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If You Could Read My Mind: Implications of Neurological Evidence for Twenty-First Century Criminal Jurisprudence

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Abstract

The advent of new technologies has permitted cognitive neuroscientists to explore the neural mechanisms underlying deceptive behaviors. Lawyers and law enforcement entities have shown great interest in exploring the legal consequences of employing such technologies; indeed such interest extends back to the days of phrenology and the advent of polygraphy. This article recounts current advances in the development of "truth telling" technologies, particularly functional magnetic resonance imaging (fMRI) and Brain Fingerprinting and recent attempts to introduce the latter into court as scientific evidence. The second part of the article explores the challenges to constitutional jurisprudence, especially to the Fifth and Fourth Amendment, that the introduction of evidence based on these technologies poses.

Introduction

Modern advances in the neurosciences have allowed investigators to correlate the activity of brain centers with behavioral and mental states in a manner previously unimaginable. Emergent technologies capable of imaging neural activity and electrophysiological recording are making it possible to "look into" the brain of an individual and determine the activity of nerve cell circuitry that is the basis of the individual's current behavior and mental state. Techniques such as functional magnetic resonance imaging (fMRI) have shown great promise both as diagnostic tools for the evaluation of injury or disease in the central nervous system and also as investigative tools by which the correlation of behaviors, including deception, and their underlying neural activity can be measured and evaluated.[1]

Such neurological methodologies have also excited the interest of lawyers. The search for legal applications of scientific methods for measuring brain activity extends back over more than two centuries. Both phrenology and polygraphy ("lie detectors") were once thought to hold great promise as tools for the evaluation of the mental state and veracity of defendants and witnesses in civil and criminal trials. However, although it was the first systematic attempt to link brain structure and behavior, phrenology was generally discredited by the early twentieth century. The argument over the scientific legitimacy of polygraphs continues to the present day,

Notes

[1] *See, e.g.,* Sean A. Spence et al., *A Cognitive Neurobiological Account of Deception: Evidence from Functional Neuroimaging.* 359 PHIL. TRANS. ROY. SOC. B 1755, 1759 (2004). *See also* D.D. Langleben, L. Schroeder, J.A. Maldjian, R.C. Gur, S. McDonald, J.D. Ragland, C.P. O'Brien, and A.R. Childress, *Brain Activity During Simulated Deception: An Event-Related Functional Magnetic Resonance Study*. 15 NEUROIMAGE, 727-732 (2002); G. Ganis, S.M. Kosslyn, S. Stose, W.L. Thompson, and D.A. Yurgelen-Todd, *Neural Correlates of Different Types of Deception: An fMRI Investigation.* 13 CEREBRAL CORTEX 830-836 (2003).

but polygraph evidence is generally held to be inadmissible in criminal cases.[2] Nevertheless, the quest for a scientifically reliable way of measuring mental activity in such a way that it can be used as evidence in the courtroom persists.

To date, attempts to introduce into court material relating neural structure and function to the character and truthfulness of defendants and witnesses have foundered on the rock of admissibility. Such technologies have not yet met the modern standard of admissibility prescribed by the Supreme Court in *Daubert v. Merrill Dow Pharmaceuticals, Inc.*[3] But even should they meet the *Daubert* standard (as their adherents claim they inevitably will) the introduction of such evidence will pose important constitutional questions under the Fifth and Fourth Amendments. The purpose of this paper is to examine the potential admissibility of neurologically-derived evidence in the post-*Daubert* era and the legal consequences of such admissibility. Part I focuses on the development of several such types of neurological evidence, including functional magnetic resonance imaging (fMRI) and "Brain Fingerprinting", which is based on the electroencephalographic measurement of a cognitive event known as the P300 wave. This latter technique has already been introduced into courtrooms as an allegedly reliable way of determining an individual's truthfulness. Part II examines the constitutional problems posed by such technologies and their possible descendants.

Part I. The Next Generation of "Lie Detectors"

A. Functional Magnetic Resonance Imaging

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[2] *See* Charles M. Sevilla, *Reliability of Polygraph Examination*, 14 AM. JUR. PROOF OF FACTS 2d 1 §§ 7-8 (2006); *See also, e.g.,* People v. Baynes, 88 Ill.2d 225, 244-45 (Ill. 1981); Bartholomew v. Wood, 34 F3d 870 (Wash. Ct. App. 1994); People v. Dunlap, 975 P.2d 723 (Colo. 1999); State v. Porter, 694 A.2d 1262 (Conn. 1997); McKenzie v State 653 So 2d 395 (Fla. Dist. Ct. App. 1995).

[3] 509 U.S. 579, 593 (1993).

Functional magnetic resonance imaging (fMRI) represents the latest development in brain imaging techniques and has recently emerged as the technology of choice for visualizing dynamic brain activity.[4] Briefly, fMRI measures the differential flow of blood containing high levels of oxygen into different regions of the brain by measuring the changes in the magnetic properties in localized regions of the brain induced by the flow of blood.[5] When areas of the brain become increasingly active due to neural activity, the demands of the nerve cells for oxygen rise and the flow of oxygenated blood to that region is consequently increased.[6] By measuring changes in the magnetic properties of those regions as blood flow increases, a measure of the change in neural activity is increased.[7]

An advantage of fMRI is that it is noninvasive; moreover it does not require the internal administration of any radioactive substances, as does positron emission tomography (PET).[8] Because of this, a relatively large number of measurements can be made over time without significant risk to the patient.[9] The absence of this risk makes the use of fMRI as a research tool, as opposed to a purely diagnostic device, much more feasible. Cognitive neuroscientists have accordingly seized upon this technology to plot localized brain activity in healthy individuals performing tasks, and relating the performance of those tasks to the concurrent brain activity.[10]

The development of fMRI as a cognitive, as opposed to simply diagnostic, tool promises to bring fresh controversy and challenges to the use of scientific evidence in the courtroom. Several studies employing fMRI to detect the truthfulness or deceit of a subject have recently

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[4] *Id.*at 315.
[5] *Id.*
[6] *Id.*
[7] *Id.*
[8] *Id.*

[9] *Id.* at 323-24
[10] *Id.*

been conducted and suggest that it may be possible to discern by MRI whether an individual is being truthful.[11] If such studies prove reliable, they may prove to be the next generation of "lie detector" employed to establish the truthfulness of a defendant or the credibility of a witness. But the implications of such uses may result in vexing evidentiary and constitutional questions as well.

The theory underlying most of these recent studies is that deception involves multiple cognitive processes that are superimposed upon a truth-telling baseline.[12] A liar is called upon to do at least two things simultaneously; she must withhold the truth (*suppression veri*) while simultaneously constructing a consistent new item of information (*suggestio falsi*), assuming that she knows and comprehends what the correct information is.[13] Thus, the baseline activity of telling the truth is what a truth-teller will tell, or what a liar may tell if distracted, fatigued, anesthetized or inebriated (*in vino veritas)*.[14] This model therefore supposes that engaging in deception requires additional cognitive processing that will involve centers in the brain controlling executive functions such as problem solving, planning and the conscious manipulation of information in working memory.[15] Thus, lying should involve these centers in a way that truth-telling, the baseline activity, should not. Cortical centers believed to be involved in the processing of such executive functions are different regions of the anterior cingulate (ACC) and prefrontal cortices (PFC).[16]

Furthermore, in "high stakes" situations, in which a deceiver has much to lose if the truth is divulged (as in a guilty suspect being interrogated, or a witness committing perjury at trial) the

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[11] *See* Spence, Sean A,, et al. *A Cognitive Neurobiological Account of Deception: Evidence From Functional Neuroimaging*. 359 Phil. Trans. Roy. Soc. B 1755 (2004).
[12] *Id.* ar 1757.
[13] *Id.*; ST. AUGUSTINE, *De Mandacio (On Lying), in* RETRACTIONS, BOOK I.
[14]. Spence, Sean A,, et al. *A Cognitive Neurobiological Account of Deception: Evidence From Functional Neuroimaging*. 359 Phil. Trans. Roy. Soc. B 1757 (2004).
[15] *Id.*
[16] *Id.*

number and complexity of the cognitive tasks increases.[17] Information that was previously divulged must be recalled, emotion and behavior controlled to appropriately correlate with information delivered or denied, and information managed.[18] All of these imperatives resemble executive tasks and should engage those areas of the PFC involved in managing such functions.[19]

Several recent studies have proposed to test this model using fMRI.[20] In one such study, Spence et al. hypothesized that telling a lie would generate enhanced activity in regions of executive PFC (particularly the dorsolateral PFC) that are believed to be involved in the generation of novel responses.[21] Suppression of the truth, on the other hand, should instead generate greater activity in the ventral regions of PFC, an area implicated in response inhibition.[22]

In Spence's study, volunteer subjects were questioned on activities that they might have performed on the day of the test, answering by pressing 'yes' or 'no' buttons on a computer screen.[23] The possible known activities of the subjects were ascertained prior to testing.[24] The questions were asked in the presence of an investigator who acted as a 'stooge" and who would be required to judge afterwards whether the subjects' responses were truth or lies.[25] On the computer screen that presented a given question, the subject also received a red or green colored prompt, indicating that they were to lie or answer the question truthfully; this cue as unknown to

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[17] *Id.* at 1756.
[18] *Id.*
[19] *Id.* at 1756.
[20] Sean A. Spence, S.R. Hirsch, D.J. Brooks, and P.M. Grasby, *Behavioural and Functional Anatomical Correlates of Deception In Humans*. 12 Neuroreport, 2849-2853 (2001).
[21] *Id.*
[22] *Id.*
[23] *Id.*
[24] *Id.*
[25] *Id.*

the stooge.[26] Response times were measured, and brain activity during the task was also measured by fMRI.[27]

Data from subjects in this study indicate that deceptive statements are correlated with a statistically significant increase in bilateral activity in ventrolateral PFC as well as ACC (which are putative executive centers) when compared to activity made during truthful statements.[28] Furthermore, the response time of subjects making deceptive statements averaged 200 ms longer than subjects who were telling the truth.[29] The data support the hypothesis that lying requires additional cognitive functions involving executive centers of the prefrontal cortex that build upon a baseline of truth telling.[30] The longer latency of untruthful responses is congruent to a report of a convicted murderer videotaped while lying and telling the truth.[31] Although recounting similar material in both instances, statements which were lies were accompanied by longer pauses and more speech disturbances.[32]

Other fMRI studies further support the contention that regions of executive prefrontal cortex play a role in deception. A study by Langleben et al. in 2002, tested the hypothesis that subjects who were withholding a truthful response would generate increased activity in executive, inhibitory brain regions.[33] Subjects in an fMRI scanner made motor responses to a series of playing cards that were presented visually.[34] The subjects held one card which was

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[26] *Id.*
[27] *Id.*
[28] *Id.*
[29] *Id.*
[30] *Id.*
[31] *Id.*
[32] *Id.*
[33] D.D. Langleben, L. Schroeder, J.A. Maldjian, R.C. Gur, S. McDonald, J.D. Ragland, C.P. O'Brien, and A.R. Childress, *Brain Activity During Simulated Deception: An Event-Related Functional Magnetic Resonance Study*. 15 Neuroimage, 727-732 (2002).
[34] *Id.*

known to them and which they believed was unknown to the investigators.[35] The subjects pushed "yes" or "no" buttons to respond to questions about the identity of the card they held.[36] Control questions, some requiring a truthful response and others determining the attention of the subject to the experimental protocol were also presented.[37] Denying possession of the identity of the playing card held by the subject (the "lie" withholding guilty knowledge) was associated with an increase in activity in angular cingulated cortex (in the same region identified by Spence).[38] There were no brain regions exhibiting greater activity during truthful responses and response times were not measured.[39]

An fMRI study by Ganis et al. demonstrated differences between deceptive statements that were part of a well-rehearsed and coherent scenario and those that are spontaneous and need not fit into a larger narrative framework.[40] The data from this study indicate that both types of lies were associated with greater PFC activation, while truthful responses did not result in increased activity in these areas.[41] Furthermore, spontaneous lies resulted in activation of the ACC in a region proximal to that described by Spence and Langleben, as well as in Brodmann Area 47 at coordinates identical to those described in Spence.[42]

The results of these studies indicate that deceptive activity made by a test subject in response to simple tasks may be measured by fMRI and that lying in this context may be accompanied by an activation of identifiable regions in the PFC that are involved in executive

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[35] *Id.*
[36] *Id.*
[37] *Id.*
[38] *Id.*
[39] *Id.*
[40] G. Ganis, S.M. Kosslyn, S. Stose, W.L. Thompson, and D.A. Yurgelen-Todd, *Neural Correlates of different types of deception: an fMRI investigation.* 13 Cerebral Cortex 830-836 (2003).
[41] *Id.*
[42] *Id.*

functions such as planning and manipulating information.[43] Such studies support the hypothesis that deception requires activation of additional brain centers when compared to truth-telling, which appears to be a "baseline" activity, requiring little in the way of mental construction or manipulation of the response.[44] Further support arises from studies of individuals suffering lesions in these regions of the PFC. Individuals suffering lesions in orbitofrontal cortex (including regions identified by fMRI studies as being involved in deception) exhibit "pseudopsychopathic personality" syndrome.[45] Although these individuals may exhibit some characteristics of psychopathy (including impulsiveness and aggression) they also tend not to lie.[46] On the contrary, they frequently exhibit a callous disregard for social conventions and a rather brutal honesty that may be offensive to decorum and the feelings of others.[47] Such offensive "truths" may be uttered by these individuals because they are released by the absence of suppressive orbitofrontal cortical activity.[48]

The data obtained from such studies, however, must be viewed carefully within their experimental contexts. The scenarios are "low risk" to the subjects in that there is no punishment or other adverse consequence of being detected in a lie. Furthermore, the volunteer subjects were presumably not habitual or chronic liars or psychopaths unable to tell truth from falsehood. The experimental protocols rely upon testing regimes that are necessarily artificial in nature and frequently rely upon non-vocal signals to relate the deception. [49]

Psychophysiological contentions concerning the neural basis of deceptive behavior need to be treated with a healthy skepticism. Models of brain function based upon correlation of brain

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[43] Spence, Sean A,, et al. *A Cognitive Neurobiological Account Of Deception: Evidence From Functional Neuroimaging.* 359 Phil. Trans. Roy. Soc. B 1755, 1759 (2004).
[44] *Id.* at 1757.
[45] *Id.*
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] *Id.*

activity with specific states are precisely that: models. Although increasingly "realistic" paradigms are being developed, and the models upon which the cognitive mechanisms of deception are revised in light of new data, the process of employing fMRI to open a window into the nature of cognitive insight remains rife with uncertainty and lacking in strongly predictive power. And no one has yet attempted to introduce evidence from fMRI studies in court. Nevertheless, the potential of fMRI, and of future developments in brain imaging technologies that have increased temporal and spatial resolution, promise to provide new insights into the neural activity forming the basis of mental state and knowledge.

B. "Brain Fingerprinting" ®

The technique known as "Brain Fingerprinting" has received considerable recent media attention hailing it as the next generation of scientifically based lie detection.[50] At the heart of the technique is a neural phenomenon known as the P300 wave.[51] The P300 is a wave of electrical brain activity, lasting as long as several hundred milliseconds, that is evoked in response to presented stimuli that suggest, depict, or recall information stored in the memory of the test subject.[52]

The electrical activity of the brain has been systematically studied since the 1920s, but it is only within recent decades that the technique has become sufficiently sophisticated to provide useful information regarding brain function.[53] The waves of electrical activity that can be measured by electroencephalography are a result of the integration of the electrical activity of

[50] Dr. Lawrence Farwell, the inventor of this technique, maintains a Website at http://www.brainwavescience.com/in-the-news.php chronicling media coverage (last visited 12/6/2006).
[51] U.S. Patent No. 5,467,777 (issued November 21, 1995).
[52] Salil H.Patel and Pierre N. Azzam, *Characterization of N200 and P300: Selected Studies of the Event Related Potential*. 2 INTERNATIONAL JOURNAL OF MEDICAL SCIENCES, 147, 149 (2005).
[53] *Id*.

large populations of neurons within a given locus of the brain.[54] An electroencephalogram ("EEG") is the measure of changes in these waves of electrical potential over time and EEGs are routinely employed in research and medical diagnosis to correlate the activities of neuronal populations with respect to behavioral states or abnormal activity, such as epilepsy.[55] Certain EEGs arise spontaneously within the brain and are related to the individual's behavioral state.[56] Others are evoked in response to presentation of an external stimulus and are known as evoked or event related potentials ("ERPs").[57] The P300 is in this latter category and is ostensibly evoked by presentation of a stimulus with which the viewer is familiar.[58] Proponents of Brain Fingerprinting contend that evocation of the wave is caused by identification and recognition of a stimulus previously encountered and stored in memory.[59] Thus, presentation of artifacts, photographs, or other evidence of a crime scene should evoke the P300 wave in the mind of a person who had knowledge or experience of the crime, whereas an innocent person will fail to recognize them and therefore produce no P300 wave.[60]

It is important to note that although an ERP such as the P300 wave indicates the activation of neural activity within a given region of the brain, it cannot relate anything concerning the specific *content* of the activity. Event related potentials in the occipital cortex

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[54] Because the human cerebral cortex is organized in a highly coherent, laminate fashion, the simultaneous and spontaneous electrical activation of large populations of neurons within a specific region results in the creation of electrical current "sinks" and "sources" depending upon the nature of the flow of current in the region being studied. The creation of these sinks and sources results in detectable changes in voltage, or potentials that can be measured noninvasively on the subject's scalp with relative ease. John H. Martin, *The Collective Electrical Behavior of Cortical Neurons: The Electroencephalogram and The Mechanisms of Epilepsy*. In: PRINCIPLES OF NEURAL SCIENCE, Third Edition (Eric R. Kandel, James H. Schwartz, and Thomas M. Jessel, eds.) 778 (Appleton & Lange, 1991).
[55] *Id.* at 778.
[56] *Id.*
[57] *Id.* at 780.
[58] Salil H.Patel and Pierre N. Azzam, *Characterization of N200 and P300: Selected Studies of the Event Related Potential.* 2 INTERNATIONAL JOURNAL OF MEDICAL SCIENCES, 147, 149 (2005).
[59] Lawrence A. Farwell and Sharon S. Smith, *Using Brain MERMER Testing To Detect Knowledge Despite Efforts to Conceal*. 46 JOURNAL OF FORENSIC SCIENCE 135-43 (2001).
[60] *Id.*

may be evoked in response to visual stimuli, but the potentials reveal nothing about the nature of the visual stimulus presented. The effect might be likened to standing outside of a baseball stadium and attempting to discern the course of the game (including the rules of baseball) by listening to the roars of the crowd inside. It is possible to ascertain that something has happened (probably, but not necessarily, related to the progress of the game), but virtually impossible to tell precisely what has happened with respect to the game itself. Likewise, an event related potential merely indicates the correlation of the integrated electrical activity of a large population of neurons with the presentation of a stimulus.

Brain Fingerprinting, developed and patented by Dr. Lawrence A. Farwell, measures what he refers to as a "memory and encoding related multifaceted electroencephalographic response" ("MERMER").[61] A MERMER includes the P300 wave as part of a larger EEG response that is elicited when a subject is presented with a stimulus that is recognized by the subject, but who willfully withholds that knowledge.[62] The Brain Fingerprinting process, as claimed by Farwell, records EEG activity on at least three locations on the skull as the subject is presented with a series of stimuli, such as objects, words or photographs.[63] The stimuli presented to the subject fall into three broad categories: probes, targets, and irrelevants.[64] Probes are stimuli relevant to information that a guilty person would know but would deny knowing, such as that relating to a crime investigation.[65] Targets are stimuli that are similar in nature to the probes, but which are known to the subject because they have been presented to the subject prior to the trial.[66] Irrelevant stimuli are unknown to the subject and irrelevant to the question at

[61] Lawrence A. Farwell and Sharon S. Smith, *Using Brain MERMER Testing To Detect Knowledge Despite Efforts to Conceal*. 46 JOURNAL OF FORENSIC SCIENCE 135-43 (2001).
[62] U.S. Patent No. 5,467,777 (issued November 21,1995).
[63] *Id.*
[64] *Id.*
[65] *Id.*
[66] *Id.*

hand.[67] The subject is asked to push one button if the stimulus is a known target and another if it is irrelevant; the guilty subject will also presumably press this latter button in response to presentation of a probe.[68] Farwell claims that MERMERs will be elicited in response only to targets in an innocent subject (to whom the probes are irrelevant) and in response to both targets and probes in subjects with guilty knowledge, or recognition, of the crime related probe stimulus.[69]

Farwell asserts that that the method is highly reliable when applied correctly, and can indicate whether an individual is withholding knowledge that is "stored in the brain."[70] However, the specificity of what he claims far exceeds the claims of most others who work with event related potentials, and although the P300 wave has been studied extensively, Farwell's studies have not yet been replicated by investigators other than himself and his collaborators.[71]

One drawback of the Brain Fingerprinting technique is that it requires the investigator to have a great deal of knowledge of both the details of the crime as well as of the past history and knowledge of the individual accused or suspected of the crime.[72] Probes in particular must be carefully chosen to elicit a response that is contextual only to the crime.[73] However, the *nature* of the knowledge held by the subject of Brain Fingerprinting cannot be measured by the technique.[74] Thus a perpetrator, a confederate, a witness, or an individual who subsequently discovered the crime could all have the same knowledge of the facts of a case, and the

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[67] *Id.*
[68] *Id.*
[69] *Id.*
[70] Lawrence A. Farwell and Sharon S. Smith, *Using Brain MERMER Testing To Detect Knowledge Despite Efforts to Conceal*. 46 JOURNAL OF FORENSIC SCIENCE 135-43 (2001).
[71] *Id*,.
[72] *Id.*
[73] *Id.*
[74] *Id.*

MERMER response from all of these individuals would likely be identical.[75] Furthermore, facts of the crime made available to the public would likewise present a confounding factor in conducting Brain Fingerprinting.[76] Thus, the technique is constrained by the facts of individual cases, and it seems likely that Brain Fingerprinting would only be applicable in a restricted number of cases. However, the larger question persists as to whether Brain Fingerprinting is admissible scientific evidence. In a few cases, courts have ruled that it may be.

B. Brain Fingerprinting and the Admissibility of Neurological Evidence

The first attempt to introduce "truth-telling technology" into court was in the case of *Frye v. United States*.[77] In *Frye*, the Court of Appeals of the District of Columbia examined the admissibility of evidence provided by the first generation of blood pressure-based polygraph machines and held that the foundation for the reliability of the polygraph device had not yet been sufficiently established because polygraphy had not yet been generally accepted as valid by the scientific community.[78]

The *Frye* test of "general acceptance" served as the benchmark for the admissibility of evidence based upon new scientific methodologies.[79] Furthermore, it effectively excluded polygraph-based testimony from the federal courts and most state and local courts for the next 70

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[75] *Id.*
[76] *Id.*
[77] Frye v. United States, 293 F. 1013 (1923). However, some courts in the nineteenth century had previously entertained testimony by phrenologists in several cases. *See, e.g.,* Brock v. Luckett's Executors, 5 Miss. 459, 459 (1840); Farrer v. State, 2 Ohio St. 54, 60-61 (1853).
[78] *Id.* According to the court:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

[79] Alice B. Lustre, *Post-Daubert Standards for Admissibility of Scientific and Other Expert Evidence in State Courts.* 90 A.L.R.5th 453, 453.

years. However, in the 1993 case of *Daubert v. Merrill Dow Pharmaceuticals, Inc.*, the Supreme Court overturned the "general acceptance" standard established by *Frye*.[80] Although detailed discussions of *Daubert* and the admissibility of scientific evidence are beyond the scope of this article, a few relevant points are worth noting. In *Daubert*, the Court held that the test of admissibility of scientific evidence rests on a preliminary assessment of whether the scientific methodologies underlying the "testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue."[81] Such an assessment may include whether the methodology generates empirically testable data, whether it has been subjected to peer review and has been published in reputable and established peer-reviewed publications, and the potential for experimental or interpretational error, in addition to the "general acceptance" standard established by the court in *Frye*.[82] This is a sensible interpretation by the Court of the basic methodologies of science; hypothesis generation, empirical evidence and repeatability are the at the very core of the scientific method and more accurately reflects the nature of scientific knowledge than a mere "show of hands" as to what is or is not acceptable as science. Furthermore, as scientific knowledge evolves with time, what is acceptable may change, but empirically-generated data does not, even though the data may be refined or the interpretation of what data means may change.

C. Harrington v. Iowa

The admissibility of Brain Fingerprinting as evidence in the post-*Daubert* legal world has been at issue in two court cases to date. In *Harrington v. Iowa*, Terry Harrington appealed to the Iowa Supreme Court for postconviction relief in from his 1978 conviction for first degree murder

[80] 509 U.S. 579 (1993).
[81] *Daubert*, 509 U.S. at 593.
[82] *Id.* at 593-594.

based, inter alia, on evidence of his innocence based upon a Brain Fingerprinting analysis conducted by Farwell.[83] Harrington had initially sought relief in the state district court in Pottawattamie County, offering, among other evidence, Farwell's analysis of Harrington's lack of guilty knowledge of the crime.[84] Judge Timothy O'Grady held an evidentiary hearing, at which Farwell testified, and ruled the Brain Fingerprinting evidence admissible.[85] Despite the Brain Fingerprinting evidence, Judge O'Grady subsequently ruled to deny postconviction relief to Harrington, who appealed to the Iowa Supreme Court.[86] That court overturned the district court and remanded Harrington's case for a new trial.[87] The court noted the district court's admission of the Brain Fingerprinting evidence, but granted Harrington's motion for postconviction relief on other grounds and expressly declined to consider the Brain Fingerprinting evidence.[88]

Judge O'Grady's admission of the Brain Fingerprinting evidence was for use in considering a postconviction motion for relief, which was not held in front of a jury and which carries little precedential weight.[89] The Iowa Supreme Court's refusal to consider the evidence in resolving Harrington's motion similarly did nothing to further validate the admissibility of Brain Fingerprinting as evidence. And in a recent case in Oklahoma, the Court of Criminal Appeals rejected the admission of Brain Fingerprinting, holding that it did not sufficiently meet the standards of admissibility established in *Daubert v. Merrill Dow Pharmaceuticals, Inc.*.[90]

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[83] Harrington v. Iowa, 659 N.W.2d 509, 512 (2003).
[84] *Harrington*, 659 N.W.2d at 512.
[85] *Id.* at 516, note 6.
[86] *Id.* at 512.
[87] *Id.* at 525.
[88] *Id.* at 516.
[89] *Id.* at 516, note 6.
[90] Slaughter v. Oklahoma, 108 P.3d 1052, 1054 (2005); Daubert v. Merrill Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).

D. Slaughter v. Oklahoma

In *Slaughter v. Oklahoma*, the defendant, Jimmy Ray Slaughter, was convicted in the District Court of Oklahoma County of two counts of first degree murder and sentenced to death.[91] That sentence was upheld on appeal by the Court of Criminal Appeals, and certiorari was subsequently denied by the U.S. Supreme Court.[92] Prior to his second postconviction motion for relief, Slaughter submitted to a Brain Fingerprinting analysis conducted by Farwell.[93] In an affidavit to the court of criminal appeals, Farwell testified to the accuracy of the method and asserted that Slaughter lacked knowledge of the crime that would have been possessed by the perpetrator.[94] Curiously, although Farwell indicated in his affidavit that a "comprehensive report" of his analysis would be presented to the court detailing the method of analysis and the results obtained, no such report was submitted in the course of this hearing or a subsequent hearing.[95] Given that the Brain Fingerprinting evidence was supported only by Farwell's affidavit without any corroborating evidence, the court held that it did not rise to the required standard of admissibility and therefore refused to consider the Brain Fingerprinting analysis in Slaughter's second and subsequent third motions for postconviction relief.[96]

Given Farwell's aggressive marketing of the Brain Fingerprinting method, his failure to provide a full report and corroborating evidence is strange, particularly in light of his willingness to testify in *Harrington*.[97] The *Slaughter* case provided an opportunity to test the admissibility of the Brain Fingerprinting method under the standards established in *Daubert*. However, the legal and scientific communities still await such a test of Farwell's method.

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[91] *Slaughter*, 108 P.3d at 1053.
[92] Slaughter v. Oklahoma, 105 P.3d 832, 834 (2005).
[93] *Slaughter*, 105 P.3d at 834.
[94] *Id.*
[95] *Id.* at 834; *Slaughter*, 108 P.3d at 1054.
[96] *Slaughter*, 105 P.3d at 837; *Slaughter*, 108 P.3d at 1056.
[97] Email inquiries by the author to Farwell's Institute upon this point were not answered.

E. Brain Fingerprinting in the post-Daubert World

In an article published prior to the *Slaughter* decision, Professor Andre Moenssons[98] examined the possible outcomes should a full-blown attempt be made to have Brain Fingerprinting admitted as evidence in court.[99] Professor Moenssens argues that Brain Fingerprinting would have likely failed under the pre-*Daubert* standard established in *Frye* of general acceptance in the scientific community, and that view is almost certainly correct.[100] Certainly the P300 wave has been generally accepted in the scientific community as an event related potential, and has been extensively studied.[101] But Brain Fingerprinting, although aggressively championed by Farwell, includes additional elements and analyses of brain electrical activity that have not been subject to a significant amount of peer review or repetitive testing by other experts in encephalography.[102] Furthermore, Farwell's claims of accuracy and precision far outstrip those of other investigators of encephalography.[103] This is not to cast any doubt on the veracity of Farwell's claims per se, but to achieve general acceptance within the scientific community generally requires that the technique be reliably repeated by other investigators who achieve substantially the same results. That has not yet happened, and Farwell's proprietary ownership of the method may discourage others from attempting to employ it during the life of the patent.

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[98] Douglas Stripp Missouri Professor of Law Emeritus, University of Missouri-Kansas City School of Law.
[99] Andre A. Moenssens, *Brain Fingerprinting—Can It Be Used to Detect the Innocence of Persons Charged with a Crime?* 70 UMKC L. REV. 891, 917 (2002).
[100] *Id.*; Frye v. United States, 293 F. 1013, 1014 (1923).
[101] Andre A. Moenssens, *Brain Fingerprinting—Can It Be Used to Detect the Innocence of Persons Charged with a Crime?* 70 UMKC L. REV. 891, 917 (2002).
[102] *Id.*
[103] *Id.*

Professor Moenssens contends that under the current more flexible standards established by *Daubert* and its progeny, the admissibility of Brain Fingerprinting would be more likely.[104] *Daubert* reduced the "general acceptance" requirement of *Frye* to just the fourth and final prong of a multipart test of admissibility in determining whether a given technique rests on reliable scientific knowledge.[105] Although Brain Fingerprinting would likely fail that prong, Professor Moenssens argues that it might possibly fare better under the other three.[106] The first prong of *Daubert's* analysis, whether the technique has been subject to peer review, is admittedly problematic because there have been relatively few papers published testing the reliability of the MERMER response, and those papers have been published by Farwell and his collaborators.[107] Although the P300 wave itself has been extensively studied by many investigators and the P300 literature is vast, Farwell's claims for the MERMER method go far beyond what is generally claimed for the P300.[108] Moreover, there has apparently been no independent verification of the reliability of the method by other investigators applying Farwell's techniques. Scientific peer review necessarily extends beyond the mere review of manuscripts submitted by an author; it necessarily implies that the methods and results are repeatable by others applying the same techniques. Brain Fingerprinting still awaits such repetitive testing.

The second prong of *Daubert* tests whether a standard technology exists for arriving at a given result.[109] Because the electroencephalographic methods forming the basis for P300 wave observations have been well established, and because experts in that field have stated that Farwell's methods seem to be based reliably upon those techniques, Professor Moenssens argues

[104] *Id.* at 918.
[105] *Id.*
[106] *Id.*
[107] *Id.*
[108] *Id.*
[109] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 593 (1993).

that this prong might be met.[110] Indeed, a review of Farwell's patent discloses nothing in the measurement methodology that differs significantly from the measurements generally employed in electroencephalography.[111] But the required standard in this prong of *Daubert* does not inquire simply whether the technology is standard; it asks whether that technology can be relied upon to provide a given result.[112] The Brain Fingerprinting technique extends far beyond what are claimed as reliable data in recent reviews of P300 wave research in the literature, and it is questionable to a reasonable scientist whether the far-reaching claims of the Brain Fingerprinting method can be reliably sustained by the electroencephalographic techniques employed in measuring the MERMER responses without further independent corroboration.[113]

The third test under the *Daubert* analysis inquires as to whether an error rate can be or has been determined.[114] Farwell's claims an astonishingly low rate of error (<0.1%), and the nature of his analyses certainly demands such scrutiny.[115] Whether such analyses of the statistical confidence of the results in the single peer-reviewed publication which has documented MERMER analysis will sustain independent scrutiny remains to be seen. The 2001 paper published in the Journal of Forensic Sciences by Farwell and Smith does not proved great detail concerning the statistical algorithms employed in the analyses in obtaining confidence values for the results, nor much in the way of quantitative data.[116] Given that, it is difficult to determine if the methods employed in this technique to determine error would meet the standards imposed by *Daubert*.

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[110] Andre A. Moenssens, *Brain Fingerprinting—Can It Be Used to Detect the Innocence of Persons Charged with a Crime?* 70 UMKC L. REV. 891, 919 (2002).
[111] U.S. Patent No. 5,467,777 (issued November 21,1995).
[112] *Daubert*, 509 U.S. at 593 (1993).
[113] A recent review of the P300 literature fails to mention Brain Fingerprinting.
[114] *Daubert*, 509 U.S. at 593 (1993).
[115] U.S. Patent No. 5,467,777 (issued November 21,1995).
[116] Lawrence A. Farwell and Sharon S. Smith, *Using Brain MERMER Testing To Detect Knowledge Despite Efforts to Conceal*. 46 JOURNAL OF FORENSIC SCIENCE 135-43 (2001).

Given these limitations, it appears that it will be an uphill battle to gain admission for evidence derived from the Brain Fingerprinting, at its current state of development technique, in court. Until the methodology has been further tested and repeated by individuals other than the proprietary originator of the technique, admissibility will remain problematic, even under the more flexible requirements of *Daubert*.

Part II. Brave New World: Constitutional Issues Presented By Further Development of Brain Activity Measurement Technology

A. Neurological Evidence and the Fifth Amendment

It remains to be seen whether Brain Fingerprinting or other neurologically based "truth-telling technologies" will meet the standards established by *Daubert* or whether further independent testing of the method by the wider scientific community will validate its accuracy to the point of admissibility by the courts. However, given the long arc of legal interest and inquiry, that extends from the days of the phrenologists to the present day, in relating mental activity and knowledge to overt acts, it is perhaps relevant to briefly examine the legal consequences of these and related future technologies should they reach a level of scientific reliability that would meet the threshold of admissibility in the courts.

The Fifth Amendment to the U.S. Constitution states: "No person…shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law…."[117] However, the prospect of mining mental information from defendants and witness in criminal cases poses new and untested Fifth Amendment issues. An initial question is whether results of brain activity measurement should be considered by the legal system as physical evidence or as actual testimony by the individual. The consequences

[117] U.S. CONST. amend. V.

and application of legal tests of their admissibility will depend upon which of the categories (if either) that "mind activity" is deemed to be.

At first glance, the classification of data derived from brain activity as physical evidence is an attractive notion. It would rely upon neurological principles widely accepted by the research community. It could be presented in court by expert witnesses to lay members of the jury in an understandable manner (as in charts of wave activity or even some sort of "mental replay" of a memory). This scenario evokes obvious, recognizable parallels to other sorts of physical evidence that may be compelled from a suspect such as fingerprints, hair and blood samples, or genetic evidence in the form of DNA. And given that it is a physical measurement of a concrete, tangible phenomenon, treatment of records of mental activity containing knowledge or memory as physical evidence has a common sense appeal. And, as with other forms of physical evidence, the recording of mental activity could be compelled in criminal cases and used against the accused by the prosecution.[118]

However, the reduction of mental activity to a mere physical artifact that can be compelled from an individual and used against her raises disturbing questions about where, if anywhere, the line between an overtly communicative act and the mental intent behind that act can be drawn. Fingerprints, blood alcohol levels, genetic information, and other forms of physical evidence are not under conscious control; they exist independent of nervous system activity and indeed can even be preserved after death, when all neural activity ceases. Not so with memories or other manifestations of neural activity (emotions, intents), the expression of

[118] Defendants in criminal cases in the past have contended that the use of other forms of physical evidence derived involuntarily from their bodies violated their Fifth Amendment-protected right against self-incrimination. Such arguments have been generally unsuccessful. *See, e.g.,* Schmerber v. California, 384 U.S. 757 (1966) (compelled blood sample did not violate Fifth Amendment protections); Vore v. U.S. Dept. of Justice, 281 F.Supp.2d 1129 (D. Ariz. 2003); United States v. Reynard, 220 F.Supp.2d 1142, 1174 (S.D. Cal. 2002) (genetic material compelled from suspects in bank robbery admissible and not violative of the Fifth Amendment).

which is under nervous system control itself and is indeed, of the same neurological nature. Certainly, "the thought is father to the act" if by "thought" we mean the physical neural activity that is the basis of conscious or subconscious intent that necessarily precedes the act itself. Without the mental intent to communicate, there can be no communicative behavior: the two are inextricably linked. If an individual chooses to communicate or testify, it is an expression of that person's intent to do so, and "intent" is a mental state with its basis, indeed its very essence, in the neural activity of the brain.[119] Similarly, an individual electing not to communicate, in response to an interrogation also has the requisite intentional state (again based in neural activity) to withhold that information. Communication and the intentionality underlying it would therefore seem to be inextricably intermingled and inseparable; without one there cannot be the other.

Thus, to use a device to discern the intentional state of an individual, or to seek to compulsorily mine the information that she is intentionally withholding may come perilously close to infringing the spirit of the constitutional privilege against self-incrimination. That privilege has its basis in the principle that the State cannot submerge the value of human dignity or moot its burden to provide accusatory evidence against the accused by its own labors by "the cruel, simple expedient of compelling it from his own mouth."[120] That privilege is only fulfilled when the person is guaranteed the right to "remain silent unless he chooses to speak in the unfettered exercise of his own will."[121] It seems contradictory to both the history and spirit of the Fifth Amendment, therefore, to permit the State to execute an end run around an individual's refusal to communicate by simply extracting that information held within his brain that he

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[119] By "intent" I mean, for the purposes of this article, the necessary activation of neural circuits necessary to accomplish a given act, regardless of whether that intent results in a "voluntary" or "involuntary" act. Such a definition is necessarily mechanistic.
[120] Miranda v. Arizona, 384 U.S. 436, 460 (1966).
[121] *Id.*

refuses to divulge. Just as the State cannot legitimately employ torture or physical duress against alleged criminals in order to extract information that the individual is withholding[122], it should perhaps not be permitted to extract that information neurologically, even if the individual undergoes little physical discomfort in the process.

B. The Fourth Amendment: Search and Seizure, Privacy, and the Brain.

The Fourth Amendment states in part that, "The Rights of the People to be secure in their *persons*, houses, papers, and effects, against unreasonable search searches and seizures shall not be violated, and no Warrants shall issue, but upon probable cause…." (emphasis added).[123] The Amendment thus "guarantees the privacy, dignity, and security of persons against certain arbitrary and invasive acts by officers of the government or those acting at their direction.[124] To what extant might evidence obtained as a result of the measure of mental activity be protected from search or seizure? And to what extent might the extraction of knowledge or memories be considered reasonable?

If the electrical activity that comprises mental processes is to be considered strictly as physical evidence, then recording the mental activity of an individual to determine the truthfulness of a statement that might be used as evidence would undoubtedly constitute a search. A "search" occurs when an expectation of privacy that society considers reasonable is infringed.[125] Persons have a reasonable expectation of privacy concerning their bodies; thus any

[122] The Eighth Amendment to the U.S. Constitution states that "… cruel and unusual punishments" shall not be inflicted. U.S. CONST. amend. V; Glidden Co. v. Zdanok, 370 U.S. 530, 601, (1962)
[123] U.S. CONST. amend. IV
[124] Skinner v. Railway Labor Executives' Assoc., 489 U.S. 602, 613 (1989).
[125] U.S. v. Jacobsen, 466 U.S. 109, 113 (1984)

bodily intrusion, such as tests to obtain blood or urine, undoubtedly constitutes a "search."[126] Indeed, the Supreme Court noted in *Schmerber*, that:

> [S]earch warrants are ordinarily required for searches of dwellings, and, absent an emergency, no less could be required where intrusions into the human body are concerned.... The importance of informed, detached and deliberate determinations of the issue whether or not to invade another's body in search of evidence of guilt is indisputable and great.[127]

Searches and seizures conducted by, or at the behest of, the government must be reasonable.[128] Whether a search or seizure is reasonable is a fact-specific determination.[129] The reasonability of a search is assessed by "balancing its intrusion on the individual's Fourth Amendment interests against its promotion of legitimate government interests."[130] In the absence of individualized suspicion of wrongdoing, a search or seizure is generally considered unreasonable.[131] Thus, the government would normally be prevented by the Fourth Amendment from compelling the examination of the mental activity of an individual without first having reasonable probable cause to suspect that the individual was guilty of wrongdoing.

The Court first considered whether searches of an individual's person that require a violation of bodily integrity violate the Fourth Amendment in *Schmerber*. In subsequent cases, the Court also recognized that such tests might involve not only pain or trauma to the subject, but also intrude upon the dignitary interests of the individual's personal privacy and bodily integrity.[132] The Court has therefore, since *Schmerber*, typically evoked a balancing test to determine whether or not the Fourth Amendment-protected interests of the individual against unreasonable search and seizures are outweighed by the reasonableness and degree of

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[126] Ferguson v. City of Charleston, 532 U.S. 67, 76 (2001)
[127]Schmerber v. California, 384 U.S. 757 770.
[128] City of Indianapolis v. Edmond, 531 U.S. 32, 45 (2000).
[129] United States v. Montoya de Hernandez 473 U.S. 531, 537 (1985).
[130] Skinner, 489 U.S. at 619.
[131] Edmond, 531 U.S. at 36.
[132] Winston v. Lee, 470 U.S. 753, 759 (1985).

intrusiveness of the governments test. The Court first looks to determine whether probable cause exists in a given case.[133] If probable cause exists, the balance between the extent of the intrusion upon the individual's privacy and the government's need for obtaining the evidence.[134]

The Supreme Court employed this test in *Winston v. Lee*.[135] In that case a suspect who was accused of robbing a store and wounding the proprietor was arrested some short distance from the store.[136] The individual was suffering from a gunshot wound to the chest, allegedly inflicted by the shopowner.[137] The accused recovered from his wound, but refused consent to surgery to remove the bullet, which the state wished to use as evidence.[138] The Commonwealth of Virginia then moved in state court for an order directing the individual to submit to surgery to remove the bullet.[139] After a number of proceedings in state and federal court, the Federal District Court enjoined the surgery as being too intrusive into the body of the accused.[140] The U.S. Court of Appeals for the Fourth Circuit affirmed, and Virginia then appealed to the Supreme Court, which granted certiorari.[141]

In its analysis, the Court balanced the nature of the intrusiveness of the surgery, both in terms of physical risk and dignitary rights against the State's interest in obtaining the bullet for evidence.[142] The surgery, which required general anesthesia, represented an "extensive" intrusion upon the accused's personal privacy and bodily integrity, involving "a virtually total divestment of respondent's ordinary control over surgical probing beneath his skin."[143] Against

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[133] Winston, 470 U.S. at 763.
[134] *Id.*
[135] *Id.* at 755.
[136] *Id.* at 756.
[137] *Id.*
[138] *Id.*
[139] *Id.*
[140] *Id.* at 757.
[141] *Id.* at 758.
[142] *Id.* at 760.
[143] *Id.* at 765.

that, the Court found that the State had amassed enough additional substantial evidence, including the shopkeeper's spontaneous identification of the accused.[144] The presence of additional substantial evidence in this case, therefore, did not outweigh the accused's rights of personal privacy and bodily integrity in this case, and the Court affirmed the District Court's injunction.[145]

A noninvasive procedure that measures electrical activity of the brain would not be likely to inflict any significant pain or trauma against which to balance the State's need for evidence. Most current procedures, such as electroencephalography or magnetic resonance imaging are not physically invasive (the integrity of the skin is not breached, nor are any orifices penetrated) and are not at all painful or stressful in their application. The privacy interest, however, is likely to be considered by the courts as very high. This would be true for an accused individual, but even more so for a witness not suspected of wrongdoing. One's own thoughts are one's most personal and private possessions, indeed, they constitute no less than who an individual is. Furthermore, we routinely guard our private thoughts in our daily lives. It is questionable, but by no means resolved, whether a test that would be so intrusive as to mine human thought or memory could ever be outweighed by a governmental interest in obtaining evidence.

If, however, mental activity is considered testimonial or communicative, rather than physical in nature as argued *supra*, an alternative approach to obtaining such evidence must be employed, and a subpoena, rather than a search warrant would be required in order to obtain such evidence. And although the protections of the Fifth Amendment might apply to a defendant seeking to avoid self-incrimination, a witness to a crime who was innocent of wrongdoing would be unable to invoke the protections of the Fifth Amendment. A refusal to submit might then

[144] *Id.*
[145] *Id.* at 766.

result in a charge of criminal contempt, as would be the case for a more conventionally subpoenaed individual.

However, if evidence of mental activity is to be considered testimonial, therefore, the strictures of the Fourth Amendment are inapplicable since searches, even of bodily evidence such as hair or blood, are searches for physical evidence. Thus, the Fifth Amendment protections against self-incrimination discussed above, rather than the Fourth Amendment's strictures preventing unreasonable search and seizure would be the appropriate frame of analytical reference, but might provide no protections for witnesses, who could possibly be compelled to submit by subpoena.

Conclusion

The concept of a "mind reading machine" capable of extracting and interpreting memories and knowledge is admittedly more science fiction than science fact at the present time. However, rapid advances continue to be made in the field of cognitive neuroscience, and investigators are developing new methods for recording and interpreting brain activity related to mental states, including recognition and deceptiveness. Brain Fingerprinting represents another method by which recorded knowledge resulting from measurements of neural activity may even now be on the verge of wider legal acceptance and admissibility, particularly in the more flexible post-*Daubert* era of evidentiary standards. But all such advances come with accompanying costs. The advent of new technologies that promise to allow investigators to "peer into" the minds and memories of alleged wrongdoers or even innocent witnesses poses grave constitutional questions concerning the rights of the individual to privacy and bodily integrity and protection against self-incrimination. Balanced against these advantages in determining the truth must be the legitimate interests of society and the legal system in determining the veracity of defendants and witnesses and, ultimately, achieving justice.

In a larger sense, such technologies might also undermine the foundations of the legal system in a more insidious manner. A principal function of juries is to assess the credibility of defendant and witness testimony and determine whether the testimony they give is truthful or not. If it is possible to determine, via technology, the truthfulness of an individual, the jury's truth finding function becomes merely a vestigial appendage of the law, its verdict echoing the testimony presented via technology.

Scientists and lawyers have chased the chimera of determining truth by studying the shape and activity of the brain for over two centuries. The results so far have been equivocal at best. However, modern advances in the neurosciences, and the consequent increase in accuracy and reliability of knowledge derived from those studies have paved the way for applications that have important legal consequences. Such advances also present such dramatic constitutional questions that must be approached with caution and circumspection before embracing fully the introduction of modern neuroscience technology into the courtrooms.