



# Neuroscientific Evidence in Italian Criminal Proceedings

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### Conceptual Paper

Volume 9 Issue 2

Received Date: March 13, 2024

Published Date: April 04, 2024

DOI: 10.23880/ijfsc-16000377

## Abstract

The author asks whether and to what extent neuroscientific evidentiary techniques can be considered admissible in Italian criminal procedure to assess the mental state of the accused or to verify the truthfulness of a statement, analyzing the national jurisprudence on the subject. First, the author asks whether neuroscientific techniques can be used to determine whether the defendant was totally or partially insane at the time of the crime charged and to determine whether the defendant is a socially dangerous person. The answer is yes, although great caution must be exercised. The main risk is to theorize the existence of a real biological basis for antisocial behavior, which could even justify the adoption of restrictive measures praeter delictum against the biologically vulnerable person. Secondly, the author asks whether the techniques called A-IAT (Autobiographical Implicit Association Test) and TARA (Temporal Antagonistic Response Alethiometer), used in Italy in some criminal proceedings to verify the truthfulness of a statement, are compatible with the Italian law of evidence, which prohibits the use, even with the consent of the person concerned, of methods and techniques that are likely to impair his freedom of self-determination and his ability to recall and evaluate facts. The answer is certainly no if it is believed that these techniques can function as "memory detection" techniques, i.e. they are capable of detecting in the mind of the person concerned even memories that he or she has erased. More controversial is whether a-IAT and TARA are to be considered admissible if they are believed to be simple "lie-detection" techniques, aimed at revealing whether or not the declarant is truthful in reporting his or her memories.

**Keywords:** Criminal evidence; Neuroscience; Memory Detection

**Abbreviations:** A-IAT: Autobiographical-Implicit Association Test; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; FACS: Facial Action Coding System; FMRI: Functional Magnetic Resonance Imaging; IAT: Implicit Association Test; MEG: Magnetoencephalography; PET: Positron Emission Tomography; SPECT: Single Photon Emission Computed Tomography; TARA: Timed Antagonistic Response Alethiometer.

## Introduction

In Italian criminal procedure, neuroscientific evidentiary techniques are sometimes used to determine the mental

state of the defendant and the reliability of the statements of defendants and witnesses. The purpose of this paper is to examine the extent to which this phenomenon has occurred and the extent to which Italian doctrine and jurisprudence consider the use of these techniques compatible with the fundamental rules of Italian criminal evidence law. Particular attention will be paid to the rule contained in Articles 64 and 188 of the Code of Criminal Procedure, according to which methods or techniques which may influence the freedom of self-determination or alter the capacity to recall and evaluate facts shall not be used, not even with the consent of the person concerned.

The contents of this paper partly coincide with those of the author's papers mentioned in the references [1-2].

### Techniques of Brain Exploration

Neuroscience is a set of scientific disciplines that study the physiological processes and brain mechanisms that regulate human behavior, using sophisticated techniques to probe the brain [3-11].

Some of these techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI), are used solely to study the anatomy of the brain. Others, more interestingly, are used to analyze brain function, i.e., which parts of the cerebral cortex are activated during the performance of certain cognitive tasks and when they are activated. In addition to the "old" (but still valid) electroencephalogram, which remains valuable for the information it can provide about the temporal dimensions of brain activity, other more invasive neuroimaging techniques fall into this category, primarily used to determine the spatial location of this activity. For example, a radioactive marker is injected into a patient's veins and its path through the bloodstream can be detected by external equipment to determine which areas of the cerebral cortex have more synaptic activity (and therefore require more blood flow) in response to certain stimuli (this technique is known as positron emission tomography, or PET). Or you can expose brain tissue to a magnetic field and short sequences of radio waves to find out which areas of the brain need more oxygen molecules in response to certain stimuli (this is known as functional magnetic resonance imaging, or fMRI). Then there are similar techniques such as MEG (magnetoencephalography), SPECT (single photon emission computed tomography), and others.

Other techniques of a different nature are used primarily (though not exclusively, as we shall see) to analyze the brain mechanisms activated during the declarative performance of a witness or defendant [12-18]. There is an important distinction to be made here between lie detection techniques and memory detection techniques. Lie detection techniques are used to test whether the declarant is telling the truth, i.e., to find out when he or she is reporting things other than what he or she actually knows or remembers. Memory detection techniques, on the other hand, are designed to determine whether a particular memory trace is present in the declarant's mind, regardless of the declarant's will and even (according to their inventors) regardless of the declarant's awareness of the memory itself.

Lie detection techniques assume that the brain activity underlying a lie is more strenuous and complex than that underlying a truthful statement. In reality, some of these techniques - such as thermography or the so-called FACS

(Facial Action Coding System) - only serve to reveal the symptoms of this more intense mental and emotional work (infrared emissions from the declarant's face, facial muscle contractions, etc.).

They are thus only updated versions of the old polygraph (or the hydroseismograph invented by Cesare Lombroso) [13] and cannot be considered neuroscientific techniques in the strict sense, since they do not involve direct observation of the subject's brain activity. A neuroscientific lie detection technique, on the other hand, is certainly functional magnetic resonance imaging (fMRI), which we have already discussed: increased oxygen flow in a certain area of the declarant's cerebral cortex would show that the process of inhibiting the truthful response and processing the lie is underway. A true lie detector of the third millennium: but it is a technique of very uncertain reliability, and it is not known that it has ever been used in Italy to check the trustworthiness of a statement.

Memory detection techniques, on the other hand, are those used to detect the existence of a memory trace, in the mind of the declarant, independent of the awareness of the memory itself. The first is Brain Fingerprinting, which consists in detecting, by means of an apparatus connected to electrodes placed on the declarant's head, a kind of brain wave (the P300) that becomes more or less intense depending on the subject's familiarity with the image or information administered to him or her (a kind of real "brain imprint" that would be left in the mind of someone who has had a certain sensory experience).

The second is the most widely used in Italy, also because it was developed by an Italian scientist (Prof. Giuseppe Sartori, Full Professor of Forensic Neuroscience at the University of Padua) and his team [13,15-18]. It is the a-IAT (autobiographical-Implicit Association Test), an advanced version of the IAT (Implicit Association Test), a memory test developed by the American social psychologist Anthony Greenwald in 1998, which is based on measuring the time it takes the subject to associate two concepts, on the assumption that the reaction time is shorter when the association is already present in the subject's mind (e.g., flower-pleasant, insect-unpleasant). The a-IAT uses sentences rather than simple words or pictures, and the subject is asked to associate sentences appearing on a computer screen with the concepts of true and false and "guilty" and "innocent" by pressing the appropriate key. Thus, it is not semantic memory that is being assessed, as in the IAT, but episodic or autobiographical memory. More precisely, sentences that are certainly true and sentences that are certainly false and that refer to the state of the subject at the time of the test (such as "I am in front of the computer", "I am at the bottom of the sea", etc.) are alternated with sentences that have relevance to the criminal episode

whose memory trace is sought in the subject's mind, some corresponding to the prosecution's thesis ("I killed Titius", "Caius molested me"), others corresponding to the defense's thesis ("I did not kill Titius", "Caius did not molest me"). In the first phase, the subject must press a particular key (e.g., the A key) corresponding to the propositions that he considers to be certainly true and those that he classifies as "guilty", and another key (e.g., the L key) corresponding to the propositions that he considers to be certainly false and those that he classifies as "innocent". At a later stage, the instruction given to the examinee changes: the A key is to be used for true and innocent propositions, the L key for false and guilty ones. Sartori writes: "The sentences that will be faster when they share the same emotional response with true sentences will be those to which the autobiographical memory trace corresponds". Thus, for example, in the case of an a-IAT test administered to a suspected murderer, if the association "I killed Titius / sentence according to the prosecution's case" is faster when the key to be pressed coincides with the key associated with the true sentences (and therefore slower in the opposite case), the memory trace revealed by the test is the memory of having committed the murder.

Similar to the a-IAT is the computerized TARA (Timed Antagonistic Response Alethiometer) test. As in the a-IAT, the subject is shown true or false propositions that relate to his or her state at the time of the test and propositions that correspond to the two contrasting versions associated with the autobiographical event being studied (i.e., the past event reported by the declarant and the alternative event that the subject describes as unrelated to his or her experience: "I did not kill Titius/I killed Titius"; "Caius molested me/Caius did not molest me"), and again he or she is asked to respond to the appearance of the sentence on the monitor by pressing a particular key. In contrast to the implicit association test, however, the subject is also asked to classify propositions of the second type using only the two logical categories true/false. In a first step of the test, the classification of sentences has to be done according to an "honest" criterion: the subject has to indicate as true those sentences that he or she considers to be true and as false those sentences that he or she considers to be false. In a second step, the opposite criterion (referred to as "dishonest") must be used: the respondent must indicate as false the propositions that correspond to his version of the facts and as true those that correspond to the alternative version. As in the a-IAT, the calculation of reaction times using sophisticated mathematical algorithms would make it possible to understand which of the two versions of the autobiographical event under investigation is the one actually experienced by the examinee and whether the examinee was honest in reporting it.

In fact, it is not entirely obvious that techniques such as the a-IAT and TARA can be called authentically neuroscientific.

In fact, as in the case of the Facial Action Coding System, there is no direct exploration of the subject's brain activity, but rather an inference of a given psychic functioning from external behavioral cues (in this case, the speed with which a stimulus categorization task is performed). Thus, there are those who believe that the a-IAT and TARA can only boast the status of neuroscientific techniques at the cost of a considerable dilution of the genus. When you call into question the brain by talking about the a-IAT - someone claims - it is done in an absolutely generic way [17].

### The Use of Neuroscientific Evidence in Italy

It is hardly worth mentioning that techniques such as those we have described can be very useful in the criminal proceedings, where it is necessary to evaluate human behavior (that which constitutes a crime) and where it is often essential to understand whether the accused or the witnesses are telling the truth and what memories are stored (consciously or unconsciously) in their memory.

Consequently, neuroscience has so far been applied in Italian criminal courts for two different purposes.

First, neuroscientific techniques have been used to assess the mental state of the accused. It is worth mentioning that in the Italian legal system, according to Article 88 of the Penal Code, a person is "not imputable" (i.e., he or she cannot be neither charged, nor convicted, lacking the requirements for criminal liability) if, due to an infirmity, he or she is in such a mental state as to exclude the awareness and the voluntariness of his or her behavior at the time of the commission of the crime (i.e., does not actually have the capacity to choose whether to commit the act that gives rise to criminal liability). Lack of imputability results in a verdict of acquittal (Article 530 of the Code of Criminal Procedure). However, a person acquitted on the grounds of total mental defect may be subjected to security measures if he or she is considered socially dangerous, that is, if he or she is likely to commit new acts defined by law as crimes (Articles 202-203 of the Criminal Code). On the other hand, according to Article 89 of the Italian Penal Code, a person is "imputable", and can therefore be charged and convicted, if, at the time of the crime, he or she was in a mental state, due to an infirmity, such that his or her capacity was substantially reduced, without excluding it. A partial mental defect, however, implies a reduction of the penalty (as a rule, to the extent of one third). Finally, if the defendant is in such a state of mind as to be incapable of conscious participation in the proceedings, the judge must, if the pathology is reversible, suspend the trial as long as it continues; if the pathology is irreversible, he must acquit the accused (Articles 71, 72, 72-bis of the Code of Criminal Procedure).

Thus, neuroscientific evaluations of the defendant's mental state can be used (a1) by looking to the past, to determine whether the defendant was totally or partially lacking mental capacity at the time of the offense being charged; (a2) by looking to the present, to determine whether the defendant is capable of consciously participating in the proceedings; and (a3) by looking to the future, to determine whether the defendant is a socially dangerous individual [19,20].

Second, neuroscientific techniques have been used to screen the reliability of the statements of defendants and witnesses. In this regard, it is worth noting that the Italian criminal judge is not bound by any legal constraints in the evaluation of evidence, but must specify, in the grounds of the judgment, the results reached and the criteria adopted (Art. 192 paragraph 1 of the Code of Criminal Procedure). In evaluating a declarative evidence, he may enlist the help of experts or technical consultants who have specific scientific expertise in the field (Articles 220, 233, 501 of the Code of Criminal Procedure).

Normally, techniques such as CT, MRI, and PET scans are used to diagnose the defendant's mental state, while lie detection or memory detection techniques are used to assess the reliability of declarative evidence (we have seen how fMRI serves both purposes). But this is not always the case: for example, in one important court case – the so-called “Como case”, which we will discuss immediately – the use of IAT and TARA revealed that the defendant did not remember criminal acts she had peacefully committed, which contributed to a diagnosis of dissociative syndrome.

### Major Court Cases

Let us briefly review the most important Italian court cases in which neuroscientific techniques were used [3,4,10,19,21,23,24].

In the so-called “Trieste case” (Corte Ass. App. Trieste, Sept. 18, 2009, B.), the defendant, a confessed murderer, underwent a “magnetic resonance imaging scan of the encephalon [...] to search for possible structural alterations of the brain”. This analysis did not reveal “significant signs of alteration”: at the same time, however, the judge ordered behavioral genetics investigations (carried out by analyzing a sample of the defendant's blood), which revealed the existence of a chromosomal structure such as to make the defendant “genetically vulnerable” to the temptation to react with violence in situations of emotional stress. The Trieste Court of Appeal inferred from this the confirmation of the defendant's partial mental disorder, which had already been diagnosed, on other grounds, in the trial at first instance.

In the so-called “Turin case”, or “Cogne-bis case” (Turin Trib., April 19, 2011, F.), the defendant, who had already been convicted by a final judgment for the murder of her very young son, was tried for the crime of calumny for having falsely attributed the crime of murder to a neighbor. During the trial, Ms. F. was subjected to a-IAT and TARA tests, which showed that she no longer had any mental traces of the murder she had committed. The court, however, found the results of the test to be essentially irrelevant and convicted the defendant. Indeed, it found plausible that the defendant's mechanism for erasing guilty memories had been activated after the slanderous act, and noted that there was ample other evidence of slanderous intent.

In the so-called “Como case” (G.u.p. Court of Como, May 20, 2011, A.), the defendant, charged with the murder of her sister and the attempted murder of her mother, was found to be partially mentally defective, both as a result of morphological-cerebral examinations (the fMRI and Voxel Based Morphometry), which had shown the existence of “alterations in the density of gray matter in some key areas of the brain” deputed to the “regulation of aggressive actions”, as well as the result of behavioral genetics investigations, which had revealed the existence of “three unfavorable alleles” capable of determining a “significantly increased risk of developing aggressive and impulsive behavior”. The defendant was also subjected to the autobiographical memory tests a-IAT and TARA, which, as mentioned above, made it possible to diagnose the existence of a dissociative syndrome, since the examinee did not remember having engaged in behaviors that she had certainly engaged in.

In the so-called “Cremona case” (G.u.p. Trib. Cremona, July 19, 2011, G.R.), the defendant, an employer accused of committing acts of sexual violence against one of his young interns, was also convicted because the use of a-IAT and TARA techniques made it possible to find the memory trace of the traumatic event in the mind of the victim of the crime.

In the so-called “Venice case” (Trib. Venice, Jan. 24, 2013, M.), the defendant, a pediatrician accused of sexual assault (committed against six little girls during medical examinations conducted in a daycare center), underwent neuroscientific research using the fMRI technique, which showed that several areas of his brain, including the orbitofrontal cortex and hypothalamus, were affected by a recent tumor formation (chordoma of the clivus). He was also subjected to the a-IAT test, which showed that he retained no autobiographical traces in his memory of a sexual impulse toward minors before the onset of the disease. However, the judges in this case found the autobiographical memory test unreliable and the correlation between the tumor mass and the onset of pedophile attitudes insufficiently substantiated. Therefore, the defendant was found fully capable at the time of the crime.

In the so-called “Salerno case” (Salerno Court of Appeal, Dec. 16, 2016, V.), the defendant had been definitively convicted of aiding and abetting a murder materially committed by an accomplice who had fired numerous gunshots at the victim. A request for revision based on the convicted man’s submission to a-IAT and TARA techniques was rejected by the Court of Salerno (after the Court of Cassation overturned an initial rejection order issued by the Catanzaro Court of Appeal) on the grounds that the aforementioned techniques could not be considered methodologically correct or sufficiently validated by the international scientific community.

In the so-called “Milan case” (Cass., Sec. I, April 10, 2015, N.), the defendant, a minor, was accused of voluntarily running over with his car a police officer who had ordered him to stop for a check following a previous traffic accident. The Supreme Court, agreeing with the arguments of the Court of Appeal, found that the results of an a-IAT test, which showed that the defendant did not retain in his mind the memory of having felt the presence of the person who was later run over, were not significant. The two courts unanimously noted both the existence of doubts about the reliability of the method, as it was newly created, and the existence of some critical issues in the application of the test to the specific case, including the fact that the defendant was asked complex questions despite the fact that he had reading difficulties, which could affect the response time.

Finally, in the so-called “Brescia case” (Brescia Court of Appeal, November 11, 2020, C.), a person who had been definitively convicted of sexual assault against a minor sought a revision of the conviction, citing, among other things, the results of a test administered using the a-IAT technique. For reasons better explained below, the Court of Appeal found the evidence inadmissible, while granting the request for revision because of other evidentiary findings.

### **Neuroscientific Techniques as a Tool for Diagnosing Mental Illness**

Some initial considerations should be reserved for the use of neuroscientific techniques to assess the mental state of the defendant.

There is no doubt that neuroscientific experimentation can help to increase the degree of epistemological soundness of expert opinions on the subject of mental capacity and, therefore, to make the assessment of the offender’s imputability more reliable with regard to persons who may be affected by a mental defect [10,13]. In Italy, the use of these techniques is considered to be particularly useful in the diagnosis of those “personality disorders” (such as paranoid disorder) which, according to the Court of Cassation, are not

always included in the narrow group of mental illnesses, but may fall within the concept of “infirmity” as defined by art. 88 and 89 of the Penal Code, at least when they appear to be of such persistence, intensity and severity as to have a concrete effect on the mental capacity of the offender (in fact, neuroscience seems to challenge one of the premises of the Supreme Court’s opinion, namely that personality disorders do not really have an organic basis in the individual’s brain) [3,9,19].

However, caution must be exercised in several respects [3-6,22]. First of all, it must be borne in mind that it is one thing to diagnose the existence of the infirmity at the time of the expert’s report (this is the task of the expert), but it is another to determine whether the infirmity was also present at the time of the act and whether it had a concrete effect on the commission of the specific crime charged (this is the task of the judge alone). The judgment of the consciousness and voluntariness of the behavior, that is, the assessment of the “concrete incidence” that the mental disorder may have had on the criminal determination, is also an exquisitely legal and non-scientific judgment, which only the judge must pronounce, although the diagnosis is often erroneously referred to the expert from the formulation of the expert question.

Second, it must be remembered that the study of the relationship between brain physiology and criminal behavior began because subjects who had suffered traumatic deformations of the cerebral cortex in the frontal lobe area had subsequently manifested unusually aggressive attitudes. This is precisely the insidious way in which neuroscientific studies of antisocial behavior have been conducted in the United States: magnetic resonance imaging and PET scans would have been detecting, among the prison population, precisely the existence of this correlation between the development of violent behavior and certain structural or functional defects in the prefrontal area, even apart from actual brain lesions. In this regard too the issue of neuroscientific evidence must be handled with great care. Indeed, the step to theorizing the existence of a real biological basis for criminal behavior is a short one [8,10]: all the more so when this type of experiment is accompanied by behavioral genetics studies aimed at correlating an individual’s chromosomal endowment with his or her ability to react to environmental stimuli, that is, to demonstrate the existence of a greater or lesser “genetic vulnerability” to the temptation of criminal behavior, as in the Trieste and Como cases.

Little harm, after all, when it comes to decreasing penalties, but there are two very obvious risks. The first is that the results of an expert opinion such as this will condition the same judgment on the existence of the objective and subjective elements of the crime: in Italy it is

rightly believed that evaluations such as the one described should be made, if at all, after the decision on guilt, in a system that should be structured according to the 'biphasic' model typical of American criminal justice (in Italy the judge decides contextually on responsibility and punishment) [22]. The second is the obvious downside of a genetic vulnerability diagnosis, namely the unfavorable prognosis of the social dangerousness of the person concerned (in both the Como and Trieste cases, for example, the defendant was considered socially dangerous). The most worrying future scenario is that of the stigmatization and incapacitation of people solely on the basis of their genetic or physiological characteristics: social dangerousness diagnosed on a genetic or neuroscientific basis, even *praeter delictum*, regardless of the commission of any crime [7,10,19].

Indeed, it is usually the neuroscientists themselves who preach caution, speaking cautiously about propensities, tendencies, without introducing rigid deterministic chains [3,6,9-10,22]. Thus, from a retrospective point of view (in assessing the existence of an "infirmity" relevant under Articles 88 and 89 of the Penal Code, i.e., a total or partial mental defect), abnormality diagnosed by means of neuroscientific techniques is never a sufficient condition to exclude or consider diminished capacity to act with consciousness and voluntariness: just as, from a prognostic point of view (in assessing social dangerousness), it is not a sufficient condition to infer a high probability of committing crimes. It is therefore widely believed that, in the diagnosis of total or partial mental deficiency, neuroscientific tools should not replace traditional ones, such as the clinical interview and psychopathological tests, but should complement them, confirming or questioning their results, as in fact has been the case in Italian trials where neuroscience has been used.

However, there is also a current of "radical" neuroscientific thought that questions the very basis of individual criminal responsibility, arguing that notions such as conscious will, capacity for self-determination, voluntariness, etc., are nothing more than illusions, mere conceptual artifacts lacking an ontological basis.

These opinions are based on the famous experiments conducted by Jonathan Libet and his staff in the 1980s. Libet, as is well known, wanted to perform a simple and seemingly innocuous test: to calculate how much time elapses between the conscious formation of a subject's will to perform a certain action (such as moving a limb or pressing a key) and the activation of the brain mechanisms that preside over the execution of that action. Libet assumed that the mental cause precedes the physical event, which consists of the electrical activity of the brain that produces bodily movement. The results of these experiments were shocking, because it was discovered that brain activity actually precedes the formation

of the conscious will to perform the act: the brain activates the bioelectric potential typical of voluntary acts at least 300 milliseconds before the acting subject becomes aware of it. The experience of conscious will, the self-perception of acting freely, would be but a sensation, an illusion, the epiphenomenon of a brain activity that has an exclusively mechanistic basis. Consequently, the paradigm of culpability understood as the "possibility of acting otherwise" would no longer be scientifically tenable, and this model of criminal responsibility would have to be set aside. Punishment, as traditionally understood, should also be completely replaced by security measures designed to correct or neutralize the offender.

This is not the place to delve into this complex issue. Suffice it to say that Libet's experiments have since received considerable confirmation, but their methodological correctness is still disputed. It should also be noted that even if Libet's test results were accepted, the individual would retain the ability to stop and inhibit unconsciously activated brain processes. At least in this sense, he would remain free: no longer free to will, but still free to will not [3-4,6-10,13].

### **Neuroscientific Techniques as a Tool for Verifying the Reliability of Defendants' and Witnesses' Statements**

Among the neuroscientific techniques that can be used as a tool for verifying the reliability of a declarative act, special attention should be paid to the a-IAT and the TARA tests (without prejudice to what has already been said about their actual classification).

In Italy, on at least two occasions (Cremona and Como), judges have usefully applied these innovative investigative techniques. Subsequently, however, doubts have been raised both about their actual scientific validity and about their compatibility with fundamental principles regarding the admissibility and acquisition of criminal evidence.

With regard to the latter aspect, it should be recalled that in the Italian criminal system, according to a well-established case law of the Court of Cassation, scientific evidence is admissible only under certain conditions, similar to those established by the U.S. Supreme Court in the famous Daubert ruling of 1993.

The assessment of the actual "scientificity" of the new evidentiary technique must be made by taking into account the breadth, rigor and objectivity of the research on which it is based, the degree of support that the facts give to the theory that constitutes its foundation, the explanatory power of this theory, the critical discussion that accompanied its elaboration, the degree of consensus it gathers in

the scientific community, and, finally, the authority and independence of judgment of both the person who carried out the research and the expert questioned by the judge (Cass, Sec. IV, September 17, 2010, Cozzini).

Secondly, it should be recalled that the Italian Code of Criminal Procedure expressly prohibits the examination of the defendant or witness by means of methods or techniques that may impair his freedom of self-determination or alter his ability to remember and evaluate facts, specifying that this prohibition remains in force even if the person examined consents to the use of the aforementioned methods or techniques (art. 64, paragraph 2, and art. 188 of the Code of Criminal Procedure).

With regard to the scientific nature of the method, Italian judges have so far reached different conclusions. In the cases of Cremona and Como, the Daubert test has been passed with flying colors. In the cases of Venice and Milan, on the contrary, the courts considered that the a-IAT was still an experimental method, based on theoretical premises that were, for the time being, unsupported by the general consensus of the relevant scientific community. This point was the subject of further specific consideration in the Salerno and Brescia cases, in which the assessment of the scientific nature of the method was entrusted to experts. In the Salerno case, the verdict was radically negative. The expert witness - whose opinion was fully endorsed by the judge - argued that only Greenwald's IAT would be sufficiently appreciated by the scientific community, and not its "derivatives" a-IAT and TARA (which would be only superficially similar to the former in structure and function). Instead, the expert in the Brescia case concluded that the a-IAT, as an extension of the original IAT measure, would be a validated and reliable instrument in the opinion of the international scientific community. The Brescia judges, however, only partially agreed with the expert's diagnosis: the Court of Appeal pointed out that while there is a large body of research on the IAT, especially international research, there are far fewer publications on the a-IAT method, and most of them come from the originator of the method himself or his school. The subject therefore remains controversial [3,13,18,21,23,24].

It is also doubtful whether the use of the a-IAT and TARA methods will result in an impairment of the declarant's freedom of self-determination and his ability to remember and evaluate facts. In this regard, the first crucial question is whether these techniques are really capable of serving as "memory detection" tools rather than mere "lie detection" tools, i.e., whether they are really capable of detecting the presence of memories that the declarant would no longer be able to retrieve because he has suppressed and/or overwritten them. The issue is far from peaceful, both in neuroscientific doctrine and in jurisprudence. In the Turin

case, for example, the result of the a-IAT was considered irrelevant, as already mentioned, precisely on the assumption that the defendant could have carried out the process of unconsciously erasing the guilty memory only after the slanderous act (thus the Turin court took it for granted that the autobiographical memory test could only investigate conscious memories). Even more explicitly, the Cremona judges wrote that the a-IAT and TARA tests are intended solely to determine what memory a subject has of a given fact (a memory that could also be the result of suggestions or distortions of what really happened). In the Brescia case, however, the opposite conclusion was reached: the a-IAT would be resistant to the "self-presentation artifact", i.e., the inevitable mixing of the declarant's actual memories with the processes of integration and narrative overwriting that characterize any conscious account of one's past sensory experience; the a-IAT would thus allow one to bypass the potential filters or biases that the subject may somehow, even unconsciously, put in place when recounting a fact. The relevance of the issue is very clear: if the correct solution is the latter, it is hard to deny that the declarant's freedom of self-determination is compromised, because the defendant or witness would literally be forced to "tell" - by pressing more or less fast computer keys - what could never have been the subject of his or her intentional testimony. Indeed, the Brescia Court of Appeal came to these conclusions: the a-IAT (but the argument also applies to the TARA) would ultimately be an overly invasive tool, and should be outlawed like hypnosis, narcoanalysis, and other "truth serums" of any kind [24].

The question remains whether a-IAT and TARA would be admissible as evidence if understood as techniques designed solely to reveal the intentionally false nature of a statement. According to some scholars, the answer to this question can only be affirmative [8,22]. As in the case of the polygraph, thermography, and FACS (and unlike hypnosis or narcoanalysis), the defendant and witness subjected to an IAT or TARA would remain completely free to answer the questions. In general, all techniques aimed at revealing the sincerity of an answer by decoding the non-verbal messages coming from the subject being asked to report a fact should be considered permissible. Hesitation, however slight, in pressing a computer key would be an indication of lack of sincerity in the answer; no more or less than blushing, stammering, sweating, etc. No one has ever doubted that the judge can deduce from these physical signals the conviction that the defendant or witness is lying: and it would even be preferable to entrust such evaluations to a machine rather than to a human evaluator.

These conclusions are opposed by other scholars [3,12]. Someone believes, for example, that the declarant's freedom of self-determination would be severely limited

precisely because of the psychological pressure exerted by the presence of a technological device allegedly capable of revealing the falsity of the answers given. The argument is not entirely convincing: even when they are not connected to a machine, witnesses or defendants are aware that the falsity of their statements could be revealed by the extra-linguistic messages they unknowingly transmit, but this mere awareness does not seem to qualify as an impairment of their freedom of self-determination. Rather, it is worth noting that in the case of the a-IAT and the TARA, the examinee is forced to express himself in a verbal language that he does not fully master: for example, when the examinee is asked, during the TARA test, to label as “false” an utterance that he thinks to be true, it is difficult to believe that he is authentically capable of understanding the meaning of what he is doing and saying. The examiner’s instructions can create a situation of disorientation in the examinee [21], which is not very different from that created by deliberately ambiguous or implicative questions, which are prohibited in the Italian legal system because they “may compromise the sincerity of the answer” (art. 499, paragraph 2 of the Code of Criminal Procedure), thus undermining the examinee’s freedom of self-determination. Ultimately, even if used solely as a lie detection tool, techniques such as the a-IAT or TARA have difficulty falling within the boundaries of compatibility with the evidentiary exclusion rule contained in Articles 64 and 188 of the Italian Code of Criminal Procedure.

Finally, another question remains to be answered, even with regard to (more or less) “neuroscientific” lie detectors. As mentioned above, the use of instruments or techniques that are likely to interfere with the declarant’s freedom of self-determination is prohibited even with the declarant’s consent. The question is whether it makes sense to override the rule that makes the declarant’s freedom of self-determination unavailable with the right of the accused to have his or her innocence recognized by voluntarily submitting to the test. In this respect, not everyone believes that the law has adequately balanced the various interests at stake (personal and moral freedom, dignity of the individual, right of defense). There is, however, the contraindication represented by the *contra reum* prejudice that would ultimately weigh against defendants who refuse to submit to the evidentiary experiment. Paradoxically, it has been pointed out [25], the more reliable memory and lie detection techniques become, the more the suspicion of concealment of the truth would grow against the party who refuses to submit to the test, who would see severely compromised his or her right not to incriminate himself or herself.

## Conclusion

The foregoing analysis shows that there is still strong resistance in the Italian legal system to admitting as evidence

the outcome of neuroscientific experiments carried out on the person of the defendant or witness. After some initial positive pronouncements, the jurisprudence has expressed considerable perplexity, both as to the real scientific nature of some of the methods used and, above all, as to their compatibility with the fundamental rule of “evidentiary ethics” (as defined by the Court of Appeal in the Brescia case) contained in Articles 64 and 188 of the Code of Criminal Procedure, which prevents the use of methods or techniques that could affect the freedom of self-determination of the person concerned.

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