

The neural correlates of deception as evidence in courts: an ongoing debate

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ABSTRACT: Recent neuroimaging studies investigating the neural correlates of deception among healthy people have raised the possibility that such methods be applied in criminal proceedings. At present, however, legal practitioners are aware of the challenges to be faced. The approach adopted in this paper is comparative and the methodological limitations and legal issues that raise from the application of fMRI-based lie detection in court are thus addressed. Two systems are taken into account: on the one hand, the Italian criminal system, and, on the other, the US one. The purpose of this work is understand what can be expected from neuroscience evidence in the foreseeable future.

KEYWORDS: Neuroimaging; lie detection; criminal proceedings; Daubert hearing; fundamental rights

SUMMARY: 1. Introduction – 2. Using developments in brain electrophysiology and neuroimaging for lie detection – 3. The challenges for neuroscience in law – 4. Methodological deficits of fMRI-based lie detection tests – 5. Questions of reliability and probative value – 6. Other legal concerns: critical compatibility with exclusionary rules – 7. Towards a new concept of “cognitive liberty” – 8. Conclusions.

1. Introduction

Nowadays, the judicial assessment of the facts in courts is increasingly entrusted to the results of scientific knowledge, which avails itself of probative means and new, sophisticated – and sometimes – controversial technologies.

One of the frontiers of novel scientific evidence is represented by the so-called ‘evidence of truth’, in other words, technical devices or instruments potentially capable of verifying and/or promoting the sincerity of anyone who makes statements relevant to criminal proceedings. Indeed, since courts usually rely on witness statements rather than direct investigation, credibility remains particularly important for the criminal justice. «And because the cross-examination is widely known to be more effective in exposing liars on television than in real courtrooms, the legal system is constantly seeking better ways of testing veracity. [...] [B]ut with few exceptions the law still prohibits the use of poly-

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graphs, electroencephalography, periorbital spectrography, and other technologies, relying instead on the technologically unaided judge and jury»¹.

Italian criminal law – as well as many other legal systems – provides a rather restricted space for such methods as part of the rules of evidence². Similar conclusions can also be drawn in the common-law systems, where the credibility assessment is generally considered the historical domain of the jury³. Consequently, the use of this type of technology has had a limited impact at trials.

Nevertheless, the debate remains open since some scholars foster in the future application of these techniques in courtrooms. Firstly, they postulate that the ongoing development of current technologies, such as functional magnetic resonance imaging (hereinafter referred to as ‘fMRI’), could result in sufficiently accurate methods to be used in court⁴. Secondly, at the same time, the studies may result in methodologies less restrictive of the individuals’ freedom. Essentially, it seems important to investigate the potential of new scientific devices in order to avoid prematurely ruling out knowledge, methods or techniques, which in the foreseeable future might be helpful in the pursuit of the goals of the legal system⁵.

Without any claims of exhaustivity, the purpose of this contribution is to explore the main challenges that fMRI-based lie detection tests pose to the law, providing some insights into the comparison between the Italian criminal law and the leading provisions in the common-law systems, with a particular focus on the US system. The analysis of some popular judicial cases in which litigants attempted to introduce this type of evidence in trial courts can clarify the debate contents among scholars. From a comparative viewpoint some constitutional issues are also discussed.

2. Using developments in brain electrophysiology and neuroimaging for lie detection

Progress in neuroscience, a branch of the life sciences encompassing various scientific disciplines dealing with anatomy, physiology, biochemistry, molecular biology of nerves and nervous tissue and, in particular, with their relation to behaviour and learning, is rapidly increasing our knowledge of

¹ F. SCHAUER, *Neuroscience, Lie-detection, and the Law*, in *Trends in Cognitive Sciences*, 2010, vol. 14/no. 3, p. 101.

² See M. GIALUZ, L. LUPÁRIA, F. SCARPA, *The Italian Code of Criminal Procedure: Critical Essays and English Translation*, 2017, 2nd ed., Padua, p. 217; E. MEIJER, P. VAN KOPPEN, *Lie Detectors and the Law: The Use of the Polygraph in Europe*, in D. CANTER, R. ŽUKAUSKIENĖ (eds.), *Psychology and Law: Bridging the Gap*, Hampshire, 2008, pp. 31-50.

³ Polygraph evidence is *per se* inadmissible in many jurisdictions (e.g. *Bloom v. People*, 185 P.3d 797, 807 (Colo. 2008): holding that «polygraph evidence [is inadmissible because it] will prejudice the jury’s evaluation of a witness’s credibility»). See further law cases and exceptions in F. SCHAUER, *Can Bad Science Be Good Evidence? Neuroscience, Lie detection, and Beyond*, in *Cornell L. Rev.*, 2010, vol. 95/no. 6, p. 1196, nt. 23.

⁴ See P.S. APPELBAUM, *The New Lie Detectors: Neuroscience, Deception, and the Courts*, in *Psychiatry Serv.*, 2007, vol. 58/no. 4, p. 461, stating that «it is conceivable that sufficient data will become available in the future to justify their admission into evidence»; also D.D. LANGLEBEN, *Detection of Deception With fMRI: Are We There Yet?*, in *Leg. & Criminol. Psychol.*, 2008, vol. 13/no. 1, p. 6, notes that «prevailing demand and technical feasibility are likely to produce a clinical fMRI-based lie detector in the near future».

⁵ M. PARDO, *Neuroscience Evidence, Legal Culture, and Criminal Procedure*, in *Am. J. Crim. L.*, 2006, vol. 33/no. 3, p. 322, asserted that «how the legal system will or should respond to the compelled use of such evidence, given the significant constitutional issues at stake, needs to be answered before its use becomes widespread».

neural correlates of the mind. The definition of ‘neural correlate’ is far from be straightforward; it can be defined as the brain activity that corresponds with and is necessary to produce a particular experience (e.g. the neural correlates of consciousness are the events that must occur in the brain for consciousness to become manifest)⁶.

Over the last decades, developments in cognitive neuroscience and behavioural genetics have provided new insights into the nature of violent and criminal behaviour by identifying genetic and neural correlates of impulsivity, aggressiveness, emotional disturbances, and personality disorders⁷. In the broad field of neuroscience, the ‘forensic neuroscience’, i.e. the set of studies that provides scientific data for the legal assessment, has taken on a specific relevance.

The study of human thinking uses various methods for indirectly measuring brain activity. The first, developed by Lawrence Farwell in the 1980s, is known as ‘brain fingerprinting’ (hereinafter referred to as ‘BF’). Subjects put on an electrode-filled helmet that measures the electrical activity emanating from the brain – colloquially known as ‘brainwaves’. This technology is based on an ‘event-related potential’ called P300, which – according to Dr Farwell – changes its frequency when people recognize images, sights and smells: the underlying assumption of BF is that every piece of information in a person’s brain is stored by specific neurons that ‘fire’ when the brain recognizes that information, producing electrical activity. After showing a suspect pictures of familiar places and measuring his or her P300 activation patterns, government officials could, at least in theory, show him or her images he or she may or may not have seen before – an al Qaeda training camp, for example, or a murder weapon under investigation – and compare the activation patterns⁸. Ultimately, the purpose of BF is to determine whether a person denying or claiming familiarity with an event or image actually has that familiarity. This device was used to generate evidence supporting the defendant’s claim of innocence in a court case in Iowa⁹, where a murder conviction was reversed and a new trial ordered because of the missing response of the convict’s brain to relevant details about the crime¹⁰.

⁶ In general, see S. FINGER, *Origin of Neuroscience: A History of Explorations Into Brain Function*, New York, 1994; E. KANDEL, L. SQUIRE, *Neuroscience: Breaking Down Scientific Barriers to the Study of Brain and Mind*, in *Science*, 2000, vol. 290/no. 5494, pp. 1113-1120.

⁷ For an overview on this topic, see D. RIGONI, S. PELLEGRINI, V. MARIOTTI, A. COZZA, A. MECHELLI, S.D. FERRARA, P. PIETRINI, G. SARTORI, *How Neuroscience and Behavioral Genetics Improve Psychiatric Assessment: Report on a Violent Murder Case*, in *Front. Behav. Neuroscience*, 2010, vol. 4/no. 160, pp. 1-10. See also D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century: Neuroscience as a Case-in-point*, in M. BERTOLINO, G. UBERTIS (eds.), *Prova scientifica, ragionamento probatorio e decisione giudiziale*, Napoli, 2015, pp. 23 ff.

⁸ See generally, E.B. FORD, *Lie Detection: Historical, Neuropsychiatric and Legal Dimension*, in *Int’l J. L. & Psychiatry*, 2006, vol. 29, p. 170; L. FARWELL, E. DONCHIN, *The Truth Will Out: Interrogative Polygraphy (“Lie Detection”) With Event-Related Brain Potentials*, in *Psychophysiology*, 1991, vol. 28/no. 5, pp. 531-547. BF has been criticized by J. ROSENFELD, *“Brain Fingerprinting”: A Critical Analysis*, in *The Scientific Review Mental Health Practice*, 2005, vol. 4/no. 1, pp. 20-37.

⁹ *State of Iowa v. Terry Harrington*, 659 N.W. 2d 509, 512 (Iowa 2003). See M. PETTIT, *fMRI and BF Meet FRE: Brain Imaging and the Federal Rules of Evidence*, in *Am. J. L. & Med.*, 2007, vol. 33, pp. 338 ff.

¹⁰ For a description of the case, see J. ILLES, E. RACINE, *Imaging or Imagining? A Neuroethics Challenge Informed By Genetics*, in *Am J Bioeth*, 2005, vol. 5/no. 2, p. 5: even though the EEG results were not dispositive in this case, the original prosecution witness – when confronted with the BF evidence – recanted his testimony and admitted that he had lied during the original trial, falsely accusing Harrington to avoid being prosecuted himself.



Nevertheless, the most prominent of these newer techniques is fMRI: commonly called ‘brain scanning’, fMRI examination is deemed to be capable of determining which parts of the brain perform cognitive activities such as viewing an image, answering a question, listening to a voice, or telling a story. The science behind fMRI may be sophisticated, but the basic concept is that certain parts of the brain ‘light up’ with electrical activity when engaged in certain tasks: what actually occurs is that the activated portion of the brain recruits more oxygenated blood cells to help it in its assignment¹¹. Unsurprisingly, more sophisticated imaging techniques have led some researchers to conclude that fMRI can be effective in distinguishing between true and false memory, and to improve the methods of lie detection¹². As already mentioned, «if – and it is a huge if – different brain regions are active when a person is lying than when telling the truth, or when acting deceptively rather than honestly, then brain scans might be able to determine whether a person is lying or telling the truth»¹³. In a study conducted in 2008, brain scans were used to determine the truthfulness of an intriguing real-life case of a mother who was convicted for poisoning her own child: this study raised important questions on how the results of fMRI-based lie detection tests should be interpreted¹⁴. The proponents of brain-imaging techniques for lie detection claim that their methods are quite distinct from those of ‘polygraph’: according to them, these techniques are far superior and much more accurate than the old-fashioned lie detector, which relies on increases in blood pressure, heart rate, and other measures of autonomic arousal to indicate whether someone is telling a lie¹⁵. It is no news that legal authorities have been skeptical of the polygraph’s value: even today, despite the improvements over the years, courts overwhelmingly reject attempts by parties to introduce results of polygraph tests into evidence at trials, because of insufficient accuracy rates¹⁶.

¹¹ C. ELLENBERG, *Lie detection: A Changing of the Guard in the Quest for Truth in Court?*, in *L. & Psychol. Rev.*, 2009, vol. 33, p. 144, highlighting that like BF, fMRI has an advantage over older methods of lie detection because it measures central (brain) rather than peripheral (galvanic skin response, heart rate, blood pressure, and respiration) correlates of the nervous system activity.

¹² See L. KITTAY, *Admissibility of fMRI Lie Detection: The Cultural Bias Against “Mind Reading” Devices*, in *Brook. L. Rev.*, 2007, vol. 72, pp. 1361-1362; D.D. LANGLEBEN, J. LOUGHEAD, W. BILKER, K. RUPAREL, A. CHILDRESS, S. BUSCH, R. GUR, *Telling Truth From Lie in Individual Subjects With Fast Event-Related fMRI*, in *Hum. Brain Mapp.*, 2005, vol. 26/no. 4, pp. 262-272; S. SPENCE, T. FARROW, A. HERFORD, I. WILKINSON, Y. ZHENG, P. WOODRUFF, *Behavioural and Functional Anatomical Correlates of Deception in Humans*, in *Neuroreport*, 2001, vol. 12/no. 13, pp. 2849-2853: individuals telling lies have increased response times and increased activation in specific regions of the brain.

¹³ Also for further references, see F. SCHAUER, *Can Bad Science Be Good Evidence?*, cit., pp. 1197-1199; S. SPENCE, M. HUNTER, T. FARROW, R. GREEN, D. LEUNG, C. HUGHES, V. GANESAN, *A Cognitive Neurobiological Account of Deception: Evidence From Functional Neuroimaging*, in *Philos. Trans. R. Soc. B: Biol. Sci.*, 2004, vol. 359/no. 1451, pp. 1755-1762.

¹⁴ S. SPENCE, C. KAYLOR-HUGHES, M. BROOK, S. LANKAPPA, I. WILKINSON, *“Munchausen’s Syndrome by Proxy” or “Mis-carriage of Justice”? An Initial Application of Functional Neuroimaging to the Question of Guilt Versus Innocence*, in *Eur. Psychiatry*, 2008, vol. 23/no. 4, pp. 309-314.

¹⁵ Moreover, some scholars claimed that because BF and FMRI test results appear in the form of high-resolution computer-generated images, they are less likely than the polygraph to be misinterpreted by biased or imperfect evaluation (see D. FOX, *The Right to Silence as Protecting Mental Control*, in *Akron L. Rev.*, 2015, vol. 42/no. 3, p. 793).

¹⁶ In 1986, the American Medical Association (AMA) declared that «the rate of false-positives is often sufficiently high to preclude use of conventional polygraphs as the sole arbiter of guilt or innocence» (AMA Council on Scientific Affairs, *Polygraph*, in *JAMA*, 1986, vol. 256/no. 9, pp. 1172-1175). See H. GREELY, J. ILLES, *Neuroscience-Based Lie Detection: The Urgent Need for Regulation*, in *Am. J. L. & Med.*, 2007, vol. 33/no. 2-3, p. 386.



Although the idea that deception imposes greater cognitive load than truth telling seems to be supported by neuroimaging research¹⁷, there is skepticism among scientists and legal practitioners because brain scanning poses substantial problems¹⁸.

3. The challenges for neuroscience in law

Law and science are entirely independent institutions; they interact with one another, but each for its own purposes. Although goals and norms in law differ from those in science¹⁹, the judicial system often requires the constant growth of scientific and technological knowledge to be taken into account²⁰. Thus, «[i]n using science, law must be cognizant of what it is getting. It must understand the vocabulary, methods, decision rules, and culture of science»²¹. In studying the areas of intersection of these two different fields, three inferential challenges have emerged: the problems of 'lingua franca', 'G2i', and 'external validity'.

In general terms, translational issues comprise significant barriers to the valid integration of scientific data in the courts: this challenge was coined as 'Lingua Franca Problem'. It should not be underestimated that the legislator's terminological choices could affect the way in which experts operate within legal proceedings: for instance, to a cognitive neuroscientist, legal standards like 'volitional capacity' or 'premeditation' – if not intrinsically meaningless – are at least sub-specified to effectively lead the scientific or technical investigation²². In other words, «legal rules don't reflect any of the valid species of human mental function that cognitive science has labored to precisely catalog over the last century»²³.

It will suffice to think of the lexical choice made in *Daubert v. Merrell Dow Pharmaceuticals*²⁴: the US Supreme Court highlighted the importance of the reliability of the evidence provided by the expert. This concept was coined as 'evidentiary reliability'. However, the term 'reliable', when used in relation to the quality of scientific evidence, is likely to lead to a misunderstanding: a scientist may as-

¹⁷ D.D. LANGLEBEN ET AL., *Telling Truth From Lie in Individual Subjects With Fast Event-Related fMRI*, cit., p. 271, conclude that fMRI images may be able to distinguish a truth from a lie on the basis that a lie «appears to be a more working memory-intensive task, characterized by increased activation of the inferolateral cortex implicated in response selection, inhibition, and generation».

¹⁸ P. WOLPE, K. FOSTER, D.D. LANGLEBEN, *Emerging Neurotechnologies for Lie-Detection: Promises and Perils*, in *Am. J. Bioeth.*, 2005, vol. 5/no. 2, pp. 39-49, arguing that forensic application is premature and that important technical and ethical issues need to be addressed.

¹⁹ D. BROMLEY, in *Science and the Law*, Address at the 1998 Annual Meeting of the American Bar Association (Aug. 2, 1998), claimed that «in simplistic terms, the goal of science is truth and the goal of law is justice». About the conflict between the legal and scientific cultures, see e.g. P. BRETT, *Law in Scientific Age*, in N. MORRIS, M. PERLMAN (eds.), *Law and Crime: Essays in Honor of Sir John Barry*, New York, 1972, pp. 91-97.

²⁰ S. JASANOFF, *Science at the Bar: Law, Science, and Technology in America*, Cambridge, 1995, p. 16, stated that «the law today not only interprets the social impact of science and technology but also constructs the very environment in which science and technology come to have meaning, utility, and force».

²¹ D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., p. 30.

²² W.J. BUCKHOLTZ, V. REYNA, C. SLOBOGIN, *A Neuro-Legal Lingua Franca: Bridging Law and Neuroscience on the Issue of Self-Control*, in *Mental Health L. & Pol'y J.*, 2016, p. 3. See also O.J. JONES, A.D. WAGNER, D.L. FAIGMAN, M.E. RAICHLE, *Neuroscientists in Court*, in *Nature Rev. Neuroscience*, 2013, vol. 14, p. 733.

²³ See D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., p. 31.

²⁴ 509 U.S. 579 (1993).



sume that ‘reliable’ means ‘replicable’²⁵. Although the Court specified that it was using ‘reliable’ to mean ‘scientifically valid’, the technician could have mistakenly assumed that the admissibility of an expert witness depended on evidence ‘consistency’ rather than its ‘accuracy’²⁶.

Ultimately, «[i]n neurolaw, there is yet no coherent framework for linking legal standards that assess mental function to specific, quantifiable cognitive processes. Neuroscience and law lack a “lingua franca” of mental functioning that could bridge the conceptual chasm that exists between these disciplines»²⁷. Building a ‘lingua franca model of communication’ would allow experts to understand better «the type of information they need to provide courts engaged in determining the admissibility of their findings»²⁸. Certainly, the greatest difficulty in developing this model of communication is to identify *a priori* concepts or notions that, having some kind of link, can be synthesized with such precision, on the one hand, to satisfy what the law needs and, on the other, to represent what science is actually able to provide.

The second major challenge was referred to as ‘The Group-to-Individual (G2i) Problem’²⁹. This challenge takes into account the difference between the aims and methods of science, and the goals of the legal system. As is known, «[s]cience is focused on understanding general phenomena. Groups of individuals are studied with the aim of making population-inferences. By contrast, the goal of a trial court is to make a determination about an individual. Courts often attempt to use science’s general knowledge of a phenomenon to make individual-level inferences»³⁰. In other words, «while science attempts to discover the universals hiding among the particulars, trial courts attempt to discover the particulars hiding among the universals»³¹.

This problem should not be an unfavorable objection to the usage of science in trial courts. It is important to consider that «science’s generalized, population-level knowledge of a phenomenon does not necessarily provide an appropriate empirical foundation for making inferences about whether a particular case is an instance of that phenomenon»³².

Last but not least, it is worth focussing on the connected issue of the ‘External Validity’. For the purpose of the admissibility of expert evidence in courts, *Daubert* required not only the reliability of the expert testimony, that is to say supported by scientifically valid reasoning or methodology, but also its relevance, in the sense of applicability to the facts at issue. This means that the knowledge proffered by the expert must be directly useful and relevant to solving the specific issue the court must

²⁵ W.J. BUCKHOLTZ, V. REYNA, C. SLOBOGIN, *A Neuro-Legal Lingua Franca*, cit., p. 5.

²⁶ See J.A. MORENO, *Beyond the Polemic Against Junk Science: Navigating the Oceans That Divide Science and Law with Justice Breyer at the Helm*, in *B.U. L. Rev.*, 2001, vol. 81, p. 1067. Also D.D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection: Where Science, Law, and Policy Collide*, in *Psychol. Pub. Pol’y & L.*, 2013, vol. 19, p. 229, noted that «complications arise from discrepancies in the meaning of crucial terms such as validity and reliability between law and science».

²⁷ D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., p. 31.

²⁸ W.J. BUCKHOLTZ, V. REYNA, C. SLOBOGIN, *A Neuro-Legal Lingua Franca*, cit., p. 6.

²⁹ See generally D.L. FAIGMAN, J. MONAHAN, C. SLOBOGIN, *Group to Individual (G2i) Inference in Scientific Expert Testimony*, in *U. Chi. L. Rev.*, 2014, vol. 81, pp. 417 ff.

³⁰ D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., p. 31.

³¹ D.L. FAIGMAN, *Legal Alchemy: The Use and Misuse of Science in the Law*, New York, 1999, p. 69.

³² See, even for some examples, D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., pp. 31-32.

resolve, and legal practitioners should be aware – among other things – that scientific findings from studies of a group of individuals may not automatically or necessarily be relevant to individual cases. In short, the baggage of knowledge functional to the decision-making is the only one that needs to be expanded.

More precisely, concerns here arise due to the risk of biases in interpreting the data provided by the expert: «no one can draw legitimate inferences from data if they do not have a good sense of how the data were obtained and what they actually mean»³³.

Legal policy must account for the fact that neuroscience evidence may not be generalized across different settings: it is well-known, in fact, that techniques or tests which have been validated for one purpose may not be appropriately applied to other unrelated purposes³⁴. Specifically, «it would be an error to presume that a neuroscientific measure of some mental process is a reliable proxy for measuring the operation of that process in the “real world”. Though behavioural science and cognitive neuroscience often rest on the presumption that behaviour measured in the laboratory tracks behaviour in the real world, much remains unclear about the degree to which lab-based measures of legally-relevant aspects of cognition predict real-world behaviour»³⁵.

To conclude, the fact that challenges arise from the intersection between (neuro)science and law is a question that needs to be addressed, above all, bearing in mind that they are inevitable. When law comes into contact with novel generations of knowledge, relevant epistemological and methodological issues should not be underestimated.

4. Methodological deficits of fMRI-based lie detection tests

Prior to focussing on the core judicial issues that raise from the application of fMRI-based lie detection in court, it is worth observing that the variety of approaches aimed at detecting deceptive statements³⁶ face a significant obstacle: the difficulty of collecting data suitable to study the issue. As has been noted, «the problem of testing the accuracy of lie detection tools in real-life field is that it is virtually impossible to determine with certainty when someone is lying and when he or she is telling the truth»³⁷.

Generally speaking, empirical investigation on lie detection uses two paradigms of research: laboratory studies and real-life studies.

³³ O.J. JONES, A.D. WAGNER, D.L. FAIGMAN, M.E. RAICHLE, *Neuroscientists in Court*, cit., p. 733: for instance, «with respect to fMRI evidence, it is essential that legal decision-makers understand that when they see an image of colours inside the skull, they are not looking at something meaningfully analogous to an X-ray of brain activity in those locations but rather at the outcomes of statistical analyses performed of the data».

³⁴ See J.E. STARRS, *Frye v. United States. Restructured and Revitalized: A Proposal to Amend. Federal Rule of Evidence 702*, in *Jurimetrics J.*, 1986, vol. 26, p. 258.

³⁵ D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., p. 33.

³⁶ The literature on deceptive communication can be divided in branches, depending on the cues investigated (see generally T. FORNACIARI, M. POESIO, *Automatic Deception Detection in Italian Court Cases*, in *Artif. Intell. L.*, 2013, vol. 21/no. 3, p. 306).

³⁷ A. VRIJ, B. VERSCHUERE, *Lie Detection in a Forensic Context*, in D.S. DUNN (ed.), *Oxford Bibliographies in Psychology*, New York, 2013. Similarly U. UNDEUTSCH, *Courtroom Evaluation of Eyewitness Testimony*, in *Intern. Rev. Appl. Psychol.*, 1984, vol. 33/no. 1, p. 64.



In laboratory studies an experimenter instructs participants (often university students, sober, mentally and physically healthy) to tell the truth or lie for the sake of the experiment. It should be borne in mind that judges should not admit evidence processed in laboratories that fall below a reasonable standard of operational efficiency³⁸.

In the light of the premises outlined above, numerous neuroscientists argue that «differences between experimental subjects and those offering evidence in court generate problems on external validity and that problems of construct validity arise because an instructed lie in the laboratory is simply not a real lie at all»³⁹. In addition, since lying involves a series of mental functions, it is important to emphasize that brain scans can produce different imaging results depending on the type of lie involved⁴⁰. Another critical aspect is that the changes in blood flow could also result from neurological processes other than efforts to conceal the truth, including a subject's anxiety with a claustrophobic machine. Therefore, even Nancy Kanwisher, one of the leading neuroscientists in the field, has emphasized that the «data offer no compelling evidence that fMRI will work for lie detection in the real world»⁴¹.

In field studies, real-life cases are investigated where the truthfulness of the statements (e.g. the victim's allegation) is assessed on the basis of other features of the case. Visibly, the latter paradigm of research is likely to have greater experimental realism and external validity. Confessions or final court decisions are, typically, used as *ground truth* (term used in various fields to refer to the absolute truth of something)⁴². Some scholars, however, warn that the use of confession may lead to an overly optimistic picture of the test accuracy⁴³. Although researchers tried to make lab research more

³⁸ E. MURPHY, *The New Forensics: Criminal Justice, False Certainty, and the Second Generation of Scientific Evidence*, in *Cal. L. Rev.*, 2007, vol. 95/no. 3, pp. 795-797.

³⁹ With these words F. SCHAUER, *Neuroscience, Lie-detection, and the Law*, cit., p. 101. H. GREELY, J. ILLES, *Neuroscience-Based Lie Detection*, cit., pp. 402 ff., noting that additional doubts stem from the size and nature of the samples, potential confounding variables (e.g. whether subjects are left- or right-handed).

⁴⁰ G. GANIS, S. KOSSLYN, S. STOSE, W. THOMPSON, D. YURGELUN-TODD, *Neural Correlates of Different Types of Deception: An fMRI Investigation*, in *Cereb. Cortex*, 2003, vol. 13/no. 8, pp. 830-836. T. BULLER, *Can We Scan for Truth in a Society of Liars?*, in *Am. J. Bioeth.*, 2005, vol. 5/no. 2, p. 59, observed that «what counts as a lie is in part, if not in whole, a matter of social convention. [I]t is not implausible to claim that these social conventions are culturally determined, and hence what counts as a lie in one culture would not count as one another».

⁴¹ See N. KANWISHER, *The Use of fMRI Lie Detection: What Has Been Shown and What Has Not*, in *Using Imaging to Identify Deceit: Scientific and Ethical Questions*, Cambridge (MA), 2009, p. 12; J. SIMPSON, *Functional MRI Lie Detection: Too Good to Be True?*, in *J. Am. Acad. Psychiatry & Law*, 2008, vol. 36/no. 4, p. 493: «how well fMRI lie detection would work in real-life situations remains an open question». Also S. SPENCE, *Playing Devil's Advocate: The Case Against fMRI Lie Detection*, in *Legal & Criminol. Psych.*, 2008, vol. 13/no. 1, p. 11, suggesting that this tool is inapplicable to the "real world" and lacks scientific reliability because no fMRI-based lie detection study has been replicated.

⁴² See C.L. RUBY, J.C. BRIGHAM, *The Usefulness of the Criteria-based Content Analysis Technique in Distinguishing Between Truthful and Fabricated Allegations*, in *Psychol. Pub. Pol'y & L.*, 1997, vol. 3/no. 4, pp. 709 ff.

⁴³ C. PATRICK, W. IACONO, *Validity of the Control Question Polygraph Test: The Problem of Sampling Bias*, in *J. Appl. Psychol.*, 1991, vol. 76/no. 2, pp. 229-238.



realistic – by raising the stakes and the negative consequences for liars⁴⁴ – the limitation of field studies remains in the difficulty in sustaining the ground truth.

Basically, as has been made clear, lab studies are not very useful in testing the accuracy of tools for the evaluation of witnesses' credibility at trials⁴⁵; personal and situational conditions relating to the specific-case must be taken into account by experts for improving the accuracy rate⁴⁶. It is easy to argue that lab experiments are very different from in-field lie-detection applications in which participants might be uncollaborative and where high-stake contexts might produce an anxious feeling about the result of their performance. Hence, field studies are often rare or impossible to set up, and when this is possible, experts should be very careful concerning the risk of *false -positives* or *false -negatives*.

Additionally, some scholars pinpointed other considerable drawbacks. First of all, there is an important factor to keep in mind: neuroscience-based lie-detection tests may be affected by countermeasures (e.g. move the tongue in the mouth or close the eyes), and may produce unreliable findings⁴⁷.

Secondly, with regard to the possible application of BF as evidence in trial courts, it is worth mentioning that experiments must be tailored to the case at hand. In order for the subject to be questioned appropriately, the investigator needs to have almost as much information about the event. This is necessary to document the subject's EEG patterns when the expected answer is provided⁴⁸. Moreover, proving a suspect has knowledge of the crime is not the same as proving a suspect has committed the crime: a high frequency of P300 waves reveals that the person (e.g. suspect or accused) merely recognized an image (e.g. weapon or crime scene). In other words, the brain acknowledged that item as more familiar than other item, but this perception might be generated by an array of causes that differ from those related to the offence and that has nothing to do with the perpetrator⁴⁹. Similar limitations arise in respect of fMRI-based lie detection tests: questions and tasks posed to the participants have to be characterized by the same cognitive effort; otherwise, the area of the

⁴⁴ See e.g. T. LEE, H. LIU, L. TAN, C. CHAN, S. MAHANKALI, C. FENG, J. HOU, P. FOX, J. GAO, *Lie Detection By Functional Magnetic Resonance Imaging*, in *Hum. Brain Mapp.*, 2002, vol. 15/no. 3, pp. 157–164, who attempted to enhance ecological validity by allowing the subjects to choose when to lie during the task.

⁴⁵ R. VOLBERT, M. STELLER, *Is This Testimony Truthful, Fabricated, or Based on False Memory?*, in *Eur. Psychologist*, 2014, vol. 19/no. 3, p. 217, stating that «persons who decide to make false allegations that could have detrimental outcomes for others may well differ markedly from persons who comply with instructions to give false reports in laboratory experiments».

⁴⁶ See for wider considerations O.J. JONES, A.D. WAGNER, D.L. FAIGMAN, M.E. RAICHLE, *Neuroscientists in Court*, cit., p. 734.

⁴⁷ As regards to the use of fMRI in lie detection, see N. KANWISHER, *The Use of fMRI Lie Detection*, cit., p. 12; J. ROSENFELD, M. SOSKINS, G. BOSH, A. RYAN, *Simple, Effective Countermeasures to P300-based Tests of Detection of Concealed Information*, in *Psychophysiology*, 2004, vol. 41/no. 2, p. 205, finding that countermeasures to undercut the effectiveness of the BF can be easily learned. Unsurprisingly, proponents claim that brain-imaging lie detection reduces chances of subjects finding ways to “beat the test” (see M. PETTIT, *fMRI and BF Meet FRE*, cit., p. 328).

⁴⁸ E.B. FORD, *Lie Detection*, cit., pp. 170-171.

⁴⁹ For instance, a suspect could store details about a crime through a discussion with another individual or by simply watching the news. See for these considerations, J. ROSENFELD ET AL., *Simple, Effective Countermeasures*, cit., p. 205; C. ELLENBERG, *Lie detection*, cit., p. 143; B. REESE, *Using fMRI As a Lie Detector – Are We Lying to Ourselves?*, in *Alb. L.J. Sci. & Tech.*, 2009, vol. 19/no. 1, pp. 209-210.



brain that light up could be linked simply to the different cognitive load executed by the person (e.g. memory or heed effort, verbal formulation etc.)⁵⁰, rather than to the act of lying.

Thirdly, since human memory is prone to various types of distortion and illusion, the practical issue dealing with 'false memories' should also be scrutinized: even proponents of techniques for lie detection recognized that brain-imaging does not depend upon consciousness of lying, and thus inaccurate information that the subject incorrectly believes to be true can be detected⁵¹.

Finally, it is worth considering that also the competence, qualifications and abilities of experts play a crucial role⁵². For example, interviewers often receive poor or no training, and at the same time their abilities may influence the contents and quality of the interview and/or test. As it has been observed with reference to forensic science⁵³, many methods lack falsifiability because many practices rely on the subjective judgement of the examiner rather than on objectively observable data. Also in this context, the risks that the assessment may be mainly subjective, and the examiner's discriminatory ability (or inability) based wholly on his or her experience and training are concrete.

5. Questions of reliability and probative value

At present, the law has been aware of the limitations and fallibility of science, thus trials have become – regardless of their intention – a testing ground for the falsification or validation of scientific methods. The judicial system is inevitably compelled to keep up-to-date, and sometimes to reconsider or redefine, its legal institutes. However, it cannot be a merely passive receptor of science insofar as scientific and technological developments are also inextricably linked to developments in the law⁵⁴. On the one hand, science is admissible in a trial court only if it is controllable, and therefore reliable in the light of *Daubert* standards⁵⁵, while on the other hand, it must guarantee that the inviolable human rights of the individuals involved in the case are respected.

In criminal law, two distinct fields of application of neuroscientific techniques can be identified. Firstly, cases in which the individual is taken into account as a *source of real evidence*, i.e. as an 'object',

⁵⁰ D.D. LANGLEBEN, *Detection of Deception With fMRI*, cit., p. 4, concluding that in practice, «the accuracy of fMRI-based lie detection is likely to vary with questionnaire-type, countermeasures, and other, hitherto unexplored variables». Concerning the methods used to generate deceptive responses, see D.D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection*, cit., p. 224.

⁵¹ M. PETTIT, *FMRI and BF Meet FRE*, cit., p. 328.

⁵² Indeed, an important question to consider is whether the expert witness has acquired by study or experience sufficient knowledge of the subject to render his opinion of value in resolving the issue before the court (see e.g. *R. v. Bonython* (1984) 38 SASR 45 at 46-47 (South Australia)).

⁵³ C. COLLEY, *Forensic Science and Capital Punishment Reform: An "Intellectually Honest Assessment"*, in *Geo. Mason U. Civ. Rts. L. J.*, 2007, vol. 17, p. 339.

⁵⁴ S. JASANOFF, *Science at the Bar*, cit., p. 19, writes that «Courts [...] are enlisted into an interactive process of social and technological change; they become partners in society's research for new rules to interpret and restructure an altered array of potentialities».

⁵⁵ Not long ago, the Italian courts recognized the guidelines for admitting expert scientific testimony in a trial court. They were derived from *Daubert v. Merrel Dow Pharmaceuticals, Inc.* and its progeny (*Gen. Electric Co. v. Joiner*, 522 U.S. 136 (1997); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999)). The *Daubert* trilogy has had a strong impact on the logic and dynamism of Italian criminal decision-making, and similar stages of a common path of adaptation to scientific knowledge are identifiable.



as the 'body' from which to acquire an item of evidence. In this context, neuroimaging is comparable to any other piece of evidence that involves the physicality of the individual (e.g. taking samples of DNA or saliva, medical assessment etc.). It is used as part of the clinical psychiatric evaluation aimed at establishing the mental health (insanity)⁵⁶, the capacity of sound mind (incapacity)⁵⁷ and capacity to participate consciously in the trial (incompetence)⁵⁸. Secondly, it can be identified cases in which the individuals are taken into account for what they want to say at trial as a *source of testimonial evidence*: in this sense, neuroscience can be deemed as a means to validate the credibility of statements relevant to criminal proceedings.

In court, neuroscience has been applied, although seldom, as a source of real evidence. Since individuals suffering from severe mental disorders may not bear the full weight of responsibility for their actions, this new generation of technology may be used in addition to traditional tools to support the psychiatric diagnosis⁵⁹, that is for assessing whether or not the defendant lacks criminal liability due to mental disease or defect, and, thus, whether or not he or she is liable for the committed crime⁶⁰. Most of the legal systems require the proof of a causal link between the pathological mental state and the criminal behaviour; therefore, mental insanity – or diminished responsibility – is proved when the crime is the symptom of an underlying brain defect or psychiatric disorder⁶¹.

Currently, however, brain-imaging evidence is most frequently used to determine whether a person is telling the truth or lying. As it has been noted, some scholars believe that the implications of neuroscience in criminal proceedings may go beyond the borders of the evaluation of criminal liability, i.e. may be applied for assessing the credibility of witness testimonies and confessions⁶².

In the last few years, litigants have attempted to introduce brain-imaging test results as evidence in courts⁶³. At this point it is clear that the methodological deficits described above may directly influ-

⁵⁶ *United States v. Hinckley*, 525 F. Supp. 1324 (D.D.C. 1981); *People v. Weinstein*, 591 N.Y.S. 2d 715 (N.Y. Crim. Ct. 1992). The first criminal case in Europe, in which the neuroscientific technologies were applied to assess the defendant's criminal liability is Assize Court of Appeal Trieste, 18 September 2009, n. 5, Bayout, in *Riv. pen.*, 2010, p. 70 ff. (see E. FERESIN, *Italian Court Reduces Murder Sentence Based on Neuroimaging*, in *Nature*, 1st September 2011; J. HAMZELOU, *Brain Scan Reduce Murder Sentence in Italian Court*, in *New Scientist*, 2nd September 2011). Another Italian criminal case is known for having applied these methodologies: Court of Como, 20 May 2011, n. 536, Albertani, in *Guida dir.*, 2012, n. 5, pp. 63 ff.

⁵⁷ *Roper v. Simmons*, 543 U.S. 551(2005).

⁵⁸ *United States v. Gigante*, 989 F. Supp. 436, 438 (E.D.N.Y. 1997).

⁵⁹ «Neuroscience is likely to be most useful as a means to either complement or supplement current medical or behavioral science tools» (D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony in the 21st Century*, cit., p. 25).

⁶⁰ See D. RIGONI ET AL., *How Neuroscience*, cit., p. 4, stating that «despite the recent advances in the understanding of biological underpinnings of violence, the implementation of cognitive neuroscience and molecular genetics within the criminal responsibility assessment is at the center of a harsh debate».

⁶¹ Also for more considerations, see M. PETTIT, *fMRI and BF Meet FRE*, cit., pp. 322 ff., who claims that «brain-imaging evidence might be used for or against an insanity defense in a criminal case».

⁶² See generally, J. SULLIVAN, *Competence to Confess: A Case of False Confession and A False Friend*, in R.L. HEILBRONNER (ed.), *Forensic Neuropsychology Casebook*, New York, 2005. Interestingly, in Italian criminal proceedings, the "confession" plays a very marginal role: without objective and irrefutable evidence it is not an "item of evidence".

⁶³ See D. FOX, *The Right to Silence*, cit., p. 766, reports that brain-based lie detectors results were admitted into evidence in a recent murder case in India (*State of Maharashtra v. Sharma*).



ence the accuracy of these devices in distinguishing truth from lie and undermine the chance to fulfil the *Daubert* guidelines⁶⁴.

In determining whether expert testimony is both reliable and relevant, trial judges must answer five – apparently simple – questions: Is the scientific hypothesis testable? Has the proposition been tested (i.e. overcome attempts to falsifiability)? Is there a known error rate⁶⁵? Has the hypothesis and/or technique been subjected to peer review and publication?⁶⁶ Is the theory upon which the hypothesis and/or technique is based generally accepted in the appropriate scientific community?

With respect to the future role of BF in lie detection, some researchers are optimistic⁶⁷, while others remain skeptical, believing that «even a relatively good test will yield more harm than benefit»⁶⁸. This technology currently faces a host of limitations: the most advanced system has not undergone peer review as it is traditionally defined. Some scientists have questioned and expressed hostility to Dr Farwell's research, alleging that he is more interested in profit and fame than scientific research⁶⁹. At this point, *Slaughter v. State* is worth mentioning, which involved a convicted murderer's claim for post-conviction relief. This case offered a most extensive discussion of the admissibility of BF evidence. The Court of Criminal Appeals of Oklahoma concluded that there was no real evidence that *Daubert* standards had been met, and insufficient confirmations that the evidence offered would survive a *Daubert* analysis⁷⁰.

In 2010, two judges issued opinions addressing the admissibility of testimony based on fMRI lie-detection test results, and both held that they were inadmissible. In both cases, parties sought to introduce the testimony of Dr Steven Laken, CEO of Cephos, a private company offering 'lie detection/truth verification' through fMRI. The most comprehensive analysis comes from Tennessee Federal Magistrate Judge Tu Pham, who conducted a so-called '*Daubert* hearing' to determine whether

⁶⁴ The ways in which criminal defendants may be able to introduce fMRI lie detection testimony without meeting, neither the *Frye* nor the *Daubert* standards, are addressed by D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection*, cit., p. 228.

⁶⁵ G. PIPOLY, *Daubert Rises: The (Re)applicability of the Daubert Factors to the Scope of Forensic Testimony*, in *Minnesota L. Rev.*, 2012, vol. 96/no. 4, p. 1597, held that when the *Daubert* Court spoke of "error rate", it referred to the scientific validity of measurements: the way we know how often a technique measures what it purports to measure is because we know how often the technique does not measure what it purports to measure.

⁶⁶ It is worth keeping in mind, that the mere fact of peer review and/or publication tells us nothing about «the nature or quality of the peer review process; the effect of peer review on the validity of the methods or conclusions contained in the published work; or whether the validity of the published methods or conclusions is impacted by the manner in which this expert proposes to use the theory or technique to make inferences or draw conclusions in [a specific] case» (see J. MORENO, *Eyes Wide Shut: Hidden Problems and Future Consequences of the Fact-Based Validity Standard*, in *Seton Hall L. Rev.*, 2003, vol. 34/no. 1, p. 99).

⁶⁷ See e.g. E.B. FORD, *Lie Detection*, cit., p. 170.

⁶⁸ P.S. APPELBAUM, *The New Lie Detectors*, cit., p. 461.

⁶⁹ See B. HOLLEY, *It's All in Your Head: Neurotechnological Lie Detection and the Fourth and Fifth Amendments*, in *Dev. Mental Health L.*, 2009, vol. 28/no. 1, p. 8.

⁷⁰ *Slaughter v. State*, 105 P.3d 834-836 (Okla. Crim. App. 2005): refusing to give weight to BF results without the comprehensive report to do with the nature of the test conducted, the manner in which it was administered, and the results.

the proposed fMRI lie-detection evidence was sufficiently reliable to be admitted in the trial of *Semrau*, a psychologist charged with health care fraud⁷¹.

The defendant in *United States v. Semrau*⁷² wanted to submit test results from an fMRI lie-detection method. At the *Daubert* hearing, Magistrate Pham accepted testimony from three expert witnesses. The judge found that the fMRI-based lie detection test had been studied in laboratory experiments and the results published in peer-reviewed journals. Nonetheless, the technique fared less well when he turned to the remaining *Daubert* factors: in particular, the judge focused on the lack of ecological validity, noting that there are no known error rates for fMRI-based lie detection outside the laboratory setting, that is, in a 'real-world' or 'real-life' setting. More importantly, the studies were conducted in circumstances quite different from those in that criminal case (e.g. *Semrau's* alleged fraudulent conduct had occurred six to eight years before his fMRI test). In other words, even though the expert is able to provide the court with a known or potential 'error rate' of the particular technique⁷³, this may not be enough to confirm its scientific validity in a specific criminal case⁷⁴. As reported above, many variables and factors must be taken into account, and the low error rate obtained in experimental studies cannot be directly generalized to field studies⁷⁵.

Normally, scientists decide whether such rates are sufficient, for instance to affirm that something is adequate for publication, for their own scientific purposes. On the contrary, «whether such an error rate is sufficient for a trier of fact to hear it, put someone in jail, keep someone out of jail, justify an injunction, or award damages is not itself a scientific question»⁷⁶. 'Junk science' is a legal problem, not a scientific one: therefore, the question of whether the judiciary should use lie-detection technology cannot be answered by scientific standards of reliability and validity alone.

Not surprisingly, the Judge Pham also found that fMRI lie detection in real-world settings was not generally accepted by the scientific community; thus, there were several reasons for questioning the probative value of the test results. First of all, *Semrau's* test was done privately, which meant that the defense was free to withhold the results if they were unfavourable. Secondly, prosecutors had no prior knowledge of the test, nor did they have an opportunity to evaluate the questions *Semrau* was asked. Finally, Dr Laken himself conceded that the fMRI test results were at best an indication of the defendant's overall credibility, rather than the truth or falsity of his specific responses. For all of these reasons, the judge was unconvinced of the test's probative value: «the court fails to see how

⁷¹ Judge Pham prepared a report and recommendation for the trial court judge in *Semrau's* criminal case. See Report and Recommendation, *United States v. Semrau*, No. 07-10074 MI/P (W.D. Tenn. May 31, 2010).

⁷² *United States v. Semrau*, No. 07-10074 JPM (W.D. Tenn. June 17, 2010) (PACER).

⁷³ See D.L. FAIGMAN, *Admissibility of Neuroscientific Expert Testimony*, in S. MORSE, A. ROSKIES (eds.), *A Primer on Criminal Law and Neuroscience*, New York, 2013, pp. 105-106, noting that after *Daubert*, the "error rate" role has not been sufficiently investigated neither by the academic literature, nor by the judges.

⁷⁴ D.D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection*, cit., p. 230, stating that «without knowing the predictive power of the test in an ecologically-valid setting, there is no accurate way to respond to *Daubert's* "known error rate" inquiry».

⁷⁵ Concerning the use of fMRI-based lie detection, see D.D. LANGLEBEN, *Detection of Deception With fMRI*, cit., p. 4, who reports that limited laboratory results suggest accuracy of lie detection using fMRI to be «between 76 an over 90%». L. FARWELL, E. DONCHIN, *The Truth Will Out*, cit., pp. 531 ff., have accurately identified whether or not an individual had knowledge of some item 87,5% of the time.

⁷⁶ F. SCHAUER, *Can Bad Science Be Good Evidence?*, cit., p. 1214.



[the CEO's] testimony can assist the jury in determining whether Dr *Semrau's* testimony is credible»⁷⁷.

To conclude, even though brain images are believed to have a particularly persuasive influence on the public perception of research on cognition⁷⁸, it has been suggested that «without better evidence of external validity, without dealing with the construct validity problem of distinguishing the genuine lie from following an instruction to utter words that are not literally true, without more rigorous scrutiny of claims of reliability, without higher verified rates of accuracy, without replication, and without subjecting the research to peer review by financially disinterested scientists, the claimed ability of fMRI to identify liars appear to be just that a claim and far from what good scientists take to be a sound scientific conclusion»⁷⁹.

6. Other legal concerns: critical compatibility with exclusionary rules

The case set forth above holds out the opportunity of addressing other issues. Actually, even though it can be concluded that a particular technique or method is scientifically valid under *Daubert* criteria, courts may have other reasons for excluding 'lie detector' results.

It may be noted, retracing the line of argument in *United States v. Semrau*, that Magistrate Pham ruled that the fMRI test results were also inadmissible under Federal Rule of Evidence 403. Relevant evidence could be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence⁸⁰. By similarity to polygraph cases, the Court noted that lie-detection evidence used to bolster credibility was highly prejudicial, mainly when credibility was a key issue, and the scans were conducted without the prosecution's knowledge.

⁷⁷ The case is described in these terms by R. DRESSER, *Brain Imaging and Courtroom Deception*, in *Hastings Center Report*, 2010, vol. 40/no. 6, pp. 7-8. See also K. LOWENBERG, *fMRI Lie Detection Fails Its First Hearing on Reliability*, June 2010, from <http://blogs.law.stanford.edu/lawandbiosciences/2010/06/01/fmri-lie-detection-fails-its-first-hearing-on-reliability/>.

⁷⁸ See D. McCABE, A. CASTEL, *Seeing Is Believing: The Effect of Brain Images on Judgments of Scientific Reasoning*, in *Cognition*, 2008, vol. 107, pp. 343-352, in which the data lend support to the notion that part of the fascination, and the credibility, of brain imaging research lies in the persuasive power of the actual brain images themselves. Conversely, N. SCHWEITZER, M. SAKS, E. MURPHY, A. ROSKIES, W. SINNOTT-ARMSTRONG, L. GAUDET, *Neuroimages as Evidence in a Mens Rea Defense: No Impact*, in *Psychol. Pub. Pol'y & L.*, 2011, vol. 17/no. 3, pp. 357-393, concluded that «the overwhelming consistent finding has been a lack of any impact of neuroimages on the decisions of our mock jurors».

⁷⁹ With these words F. SCHAUER, *Can Bad Science Be Good Evidence?*, cit., p. 1202.

⁸⁰ See P. PATEL, C. MELTZER, H. MAYBERG, K. LEVINE, *The Role of Imaging in United States Courtrooms*, in *Neuroimag. Clin. N. Am.*, 2007, vol. 17/no. 4, p. 562. M. PETTIT, *fMRI and BF Meet FRE*, cit., p. 327, explaining the reasons why one might expect that FRE 403 would rarely operate to exclude expert testimony. The Author states that «courts are used to analysing evidentiary offers under 403, and courts have not been as reluctant as one might expect to employ 403 to exclude expert testimony, particularly expert testimony about lie detection tests».

In the legal literature, *Wilson v. Corestaff Services*⁸¹ is also a well-known case: the plaintiff in an employment discrimination case sought to introduce fMRI test results to show that a certain witness was being truthful in his testimony. More specifically, the Court disallowed Dr Laken's testimony because the proposed testimony concerned a collateral matter – credibility of a witness – remarking that «anything that impinges on the province of the jury on issues of credibility should be treated with a great deal of skepticism»⁸².

Thus, it is important to focus on the subject matter of the evidence, i.e. credibility. Indeed, before admitting the opinion of a witness into evidence as expert testimony, the judge must take into account whether the subject matter of the opinion falls within the category of topics upon which expert testimony is permissible. A trial judge might conclude, therefore, that although the evidence passes *Daubert* standards (FRE 702), there is a great danger that the jurors will use such evidence for not acceptable or erroneous purpose (even if the judge instructs the jury correctly), or that such evidence will serve primarily to confuse the jurors because they are not likely to understand it. From the dawn of the common law, the task of determining witnesses' credibility has been left to the scientifically-unaided determination of the trier of fact: the jury⁸³. It has long been believed, indeed, that cross-examination is the «greatest legal engine ever invented for the discovery of truth»⁸⁴.

The jury's function as arbiter of credibility has long-standing, carefully cultivated jurisprudential roots⁸⁵, and most courts have disallowed testimony that comments directly on the truthfulness of a witness, finding it not helpful to the jury or having little probative value. Interestingly enough, though, not all courts disregard such testimony. Indeed, a minority of jurisdictions have held that the trial court has discretion to decide if expert testimony on 'veracity' should be admitted. Even though the ultimate issue of credibility is not usually addressed by psychologists in the proceedings, many judges have admitted expert evidence that indirectly comments on credibility, notably, behavioural-science testimony about child sexual abuse, suggestibility of children in interrogations, problems of eyewitness identification, and reasons for false confession⁸⁶. Some scholars suggest that many of

⁸¹ *Wilson v. Corestaff Services*, 2010 WL 1949095, at *3 (N.Y. Sup. Ct., May 14, 2010). Since in New York, the admissibility of scientific evidence is governed by standards set forth in *Frye v. United State*, this case may be also cited for its holding that the fMRI-based lie detection lacks "general acceptance" in the relevant scientific field.

⁸² See D.D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection*, cit., pp. 225-226.

⁸³ See F. SCHAUER, *Can Bad Science Be Good Evidence?*, cit., p. 1195, quoting e.g. *United States v. Scheffer*, 523 U.S. 303, 313 (1998): «[T]he jury is the lie detector». More specifically, the *Scheffer* Court concluded that science has boundaries, and since polygraph test results fall outside the boundaries of science, they can be excluded by the legislature without employing a *Daubert* analysis.

⁸⁴ J. WIGMORE, *Evidence in Trials at Common Law*, vol. 5 § 1367 at 32 (Chadbourn rev. 1974). See e.g. *State v. Lyon*, 744 P.2d 231, 240 (Or. 1987): «[t]he cherished courtroom drama of confrontation, oral testimony and cross-examination is designed to let a jury pass judgment on [parties' and witnesses'] truthfulness and on the accuracy of their testimony».

⁸⁵ J. SEAMAN, *Black Boxes*, in *Emory L. J.*, 2008, vol. 58, p. 58, quoting e.g. *United States v. Stromberg*, 179 F. Supp. 278, 280 (S.D.N.Y. 1959). See also, G. FISHER, *The Jury's Rise as Lie Detector*, in *Yale L. J.*, 1997, vol. 107, pp. 575 ff.

⁸⁶ See M. ROGERS, *Review of the Current Status of the Use of Statement Validity Analysis Procedures in Sex Abuse Cases in the United States*, in *Child Abuse Accusations*, 1990, vol. 2/no. 2, pp. 69-75. Recently, *State of Illinois v.*



these testimonies – so-called ‘social framework evidence’ – might help the jury to decide whether a given witness is credible, without specifically commenting on the truthfulness of any particular witness⁸⁷.

Additionally, in the Italian legal system, it has been argued that the decision on the truthfulness of a witness is in the exclusive competence of the judge and does not rely on clinical assessment⁸⁸. This consideration has led to believe that the ‘veracity’ of a statement should not be the object of expert evidence: ultimately, the Italian evidentiary system does not admit the intervention of an expert to assess the credibility of a subject in criminal proceedings.

The second concern involves other constitutional and/or legislative provisions⁸⁹.

Some scholars argued that the question is not, or at least not only, whether ‘lie-detection technology’ is reliable enough to be used in court. Rather, it is whether there are sound reasons to prohibit the use of evidence of witness ‘veracity’⁹⁰.

It is worth noting that in Italian criminal proceedings, under Article 188 of the Italian Code of Criminal Procedure (hereinafter referred to as the ‘CCP’)⁹¹, 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. This exclusionary rule aims at protecting anybody against physical and psychological coercions to produce evidence. For this reason, like any other investigative method that implies the examination of a subject’s statements by legal authorities, neuroscience evidence must comply with the *freedom of self-determination*.

According to current Italian academic literature, BF and brain-imaging techniques for lie detection fall within the category of investigative techniques that may be invasive, given that they assess physical qualities normally out of the direct control of the subject (e.g. electrical activity or blood flow in the brain). Ironically, it is as if subjects were treated as helpless witnesses of their thoughts: they can say one thing, but their ‘body’ will indicate another⁹². It could be said that every statement spurs from a physical phenomenon, thus it can be investigated as if it were an object. If that were so, such methodologies may fall within the compulsory medical checks provided for by Articles 224-*bis* and 359-*bis*

Eduardo Lerma (2016) IL 118496, has provided directions in order to allow expert testimony on eyewitness identification subject to the provisions of Rule 702 of the Illinois Rules of Evidence.

⁸⁷ For a further discussion, see D.D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection*, cit., p. 226: among courts there is no unanimous opinion on the point.

⁸⁸ See e.g. Court of Cassation, 3 October 1997, n. 8962, Ruggeri, in *Cass. pen.*, 1998, p. 1060: it was held that the examination on the credibility made by the expert should be kept separate from the reliability of the testimonial evidence, the latter assessment is within the exclusive tasks of the judge (translated by myself).

⁸⁹ In general, see A. POULIN, *Credibility: A Fair Subject for Expert Testimony?*, in *Florida L. Rev.*, 2007, vol. 59, pp. 991 ff.

⁹⁰ F. SCHAUER, *Can Bad Science Be Good Evidence?*, cit., p. 1213.

⁹¹ Translation available in M. GIALUZ, L. LUPÁRIA, F. SCARPA, *The Italian Code of Criminal Procedure*, cit.

⁹² According to M. PETTIT, *fMRI and BF Meet FRE*, cit., p. 333, researchers are developing methods that go beyond the detection of conscious lies and purport to show what information is in a person’s brain – even in the absence of any speech by the person.



of the CCP⁹³. Consequently, having a proclivity for ‘physical’ rather than ‘testimonial’ turns the individual into a ‘body’ from which to obtain – also mandatory – an exceptional form of evidence. Thus, Italian scholars are still engaged in a lively debate on neurotechnology-based lie detectors (hereinafter referred to as ‘NTLDs’), which are considered invasive of the physical freedom of individuals *per se*, for the mere fact that the subject must be connected to technical devices. Some commentators – by contrast – affirmed that, although potentially quite dangerous, fMRI is widely and routinely used and is considered safe, as long as certain precautions are taken⁹⁴. It can be concluded that fMRI has many limitations: it is expensive and highly sensitive to motion artefact⁹⁵, it confines the participants to a restricted position and exposes them to loud noises. For all these reasons, it falls within the category of techniques mentioned in Article 188 of the CCP.

7. Towards a new concept of “cognitive liberty”

The debate around the potentiality of fMRI in detecting lie for the purposes of justice includes also some concerns associated with the safeguard of a series of fundamental rights of the parties expressly endorsed by the Italian Constitution and the European Convention of Human Rights (hereinafter referred to as the ‘ECHR’)⁹⁶.

Unsurprisingly, legal practitioners wondered whether these tools could be used only for testimony provided by witnesses, or if they could also be used to assess the ‘veracity’ of statements made by defendants. Indeed, since the novel scientific evidence must meet a number of Italian Constitutional principles – for instance, the *presumption of innocence* (Article 27, par. 2, Italian Constitution) and the *right to defence* (Article 24, par. 2, Italian Constitution) – most Italian scholars consider these techniques not permissible in respect of the suspect or accused. In other words, expert testimony about the ‘veracity’ of defendants’ statements, aimed at the acquisition of a scientific and technical opinion – even if qualified – should be precluded from entering into trials. Both the suspect, due to the *right to silence* provided for by Article 64, par. 2, let. *b*, of the CCP⁹⁷, and the accused should not

⁹³ This discussion is well-known also among American jurists: in *State v. Lyon* 744 P.2d 239 (Or. 1987) Justice Hans A. Linde conceded that the polygraph is not altogether unique among interrogation techniques that seek to achieve the objective of detecting lie by «turn[ing] its subject into an object».

⁹⁴ B. HOLLEY, *It’s All in Your Head*, cit., p. 21. See also M. PARDO, *Neuroscience Evidence*, cit., p. 326, claiming that «the neuroscience tests appear to be less intrusive than a blood test; they are safe, relatively painless, and do not involve piercing the skin».

⁹⁵ As reported by D. FOX, *The Right to Silence*, cit., p. 773, «since the fMRI machine requires that a subject’s head remain still for several hours, even a small physical movement can impede the scanner’s ability to obtain data on blood flow patterns».

⁹⁶ Concerning the ethical problems resulting from brain research, see e.g. T. FUCHS, *Ethical Issues in Neuroscience*, in *Current Opinion in Psychiatry*, 2006, vol. 19/no. 6, pp. 600-607, who asserts that «such techniques are capable of affecting the individual’s sense of privacy, autonomy and identity. Moreover, reductionist interpretations of neuroscientific results challenge notions of free will, responsibility, personhood and the self which are essential for western culture and society».

⁹⁷ This rule obliges the authority to inform the accused of his right to remain silent before commencing the interview. If this provision is not fulfilled, the statements made by the person questioned shall be excluded. For further related safeguards, see e.g. M. GIALUZ, *The Italian Code of Criminal Procedure: A Reading Guide*, in *The Italian Code of Criminal Procedure: Critical Essays and English Translation*, cit., pp. 27 ff.



be assessed through forms of introspection of mind or behaviour, even though the techniques do not establish obstacles to the self-determination: they are free to choose to make statements, with the power to decide their content, and as a result, they have no obligation to answer questions and to tell the truth⁹⁸.

The position of witnesses (e.g. eyewitnesses) is quite different: the refusal to answer or falsity is punishable. Despite this, caution is needed in these cases as well: indeed, the interest of justice has to be balanced with other Constitutional interests, such as the *right to individual dignity*, the *privilege against self-incrimination* (Article 198, par. 2, of the CCP, implicitly also guaranteed by Article 6 ECHR⁹⁹) and the rules governing the *secrets privilege* (Articles 200 ff. of the CCP).

From a comparative perspective, it should be noted that the US Supreme Court highly values personal autonomy, which the Fourth Amendment seeks to protect, by restricting government intrusions – notably those involving criminal investigations – in extraordinary cases. Unless a person has waived this protection, the government may only proceed if the search or seizure – potentially able to infringe the right of the people to be secure in their ‘persons’ – is reasonable. Clearly, defining what is ‘reasonable’ is far from easy. It suffices here to observe that because NTLD measures a ‘body component’ with a device which is not-generally-available (at least for the time being), «individuals retain a reasonable expectation of privacy in their electrochemical emissions and the government would need a warrant or warrant exception to utilize these tools to assess these emissions without the subject’s consent»¹⁰⁰.

Courts addressing the proposed use of these technologies will also need to consider the Fifth Amendment’s ban on compelled self-incrimination¹⁰¹. The constitutional scrutiny under this provision has been dealt with reference to the NTLD evidence, and still debated by jurists and scholars. When these technologies are used by law enforcement to determine whether a subject is lying about his or her knowledge of a crime, incrimination is a likely result¹⁰² and thus Fifth Amendment protections would be applicable. There are three requirements – compulsion, incrimination, and testimony – that must be satisfied to fall within the protection of the self-incrimination clause¹⁰³.

By protecting citizens’ privacy, this Constitutional provision is strictly related to the guarantee of *freedom of thought*: the US Supreme Court suggested that «the right of freedom of thought includes

⁹⁸ F. SCHAUER, *Can Bad Science Be Good Evidence?*, cit., p. 1203, arguing that «given that law enforcement authorities may not require a suspect to talk at all, it is difficult to imagine that a defendant’s statement could be subject to an involuntary neural evaluation of its accuracy».

⁹⁹ See e.g. ECtHR 8 February 1996, *Murray v. United Kingdom*, § 45; ECtHR 25 February 1993, *Funke v. France*, § 44. The right to silence is an “intrinsèquement” part of the right to a due process.

¹⁰⁰ For a wider discussion, see B. HOLLEY, *It’s All in Your Head*, cit., pp. 12 ff., observing that searches at national borders and airport security checkpoints need not comply with the Fourth Amendment.

¹⁰¹ It has been asserted that a defendant might also find recourse in the Fourteenth Amendment’s due process protections. To do so, the defendant would need to demonstrate that the use of NTLD “shocks the conscience” (see S. THOMPSON, *A Brave New World of Interrogation Jurisprudence?*, in *Am. J. L. & Med.*, 2007, vol. 33/no. 2-3, pp. 351-354).

¹⁰² M. PARDO, *Neuroscience Evidence*, cit., p. 329, observing that “incrimination”, and hence the privilege, does not apply when subjects are granted immunity; when the information would lead to non-criminal sanctions only; or when the information is sought to incriminate a third party.

¹⁰³ U.S. Const. amend. V: «no person shall be compelled in any criminal case to be a witness against himself». See generally, B. HOLLEY, *It’s All in Your Head*, cit., pp. 15 ff.

both the right to speak freely and the right to refrain from speaking at all»¹⁰⁴. More recently, in the 2003 case of *Lawrence v. Texas*, it was explained that «liberty presumes an autonomy of self that includes freedom of thought, belief, expression, and certain intimate conduct»¹⁰⁵.

Therefore, the most skeptical fear that, in particular, the use of brain-scanning technology as a kind of super mind-reading device will threaten our privacy and mental freedom has led some scholars to call for the legal system to respond with a new concept of *cognitive liberty*¹⁰⁶. For this reason, the use of compelled neuroscientific evidence is illegitimate when it deprives people of control over their mental life¹⁰⁷. This suggests that the prosecutor may not comment on a defendant's decision to decline the testing, and that judges should instruct jurors not to draw adverse inferences from this choice¹⁰⁸.

Secondly, it is worth observing that the privilege would not preclude compelled tests when used for any purpose other than those that rely on incriminating propositional content. Although the tests gather physical evidence from the subjects' body, they may provide inductive evidence of their beliefs, knowledge, and other mental states directly related to the crime: concisely, «when the government attempts to make evidential use of the propositional content of such states, the privilege applies; when it does not, the privilege does not apply»¹⁰⁹.

The third requirement, however, is the one which raises more issues. In the American criminal justice system, it is crucial to distinguish between physical and testimonial evidence, given that the Fifth Amendment prohibits the government from forcing a suspect to provide 'communications' or 'testi-

¹⁰⁴ *West Virginia State Board of Education v. Barnette*, 319 U.S. 624 (1943). The "right to remain silent" in the face of police interrogation was established by the Supreme Court in *Miranda v. Arizona*, 384 U.S. 436 (1966). See, S. THAMAN, *Contributing Authors: Miranda in Comparative Law*, in 45 *St. Louis L. J.*, 2001, pp. 581 ff., who, furthermore, recognised that «the Italian Code of Criminal Procedure of 1988 contains the most radical protections for criminal suspects when confronted with interrogation, whether by police, public prosecutor or judicial authorities».

¹⁰⁵ *Lawrence v. Texas*, 539 U.S. 558 (2003).

¹⁰⁶ J. ROSEN, *The Brain on the Stand*, in *N. Y. Times*, 11 March 2007. The term "cognitive liberty" – as the right of each individual to think independently and autonomously, to use the full spectrum of his or her mind, and to engage in multiple modes of thought – was coined by neuroethicist Dr. Wrye Sententia and legal theorist and lawyer Richard Glen Boire, the founders and directors of the non-profit Center for Cognitive Liberty and Ethics (CCLE).

¹⁰⁷ The use of non-consensual NTLD results would be excluded under the self-incrimination clause «because of its potentially significant intrusion into privacy and autonomy in using a person's thoughts and innate physiological responses» (see B. HOLLEY, *It's All in Your Head*, cit., p. 18). In *State v. Lyon* 744 P.2d 238-240 (Or. 1987) Justice Hans A. Linde held that «he would hesitate to admit into evidence any interrogation method, no matter how reliable, that purports to verify veracity in the thoughts of criminal suspects». In particular, he denied admission of inculpatory polygraph results on ground of "personal dignity": polygraph testing threatened to undermine certain fundamental tenets about human personhood. See also D. FOX, *The Right to Silence*, cit., 796, arguing that when the State seizes photographs, handwriting samples or DNA, it does not deprive subjects of their ability to be in command of the use and disclosure of their thoughts. By contrast, compelled brain-imaging does compromise this ability.

¹⁰⁸ See e.g. *Griffin v. California*, 380 U.S. 609 (1965), holding that the Fifth Amendment prohibits prosecutors and judges commenting adversely on a defendant's failure to testify in a criminal proceeding.

¹⁰⁹ According to M. PARDO, *Neuroscience Evidence*, cit., p. 332, if the tests could be used to determine mental capacity, intent, bias, voluntariness, etc., without relying on incriminating propositional content, then the privilege would not preclude such uses.



mony' such as a verbal account or a gesture like nodding, but does not preclude compulsion which makes a suspect or an accused the source of 'real' or 'physical' evidence, such as a blood or handwriting sample¹¹⁰. Courts have never been particularly consistent in their interpretation of the purpose or scope of the self-incrimination clause¹¹¹, and this feeds the gap in the academic literature on what is physical and unprivileged or testimonial and privileged. Some rulings suggest, basically, that this kind of evidence is more akin to 'physical' evidence, thus rendering it admissible under the Fifth Amendment¹¹². It has been argued that BF or fMRI do not read thoughts, but simply detect internal bodily activity indicative of mental processes, and cannot be dependent on or require any statements from the subject¹¹³. Put simply, what makes brain-imaging unique is that «it measures direct and involuntary brain activity that cannot be effectively controlled by the subject undergoing interrogation»¹¹⁴.

Nevertheless, it was suggested that if a person has to answer 'yes' or 'no' or make any type of statement during the test (including pushing buttons or other physical acts that are intended as a communication), the test results will necessarily rely on the protected 'testimony' (that is, the statement) of the person. Thence, even though the following consideration is far from straightforward, some scholars believe that, at least in their current form, BF and brain-imaging require some type of clear testimonial response from the subject¹¹⁵.

A 'testimonial act' requires that the subject exercises control over the transmission of information: in other words, the subject must take an active and deliberate part in transferring that information to the law enforcement. Whether evidence counts as physical or testimonial depends on whether the *process* by which it was acquired or evaluated 'implied' the subject's 'testimonial capacities'¹¹⁶. Lie-

¹¹⁰ In general, see N. FARAHANY, *Incriminating Thoughts*, in *Stan. L. Rev.*, 2012, vol. 64, pp. 351 ff., claiming that neuroscience reveals the need for a new taxonomy underlying the privilege against self-incrimination; E. STOLLER, P. WOLPE, *Emerging Neuro-technologies for Lie Detection and the Fifth Amendment*, in *Am. J. L. & Med.*, 2007, vol. 33, pp. 364 ff. For further discussion concerning the possibility to extend the privilege to non-testimonial evidence as well, see M. PARDO, *Neuroscience Evidence*, cit., p. 331, nt. 203.

¹¹¹ See generally, M. O'NEILL, *Undoing Miranda*, in *B.Y.U. L. Rev.*, 2000, vol. 2000/no.1, pp. 185 ff.

¹¹² The seminal case in the history of the physical/testimonial distinction is *Schmerber v. California*, 384 U.S. 757, 765-69 (1966), which involved a compelled blood test after an automobile accident. The Court concluded that the compelled test was a search and seizure under the Fourth Amendment, but that because the human body is not "inviolable" against all forms of government evidence-gathering, such a test would be acceptable if supported by "probable cause". See also *United State v. Wade*, 388 U.S. 224 (1967), according to which evidence provided in the lineup to identify the perpetrator was not within the cover of the privilege; *Gilbert v. California*, 388 U.S. 263 (1967), held that compelled handwriting exemplars are admissible, because the content of the handwriting sample is not the focus, but rather like the voice or body itself (handwriting style) is an identifying physical characteristic outside Fifth Amendment protection.

¹¹³ B. HOLLEY, *It's All in Your Head*, cit., pp. 19-20. This seems to be confirmed by the fact that in the India murder case (*supra* nt. 63) the defendant did not speak, write, nod, or take any other active measure to communicate her thoughts in response to targeted stimuli. Instead, EEG sensors detected patterns of electrical activity in her brain that corresponded to a physical code for her stored knowledge, the incriminating content of which was used to prosecute her for murder.

¹¹⁴ Also for further references, see D. FOX, *The Right to Silence*, cit., pp. 792-793.

¹¹⁵ See e.g. E. STOLLER, P. WOLPE, *Emerging Neuro-technologies*, cit., p. 365, observing that it is possible that modified versions of neurotechnology-based lie detectors would not require such responses, and this possibility raises interesting Fifth Amendment issues.

¹¹⁶ *Schmerber v. California*, 384 U.S. 757, 765 (1966).

detection technologies which merely monitor a silent subject, would not violate the Fifth Amendment because they do not require a volitional act and do not expose him or her to the 'cruel dilemma' of choosing among self-incrimination, contempt of court, and perjury¹¹⁷.

Ultimately, the privilege against self-incrimination set out by the Fifth Amendment seems ill-equipped to address the moral and legal implications of safe and reliable forensic neuroscience: none of the ways of thinking about the privilege articulated by the American legal science would bar the compelled use of certain techniques to extort information from a criminal suspect's brain. If the suspect is deprived of any intentional participation that could qualify his or her test as testimonial, the results might count as physical evidence not simply because the evidence concerned the suspect's physical body¹¹⁸.

The purpose of the Italian self-determination clause seems to be able to protect the physical safety and the moral freedom of people diversely involved in criminal proceedings in a broader way. In the Italian justice system, the fact that the suspect does not play a conscious or purposeful role in the transfer of incriminating information to the law enforcement, might be enough to ban the admittance of these technologies under Article 188 of the CCP. If the method is considered admissible, under this provision the person's consent seems to be an essential requirement for assessing both criminal liability and the 'veracity' of his or her statements. In any case, the pain, danger, or severity of a methodology would render the procedure invalid for the purposes of justice.

8. Conclusions

The function of detecting a lie in statements made by suspects and witnesses is undoubtedly valuable in the criminal justice system. In the 'post 9/11 era', the reason why the international security agencies show so much interest towards these technologies is quite evident¹¹⁹.

Surely, progress in neuroscience has created the expectation of a breakthrough in the search for objective methods of lie detection. The tension between due process and crime control is, nonetheless, inevitable: «balancing the need for physical security and protecting our cherished freedoms and liberties will require continued dialogue and vigilance»¹²⁰.

There is ongoing concern, decades after *Daubert*, that judges and jurors may still be influenced by scientific evidence that lacks validity¹²¹. Some scholars state that courts continue to admit various

¹¹⁷ B. HOLLEY, *It's All in Your Head*, cit., p. 21. For a wider discussion, see M. PARDO, *Neuroscience Evidence*, cit., pp. 333 ff.

¹¹⁸ D. FOX, *The Right to Silence*, cit., p. 801, concluding that brain imaging techniques that deprives individuals of control over their thoughts violate the "spirit and history of the Fifth Amendment" (quoting *Schmerber*, 384 U.S. at 764).

¹¹⁹ See e.g. V. WEINBERGER, *Airport Security: Intent to deceive?*, in *Nature*, 2010, vol. 465, pp. 412-415.

¹²⁰ L. McDONALD GLENN, *Keeping an Open Mind: What Legal Safeguards Are Needed?*, in *Am. J. Bioethics*, 2005, vol. 5/no. 2, p. 61.

¹²¹ J. MORENO, *Eyes Wide Shut*, cit., p. 91, nt. 6, arguing that «if jurors are unable to differentiate high-quality research from junk science, then it is likely that their decisions will be influenced by both methodologically sound and methodologically inferior research, which is clearly an undesirable outcome».



types of novel scientific evidence, frequently ignoring its documented shortcomings¹²², also adding that these are often admitted in civil and criminal trials for various purposes, often without meeting *Daubert's* reliability standard¹²³.

Interestingly, the long-standing debate on whether courts are up to the daunting task of evaluating the empirical merit of proffered expert testimony continues to put in doubt the effectiveness of those criteria. Since judges lack the scientific training that may facilitate the evaluation of scientific claims or that of expert witnesses, who might make such claims, some scholars conclude that «*Daubert* may have created a vague and unwieldy standard»¹²⁴. Another factor to bear in mind is that the '*Daubert* inquiry' should be flexibly applied: its list of factors was meant to be helpful, not definitive¹²⁵. To be concise, after more than twenty years, it can be concluded that «the decision remains generally misunderstood in many respects»¹²⁶.

Despite these remarks, it seems clear that courts will continue to be cautious and skeptical of the claims made by supporters of truth detection. Official scientific validation remains the *key factor* for admitting whatever methodology or technology into evidence at trials. In *Gen. Electric Co. v. Joiner* the Court conceded that judges are not scientists and do not have the training that can facilitate the making of such 'scientific' decisions¹²⁷. Obviously, they cannot refuse to perform a *gatekeeper* function, because in doing so they would end up in neglecting the same claims underlying criminal justice. All things considered, it can be concluded that judges need to broaden their understanding of basic scientific language and of fundamental statistical concepts. Overall, it is not important to expand the list of factors, but rather to explain better those that constitute the standard of evidentiary reliability in greater detail. Generally the promise of science with respect to the law «can only ever be fulfilled if we clearly identify and resolve the significant inferential issues that lie at the intersection of these two disciplines»¹²⁸.

In order to cope with what – for many – is an 'insurmountable hurdle', following the latter recommendation may be the best way to improve the quality of legal decision-making and enhance the ability to create interdisciplinary solutions for resolving legal cases that rely on highly complex scientific or technical information¹²⁹. Certainty, until the needed research is accrued, these methods should be used cautiously and judiciously.

¹²² D.L. FAIGMAN, D. KAYE, M. SAKS, J. SANDERS, *How Good Is Good Enough? Expert Evidence Under Daubert and Kumho*, in *Case W. Res. L. Rev.*, 2000, vol. 50, p. 665, finding that «in the forensic context, courts have long admitted a surfeit of expertise with little or no evaluation of the foundation upon which the opinion rests».

¹²³ D.D. LANGLEBEN, J. CAMPBELL MORIARTY, *Using Brain Imaging for Lie Detection*, cit., pp. 222 ff.

¹²⁴ J. MORENO, *Beyond the Polemic*, cit., pp. 1060 ff.

¹²⁵ M. DENBEAUX, D. RISINGER, *Kumho Tire and Expert Reliability: How the Question You Ask gives the Answer You Get*, in *Seton Hall L. Rev.*, 2003, vol. 34, p. 32, express concern that courts frequently overlook the fact that the *Daubert* factors were intended to be flexible, despite the fact that *Kumho* Court further emphasized that the factors were not each necessary conditions for a proper reliability warrant, nor were other factors foreclosed.

¹²⁶ D.L. FAIGMAN, *The Daubert Revolution and the Birth of Modernity: Managing Scientific Evidence in the Age of Science*, in *UC Davis L. Rev.*, 2013, vol. 46/no. 3, p. 110.

¹²⁷ *Joiner*, 522 U.S. at 148.

¹²⁸ With these words, D.L. FAIGMAN, *The Challenge of Scientific Expert Testimony*, cit., p. 36.

¹²⁹ J. MORENO, *Beyond the Polemic*, cit., p. 1091.

In spite of this, finding the *truth* is not the only goal of legal proceedings: constitutional rights sometimes trump the search for truth. Consequently, regardless of reaching high levels of accuracy, new and sophisticated lie detection technologies may leave crucial questions about society's interest in privacy and individual freedoms open. These issues could also unquestionably encourage society to adopt more robust safeguards of *cognitive liberty*¹³⁰.

Ultimately, nowadays, it may be difficult to conclude that these techniques have matured to the point that they are broadly recognized as the single standard methodology for assessing the credibility of statements, given by subjects in specific legal cases. Courts have been wary about allowing recent methods of scientific lie detection into evidence: these tools suffer from several drawbacks that would make such evidence inadmissible.

The most optimistic researchers are confident that scientific development will meet the legal standards and courts will be more receptive in admitting 'lie detection techniques' at trials. Although inconsistencies remained across the studies mentioned above, some commentators have argued that there is a recurring pattern of findings «suggesting that at some point, in the future, functional neuroimaging may be used to detect deception in situations that have significant legal consequence»¹³¹. However, «there are still no techniques that consistently meet the legal standard of scientific evidence and very few that scientists even consider acceptable. Detecting deception is still very much a 'best guess' game»¹³².

¹³⁰ N. FARAHANY, *Incriminating Thoughts*, cit., p. 408.

¹³¹ S. SPENCE, A. HOPE-URWIN, S. LANKAPPA, J. WOODHEAD, J. BURGESS, A. MACKAY, *If Brain Scans Really Detected Deception, Who Would Volunteer to Be Scanned?*, in *J. Forensic Sci.*, 2010, vol. 55/no. 5, p. 1352.

¹³² E.B. FORD, *Lie Detection*, cit., p. 174.