

In about half of the cases, the underlying cause of epilepsy is still unknown (primary or idiopathic epilepsies). In the other half of the cases, there are several factors that can cause the onset of this disease (secondary epilepsies) genetic factors (the

disease runs in families; to date, it is believed that there are around 500 genes that could be linked to the development of this condition); head trauma; other pathological conditions such as brain tumours or stroke (stroke is one of the main causes of epilepsy in adults over 35 years of age); infectious diseases such as meningitis, Aids and viral encephalitis; prenatal injuries such as maternal infections, malnutrition or oxygen deficiency; developmental disorders such as autism and neurofibromatosis.

Since epilepsy is caused by abnormal activity of brain cells, there are several symptoms that seizures can give rise to: temporary confusion; involuntary movements of the arms and legs; loss of consciousness or awareness; psychic symptoms of various kinds (estrangement, déjà-vu, déjà-vécu) and it should not be forgotten or overlooked that symptoms vary depending on the type of seizure (generalised or focal, simple or complex).

From this –entirely didactic– description, can 'lucid intervals' be seriously considered to exist considering the broad spectrum of causes? In the case of brain tumours, head traumas, infectious diseases and prenatal injuries, can we separate epilepsy from the pathology or the causative factor and speak of 'intervals of genuine lucidity' (to the extent of determining the subject's imputability)? The risk is to consider that when the person is not in a phase of epileptic 'crisis', he is in an interval of 'sanity' or at least of mental equilibrium (which is not excluded, but neither is it scientifically certain, or worse, criminally determinable).

Criminal law also considers the hypothesis of the so-called 'partial mental defect' with the related 'partial capacity to understand'. "This is the case of a person who at the time of committing the offence was in such a state of mind by reason of infirmity as to *'greatly diminish, but not exclude, his capacity to make decisions'* and in this case benefits –depending on the legal system– from a reduction or commutation of the penalty (because he is found guilty of the offence and was capable of understanding its value and at the same time the value and 'justness' of the penalty-sanction).

The distinction weighs in the scales of criminal justice no longer qualitatively but quantitatively, and mental defect no longer affects a part (or sector) of the mind, but its entirety, but to a lesser extent. Partial mental defect is compatible with the aggravating circumstance of premeditation (provided that this is not itself a manifestation of the pathology) and futile motives, and with the mitigating circumstance of provocation, while in terms of punishment it entails a reduction in the penalty. In short, a sort of semi-infirmity or non-imputability-reduction, almost as if *'not to criminally deresponsibilise the sick person who has committed a crime'* (Ponti, 1980), which however rests on a concretely excessive discretionary power of a judge who is absolutely technically unprepared and who, in the majority of hypotheses must (in fact and in practice) delegate the content of the judgement to a subject (the medical expert) who is in turn technically not deputed to this public service.

A historically heated and lively debate then concerns the exclusion of punishability in cases of drunkenness and drug intoxication. To simplify and summarise, we can outline a twofold scenario in which the occasional or accidental altered state ex-

cludes imputability and thus culpability, which, on the other hand, is not excluded in the case of the voluntary or culpable altered state.

In this dual interpretation, a moralistic rather than positivistic heritage is clear. If the altered state excludes mental lucidity (i.e. a presence of awareness, consciousness and capacity for determination and self-determination), it excludes it as much in the accidental case as in the voluntary or 'habitual' case. What is punished, therefore, is habit, not the assessment of the act performed in an (altered) state of mind. This is reinforced by the fact that the state of habitual drunkenness even leads to an increase in punishment.

Guilt is only excluded in the case of chronic intoxication. This must therefore manifest itself and be ascertained and declared with solid criteria of medical nosography, even where it appears very difficult to exclude ontologically a 'chronic intoxication' absent in 'habitual alcoholism' (and even worse in the habitual use of narcotic substances, which, as is well known, can produce dysfunctions, as well as real damage and structural and functional modifications of the brain's biology even years after the cessation of use and abuse).

According to Karen Ersche (2010), from the Behavioural and Clinical Neuroscience Institute at the University of Cambridge, the active ingredient of cocaine permanently alters the physical conformation of the frontal lobe and reward centres of cocaine users. Cocaine intake progressively reduces the attention threshold and makes consumption more compulsive and uncontrollable. Magnetic resonance imaging of the brains of 60 cocaine-addicted volunteers revealed significant abnormalities compared to the brains of people who had never used drugs. The frontal lobe and anterior cingulate of cocaine addicts show significantly less grey matter than normal, which adversely affects decision-making abilities, determination to achieve goals, attention and emotional processes. Cocaine users show abnormal development of the insula and the nucleus chordata (a deep region of the brain), with alterations in the mechanisms of pleasure, reward and motor co-ordination. According to Ersche, 'we have shown that cocaine addiction is a disease of the brain and not a moral problem, as we still tend to consider it today'.

On a legal level, 'chronic intoxication can be defined as that which causes permanent pathological alterations, such that it appears indisputable that one is dealing with a real psychic illness' (Cass. Italiana 1986, with reference to alcoholism).

We now know that the use of drugs and even one strong bout of drunkenness bordering on an alcoholic coma radically changes the topography and the neural fauna itself (quantitatively and qualitatively) in a brain that –as a whole and by 'neuronal selection groups'– is increasingly recognised as plastic, mobile, adaptive.

What damages and what changes in the mind-brain relationship and in the development of consciousness and in the interaction of neuronal groups in the formation of thought (conscious and unconscious) are future stages of research and the subject of lengthy and complex investigations, only in the last thirty years barely made accessible by fMRI.

Deafness, understood as the condition of one who is 'deaf and dumb', is a cause of exclusion of imputability –due to incapacity. While it is claimed that this capacity is reduced, and at least to be assessed in the concrete case in the "deaf", also making a distinction between early and late deaf (the reference would be to the pre– and post-language phase).

The rationale should lie in the fact that deaf-mutes are deprived of adequate tools for full access to the outside world, thus effectively unable to acquire appropriate tools to educate themselves and socialise, at least the minimum to be aware of the boundaries of 'right and wrong', of what is socially acceptable, and of what is criminal.

I would like to dwell on this issue in some detail, since I believe it can be symptomatic and illustrative of various 'sensitive minorities' –which we often simply consider to be 'disabilities', assuming 'what they lack' (as opposed to an abstract subject considered to be normal) and without understanding and perceiving 'what they have'. This change of point of view (for all see Lurija and Vygotsky) has considerable implications, first and foremost social, medical and clinical, and even legal in a general sense (and penal in particular, where the person's freedom is at stake and his or her possible treatment under security measures). What I will say about deafness applies to the deaf, the dumb, the blind and also to those with different motor skills.

Deafness is a wide world and first of all, it must be distinguished into at least three geological eras of the approach by 'we who hear'.

In our Mesozoic era (i.e. until the 1960s), our conception as hearing-speakers was that the world of the deaf (even worse if they were also mute) was made up of completely incapacitated people who would never be able to communicate except by gestures and with each other (more or less at the level of primates). Already in the 16th century there are cases of deaf children from noble families who were taught to speak and read, so that they could be recognised as legal persons (recognition from which the dumb were excluded anyway) and could therefore inherit family titles and property.

According to Oliver Sacks (1989)

"the origin of such a deep-rooted judgement can perhaps be traced back to biblical times, since the subhuman condition of the mute was already codified in Mosaic law, and reinforced by the biblical exaltation of the voice and the ear as the one and only true way in which Man and God can communicate (e.g. "in the beginning was the Word")".

In the genozoic phase (from the 1970s to the past decade), we have come to realise that the deaf (and deaf-mutes) are simply another population, with other language systems, indeed to be considered as a true linguistic minority.

Incidentally, it is worth remembering that 'sign-based' linguistics is anything but a nineteenth- or twentieth-century revolution: there are references to non-verbal communication systems between deaf people as far back as ancient Egypt, and in the Maya language even actual sign languages distinct between different communities in Central America. This speaks volumes not only about a form of language

that is in some ways 'innate', but also about our lack of ability to observe and understand the 'different from us'.

[The language acquisition device is a theoretical brain mechanism that Chomsky (1965) postulates to explain the innate human ability to learn the syntactic structures of language].

Also according to Sacks (1989)

"true sign languages are self-sufficient languages, with complete syntax, grammar and semantics, but of a different nature than spoken or written languages... profoundly deaf people do not show the slightest innate disposition to speak... on the other hand, they show a strong and immediate disposition for signs which, as a visual language, are completely accessible to them."

Klima and Bellugi (1970) introduced a new concept for describing the complexity of sign language by imagining a 'spatial grammar'. The extraordinary difficulty we encounter in imagining a spatial language is perhaps due to the fact that we (hearing people who do not sign) are physiologically incapable of imagining how it could happen (just as we cannot imagine the infrared vision of insects or walking by balancing ourselves with our tails).

Stokoe (1960, 1965) was the first to convince himself that signs were not simple images, but complex symbols with a complex structure: each sign consisted of three independent parts, or parameters (place, configuration and movement) and each had a more or less large but limited number of combinations [two elegant confirmations of Stokoe's imagined structure are the 'manual slips' –which are not arbitrary mistakes but errors of configuration– and an all-3D version of humour and sign art –prevalent in deaf-natives].

Today, in our Neozoic (which we hope could be our Holocene, i.e. the beginning of post-glacial time) we discover –but this is something of the last decade, especially thanks to linguistic research on hearing children of deaf parents– that the early learning of sign language, also and together with verbal linguistics, greatly enriches and accelerates the development of entire brain areas facilitating learning.

For one hundred and fifty years (Jackson, 1870), it has been held that the left cerebral hemisphere is specialised in analytical tasks, in lexical and grammatical analysis that enable comprehension of spoken language, and that the function of the right hemisphere, in this task, is complementary, dealing with the totality, and not with the individual parts, sequential analysis, visual and spatial components. In this system, sign languages break down this differential order, having a grammatical and lexical dimension, but at the same time a space-time dimension, and these last two aspects are inseparable parts of language: somehow grammar and syntax are to vowels as time and space are to consonants, in one inseparable whole.

Jackson wrote on this subject (1890) *"undoubtedly, the deaf-mute may lose, due to an injury in some part of the brain, the natural sign system, which has for him the value of language"*, and considered that this injury should have affected the left hemisphere.

This would be demonstrated a century later by Damasio's (1986) PET scans showing that vocal language and the use of signs affect similar portions of the left hem-

isphere, although signs seem to require larger brain areas, also affecting the left parietal lobe.

An entirely new neurological development, in which the left hemisphere of the signers takes over a spatial-visual domain, modifies it, refines it, making a visual language and conceptualisation possible.

In tests of spatial organisation and construction, signalling children performed far above the norm in comparison to their hearing peers (Bellugi 1989): *"four-year-old deaf children manage to achieve scores that are even unthinkable for some hearing high school students"*

and this also in the Benton test for face recognition.

See then the shocking results of Bellugi, Tzeng, Klima and Fok in Hong Kong (1989)

"apparently deaf children were able to do grammatical analysis... through a very complex spatial analysis, and this greatly enhanced their visual perception..." and continues *"the acquisition of signs is accompanied by the acquisition of special visual skills, the test of spatial organisation involves not only recognition and naming of objects, but also mental rotation, perception of form... all skills connected with the spatial basis of sign syntax"*.

According to David Corinna

"the linguistic use of the face is a peculiarity of the signers and differs fundamentally from the normal use for the expression of affect: it is the neuronal basis that is different... it is evident how hearing subjects process figures in the right hemisphere, while deaf subjects present a predominance of the left hemisphere in decoding linguistic facial expressions".

In reality, congenitally deaf children generally suffer from 'information deprivation', are less exposed to 'incidental learning' (which makes up the bulk of our basic learning) and the school education of deaf children is poorer in content than that of hearing children.

This poses a problem more of social policies and education than of actual learning, awareness and communication skills. On the contrary, studies show that a deaf and deaf-mute child can not only have a full life, but also greater resources than so-called normal children if only put in the right conditions for development and learning. The same studies (on hearing children of sign-parents) show that these children, learning naturally and from the very beginning of their linguistic development, in addition to verbal language also sign language, can incredibly develop their "normal abilities in a society of normals".

For better or worse, the criminal law approach is still (in its premises and legislation) in the Mesozoic era. And it does not hint at evolving except with particular aberrations that are particularly punitive towards deaf individuals belonging to more disadvantaged social strata.

In fact, to remain strictly in the field of criminal justice, we can state that due to the particular configuration of the field and visual capabilities, deaf and deaf-mutes are more reliable (certainly not less) as eyewitnesses, have decidedly superior de-

scriptive capabilities, grasp greater spatial-temporal-visual details, and have an absolutely amplified viewpoint on details that hearing people miss.

Their procedural ability-incapacity can be assessed according to only one discriminant, namely direct and indirect training, and of this an immediate indicator is signalling ability: a signer in all respects cannot be considered inferior or impaired compared to a hearing person.

4. INTENT AND FAULT

Malicious intent and guilt are the two ways in which a person can be charged with an offence and are the second prerequisite for culpability, and here too there are intersecting elements in the medico-legal debate. According to the criminal definition, intent is based on three cornerstones: foresight, will and event.

According to the representation theory, the will and the representation-prediction as distinct psychic phenomena also had to be referred to different data and verified separately: the will could in this case only have as its object the physical act or bodily movement while the representation had to be attributed to changes in the external world (will: I stab you - representation: the death of the person). According to will theory, on the other hand, the results of the action can also be the object of will, and representation is an implicit presupposition of will (i.e. I stab you and you die are both 'willed' moments: the latter is also an implicit representation of the action I willed, as in not stabbing you in order to perform the act of just stabbing you, but stabbing you with the purpose I represented to myself of killing you).

The entire legal case of wilful intent on which the entire theory of crime is based –indeed it is often from the description of the wilful offence that one starts to describe any case constituting a crime, whereas the 'culpable' form constitutes an exception that must be rigorously foreseen as well as typified (so-called fragmentary nature of criminal law)– is constructed of two psychological cases: will and prediction (or psychological representation).

The intellectual element of intent, meanwhile, requires that there be knowledge and awareness of the elements that make up the objective case of the offence: if the person does not know or misrepresents the elements or a requirement of the fact, punishability is excluded for lack of intent.

Criminal law distinguishes between descriptive and normative elements: the former are elements of the external world as they appear in nature (e.g. if an Indio is not believed to have a soul and therefore is not a man, the fact of killing him does not constitute murder), the latter are those described through legal norms and relate to technical facts (e.g. public official) and for the law it is sufficient for the agent to have 'knowledge parallel to the natural sphere' (Mezger). public official) and it is sufficient for the law that the agent has 'knowledge parallel to the secular sphere' (Mezger) (e.g. if a person wears a policeman's uniform it is probable that he is a policeman and therefore like a public official, and yet it is not enough that the Indian is 99.9% identical to me as a man, it is not enough if someone does not

recognise him as such by assuming that he does not have a soul, without, moreover, telling us where it is and resides),

[*The historical example may appear forced and extreme, but in the idea of criminal law it is not, and even only apparent, even vaguely plausible, exemptions have always been sought, in the unconscious (and often conscious) awareness that the act committed was ontologically a crime. It would be interesting to note how, for example, almost all non-historians hold true the statement that 'the Inquisition burned witches': in reality the ecclesiastical court (which was not even a court) 'merely' affirmed that that person was guilty of witchcraft, leaving it to the 'secular arm' to determine and execute the consequent punishment (for the secular arm, the death sentence was the only plausible one in concrete terms, so as not to end up branded with connivance in turn); it may appear to be of little consequence, but in fact the Church by this route has never been guilty of any capital execution for such facts.*]

Representation –in the criminal law sense– becomes true 'prediction' with reference to future events which are therefore the result of the conduct: I foresee that if I stab you you will die. In this the representation is compatible with the doubt, (which is neither ignorance nor error in knowledge) since the assumption is that I stab you, foreseeing that you will die, even in the doubt that you (because of the stab) might (also) not die (incidentally, I have introduced the much broader concept of the 'causal nexus' necessary for the criminal relevance between action and event).

[*The state of doubt in reality does not always integrate wilfulness, indeed it excludes it when the rule describes a specific structure of the case. A school example is slander, which only occurs when the slanderer knows with certainty that the accused person is actually innocent*].

But wilfulness, in the sense explored by criminal doctrine and debate, is not merely the theoretical representation of the consequence of the act (action or omission), but rather a 'conscious will to carry out the typical act'.

I –for the criminal judge– must not only abstractly represent your death to me, but I must have a conscious will that by carrying out the action of stabbing you I will kill you and that this is the ultimate goal I have represented to myself as the outcome of the stabbing.

A will that is therefore to be understood in the broadest and widest sense that invests both the action in itself (defined as bodily movement - stabbing) and the overall fact in its unity of meaning (modification of reality - death).

A full will, therefore, encompassing all the elements of the fact: a will that if lacking cannot be supplemented –in terms of malice– by other psychological elements such as hopes, desires, inclinations, ambitions...

[*Up to this point, I am sure, the reading of a criminalist will be almost bored, of things well known and even described in little detail, but I am also sure that if the neuroscientist practices the translation of terms 'adopted' by law such as will, awareness, representation, action, knowledge, in their 'authentic' meaning proper to neuroscience he will literally find himself, if not on another planet, at least in a parallel dimension*].

In criminal law, the intensity of the intent (on which the seriousness of the offence depends) essentially indicates the intensity of the will, which must be related to the degree of the subject's psychological adherence to the fact, but also to the com-

plexity and duration of the deliberative process: the (guilty) will thus presupposes the (actual and present) consciousness of the unlawfulness.

Leaving aside here the examination of the various forms and gradations of malice, it is evident that the central element to be clarified is threefold: there is the volitional process, the process of consciousness and awareness, and there is a moment in which both these elements must necessarily merge into an indistinct unicum, from which arises (and only from this moment) the capacity to charge the fact to the agent.

"Consciousness and will must be conceived as real psychological data, i.e. present in the psyche of the agent in an actual and present manner (not already hypothetical and potential)... it is understandable that the criminalistic use of concepts such as consciousness and will mostly continues to follow the old path of common sense... in the belief that the assumptions of liability should as far as possible anchor themselves in the notions and criteria of judgement typical of everyday life" (Fiandaca 2017).

While we may concede a 'criminalistic use' of terms that ontologically are not, there remains the central issue of understanding (and then progressively, if need be, addressing the implications of) what will is and what consciousness can ever be at the level of the brain.

This need emerges in Fiandaca (2004), who - after having discussed the decisive relevance of this boundary and this knowledge for the distinction between wilful intent and conscious guilt, i.e. between voluntary acceptance of risky conduct and voluntary acceptance also of the damaging event (which I save for examination by neuroscientists)– notes that this distinction

"reflects a real difference in psychological attitudes, two different psychic states as such diagnosable in a differentiated way on the empirical level and therefore susceptible of corresponding proof in the trial" he wonders whether jurists should not *take "charge of the possible distance that separates common-sense psychology, on which criminal law is still predominantly based and the actual way in which the human mind functions as explained by the most up-to-date sciences"*, warning that *"if we criminalists were to neglect confrontation with the latter, in addition to contradicting the often hoped-for openness towards empirical-social sciences, we would once again end up perpetuating an intellectual attitude substantially born of philosophical idealism and pure normativism"*.

5. CAUSES OF EXCLUSION OF CULPABILITY

The entire criminal legislation on the subject of error and consciousness of unlawfulness is filled with the same considerations on the subjects of awareness, consciousness and will. The criminal law literature is self-sufficient in this, and to those concerned with neuroscience, there is nothing to add that is not offered by common-sense knowledge.

Something, on the other hand, needs to be added for the sake of completeness on the subject of the grounds for exclusion of guilt, which are also based on the

motivational process (which has little to do with law and much to do with the psychological situation of the agent).

According to the normative conception, the reproach of culpability presupposes the absence of abnormal circumstances, which in essence invalidate the normal process of motivation: conduct other than that which was performed (formally unlawful) is inexcusable in the presence of particular concrete circumstances in which the agent found himself (a 'valve that allows a system of norms to breathe in terms of humanity' Bettiol, 1986).

In criminal law, the categories of state of necessity, moral coercion, conflict of duties, and to some extent the conflict between norms of conduct of different normative spheres (legal order and religious norm, for example) emerge.

While there are abundant monographs on each of these 'valves of humanity' (for the theory of error we speak of entire encyclopaedias), legal study has rarely been permeated by the social sciences - except with that nuance of being 'selective pro domo sua', i.e. taking those elements of the sciences useful to support this or that thesis, without a true overall examination [forensic professional deformation or, more benevolently, 'vice' common to all human beings?]

We must at this point address and clarify what are the brain bases of the various types of behaviour in which the will comes into play.

6. WILL AND DECISION MAKING

In agreement with Filippo Tempia (2017) we can argue that

"neuroscientific research in recent years has conclusively demonstrated that emotions and rational reasoning are integrated into the evaluation process leading to moral decision-making. However, moral responses are often the result of intuitions of which the subject is unaware. Emotional and rational elements are analysed in a number of brain areas, comprising acc, dlpfc/dmpfc and vmpfc, by processes that are only partially accessible to the subject's consciousness. However, the result of such analysis does not dictate judgement but, if the subject is willing, it can be consciously reworked".

Voluntary acts include behaviours such as intentional motor actions and conscious decisions such as moral judgements and resulting behaviour.

The first aspect that has been investigated historically, that of voluntary movement, has yielded paradoxical results, leading to the denial of free will.

The starting concept of the experiments on brain activation preceding and causing voluntary movement was that the subject's will, a mental event, had a causal effect on brain matter. In other words, the subject's decision to make a movement had to be transformed into a nerve signal capable of initiating the execution of the desired action.

The first experiments were carried out by the research group of Hans H. Kornhuber (1965), who first identified the area of the cerebral cortex that first began to activate to generate the nerve signals necessary to perform movement. Kornhuber

used the electroencephalogram (eeg), which possesses considerable temporal accuracy, as a technique for measuring brain activity. The type of voluntary movement chosen by Kornhuber was actually a very simple action, such as bending the wrist or a finger.

Almost twenty years later Benjamin Libet (et al. 1983) [see essay...], invented a system to situate the mental event of awareness of the will to act on the time scale.

The result was that the awareness of wanting to act occurred just 0.2 seconds before the movement. In contrast, brain activation occurred in many cases approximately 0.8 seconds earlier, and in cases in which the subject reported having decided instantaneously and performed the movement without hesitation, 0.55 seconds earlier. Thus the additional motor area is activated and initiates motor signals at least a third of a second (0.35 seconds or more) before the subject is conscious of wanting to perform the movement. This 'unconscious' brain activation would be the one truly responsible for the movement. Consciousness of having wanted the movement occurs later, when the nervous signals are already in a very advanced state and within 0.2 seconds will result in the actual action.

In this view, there would be no freedom in the universe, and all human actions would be a consequence of the activity of brain matter, which in turn can only follow the laws of physics. From this perspective, a complete knowledge of the physical situation of the brain at a certain instant would make it possible to derive all subsequent brain signals, including all actions that we illusorily perceive as free and voluntary. In reality, everything we will do and think is predicted and predestined by the initial state of the brain and the laws of the physics of matter (a sort of extension of the mathematical assumption that if we knew the position, velocity and direction of every particle in the universe we could predict the future). If one accepts this interpretation of the results, the will is nothing more than a sensation without any effect. The same can be said of any other mental event.

This paradoxical timing of brain activation with respect to the awareness of the will to act has been confirmed by numerous laboratory studies. A rather recent study, which further increased the distance between brain activation and the consciousness of wanting to act, was performed by the research group of John-Dylan Haynes (2008).

In this case, the technique of functional magnetic resonance imaging was used and the signal was processed using algorithms to decode different aspects of brain activity. The timing of the will was achieved by presenting two consonants per second on a screen, thus with a precision of half a second. The will to start the movement was felt approximately one second before the action, while brain activation was decoded as early as five seconds before the movement began. At present, the majority of scholars believe that these results prove that we are not free subjects and that our will is an epiphenomenon of brain activity, lacking causal efficacy.

However, there are various types of criticism of conclusions that deny the freedom of will and action. One of these starts from the notion that the perception of time itself is a mental construct generated by our brain not true to reality, but modified

and adapted to the need of the moment (Haggard, Clark, Kalogera, 2002 - Libet, 2004).

This perceptual distortion is also present in all sensory systems, probably in order to increase acuity, contrast, signal-to-noise ratio, and to avoid the perception of signal-free areas by interpolating missing data.

The most important criticism of the interpretations of Libet's and Haynes' results, which deny the freedom of the human will, starts from the consideration of the type of action analysed in these studies. The experimental conditions are very restrictive and the 'voluntary' movement must start without any real need and not from the instruction initially received by the experimenter. The only freedom left to the subject in this context is the sole decision of 'when' to perform the action. But this 'when' is completely meaningless and implies no consequences for the subject. One cannot therefore consider such a paradigm as representing a free decision.

As stated by Baddeley and Hitch (1974), there is a type of memory, called 'working memory', that retains information for as long as is necessary for it to be used for various mental tasks. Other functions that require working memory are abstract thinking, reasoning, judgement, decision-making and language comprehension.

As shown by Fuster (1973), recordings from single brain neurons in monkeys have demonstrated that in the prefrontal areas involved in working memory, certain neurons are activated when the subject receives the instruction on the task to be performed, and remain active during the entire time interval in which they are to await the 'go' signal indicating the instant when the task is to be performed. The activity of such neurons encodes the task that is to be completed. This concept fits into the much broader strand of mechanisms that influence decisions based on previous experience.

One strand of thought (S. Bode, C. Murawski, C.S. Soon, P. Bode, J. Stahl, P.L. Smith, 2014) considers the brain's previous history and the context in which the task takes place to be the ultimate determinants of any decision.

The presence of brain potentials prior to the conscious intention of the single simple motor act, as in Kornhuber's and Haynes' experiments, are inconclusive with respect to the causal efficacy of consciousness. However, a multitude of nerve signals come into play in conscious decisions, most of which we are not aware of.

As Dehaene (2014) argues, even in the simple processing of sensory signals (visual, but not only) the nervous system analyses many elements of the visual scene, of which only a small part will reach the conscious level. This non-conscious analysis does not only occur in the early stages of signal processing, but reaches intermediate stages in which the meaning of words or numbers is even decoded, without the subject being aware of their presence yet.

At the end of this process, only the aspect on which attention is focused becomes conscious.

By studying brain activation in cases where conscious perception occurred, as opposed to those in which the stimulus did not reach the level of consciousness, it

was possible to recognise four specific features of the brain response related to consciousness 1) a sudden amplification of the nerve activity of the brain areas processing the stimulus signal associated with an immediate switching on of large prefrontal and parietal areas; 2) the appearance of a particular wave of electrical potential (P3 wave) detectable with the electroencephalogram; 3) an explosion of high-frequency voltage oscillations; 4) a synchronisation of the electrical activity of many brain areas even distant from each other, forming a kind of global network of activity.

Once an object on which attention is focused enters the working space of consciousness, it becomes a conscious experience that the subject can use to select an action, to predict future developments of the situation, to combine it with previous and subsequent ones in order to arrive at a solution to a problem. In other words, what becomes conscious experience is shared throughout the global space of the cerebral cortex and can be used by the subject for any type of task.

This is why consciousness is considered to be a very powerful element in guiding thoughts and actions. These findings contrast with the conclusions of Libet and Haynes' experiments, which analysed behaviour in which conscious decision-making was irrelevant.

In order to study an example of conscious decision-making, one must therefore turn to situations in which the timeframe is longer, so that the consciousness has a chance to process the data and come to a conclusion.

An excellent experimental model is moral judgements, in which the subject becomes aware of a situation of strong conflict between factors for and against a difficult decision. The time available to arrive at a moral judgement is several minutes, and allows for conscious processing of the elements involved.

Neuroscience in recent decades has provided a wealth of data in favour of the central role of emotions and instinctive reactions in moral decisions. This thesis is supported by the neuropsychology findings of Antonio Damasio and the moral psychology data of Jonathan Haidt.

The fact that a brain area is activated while the subject analyses a moral dilemma does not prove that this activity has an influence on the outcome of the judgement. It could be an activation associated with the outcome of moral reasoning. To avoid this problem, Damasio decided to evaluate moral judgement deficits in patients with damage to a cortical area involved in the analysis of emotions. In a study (1994) extended to several directly analysed subjects, Damasio's laboratory showed that, in certain moral dilemmas, patients with a vmpfc lesion made more utilitarian judgements than control subjects.

The theory of the causal role of emotions in moral decisions is confirmed by the psychology experiments of Jonathan Haidt's research group (2001, 2007). According to Haidt, moral judgements normally arise from non-conscious intuitions.

Moral intuition is defined as an abrupt appearance of a moral judgement at the level of consciousness, including the affective valences involved, but without aware-

ness of having gone through stages of searching for evidence, weighing the evidence or inferring a conclusion.

Haidt introduced the principle of the primacy of intuition demonstrated by a series of experimental observations, in which the subject arrived at a moral judgement before making a rational evaluation. In fact, when Haidt asked subjects to justify their decision, they provided a rational explanation. But Haidt was able to show in many cases that the process of such an explanation could not have played a causal role in the judgement. The rational explanation was thus a construction fabricated post hoc by the brain.

In another series of experiments, Haidt showed that, when asked to justify their judgements, subjects were 'morally stunned' and staggered at their own inability to find reasons to support their decision. Haidt showed that moral intuition is actually permeated and strongly influenced by emotions, without the subject being aware of it.

Haidt concluded that *"high-level human thinking is preceded, permeated and influenced by affective reactions (simple feelings of attraction or aversion) that prompt us to approach or avoid"*. In contrast, *'moral reasoning is usually a post hoc process in which we search for evidence in support of our initial intuitive reaction'*.

It therefore appears that moral decisions arise instinctively without the control of reason, but are dominated by emotional drives of which the subject is not conscious. In this scenario, there would be no place for the freedom of the subject's ego, because decisions would occur in a forced manner based on affective/emotional brain signals.

However, Haidt himself states that the primacy of intuition is a push to decide in a certain direction, but it is not a dictatorship, because *'affective reactions push in a certain direction, but do not force absolutely'*.

The inability of patients with vmpfc lesion to use emotions in moral decisions leads to the hypothesis that activation of this brain area should lead to moral choices guided by emotional aspects.

Joshua Greene's research group (2004) used dilemmas to distinguish the role of emotional versus rational elements. In accordance with the hypothesis that the vmpfc area was involved in the evaluation of emotional elements, its greater activation was observed in cases involving greater personal emotional involvement and in which the decision was in accordance with the emotion aroused by the scenario. On the contrary, in particularly difficult moral decisions, in which the subject thought for a long time before choosing the solution he thought was right, greater activation of the dorso-lateral area of the prefrontal cortex (dlpfc), which is involved in rational thinking, was observed.

This theory of competition between brain areas was disproved by later experimental observations by Koenigs and Tranel (2007). In a test called the 'ultimatum game', which involves strong emotional involvement, patients with vmpfc lesions, instead of behaving in a more detached and utilitarian manner, showed greater emotional involvement.

Another experiment that contradicts the area competition hypothesis was performed using the technique of transcranial magnetic stimulation, which selectively inactivates a brain area.

During functional inactivation of the dlpfc complex, decisions should become less rational; on the contrary, in this experimental condition, subjects were more likely to accept intentionally unfair offers, thus choosing a more rational solution.

It is therefore clear that moral decisions do not simply arise from competition between emotional and rational areas, but from a more complex process.

In accordance with this more articulated conception, Jorge Moll's research group (J. Moll, R. de Oliveira-Souza, R. Zahn, 2005, 2008) emphasised the fact that the contrast between behavioural decisions cannot be divided into cognitive and emotional choices. In fact, the competition that arises in moral dilemmas occurs within alternatives each of which possesses a mixed emotional-cognitive content.

The relationship between the brain areas involved in processing the emotional and cognitive factors of moral judgement has been studied in greater depth in recent research (Hutcherson, Montaser-Kouhsari, Woodward, Rangel, 2015).

Although the areas identified do not completely coincide with those of previous studies, this research confirms that there are two separate circuits for emotional and rational/utilitarian analysis, the first based on the anterior cingulate cortex (acc) and the second on the dorsomedial prefrontal cortex (dmpfc). The evaluations made through the activity of these two areas are integrated into a global judgement in the vmpfc area.

The study also clarified the role of emotion in relation to reasoning.

In utilitarian decisions, Hutcherson's research group did not see activation of the circuit involved in emotional analysis, but only of that involved in rational evaluation. This shows that rational appraisal also occurs during the analysis of the situation and not only afterwards, and probably plays an important role in moral judgements, especially in the case of utilitarian decisions.

All that remains is to consider the strands of research on the pathological aspects that can affect the brain by directly influencing the processes of will-building, on the one hand, and reality perception, on the other.

On the one hand, the actual injuries, in the first place (as mentioned by Sartori, 2008) *"the now classic research on frontal lobe pathologies, pathologies in which the selective impairment of sociomotor abilities in the presence of a substantially preserved picture of general cognitive functioning"*.

In such cases, in fact, following lesions in areas of the prefrontal cortex (in particular the 'orbital' or 'ventromedian' areas of the anterior cortex), there is a pathological dissociation between general cognitive faculties and what is defined as 'social intelligence' (understood as the ability to understand and interact correctly in the most diverse social contexts): it thus occurs that '...patients who present conspicuous abnormalities in social behaviour can respond in a completely normal manner in intelligence tests' (Abbott 2001 - Sapolsky 2004).

As Damasio (2000) argues, in the frontal syndrome precisely that subtle, 'metaphysical' faculty that is 'free will' seems to be compromised:

"...With this sane and intelligent subject, the tragedy was that, while he was neither stupid nor ignorant, he acted as if he were... Elliot did not learn from his mistakes: he seemed to be beyond redemption, like the hardened evildoer who declares his regret, but immediately returns to commit yet another crime. It is fair to say that his free will had been compromised ..."

Another line of research relevant to criminal imputability are studies on the normality and pathology of neural centres related to moral reasoning and social cognition.

The magnetic resonance images published by King (et al, 2006) show the coexistent activation of the structures of the amygdala and the orbitofrontal cortex in concomitance with 'appropriate' social behaviour, whether of a violent character (e.g. reaction to an aggressor) or of a non-violent character (e.g. rescue of an injured individual). Such research thus seems to indicate the existence of a common neural system that guides the expression of behaviour appropriate to the social context, regardless of whether this has characteristics of violence/aggressiveness or compassion.

However, there are also some common (in the sense of widespread) pathologies that largely affect the relationship with the outside world and the perception of reality.

This is the case with migraine, menstrual syndromes, auras and scotoma.

Phenomena whose meaning and medical intensity sometimes deviate profoundly from the idea of 'common sense' and whose definitions cannot be entrusted to the 'lay conception' of law (especially in criminal law).

"It is easy to misunderstand migraine by describing it in terms of a single symptom. In this way a common migraine can be reduced to a headache, and a migraine aura to a scotoma. From a clinical point of view these descriptions are ridiculously inadequate and allow the formulation of equally absurd physiological theories... It may be important to consider migraine as a complex dynamic disturbance of nerve regulation and behaviour. For migraine sufferers, at certain critical moments, the most modest stimulus will cause a physiological imbalance that quickly leads to further imbalances and overcompensation, which amplify in reciprocal interaction, until they reach the end point that we call migraine'.

Thus Oliver Sacks, whose monograph on 'Migraine' (1970, 1992) is arguably the most important and comprehensive work on the subject since Jackson (1870) and Wolff (1961).

During migraine attacks, irritability and photophobia are extraordinarily common and have been adopted from Wolff onwards as pathognomonic features for diagnostic purposes.

There are two types of irritability related to migraine: the first is an aspect of the mood swings and defensive attitude typical of the sufferer, the second stems from widespread sensory arousal and excitability so strong that any stimulus is intolerable.

In Peters' words, *'a general dulling of the sensory faculties'*.

Tell Sacks (1970) *"one of my patients, an Italian of average build and violent temperament, puts an end to his migraines by sexual intercourse if he is at home, or by fighting or drinking with his colleagues if the attack occurs when he is at work. Both systems prove effective within five to ten minutes'.*

And another case *"This middle-aged man was phlegmatic in nature and manifested in his appearance and manner a standoffish austerity. He had suffered from common migraine since childhood and described the prodromal excitement of these attacks with some embarrassment. Two or three hours before the onset of the headache, he would 'transform': he would feel thoughts swirling in his mind and experience an almost uncontrollable desire to laugh, sing, dance, whistle'.*

Such states of arousal can sometimes reach the intensity of panic or psychosis, emotional prodromes common with premenstrual syndrome.

Always Sacks

"Twenty-nine-year-old woman with agitated and very intense menstrual syndromes. The premenstrual phase was characterised for two days by increased fluid retention, accompanied by a crescendo of anxiety and widespread irritability. She slept little and her sleep was punctuated by nightmares. The emotional disturbances reached their acme in the hours immediately preceding menstruation, during which the patient became hysterical, violent and hallucinated'.

It can be argued that the menstrual cycle is always associated with a certain degree of physiological disturbance, even though this may go unnoticed by the woman. The disturbance tends to take on the character of psycho-physiological arousal before menstruation; afterwards it takes on a character of 'relaxation' followed by recovery.

The awakening period may be characterised by tension, anxiety, hyperactivity, insomnia, fluid retention, thirst, constipation, abdominal dilatation; but more exceptionally, asthma, psychosis, epilepsy are also observed.

The hallucinatory experience typical of the so-called classic migraine auras have the characteristic of being mistaken for reality and eliciting a perceptual reaction or 'focused reflex' (Konorski, 1967).

It is likely that the abnormal sensations of a migraine aura are experienced in a fully conscious waking state, and there is a tendency to subjectivise such sensations.

In the most severe auras such objective sensations can completely overwhelm the person and be experienced as absolute reality.

In addition, there is a veritable constellation of general alterations of sensory thresholds, with a widespread blurring of sensory faculties: a blurring of vision, an exponential enhancement of auditory perception, tactile hypersensitivity (even a light touch can be perceived as intolerable).

The person may feel (in this specific case 'be') assaulted by the surrounding environment, or completely isolated. In general, there is a generalised activation of consciousness and muscle tone (phase of alertness, tension and vigilance). In general, there are complex disorders of visual perception (in a scotoma it is the very idea of space itself that is extinguished, together with the visual field, and one is

left without a place and time of reference), complex difficulties in the perception and use of one's body, disturbances and dysfunctions of the entire language spectrum, states of actual splitting of consciousness up to dreamlike, delirious and trance-like states.

Hughlings Jackson (1870) describes such a true splitting of consciousness as follows *"along with the remnants of normal consciousness there is an almost parasitic condition of consciousness (dream state) and a double consciousness... a mental diplopia."*

It is impossible to draw a clear dividing line between these 'oneiric states' and migraine delirium or psychosis: transient states of true depersonalisation are remarkably common during migraine auras, which when accompanied by hallucinations, amply render the psychic picture of someone under the influence of mescaline.

As Freud states *'the ego is first and foremost a corporeal ego... the mental projection of the surface of the body'* and, Sacks (1992) continues, *"the sense of self seems to be based on a continuous inference from the stability of body image, external perceptions and temporal perception. Feelings of ego dissolution arise readily if there is a serious disturbance or instability of body image, external perception, or temporal perception; we have seen that all of these disturbances can occur during a migraine aura'.*

The term scotoma indicates darkness, shadow. In the case of a 'bilateral scotoma', ontologically terrible experiences can occur: the disappearance of the central part of the visual field, of the real world. In severe attacks, not only does a part of one's self seem to disappear, but the person can become profoundly confused about the whole of his or her body, has no reference to where each part and 'his or her' part is, nor that that part even exists. Such conditions have often been considered illusory, insane, invented, too strange to even be imagined (except by those experiencing them).

According to Gerald Edelman, consciousness arises primarily from a perceptual integration combined with a sense of historical continuity, a continuum of relationships between the perception of coherence between one's body and the world (primary consciousness), past (personal time) and present (personal space).

In a deep scotoma, all three disappear: one's body and one's world cannot be recognised, and one's place and time have disappeared.

Lance (1992) finds the onset of migraine attacks at the hypothalamic level, either on the basis of innate periodicity or in response to external sensory stimuli from the cerebral cortex.

The cortex (Siegel et al. 1991) is a complex of billions of cells, of about twenty different types, arranged in six layers, with an almost incalculable number of connections; the neurons in the cortex have action potentials that result from a complex, time-dependent movement of ions in and out of the cell, and these 'action potentials' constitute the only means of communication between cells and are not transmitted instantaneously, but take some time to propagate between axons and synapses.

The impulses then descend to the grey substance (periaqueductal) and then to the raphe nuclei, where they can influence the cerebral microcirculation, triggering radiating depression at the cortical level, closing the 'pain door' in the spinal cord.

This phase –which depends on the hyperactivity of the brainstem's norepinephrine and serotonin systems– is followed by a reduced transmission of monoamines, which causes a sudden reopening of the 'pain door' and thus the entire skull is literally flooded with a wave of previously inhibited pain.

At the same time, the afferent gateway to the senses is opened (a probable evolutionary legacy reaction: the creation of a state of alertness and vigilance in response to a danger that causes pain), resulting in hyperactivity and intensification of hearing, touch, smell and sight.

No less than six neurotransmitters (it would also be more appropriate to speak of neurotransmission systems) appear to be involved in the genesis of a migraine: norepinephrine, acetylcholine, dopamine, histamine, GABA, enkephalins and serotonin (which explains why some pharmacological remedies that operated on only one of these neurotransmitters were sometimes and occasionally successful).

From a chemical-hormonal imbalance point of view, something superior to the chemical effects of most drugs!

7. CONCLUSIONS AND PRELIMINARY INCONCLUSIONS

According to Filippo Tempia (2017)

"knowledge of these non-conscious mechanisms not only does not eliminate the responsibility of the subject, but also highlights the possibility and importance of thoroughly examining the validity of judgments that appear intuitively... I propose to rethink the elements at play in the decisions we consider free, in the light of the hypothesis that during the state of consciousness mental and cerebral activity are simultaneous and not one the product of the other. This conception overcomes some of the problems posed by a dualistic view, in which mind and brain are not only distinct, but must interact with each other with cause-effect relationships in which the cause temporally precedes the effect. This conception creates a hiatus between mind and brain, easily leading to the denial of the causal efficacy of either... There is currently no valid demonstration that consciousness is simply an ineffective bystander in guiding neuronal activity. On the contrary, these studies have revealed the type of brain activation and the areas involved in consciousness: it is this set of active and synchronised areas that is conscious. Thus, conscious decisions are made by these areas when they are in the conscious functional state... I propose to overcome the mind/matter dualism, and to think in terms of the conscious neuronal network constituted by the workspace unified by the global firing and synchronisation of nerve signals."

A 'moderate' approach (Eastman & Campbell, 2006) suggests two parallel and relatively independent areas of reflection: a first sphere –strictly scientific– in which an ever-increasing theoretical and methodological deepening is called for in the study of the components of violent and antisocial behaviour; a second sphere –more of a psychological-forensic nature– which aims at a critical reflection on the concrete possibilities of direct transposition of neuroscientific knowledge into the courtrooms (thus re-proposing the old questions of the meaning of the organicity of behaviour and psychic anomalies in the absence of obvious organic aetiological factors).

As Gazzaniga and Steven (2005) probably guessed *"Neuroscience will never discover the brain equivalent of responsibility, because it is something we attribute to people and not to brains. (…). Responsibility is a social construction, and exists in the rules of society, but not in the neuronal structures of the brain."*

As Sammicheli and Sartori (2008) stated

"if what is to be proved for legal purposes is a pathological mental functioning, the neural correlate turns out to be an effective proof of this. Once an anatomo-functional correlation between a given mental function (which is legally relevant) and the activation of a given brain region has been established with certainty, it will be possible, by means of neuroimaging techniques, to introduce into the trial possible evidence of a mental dysfunction that must be judicially ascertained. That is already something'.

As we have seen, recent neuroscientific studies have in the last forty years profoundly increased our knowledge of the functioning of the human brain and the underlying physiological and chemical-biological processes.

At the same time, also thanks to technological progress, it has been possible to describe, read, see and understand (sometimes even touch) these processes in depth, and to describe in detail the topography and fauna and the functional mechanisms of parts of the brain and some of its functional complexes.

A physiological description of widespread and (fortunately) less widespread pathologies (strokes, tumours, parkinsonian plaques, even minute highly localised lesions, migraine, sense systems and their dysfunctions) that today makes us realise how the threshold of 'awareness and will' of human action –besides being a very complex process– is far removed from the perception of 'common sense' and 'lay knowledge' underlying the definitions of criminal law.

Far from considering pathologies such as migraine or a tumour or DPS and menstrual syndrome as 'absolutely exculpatory' causes per se (we would end up by considering more than half of the population as not imputable!), today's clinical picture, in appearing clearer, more articulated, more complex and better described, nevertheless imposes a greater declination and articulation of the threshold of imputability (and therefore of punishability).

In this process of redefinition in concrete terms, on the one hand practitioners of criminal law have to surrender something of the 'common sense' to more complex meanings and signifiers, and on the other hand they cannot submit to what science says, but have to ask (with clear questions) science to better define and unambiguously answer the definition of these thresholds.

For their part, neurosciences must take note of their unfailing role in providing answers –that only they can provide– to the (now macroscopic) gaps in the definitions of criminal law.

In this dialogue of two, by each giving up a part of their 'place of study and action', far from moving away from their own territory and vocation and role and purpose, they have the chance to return, instead, to that common territory and main vocation. In this sense, at least two elements bring the two branches together.

The first is that they have man, human action, and people's decision-making and behavioural processes as their subject. The second is that both areas aim to (or should aim to) improve the quality of life of the individual and the society in which he or she lives.

If it is true that neuroscience often finds its object of study in pathology, criminal law, too, lives –and it cannot be otherwise (unlike civil justice)– in the courts, i.e. in the pathological moment to which the justice-system is called to account and respond.

Recovering common premises and goals therefore ends up being the point of this process.

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