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Admissibility of fMRI Lie Detection

THE CULTURAL BIAS AGAINST “MIND READING” DEVICES

I. INTRODUCTION

In the last fifteen years, scientists have discovered a way to watch the brain think.¹ New functional magnetic resonance imaging (fMRI) technology can take pictures of a person’s brain at the very moment the person is engaged in a task.² An fMRI machine can generate images that vividly show which brain regions are at work while, say, answering a question or telling a story.³ Studies show that a person answering a question truthfully uses relatively few brain regions, typically those associated with memory.⁴ Telling a lie, however, seems to require many more brain regions, including those linked to calculation and cognitive control.⁵ Thus, by showing how much brain activity is taking place and where in the brain the activity is occurring, fMRI technology can reveal one’s cognitive tasks.⁶

¹ See Roberta Conlan, *A Life-Saving Window on the Mind and Body: The Development of Magnetic Resonance Imaging*, in NAT’L ACAD. OF SCI., BEYOND DISCOVERY: THE PATH FROM RESEARCH TO HUMAN BENEFIT (2001), <http://www.beyonddiscovery.org/content/view.page.asp?I=135> (“The breakthrough that led to functional MRI, fMRI as it is known, came in the early 1980s, when George Radda and colleagues at the University of Oxford, England, found that MRI could be used to register changes in the level of oxygen in the blood, which in turn could be used to track physiological activity.”); Columbia fMRI, *The Future Role of functional MRI in Medical Applications*, <http://www.fmri.org/fmri.htm> (last visited Mar. 21, 2007) (“The recent discovery that magnetic resonance imaging can be used to map changes in brain hemodynamics that correspond to mental operations extends traditional anatomical imaging to include maps of human brain function. . . . This new ability to directly observe brain function opens an array of new opportunities to advance our understanding of brain organization . . .”).

² Press Release, ACLU, ACLU Seeks Information About Government Use of Brain Scanners in Interrogations (June 28, 2006), <http://www.aclu.org/privacy/medical/26035prs20060628.html>.

³ *Id.*; Columbia fMRI, *supra* note 1.

⁴ Steve Silberman, *Don’t Even Think About Lying: How Brain Scans are Reinventing the Science of Lie Detection*, WIRED, Jan. 2006, at 142.

⁵ *Id.* See *infra* note 47.

⁶ Silberman, *supra* note 4, at 142.

At the moment, two rival companies, Cephos Corp.⁷ and No Lie MRI, Inc.,⁸ are competing for the new market in fMRI lie-detection technology.⁹ They hope to assist defendants who would voluntarily submit to the test in order to bolster claims of innocence.¹⁰ The companies “use similar techniques, but different software” to analyze the scans.¹¹ They both want to be the first to successfully use the technology at trial.¹² No court has passed judgment on the new test’s admissibility.¹³ However, while the science is still being tested,¹⁴ No Lie MRI administered the first commercial use of fMRI lie detection in December of last year.¹⁵ Cephos has not begun commercial

⁷ The company is headquartered in Pepperell, Massachusetts. See Cephos Corp., Contact, <http://www.cephoscorp.com/contact.htm> (last visited Apr. 10, 2007). Note that David Faigman, leading evidence scholar and author of the treatise *Modern Scientific Evidence: The Law and Science of Expert Testimony*, is a legal advisor to Cephos. See Cephos Corp., Legal Advisors, <http://www.cephoscorp.com/legal.htm> (last visited May 18, 2007).

⁸ Headquartered in San Diego, California. Vicki Haddock, *Lies Wide Open, Researchers Say Technology Can Show When and How a Lie is Created Inside the Brain*, S.F. CHRON., Aug. 6, 2006, at E1.

⁹ See Silberman, *supra* note 4, at 146. No Lie MRI currently claims “fifty prospective clients.” Haddock, *supra* note 8, at E1 (The prospective clients include, “wives who want to assure their husbands of their sexual fidelity, fathers fighting accusations of child molestation in child-custody disputes, and one California defendant the company won’t identify who faces the possibility of a death penalty unless he can convince a jury of his innocence.”). Cephos maintains that it receives “at least a call a week” from potential clients. Telephone Interview with Steven Laken, Founder and Chief Executive Officer of Cephos Corp., in Pepperell, Mass. (Oct. 27, 2006) [hereinafter Laken Transcript] (transcript at 5:13; on file with author).

¹⁰ See Laken Transcript, *supra* note 9, at 4:24-5:3 (discussing Cephos’ aims); Haddock *supra* note 8, at E1 (suggesting No Lie MRI’s aims). It is important to note that voluntary submission generally renders moot various constitutional challenges the technology may imply regarding illegal searches and self-incrimination. For a discussion of fMRI lie detection and the Fourth and Fifth Amendments, see, for example, Michael S. Pardo, *Neuroscience Evidence, Legal Culture, and Criminal Procedure*, 33 AM. J. CRIM. L. 301 (2006).

¹¹ Richard Willing, *MRI Tests Offer a Look at the Brains Behind the Lies*, USA TODAY, June 27, 2006, at 5A. See No Lie MRI, <http://www.noliemri.com> (last visited Mar. 30, 2007).

¹² See Laken Transcript, *supra* note 9, at 6:20-7:20, 9:20-24.

¹³ As of March 21, 2007, Lexis and Westlaw searches of “functional magnetic resonance imaging” and of “fMRI” reveal no state or federal case concerning lie detection. A handful of federal cases discuss fMRI at length in reference to proving detrimental effects of violent video games on children. *E.g.*, *Entm’t Software Ass’n v. Blagojevich*, 404 F. Supp. 2d 1051 (N.D. Ill. 2005). See also Silberman, *supra* note 4, at 150.

¹⁴ Silberman, *supra* note 4, at 150.

¹⁵ Phil McKenna, *Can a Brain Scan Prove You’re Telling the Truth?*, NEWSSCIENTIST.COM, Feb. 10, 2007, at 13, <http://www.newscientist.com/channel/opinion/mg19325904.600-can-a-brain-scan-prove-youre-telling-the-truth.html>. (A deli-owner, being sued by his insurance company after his building was consumed in a fire, was attempting to demonstrate that he did not set the fire.) There is no indication that an evidentiary hearing has taken place.

tests, insisting that further studies still need to be done to prove to the courts the technology's validity.¹⁶

The *New York Times*, in a recent article on the subject, put forward the common wisdom: Once this technology's proven accuracy reaches ninety to ninety-five percent, trial courts will admit it.¹⁷ This Note suggests that such an analysis fails to take into account one powerful factor: society's suspicion and fear of "mind reading" technologies. Beyond and beneath the established evidentiary hurdles, a cultural dislike of such technologies will further stiffen the admissibility requirements. United States District Judge for the Southern District of New York Jed Rakoff spoke this year at a panel discussing fMRI lie detectors.¹⁸ The title of his presentation betrays a lurking, individualized skepticism perhaps shared by other members of

¹⁶ Laken released a statement on the Cephos website during the same month as the No Lie MRI commercial launch. The statement reads in part:

Because of the power inherent in the ability to distinguish truth from deception and because of the potential of such technologies to create changes in social behavior, the team at CEPHOS believes that it is incumbent upon us to be particularly thorough before releasing any products to the commercial market. And we intend to ensure that we hold ourselves to the highest scientific standards by conducting reproducible experiments. We feel strongly that any entity offering commercial services in this field should limit their availability to those areas where peer-reviewed scientific data supports their use.

Press Release, Cephos Corp., Cephos' CEO speaks on Commercial Testing (Dec. 2006), http://www.cephoscorp.com/cephos_comm_testing_20061215%20v2.pdf [hereinafter CEO speaks]. Laken also states, "we are focused in the near-term on the national security marketplace, where fMRI technology has specialized applicability to unique and critical issues within the U.S. Government." *Id.* Cephos is currently doing a study funded by the Defense Department. Michael Arndt, *Scanning the Brain—For Lies*, BUS. WK., Nov. 7, 2005, at 123.

¹⁷ Jeffrey Rosen, *The Brain on the Stand: How Neuroscience is Transforming the Legal System*, N.Y. TIMES, Mar. 11, 2007, (Magazine), at 53 (cover story) ("Steven Laken, the president of Cephos, . . . says he hopes to reach the 90-percent- to 95-percent-accuracy range—which should be high enough to satisfy the Supreme Court's standards for the admission of scientific evidence. Judy Illes, director of Neuroethics at the Stanford Center for Biomedical Ethics, says, 'I would predict that within five years, we will have technology that is sufficiently reliable at getting at the binary question of whether someone is lying that it may be utilized in certain legal settings.'"). See Pardo, *supra* note 10, at 304-05 (stating that sufficient accuracy along with a proper understanding of the technology will lead to admittance). For discussion of Pardo's analysis, see *infra* text accompanying notes 343-50.

¹⁸ See Corydon Ireland, *Symposium: "Will Brain Imaging Be Lie Detector Test of the Future?"*, HARV. UNIV. GAZETTE, Feb. 8, 2007, available at <http://www.news.harvard.edu/gazette/2007/02.08/01-lying.html> (referencing Judge Rakoff's comments from a recent symposium at the American Academy of Arts and Sciences, entitled *Is There Science Underlying Truth Detection?*).

the judiciary: *Can Science Detect Lies? Not in My Court*.¹⁹ One need only examine the history of polygraph evidence to see that an important cultural prejudice against devices that betray the brain's private workings provides a further obstacle towards acceptance.²⁰ The bold courtroom aspirations of fMRI advocates will hinge on their ability to distinguish it from the polygraph and quell Orwellian fears, as much as it will on proving the technology's validity.

After the Supreme Court's decision in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* that reopened the door to polygraph admittance, even the most accurate of polygraph techniques (which are more accurate than many forms of admissible expert evidence)²¹ have been routinely rejected. While evidentiary law, attempts to steer clear of such cultural stigmas, the *Daubert* analysis, the Province of the Jury doctrine, and Rule 403 relevance analysis all are susceptible to such leanings. As a result, no matter how accurate the technology becomes, nor how meticulously a party briefs the relevant doctrines, the looming societal aversion toward "mind reading" machines may affect the judicial ruling.²²

There are a host of reasons why this technology ought to fare better in trial courts than its oft-excluded²³ predecessor, the polygraph. (In fact, the two companies are already trying to distinguish their analyses from the polygraph's.²⁴) The polygraph measures the physiological response to deception—

¹⁹ *Id.* Judge Rakoff went on to critique the methodology and claimed cross-examination is still the most useful tool to detect a lie. *Id.*

²⁰ Judge Rakoff compared fMRI technology to the polygraph during his critique. *Id.* See *infra* note 291.

²¹ See *infra* text accompanying note 185.

²² This is despite the willingness of the fMRI subjects.

²³ John C. Bush, Note, *Warping the Rules: How Some Courts Misapply Generic Evidentiary Rules To Exclude Polygraph Evidence*, 59 VAND. L. REV. 539, 542-52 (2006).

²⁴ See Silberman, *supra* note 4, at 146 (Steven Laken says, "The biggest challenge is that this is new to a lot of different groups of people. You have to get lawyers and district attorneys to understand this isn't a polygraph. I view it as no different than developing a diagnostic test."). No Lie MRI's website has an entire web page devoted to competing technologies. No Lie MRI, *Competing Technologies*, <http://www.noliemri.com/products/CompetingTechnologies.htm> (last visited Mar. 11, 2007). At the top of the page, the company states: "The classification of human deception by No Lie MRI . . . software is far superior to all other methods, including polygraphs . . ." *Id.* Cephos has a web page devoted exclusively to frequently asked questions regarding polygraphs, including a link to purchase a recent published national study criticizing polygraph tests. Cephos Corp., *Polygraph*, http://www.cephoscorp.com/polygraph_faq.htm (last visited Mar. 22, 2007).

the stress and nervousness that comes from lying.²⁵ The fMRI, however, watches the brain activity involved in executing the cognitive task that is deception; a task that, researchers allege, is more difficult to dissimulate.²⁶ The assumption is that even a trained counter-spy must use creativity and calculation to formulate a new lie, and the most nervous Nellie will use memory to recount an event in her past.²⁷ Moreover, as opposed to the squiggly-lined printouts of the polygraph, the fMRI process can be explained using clear, high-contrast images of the brain with the regions at work appearing in bright colors.²⁸ Furthermore, the fMRI appears less subject to examiner bias because the exam questions are presented visually on a screen and the analysis is performed using computer software.²⁹

Nevertheless, judges may well use the flexible evidentiary standard that the Supreme Court laid down in *Daubert*,³⁰ designed in part to embrace newer technology,³¹ to apply a stricter standard to the fMRI than it would to other scientific evidence. Critics already argue that *Daubert's* loose, non-exclusive list of factors, upon which trial courts determine the relevance and reliability of scientific evidence, permit

²⁵ Charles N.W. Keckler, *Cross-Examining The Brain: A Legal Analysis of Neural Imaging for Credibility Impeachment*, 57 HASTINGS L.J. 509, 543 (2006).

²⁶ See Press Release, Radiological Soc'y of N. Am., Who's the Liar? Brain Stands Up to Polygraph Test (Jan. 31, 2006), available at <http://www2.rsna.org/pr/target.cfm?ID=273> (quoting one researcher claiming that “[s]ince brain activation is arguably less susceptible to being controlled by an individual, our research will hopefully eliminate the shortcomings of the conventional polygraph test and produce a new method of objective lie detection that can be used reliably in a courtroom or other setting.”).

²⁷ See discussion *infra* Part II.B.

²⁸ Sample brain scan images can be found at the Cephos and No Lie MRI websites. Cephos Corp., Photographs, <http://www.cephoscorp.com/photos.htm> (last visited Mar. 11, 2007); No Lie MRI, Product Overview, <http://www.noliemri.com/products/Overview.htm> (last visited Mar. 11, 2007).

²⁹ See *infra* Part II.C.3.

³⁰ 509 U.S. 579, 592-95 (1993) (holding that trial judges should consider a list of non-exclusive factors in exercising gate-keeping function).

³¹ See *id.* at 589 (contrasting *Frye's* “austere standard” with the “liberal thrust” of the Federal Rules and their “general approach of relaxing the traditional barriers to “opinion” testimony.” (citing *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169 (1988))). See also *United States v. Kwong*, 69 F.3d 663, 668 (2d Cir. 1995) (“The Federal Rules of Evidence, although concededly more liberal than the *Frye* test, still require a determination that the proffered scientific evidence is both relevant and reliable.”); Edward J. Imwinkelried, *Expert Testimony by Ethicists: What Should be the Norm?*, 33 J.L. MED. & ETHICS 198, 205 (2005).

cultural phenomena to color the judges' decisions.³² If this is so, society's incredulity and trepidation of "mind reading" devices might further tip the evidentiary analysis towards exclusion.³³

This Note examines the various evidentiary aspects of the fMRI debate and how it diverges from the corresponding polygraph discussion and suggests that the tendency to associate fMRI tests with polygraphs, as well as other "mind reading" techniques, may be a more significant liability for fMRI admission than the law itself. Nevertheless, assuming future tests of fMRI technology continue to demonstrate accuracy in lie detection in both clinical trials and "real world" conditions, the test should be allowed into the nation's courtrooms.³⁴ Section II explains the fMRI technology used to detect deception and contrasts it with the traditional polygraph methods. Section III lays out an evidentiary analysis under Rules 702 and 403, as well as the Province of the Jury doctrine, demonstrating that, soon, a court may validly admit fMRI evidence. Finally, Section IV suggests that factors beyond the black-letter law, such as the stigma of the polygraph and the cultural wariness of "mind reading," may improperly influence a court's analysis of fMRI evidence. Thus, courts will have to contend with two hurdles, not one—the evidentiary doctrine and the cultural stigma. Failing to clearly parse these two factors will (1) lead to what appears to be a suspect evidentiary analysis and (2) leave these two companies unable to properly prepare for the inevitable courtroom battles in the numerous jurisdictions throughout the country.

II. TECHNOLOGY

Because fMRI technology is so readily associated with the polygraph, despite fundamental (and judicially relevant) distinctions, Section II seeks to compare and contrast the two processes. Part A will explain how fMRI technology works and discuss its current state of development given published

³² See, e.g., A. Leah Vickers, Daubert, *Critique and Interpretation: What Empirical Studies Tell Us About the Application of Daubert*, 40 U.S.F. L. REV. 109, 110 (2005).

³³ Devin Brennan, Book Note, *Carl F. Cranor's Toxic Torts: Science, Law, and the Possibility of Justice*, 30 HARV. ENVTL. L. REV. 565, 566 n.8 (2006) (Cranor "argues that, because of prejudicial tendencies in both science and legal procedure, much of the burden of scientific misunderstanding falls on plaintiffs in cases in which proof of liability depends upon scientific and expert testimony.").

³⁴ See *infra* Part III.

studies. Part B will provide a brief description of the polygraph. Finally, Part C will outline the key differences between the technologies to the extent they will affect an evidentiary analysis: Many of the various differences between fMRI technology and the polygraph should cause the fMRI exam to fare better under a proper *Daubert* and Province of the Jury analysis than the polygraph because the fMRI test (1) measures that which is more closely associated with deception, (2) promises increased accuracy, and (3) more computerized standards than the polygraph.

A. *How fMRI Technology Works*

1. Background on fMRI

A traditional magnetic resonance imaging device (MRI) can produce a detailed image of a person's brain.³⁵ The subject lies within a large machine that is composed primarily of a magnet "50,000 times more powerful than . . . the earth's magnetic field."³⁶ This magnet aligns the orientation of the hydrogen atoms in the brain³⁷ each of which acts like a miniscule compass.³⁸ The machine then sends out a "short pulse of radiofrequency energy" that disrupts the atoms' orientation.³⁹ Finally, as the atoms realign, they each "give off small amounts of energy," and the MRI machine can map the locations of each energy burst. The resolution of the resulting image "is less than 0.5 mm, about the size of the tip of a typical ballpoint pen."⁴⁰

An fMRI machine uses the same technology to take pictures of the brain during a specific cognitive process such as answering a question or looking at an image.⁴¹ The pictures

³⁵ Silberman, *supra* note 4, at 142.

³⁶ A. Parry & P.M. Matthews, *Functional Magnetic Resonance Imaging (fMRI): A "Window" into the Brain* (Ctr. for Functional Magnetic Resonance Imaging of the Brain, Dep't of Clinical Neurology, Univ. of Oxford, 2002), available at http://www.fmrib.ox.ac.uk/fmri_intro/fmri_intro.php.

³⁷ Approximately 70% of the brain is water, which is composed of hydrogen and oxygen. *Id.*

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ fMRI research is "focused on the investigation of the neurocircuitry of the brain that underlies cognition, perception and action." Joy Hirsch, *The Neurocircuitry of Mind: Functional Magnetic Resonance Imaging Investigations of Brain Structure and Function* (Columbia Univ. Ctr. for Neurobiology and Behavior), http://www.cumc.columbia.edu/dept/neurobeh/Hirsch_center.html (last visited Mar. 30,

reveal which brain regions are involved in a particular cognitive task by showing the newly oxygenated blood's location.⁴² The companies promoting fMRI lie detection assert that certain regions of the brain have been associated with various types of deception in a broad spectrum of people.⁴³ The underlying theory is that, when one is questioned, a normal cognitive reaction is to formulate a truthful answer.⁴⁴ Therefore, deception involves overriding, or thwarting, the impulse and then carrying out the deception.⁴⁵ Scientists disagree to an extent on precisely which brain regions are directly associated with lying,⁴⁶ but generally agree that there is more activity in the prefrontal lobe during a lie because this is where cognitive reasoning takes place.⁴⁷

2007). For now, lie-detection studies have reportedly focused on answering yes-or-no questions put to the subject via computer screen. Laken Transcript, *supra* note 9, at 19:19-20:22. It is not clear whether a person who is carefully choosing language to manipulate the truth will present similarly to one who is lying. Publications have not yet addressed this issue head on. *But see* G. Ganis et al., *Neural Correlates of Different Types of Deception: An fMRI Investigation*, 13 CEREBRAL CORTEX 830 (2003) (finding that memorized lies activate different regions than improvised lies but both involve similarly heightened brain activity). The binary (yes/no) questioning may limit this problem.

⁴² See Conlan, *supra* note 1.

⁴³ See, e.g., Laken Transcript, *supra* note 9, at 36:21-37:11.

⁴⁴ See Silberman, *supra* note 4, at 144.

⁴⁵ *Id.* at 145.

⁴⁶ Laken Transcript, *supra* note 9, at 36:21-37:11. According to Laken, the areas each group is focusing on overlap somewhat. *Id.*

⁴⁷ Haddock, *supra* note 8, at E1. A recent published study conducted by Daniel D. Langleben, the inventor of the technology used by No Lie MRI, see No Lie MRI, About Us, <http://www.noliemri.com/aboutUs/Overview.htm>, concluded that “[a]lthough lie and truth are mediated by a similar frontoparietal network, lie appears to be a more working memory-intensive activity, characterized by increased activation of the inferolateral cortex implicated in response selection, inhibition, and generation.” Daniel D. Langleben et al., *Telling Truth From Lie in Individual Subjects With Fast Event-Related fMRI*, 26 HUMAN BRAIN MAPPING 262, 271 (2005). Cephos’ research has isolated these five brain regions: “right anterior cingulate, right inferior frontal, right orbitofrontal, right middle frontal, and left middle temporal areas.” Frank Andrew Kozel et al., *A Replication Study of the Neural Correlates of Deception*, 118 BEHAVIORAL NEUROSCIENCE 852, 855 (2004) [hereinafter Kozel et al., *Neural Correlates of Deception*]. Previous studies have demonstrated that the right inferior and orbitofrontal cortex are associated with inhibiting responses and controlling emotions. *Id.* Note that to the limited extent the brain activity associated with lying relates to emotional responses, the fMRI suffers some of the same vulnerabilities as the polygraph, namely affects from general anxiety surrounding the test, countermeasures based on emotional control, and perhaps Province of the Jury attacks. See *infra* Part III.B.2. In addition, some “regions of the cingulate gyrus have been studied for their involvement in attention, concentration, and multitasking.” Kozel et al., *Neural Correlates of Deception*, *supra*, at 855.

Furthermore, because telling a lie involves more “conscious control” than telling the truth,⁴⁸ more areas of the brain are involved.⁴⁹ Cephus has focused on a set of brain regions and divided them up into roughly 700 small three-dimensional quadrants referred to as voxels.⁵⁰ A voxel is considered activated when there is newly-oxygenated blood present in that area and it meets a minimal statistical threshold.⁵¹ The more voxels that are activated in the larger brain region, the more involved the cognitive activity.⁵² Neutral questions establish the level of voxel activation during a truthful answer.⁵³ This number varies from individual to individual based on the person’s brain activation pattern.⁵⁴ Additional questions establish the subject’s voxel activation *during a lie*; studies show more voxel activation here.⁵⁵ The responses to the pertinent questions are then compared to these two levels.⁵⁶

One major study found that twice as many brain regions were activated during a deceptive response.⁵⁷ While seven areas were measured as having increased use while a person gave a truthful response, fourteen areas were at work during a lie.⁵⁸ Therefore, a jury will be able to consider not only whether a subject used a particular brain region associated with lying during a particular response, but the presumably more

⁴⁸ F. Andrew Kozel et al., *Detecting Deception Using Functional Magnetic Resonance Imaging*, 58 BIOLOGICAL PSYCHIATRY 605, 605 (2005) [hereinafter Kozel et al., *Detecting Deception*]. Note that the theory of additional conscious effort is the same principle offered to the court in *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923), concerning the polygraph. See *infra* note 82.

⁴⁹ Beth W. Orenstein, *Guilty? Investigating fMRI's Future as a Lie Detector*, RADIOLOGY TODAY, May 16, 2005, at 30.

⁵⁰ Laken Transcript, *supra* note 9, at 38:14-24. A voxel is approximately three cubic millimeters.

⁵¹ See *id.* at 2:18-23, 38:18-20.

⁵² *Id.* at 38:14-39:4.

⁵³ *Id.* at 40:10-12.

⁵⁴ *Id.* at 39:19-40:7. Factors for this include heart rate and innate hemodynamic response. See *infra* Part II.B.

⁵⁵ See, e.g., Feroze B. Mohamed et al., *Brain Mapping of Deception and Truth Telling About an Ecologically Valid Situation: Functional MR Imaging and Polygraph Investigation--Initial Experience*, 238 RADIOLOGY 679, 679 (2006).

⁵⁶ Laken Transcript, *supra* note 9, at 43:20-25. Laken raises the importance in maintaining transparency in the software algorithm used to interpret the voxel count.

⁵⁷ *Id.*

⁵⁸ *Id.*

apparent issue of whether the subject used significantly more brain regions.⁵⁹

Granted, even the technology's most ardent supporters acknowledge limitations to the fMRI's accuracy.⁶⁰ However, if the triers of fact can learn to use this technology the way they use other admitted scientific or forensic technologies, only inasmuch as it is pertinent in a particular case, the technology may be helpful⁶¹ without being unduly⁶² prejudicial.⁶³

2. State of the Field

The director of Neuroethics at the Stanford Center for Biomedical Ethics asserts "that within five years, we will have technology that is sufficiently reliable at getting at the binary question of whether someone is lying [such] that it may be utilized in certain legal settings."⁶⁴ Nevertheless, Cephos gets approximately "two to three" calls per week from people who want to be tested.⁶⁵ The company, however, is not yet sufficiently satisfied with its accuracy rate to begin operating commercially.⁶⁶ When the tests show a 90% accuracy rate in successfully detecting deception, the company says it will open for business.⁶⁷ Steven Laken, Cephos Founder and Chief Executive Officer, believes that a 90%-95% accuracy rate⁶⁸ will

⁵⁹ It is important to note that fMRI exams are only meant to detect an intentional act to con or deceive. Laken Transcript, *supra* note 9, at 22:25-23:1. The subject must know that he or she is lying, or else the decision-making and response inhibition that the test detects may not take place. *Id.* at 23:4-20. A person truly convinced of a proposition, regardless of its actual truth, is not lying and will likely appear on the brain scan to be telling the truth. *Id.* at 23:4-24.

Therefore, there are people with mental conditions associated with altered conceptions of reality that may confound the test. *Id.* at 4:21-24. In this regard, the fMRI and the polygraph appear similarly limited. No fMRI studies are purportedly being done on compulsive liars, schizophrenics, or the mentally retarded. *See id.*

⁶⁰ Laken Transcript, *supra* note 9, at 2:24-3:1.

⁶¹ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 591 (1993).

⁶² *See* FED. R. EVID. 403.

⁶³ *See* Laken Transcript, *supra* note 9, at 2:24-3:11.

⁶⁴ Rosen, *supra* note 17, at 53.

⁶⁵ *Id.* Harvard University Provost and Professor of Neurobiology at Harvard Medical School Steven Hyman premised the conference on the notion that "[t]here's an incredible hunger to have some test that separates truth from deception . . ." Ireland, *supra* note 18.

⁶⁶ Laken Transcript, *supra* note 9, at 5:16-6:21; CEO speaks, *supra* note 16.

⁶⁷ Laken Transcript, *supra* note 9, at 5:22-24.

⁶⁸ False positives and false negatives cannot be isolated yet. Until studies examine multiple aspects of the same event, an incorrect reading is both a false positive and a false negative. Telephone Interview with Steven Laken (Apr. 9, 2007).

surpass the abilities of available technologies⁶⁹ and warrant admissibility.⁷⁰ Since Cephos has not yet reached 90% accuracy,⁷¹ its primary focus is to test and refine its technology.⁷² No Lie MRI is more confident, having already begun accepting clients.⁷³

As Cephos strives to cement error rates so that the accuracy can be clearly expressed to the court,⁷⁴ it has limited its study population to people who are between the ages of eighteen and fifty, “fairly well educated,”⁷⁵ non-medicated, and not current users of illegal drugs.⁷⁶ Those with a past history of psychological problems have been excluded, and Cephos is not claiming the technology’s validity with psychopaths or pathological liars.⁷⁷ (Presumably, the science is more complicated for these anomalies.) Rather, the company is focusing on a prospective clientele of white-collar defendants and civil litigants who it expects to be most analogous to its test subjects.⁷⁸

B. *How Polygraph Technology Works*

In contrast to fMRI technology’s focus on brain activity, polygraphs measure a set of physiological reactions associated with deceptive behavior.⁷⁹ While the subject is being interviewed, the polygraph measures respiratory, electro-

⁶⁹ Rosen, *supra* note 17, at 53; Laken Transcript, *supra* note 9, at 5:22-6:13. The new competing technologies in the lie-detection market are EEG or ‘brain fingerprinting’ designed by Lawrence Farwell, see Barnaby J. Feder, *Truth and Justice, by the Blip of a Brainwave*, N.Y. TIMES, Oct. 9, 2001, at F3, and voice stress technology, see Douglas Heingartner, *It’s the Way You Say It, Truth Be Told*, N.Y. TIMES, Jul. 1, 2004, at G1.

⁷⁰ Laken Transcript, *supra* note 9, at 5:22-6:13.

⁷¹ *Id.* at 5:16-24.

⁷² Rosen, *supra* note 17, at 53.

⁷³ McKenna, *supra* note 15, at 13.

⁷⁴ Laken Transcript, *supra* note 9, at 3:7-11.

⁷⁵ *Id.* at 4:2-5 (stating most test subjects had completed a high school education).

⁷⁶ *Id.* at 3:14-4:16 (employing urine testing). Cephos uses people of various ethnicities, English and non-English speakers, and both full-time and part-time employees.

⁷⁷ *Id.* at 4:14-24.

⁷⁸ *Id.* at 4:24-5:8. If its first commercial use is an indication, No Lie MRI has also chosen to focus on civil litigants. Because this narrow set of cases is limited to voluntary subjects, privacy concerns associated with involuntary testing are not relevant.

⁷⁹ American Polygraph Association, Frequently Asked Questions, <http://www.polygraph.org/faq.cfm> (last visited Mar. 30, 2007).

dermal, and cardiovascular data.⁸⁰ The typical procedure tracks the subject's breathing rate (using rubber tubes wrapped around the chest), perspiration (by attaching metal sensors to the fingers or palms), and both heart rate and blood pressure (with an arm cuff).⁸¹ These factors measure added effort,⁸² stress, and nervousness, each of which tends to be present when a person lies.⁸³ The data charts are graphed and analyzed.⁸⁴ A polygraph examiner will typically ask questions for which the answers are known in order to establish a baseline reading of the physiological responses.⁸⁵ Then the examiner will compare these results to responses during more probing questions.⁸⁶ Because the exam is based on the subject's stress levels, the examiner's behavior may affect the results.⁸⁷ A polygraphist who is overly intimidated by, or particularly suspicious of the subject can engage in covert or overt methods to impact results.⁸⁸

To assess polygraph accuracy, one must look at both reliability and validity.⁸⁹ Reliability measures the technique's replicability.⁹⁰ That is to say, if several qualified polygraphists can test the same subject and get similar results, then the technique is reliable and may be evaluated for validity.⁹¹ Of the several different questioning methods, two of the principal techniques are generally considered very reliable.⁹²

⁸⁰ *Id.*

⁸¹ *Id.*

⁸² *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923) (“[T]he theory seems to be that truth is spontaneous, and comes without conscious effort, while the utterance of a falsehood requires a conscious effort, which is reflected in the blood pressure.”).

⁸³ Michael J. Ligons, Comment, *Polygraph Evidence: Where Are We Now?*, 65 MO. L. REV. 209, 209 (2000).

⁸⁴ American Polygraph Association, *supra* note 79.

⁸⁵ Paul C. Giannelli, *Polygraph Evidence: Post-Daubert*, 49 HASTINGS L.J. 895, 905 (1998) (“The examiner's role cannot be overstated, because it is the examiner who decides whether there is sufficient indication of deception.”).

⁸⁶ For a discussion of the various questioning techniques, see 4 DAVID L. FAIGMAN ET AL., MODERN SCIENTIFIC EVIDENCE §§ 40:25-28 (2005-06).

⁸⁷ Dan Eggen & Shankar Vedantam, *Polygraph Results Often in Question: CIA, FBI Defend Test's Use in Probes*, WASH. POST, May 1, 2006, at A1.

⁸⁸ *Id.*

⁸⁹ 4 FAIGMAN ET AL., *supra* note 86, § 40:25.

⁹⁰ *Id.*

⁹¹ *Id.* (“Reliability and validity are related in that reliability is necessary, but is not sufficient for validity.”).

⁹² *Id.* (The Control Question Test and the Guilty Knowledge Test both exhibit near perfect replicability.).

To determine validity, on the other hand, researchers are forced to look at clinical studies that present a tightly controlled environment with confirmable results, as well as field studies in which important real-life motivations and complexities exist. Verifying accuracy is more treacherous in field studies, however, because there are rarely reliable ways to determine whether the subject has lied.⁹³ Since validity varies significantly depending on the questioning method, the quality of the study, and whether it was clinical or in the field, polygraph results are complex and controversial.⁹⁴ The highest-quality studies of the most successful questioning-method have yielded average accuracy rates of 91% in laboratory tests and 90.5% in field studies.⁹⁵ The other commonly used questioning techniques had far lower accuracy rates.⁹⁶ One court wrote:

[S]ome studies indicate [that] the potential error rate is, at best, unknown. Eleven studies of polygraph evidence showed a wide range of accuracy rates—from 48% to 90%—with an average rate of 71%. Two critics have maintained the Control Question Test approach is little better than “the toss of a coin.”⁹⁷

Furthermore, the National Research Council undertook an extensive study of polygraphs by looking at effectiveness in legal proceedings and employment contexts.⁹⁸ The study determined that polygraph “evidence [was] scanty and scientifically weak” in part because “[t]he physiological responses measured by the polygraph are not uniquely related to deception.”⁹⁹ Therefore, inaccurate polygraph techniques, susceptibility to examiner error, and doubts regarding a link between physiology and deception have stigmatized polygraph technology.

⁹³ *Id.* It is difficult to establish if a prisoner is in fact lying about the alleged crime, for example.

⁹⁴ *Id.*

⁹⁵ 4 FAIGMAN ET AL., *supra* note 86, §§ 40:26, :30 (results of the Control Question Test).

⁹⁶ *Id.* §§ 40:27-28.

⁹⁷ *United States v. Cordoba*, 991 F. Supp. 1199, 1203 (C.D. Cal. 1998) (quoting W. Iacono & D. Lykken, *The Scientific Status of Research on Polygraph Techniques: The Case Against Polygraph Tests*, in 1 MODERN SCIENTIFIC EVIDENCE § 14-3 (D. Faigman et al. eds., 1997)).

⁹⁸ NAT'L RES. COUNCIL, BD. ON BEHAVIORAL, COGNITIVE, AND SENSORY SCIENCES AND COMM. ON NAT'L STAT., *THE POLYGRAPH AND LIE DETECTION* 212 (2003).

⁹⁹ *Id.*

C. *Key Distinctions Between fMRI Lie Detection and Polygraphs*

The fMRI technology should fare better under *Daubert* than the polygraph due primarily to the fMRI test's focus on cognition, increased accuracy, and more extensive computerization.

1. The Cognitive/Emotional Distinction

Scientists maintain that fMRI technology examines the primary cognitive process, not a secondary emotional response, and should thus prove better against countermeasures than the polygraph.¹⁰⁰ It is common lore that polygraphs can be beat.¹⁰¹ Subjects have used counter-measures, such as sedatives, to dampen their autonomic responses and stressors, such as flexing muscle or placing tacks in a shoe, to artificially inflate or create stress reactions.¹⁰² Presumably, the same techniques would not work to fool the fMRI because the fMRI scan is analyzing cognitive tasks associated with answering a question that take place regardless of stress levels.¹⁰³

However, many fMRI studies are being done in other fields to examine the extent to which people can alter which neural pathways they use. Scientists studying pain control have found they were able to train test subjects to “learn to control activation in the rostral anterior cingulate cortex . . . , a region putatively involved in pain perception and regulation.”¹⁰⁴ Another study measured the extent to which paralyzed people using a “Brain Computer Interface” could be trained to regulate activity in specific brain regions so as to communicate with an external device.¹⁰⁵ Recently, German scientists found

¹⁰⁰ Silberman, *supra* note 4, at 144.

¹⁰¹ The CIA agent Aldrich Ames passed several polygraph tests despite being a Russian spy. *Id.*

¹⁰² American Psychological Association, *The Truth About Lie Detectors*, PSYCHOL. MATTERS, Aug. 5, 2004, <http://www.psychologymatters.org/polygraphs.html>; Susan McCarthy, *Passing the Polygraph*, SALON, Mar. 2, 2000, http://archive.salon.com/health/feature/2000/03/02/lie_detection/index.html.

¹⁰³ Silberman, *supra* note 4, at 144.

¹⁰⁴ R. Christopher deCharms et al., *Control over Brain Activation and Pain Learned by Using Real-Time Functional MRI*, 102 PROCEEDINGS OF THE NAT'L ACAD. OF SCI. IN THE U.S. (PNAS) 18626, 18626 (Dec. 20, 2005).

¹⁰⁵ Thilo Hinterberger et al., *Neural Mechanisms Underlying Control of a Brain-Computer-Interface*, 21 EUR. J. NEUROSCIENCE 3169, 3169 (2005) (“The data support the assumption that human subjects learn the regulation of cortical excitation

that healthy subjects could be taught relatively quickly to self-regulate their responsive brain oxygen level changes in certain areas of the brain.¹⁰⁶ While the study was aimed at helping patients suffering paralysis or on respirators, the results indicate that regional brain activation is trainable.¹⁰⁷ If so, perhaps one could train to lie without employing brain areas typically associated with deception.

Nevertheless, amateur countermeasures by “normal” individuals have been shown preliminarily to be ineffective and subjects with anomalous behavior patterns (those who get nervous easily or those who are having an unrelated emotional response) presumably would not cause incorrect readings.¹⁰⁸ Thus the fMRI test’s cognitive focus promises to be more reliable than the polygraph’s physiological emphasis.¹⁰⁹

2. Accuracy of fMRI

In theory, the fMRI will be far more accurate than the polygraph because it homes in on the source of the lie rather than the outward manifestations of the lie.¹¹⁰ In practice, though, indications of this accuracy are only in early stages.

thresholds of large neuronal assemblies as a prerequisite for direct brain communication.”).

¹⁰⁶ N. Birbaumer & R. Sitaram, *BCI-Regulation of Neuronal Substrates of Emotions*, 43 *PSYCHOPHYSIOLOGY* S20, S23-S24 (July 2006).

¹⁰⁷ *Id.*

¹⁰⁸ “Researchers believe that fMRI should be tougher to outwit because it detects something much harder to suppress: neurological evidence of the decision to lie.” Silberman, *supra* note 4, at 144. *See also* Laken Transcript, *supra* note 9, at 21:9-22:13 (claiming perfect accuracy against amateur countermeasures such as holding breath, delaying pressing a button, and visual imagery). Some scientists, in unrelated lie-detection studies, have examined timing of responses as indicative of deception. *See, e.g.*, Paul Ekman & Maureen O’Sullivan, *From Flawed Self-Assessment to Blatant Whoppers: The Utility of Voluntary and Involuntary Behavior in Detecting Deception*, 24 *BEHAV. SCI. & L.* 673 (2006). As stated above, no claims are being made that this test will be effective for those suffering from neurological disorders. *See supra* text accompanying notes 77-78.

¹⁰⁹ Robert P. Mosteller, *Commentary, Evidence History, the New Trace Evidence, and Rumblings in the Future of Proof*, 3 *OHIO ST. J. CRIM. L.* 523, 538 (2006). There are suggestions that the increased brain activity is in part due to the emotional component of deception since some of the brain regions that the companies are monitoring have been associated with emotional states. Kozel et al., *Detecting Deception*, *supra* note 48, at 605.

¹¹⁰ Mosteller, *supra* note 109, at 538 (“Conceptually, this new technology promises to advance lie detection greatly beyond the effectiveness of today’s polygraph. . . . I do not know that we will ever achieve a technology that reliably determines deception. Functional MRI may in the end prove no better than earlier lie-detection technologies, but it has a potential to move the process of determining deception forward even if it does not itself reach proficiency.”).

The CEO of No Lie MRI boasts 90% accuracy,¹¹¹ which would make the fMRI more accurate than many polygraph tests.¹¹² However, there are only a handful of fMRI lie-detection studies and many of them tested only a small number of subjects.¹¹³ One recent study yielded a 92% accuracy rate for detecting those who had lied and 70% for those who had told the truth.¹¹⁴ However, there were only eleven subjects.¹¹⁵ In a twenty-two person study, the test accurately evaluated 99% of responses.¹¹⁶

The largest published study to date appeared in the scientific, peer reviewed journal *Biological Psychiatry* and was done by the scientists working in collaboration with Cephos.¹¹⁷ Sixty-one participants each took part in a mock-crime, stealing either a ring or a watch.¹¹⁸ Then, the participants each submitted to an fMRI exam in which they were asked whether they had stolen the ring and whether they had stolen the watch.¹¹⁹ They were instructed to deny stealing any object, thus telling one lie and one truth.¹²⁰ The subjects were promised financial awards for being able to deceive the machine.¹²¹ According to the authors of the study, this was the first time that fMRI lie-detection results were analyzed by researchers who were unaware of which subjects were in fact lying.¹²² The researchers were able to differentiate the lies from the truth, thereby accurately determining the item “stolen” in

¹¹¹ Haddock, *supra* note 8, at E1.

¹¹² See *Brain Scans May Beat Polygraphs at Lie Detection*, FORBES.COM, Jan. 31, 2006, <http://www.forbes.com/lifestyle/health/feeds/hscout/2006/01/31/hscout530651.html>; Press Release, Medical University of Southern California, Scientists: fMRI Can Detect Deception with 90% Accuracy (Sept. 26, 2005), *available at* <http://www.musc.edu/pr/cephos.htm>; Haddock, *supra* note 8, at E1.

¹¹³ Haddock, *supra* note 8, at E1.

¹¹⁴ Mohamed et al., *supra* note 55, at 679.

¹¹⁵ *Id.*

¹¹⁶ C. Davatzikos et al., *Classifying Spatial Patterns of Brain Activity with Machine Learning Methods: Application to Lie Detection*, 28 *NEUROIMAGE* 663 (2005). However, predictive accuracy was determined to be 88%. *Id.* See also Daniel Langleben et al., *Telling Truth from Lie in Individual Subjects With Fast Event-Related fMRI*, 26 *HUMAN BRAIN MAPPING* 262 (2005).

¹¹⁷ Kozel et al., *Detecting Deception*, *supra* note 48, at 605.

¹¹⁸ *Id.* at 605-06.

¹¹⁹ *Id.* at 605.

¹²⁰ *Id.* at 605-06.

¹²¹ *Id.* at 606.

¹²² Cephos Corp., fMRI & Deception, http://www.cephoscorp.com/fmri_deception.htm (last visited Mar. 30, 2007). This would ensure that those who analyzed the results would have no other information about the examinee other than the brain scan. See Laken Transcript, *supra* note 9, at 14:24-25:15.

90% to 93% of the subjects.¹²³ The errors were not related to the countermeasures some subjects employed to fool the machine.¹²⁴ Larger studies are underway, especially by those commercially vested in the outcome,¹²⁵ but it will be some time before these future studies can be confirmed or replicated by more neutral parties.

A recent symposium on fMRI lie detection at the American Academy of Arts and Sciences, co-sponsored by Harvard University and the McGovern Institute for Brain Research at the Massachusetts Institute of Technology, elicited opinions from three experts on the technology's current accuracy.¹²⁶ The three tended "to agree that the fMRI shows promise as a lie detector, but that current research is not enough to support using it now."¹²⁷

Furthermore, fMRI tests face many of the same challenges that have plagued polygraph validity studies: It is difficult to replicate real-life motivations and complexities in the lab and on volunteers; and it is difficult in the field to distinguish an actual lie from a truth.¹²⁸ Firstly, those who volunteer for studies on university campuses are a different demographic than the average criminal.¹²⁹ Secondly, the subjects are screened and those who use illegal drugs or show signs of mental illness or medical complications may not participate.¹³⁰ Thirdly, in the lab, the subjects are asked about recent, straightforward,¹³¹ relatively non-stigmatized events in a neutral setting. Additionally, the laboratory subjects are not under the kind of stress that is characteristic of one who is falsely accused. Finally, the motivation of winning a small cash award to fool the machine is quite different from that of

¹²³ Kozel et al., *Detecting Deception*, *supra* note 48, at 605.

¹²⁴ Laken Transcript, *supra* note 9, at 21:9-22:13.

¹²⁵ *See, e.g., id.* at 19:24-20:2. Frank Andrew Kozel is a scientific advisor for Cephos, *see* Cephos Corp., Scientific Advisors, <http://www.cephoscorp.com/scientific.htm> (last visited Apr. 1, 2007), and Christos Davatzikos is on the scientific board of No Lie MRI, *see* No Lie MRI, <http://www.noliemri.com/aboutUs/ScienceBoard.htm> (last visited Apr. 1, 2007). Both men are responsible for a significant portion of the current research on fMRI lie detection. *See infra* note 233.

¹²⁶ Ireland, *supra* note 18.

¹²⁷ *Id.* (expressing concern over the clinical studies inability to replicate real-world emotional stakes and lack of testing regarding countermeasures such as mental imagery).

¹²⁸ *See* 4 FAIGMAN ET AL., *supra* note 86, § 40:25.

¹²⁹ Haddock, *supra* note 8, at E1.

¹³⁰ Laken Transcript, *supra* note 9, at 4:9-16.

¹³¹ It is clear that one either took the watch or the ring. There is little room for differing interpretations or viewpoints.

avoiding a significant penal consequence.¹³² However, the CEO of Cephos and the *Biological Psychiatry* study's co-author, claims to recognize various limitations.¹³³ For now, Cephos looks to work with primarily white-collar criminals and civil litigants who typically face less serious consequences than, say, violent criminals and suffer from fewer behavioral and mental conditions.¹³⁴ In the study's conclusion, he notes: "Further work is required to determine how well this technology will work in different settings or populations."¹³⁵

3. Increased Computerization

To a considerable degree, a computer administers and analyzes the fMRI such that the same properly developed and tested software can be used to test each new subject.¹³⁶ In fact, Laken suggests that once the exam begins, there is typically no interaction between the subject and another person.¹³⁷ The computer presents the question on a screen inside the MRI chamber, receives the answer from a modified keyboard controlled by the subject, randomly selects the next question, and, at the completion of the exam, processes the results.¹³⁸ The MRI takes multiple "snapshots" of the brain during the presentation of each question.¹³⁹ The question order is essentially random, thus Cephos' exam does not change as a result of previous answers.¹⁴⁰

The polygraph, however, has shown to be affected substantially by human examiners.¹⁴¹ One scholar writes:

The examiner's expertise is critical in (1) determining the suitability of the subject for testing, (2) formulating proper test questions, (3) establishing the necessary rapport with the subject, (4) detecting attempts to mask or create chart reactions, or other

¹³² Haddock, *supra* note 8, at E1.

¹³³ Laken Transcript, *supra* note 9, at 2:24-3:5 ("Clearly, unlike DNA evidence, this technology is not going to be 100% accurate. There will be limitations to its accuracy. And, as such, what will obviously need to happen is the triers will have to figure out . . . how to use this evidence just like any other type of evidence . . . presented in a courtroom.").

¹³⁴ *Id.* at 4:24-5:8.

¹³⁵ Kozel et al., *Detecting Deception*, *supra* note 48, at 605.

¹³⁶ See Willing, *supra* note 11, at 5A.

¹³⁷ See Laken Transcript, *supra* note 9, at 14:19-23, 48:5-9.

¹³⁸ Both the polygraph and the fMRI questions are written by a human being.

¹³⁹ See Ireland, *supra* note 18.

¹⁴⁰ Laken Transcript, *supra* note 9, at 21:5-7.

¹⁴¹ Eggen & Vedantam, *supra* note 87, at A1.

countermeasures, (5) stimulating the subject to react, and (6) interpreting the charts.¹⁴²

One might argue that the examiner's question order may affect the subject's reaction. Psychologist William Iacono, suggested that bias can present a problem with polygraphers: Organizations that routinely test employees with the polygraph find very few senior employees fail the test.¹⁴³ Meanwhile 30-40% of lower-level employees fail.¹⁴⁴ Iacono suggests that powerful subjects may intimidate polygraph examiners.¹⁴⁵ "The director of the CIA just took a test,' said Iacono. 'How would you like to be the examiner who gave him a test and say he failed? What kind of a career would you have?'"¹⁴⁶

Techniques such as numeric and computerized scoring have been developed to eliminate polygraph examiner error and variation.¹⁴⁷ However, numeric scoring's zero-to-three system appears crude compared to the fMRI method.¹⁴⁸ In addition, computer scoring is relatively new and analyzed "input [still] depends on the examiner's ability, a subjective" factor.¹⁴⁹

Given these differences between polygraph and fMRI technology, the few courts that have begun to welcome polygraphs should also admit fMRI evidence. But more importantly, even courts that regularly reject polygraphs will have to independently examine fMRI evidence.

¹⁴² Giannelli, *Polygraph Evidence*, *supra* note 85, at 905. *See infra* note 184.

¹⁴³ Eggen & Vedantam, *supra* note 87, at A1.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*

¹⁴⁶ *Id.* There is also the related "friendly polygrapher issue." Giannelli, *Polygraph Evidence*, *supra* note 85, at 915 ("[A] polygraph examination privately conducted by the defense may not be reliable because the fear of detection is not sufficiently realistic.").

¹⁴⁷ Giannelli, *Polygraph Evidence*, *supra* note 85, at 909-10. Furthermore, federally administered polygraph results are usually "independently reviewed by senior examiners." *Id.* at 910.

¹⁴⁸ *Id.* at 909-10 ("The subject's behavioral reactions are not considered, only the recorded chart reactions. There are several different scoring systems. The [Department of Defense] Polygraph Institute and the University of Utah have developed similar systems. . . . The scores range from 3 for a dramatic reaction to a control question to -3 for the same type of reaction to a relevant question. Noticeable but smaller reactions are scored 1 or -1. A lack of a significant reaction is scored 0. Total scores of 6 or higher indicate truthfulness, while -6 or lower indicate deception. Scores that fall in between are considered inconclusive. The primary advantage of the numerical approach is that it 'helps to ensure a rigorous, semi-objective evaluation of the physiological information contained in the charts.' Numerical scoring reduces, but does not eliminate, subjectivity." (footnotes omitted)).

¹⁴⁹ *Id.* at 909-10, 922.

III. WHY FMRI SHOULD BE ADMITTED BASED ON THE EVIDENTIARY DOCTRINE

A. *The Daubert Analysis*

1. Basic Doctrine

Until recently, polygraphs were generally inadmissible at trial.¹⁵⁰ In 1923, the United States Court of Appeals for the District of Columbia, in *Frye v. United States*, determined that any scientific theory that was not sufficiently accepted in the scientific community should not be admissible in court.¹⁵¹ Because this landmark case on scientific evidence centered on polygraph evidence and the Court determined that the technique did not meet this standard, the polygraph test was dealt a serious blow from which it has never recovered.¹⁵² Even though the Court made clear that the polygraph was not admissible because it was not “sufficiently established to have gained general acceptance,”¹⁵³ and not because of an inherent flaw in the science, little re-examination was done over the years to determine whether the level of acceptance had improved.¹⁵⁴

The United States Supreme Court’s decision in *Daubert v. Merrell Dow Pharmaceuticals*,¹⁵⁵ however, changed the landscape of scientific evidence admissibility that in turn affected the polygraph analysis.¹⁵⁶ The Court held that “the *Frye* test was superseded by the adoption of the Federal Rules of Evidence,”¹⁵⁷ and that Rule 702 now governs expert evidence without reference to *Frye*’s “general acceptance” doctrine.¹⁵⁸ The Court also pointed to the Federal Rules’ pervasive “liberal thrust [in] . . . relaxing the traditional barriers to opinion testimony.”¹⁵⁹ From these two indications, the Court

¹⁵⁰ *United States v. Scheffer*, 523 U.S. 303, 311 n.7 (1998). *See also* *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923); 4 FAIGMAN ET AL., *supra* note 86, § 40:1; Giannelli, *Polygraph Evidence*, *supra* note 85, at 900-01.

¹⁵¹ 293 F. at 1014.

¹⁵² Jodi Meyers, Lee v. Martinez: *Does Polygraph Evidence Really Satisfy Daubert?*, 46 JURIMETRICS J. 391, 393-94 (2006).

¹⁵³ *Frye*, 293 F. at 1014.

¹⁵⁴ Meyers, *supra* note 152, at 393.

¹⁵⁵ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993).

¹⁵⁶ Meyers, *supra* note 152, at 393-94.

¹⁵⁷ *Daubert*, 509 U.S. at 587.

¹⁵⁸ *Id.* at 588.

¹⁵⁹ *Id.* (quoting *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169 (1988)).

concluded, “[t]hat [*Frye*’s] austere standard, absent from, and incompatible with, the Federal Rules of Evidence, should not be applied in federal trials.”¹⁶⁰

The Court, however, also interpreted Rule 702 to provide trial judges with a significant gate-keeping function: “[T]he trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant but reliable.”¹⁶¹ Before discussing the *Frye* test, the Court discussed the definition of scientific knowledge:

The adjective “scientific” implies a grounding in the methods and procedures of science. Similarly, the word “knowledge” connotes more than subjective belief or unsupported speculation. The term “applies to any body of known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds.”¹⁶²

The Court went on to acknowledge that assertions of a scientific theory need not be “‘known’ to a certainty” because “arguably, there are no certainties in science.”¹⁶³ However, testimony must “be derived by the scientific method . . . [and] supported by appropriate validation.”¹⁶⁴

The Court did not entirely turn its back on *Frye*. Rather, it held that a trial judge may look at the theory’s general acceptance as one of many factors in determining whether to admit testimony based on a scientific theory or technique.¹⁶⁵ These other factors include but are not limited to: whether the theory or technique can be tested, whether it “has been subjected to peer review and publication,” “the known or potential rate of error,” and “the existence and maintenance of standards controlling.”¹⁶⁶ Rule 702 was modified after *Daubert*

¹⁶⁰ *Id.* at 589.

¹⁶¹ *Id.*

¹⁶² *Id.* at 590 (citing WEBSTER’S THIRD NEW INT’L DICTIONARY 1252 (1986)).

¹⁶³ *Daubert*, 509 U.S. at 590.

¹⁶⁴ *Id.* (“In short, the requirement that an expert’s testimony pertain to ‘scientific knowledge’ establishes a standard of evidentiary reliability.”).

¹⁶⁵ *Id.* at 594.

¹⁶⁶ *Id.* at 593-94. Other factors trial judges have considered include:

- (1) Whether experts . . . have developed their opinions expressly for purposes of testifying [in the case]. . .
- (2) Whether the expert has unjustifiably extrapolated from an accepted premise to an unfounded conclusion. . .
- (3) Whether the expert has adequately accounted for obvious alternative explanations. . .
- (4) Whether the expert is being as careful as he would be in his regular professional work outside his paid litigation consulting.

to codify the trial judge's new gate keeping function.¹⁶⁷ Under the federal rule, the judge may exclude testimony that is not "the product of reliable principles and methods."¹⁶⁸ Under Rule 702, the court has considerable discretion¹⁶⁹ in its rationale for deciding that expert testimony is reliable and relevant to the matter at issue.¹⁷⁰ Furthermore, during discussion of Rule 403 which requires a court to exclude evidence when its prejudicial effect substantially outweighs its probative value, the Court warned: "Expert evidence can be both powerful and quite misleading because of the difficulty in evaluating it. Because of this risk, the judge in weighing possible prejudice against probative force under Rule 403 . . . exercises more control over experts than over lay witnesses."¹⁷¹

The trial courts, however, have so embraced the gate-keeping function that the liberalizing aspirations¹⁷² of the *Daubert* opinion have been thwarted.¹⁷³ Since *Daubert*, more parties have sought exclusion of scientific evidence and more have succeeded.¹⁷⁴ In addition, judges have been examining scientific evidence more rigorously and excluding a larger percentage of it.¹⁷⁵ At least one study shows that making general acceptance merely one of several factors failed to lessen this criterion as a bar to admissibility.¹⁷⁶ Perhaps the additional factors merely increased grounds upon which judges might exclude evidence, because if a piece of evidence appeared

¹⁶⁷ FED. R. EVID. 702 (amended in 2000).

¹⁶⁸ *Id.* The Court may still exclude testimony in which the testimony is not "based upon sufficient facts or data," or if "the witness has [poorly] applied the principles and methods to the facts of the case." *Id.*

¹⁶⁹ *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 152 (1999) (holding that the "trial judge must have considerable leeway in deciding in a particular case how to go about determining whether particular expert testimony is reliable").

¹⁷⁰ *Daubert*, 509 U.S. at 597.

¹⁷¹ *Id.* at 595 (citing 138 F.R.D. 631, 632 (S.D. Ga. 1991)).

¹⁷² See Paul C. Giannelli, *Ake v. Oklahoma: The Right to Expert Assistance in a Post-Daubert, Post-DNA World*, 89 CORNELL L. REV. 1305, 1316 (2004).

¹⁷³ Vickers, *supra* note 32, at 110. ("*Daubert*, as applied by judges, has heightened the bar for admissibility and, accordingly, reduced the proportion of evidence deemed admissible.>").

¹⁷⁴ *Id.* at 109-10. A 2001 RAND Corporation study concluded that twenty percent more evidentiary challenges were successful in the years after *Daubert* than prior to the decision. 1 FAIGMAN ET AL., *supra* note 86, § 1:34.

¹⁷⁵ Christina L. Studebaker et al., *Judge and Attorney Experiences, Practices, and Concerns Regarding Expert Testimony in Federal Civil Trials*, 8 PSYCHOL. PUB. POL'Y & L. 309, 330 (2002).

¹⁷⁶ Press Release, RAND Corporation, Federal District Judges are Screening Expert Evidence More Strictly (Nov. 29, 2001), <http://www.rand.org/news/Press/expert.html>.

to be weak under *any* factor, a judge could justify exclusion.¹⁷⁷ Academics have also pushed courts “to re-evaluate existing presumptions about expert admissibility.”¹⁷⁸ Regarding polygraphs, one scholar argues, “growing evidence indicates that the proffered expert testimony is reliable, and *Daubert* has given courts the opportunity[,] if not the duty,” to broach the issue anew.¹⁷⁹

In the wake of *Daubert*, the courts were again “forced to address polygraph evidence.”¹⁸⁰ If the courts are free to consider the polygraph’s other attributes, perhaps motivated counsel could take on the court’s seemingly forgone conclusion that the test was not generally accepted in the scientific community. Furthermore, counsel may also have judged that the watershed case and the more open-ended language within it might permit a re-tooled argument for the polygraph’s recent general acceptance.

Nearly half of the circuit courts have re-evaluated polygraphs after *Daubert*.¹⁸¹ In *United States v. Posado*,¹⁸² the Fifth Circuit considered the *Daubert* factors and held open the possibility that the polygraph could satisfy Rule 702 in some circumstances, although it did not in the case before it. The court first noted that the polygraph test had grown more sophisticated since *Frye*, now with “modern instrumentation” measuring more than just blood pressure.¹⁸³ The court asserted that the error rate was measurable and attributable to a

¹⁷⁷ Vickers, *supra* note 32, at 120-21 (Using “multi-factored tests . . . is too flexible and leaves too much discretion in the [judge’s] hands. . . . Its application is likely to produce inconsistent, arbitrary, and unpredictable results.”).

¹⁷⁸ Ric Simmons, *Conquering the Province of the Jury: Expert Testimony and the Professionalization of Fact-Finding*, 74 U. CIN. L. REV. 1013, 1046 (2006).

¹⁷⁹ *Id.* See Ronald L. Carlson, *Navigating the Nuances of Modern Expert Witness Law: How to Teach About Experts*, 50 ST. LOUIS U. L.J. 1115, 1128 (2006) (“*Daubert* asks courts and scholars to review formerly rejected technical processes to determine if their rejection is based upon unreliability of the process, or if it simply results from the *inherent conservatism of the law.*” (emphasis added)).

¹⁸⁰ Giannelli, *Polygraph Evidence*, *supra* note 85, at 903.

¹⁸¹ See Simmons, *supra* note 178, at 1042-43 (citing *United States v. Gilliard*, 133 F.3d 809 (11th Cir. 1998); *United States v. Call*, 129 F.3d 1402 (10th Cir. 1997); *United States v. Beyer*, 106 F.3d 175, 179 (7th Cir. 1997); *United States v. Cordoba*, 104 F.3d 225, 228 (9th Cir. 1997) (holding per se ban overturned by *Daubert*); *United States v. Williams*, 95 F.3d 723, 728-30 (8th Cir. 1996); *United States v. Posado*, 57 F.3d 428, 434 (5th Cir. 1995)).

¹⁸² 57 F.3d 428, 436 (5th Cir. 1995).

¹⁸³ *Id.* at 434. While this observation about sophistication does not seem to fit in to any of the *Daubert* inquiries, it seems to play a role in the court’s analysis. When Judge Jed Rakoff expressed his hesitations about the new technology, he acknowledged his regard for the underlying science. Ireland, *supra* note 18.

minimum number of factors.¹⁸⁴ Furthermore, according to the court, the error rate lay between 70% and 90%, a variation that “exists in many of the disciplines and for much of the scientific evidence we routinely find admissible under Rule 702.”¹⁸⁵ Finally, increased standardization, peer review, testing, and general acceptance outside the courtroom all influenced the court to decide that the test is permissible under *Daubert*.¹⁸⁶

The Ninth Circuit has also held that *Daubert* overruled the per se ban on polygraph evidence, and it instructed the lower court to do a *Daubert* analysis.¹⁸⁷ The lower court conducted an extensive two-day hearing on the polygraph, however, and found that the polygraph did not pass the *Daubert* test.¹⁸⁸ On appeal, the Ninth Circuit stated that “the district court did not abuse its discretion in finding that ‘polygraph evidence does not presently satisfy the *Daubert* standards.’”¹⁸⁹ The Tenth Circuit has likewise determined that *Daubert* applied to polygraphs, but stated that the lower court’s *Daubert* analysis did not abuse discretion in finding that “nothing in *Daubert* would disturb the settled precedent that polygraph evidence is neither reliable nor admissible to show that one is truthful.”¹⁹⁰ The Fourth Circuit has continued to apply a ban, but has discussed at length an inclination to soon employ a *Daubert* analysis to polygraphs.¹⁹¹

One circuit court simply avoided the question of polygraph admissibility.¹⁹² Two years after *Daubert*, the Second Circuit affirmed a lower court’s exclusion of polygraph evidence under Rule 403 based on the problematic nature of the polygraph questions posed to the defendant.¹⁹³ The court found

¹⁸⁴ “Remaining controversy about test accuracy is almost unanimously attributed to variations in the integrity of the testing environment and the qualifications of the examiner.” *Posado*, 57 F.3d at 436.

¹⁸⁵ *Id.*

¹⁸⁶ *Id.*

¹⁸⁷ *United States v. Cordoba*, 104 F.3d 225, 228 (9th Cir. 1997).

¹⁸⁸ *United States v. Cordoba*, 991 F.Supp. 1199 (C.D. Cal. 1998) (“The court finds polygraphy has not achieved general acceptance in the scientific community for courtroom use, the error rate for real-life polygraph tests is unknown, and there are no controlling standards for polygraphy.”), *aff’d*, 194 F.3d 1053 (9th Cir. 1999).

¹⁸⁹ *United States v. Cordoba*, 194 F.3d 1053, 1063 (9th Cir. 1999) (internal quotation and citation omitted).

¹⁹⁰ *United States v. Call*, 129 F.3d 1402, 1405 (10th Cir. 1997).

¹⁹¹ *United States v. Prince-Oyibo*, 320 F.3d 494, 501 (4th Cir. 2003); *United States v. Ruhe*, 191 F.3d 376, 388 & n.9 (4th Cir. 1999). See also *Lignons*, *supra* note 83, at 218 n.76 (summary of states that employ a per se ban).

¹⁹² *United States v. Kwong*, 69 F.3d 663, 668 (2d Cir. 1995).

¹⁹³ *Id.*

the test results irrelevant because three questions were not sufficiently and precisely tailored to the issues of the case.¹⁹⁴ The court did not rely on Rule 702 because “the record . . . simply d[id] not provide the proper opportunity to explore the validity of polygraph evidence under Rule 702.”¹⁹⁵

The Supreme Court most recently addressed polygraph admissibility in 1998 and held that a *per se* rule excluding polygraph evidence for criminal defendants was constitutional.¹⁹⁶ The case involved Military Rule of Evidence 707(a), which bans polygraph evidence from court-martial proceedings.¹⁹⁷ The Court found that there was “no consensus that polygraph evidence is reliable”¹⁹⁸ and that disagreement in lower courts emphasized the controversy.¹⁹⁹ The Court held that it was not arbitrary for the President (who dictates military law) to deem polygraphs unreliable given the widespread disagreement regarding accuracy.²⁰⁰ Thus, the exclusion of the polygraph evidence was based on legitimate reasons, despite a defendant’s Sixth Amendment right to compulsory process.²⁰¹

In a part of his opinion supported only by a minority, Justice Thomas added that “preserving the court members['] role in determining credibility . . . and avoiding litigation that is collateral to the primary purpose of the trial” also support exclusion.²⁰² In the opinion of the Court, *Daubert* did not prohibit a ban on a particular form of scientific evidence:²⁰³ “[T]here is simply no way to know in a particular case whether a polygraph examiner’s conclusion is accurate, because certain doubts and uncertainties plague even the best polygraph exams.”²⁰⁴ *United States v. Scheffer* dealt a significant blow to polygraphs both because it has been interpreted as finding

¹⁹⁴ *Id.*

¹⁹⁵ *Id.* at 669.

¹⁹⁶ *United States v. Scheffer*, 523 U.S. 303, 305 (1998).

¹⁹⁷ *Id.* at 306-07.

¹⁹⁸ *Id.* at 309.

¹⁹⁹ *Id.* at 310-11.

²⁰⁰ *Id.* at 312.

²⁰¹ *Id.*

²⁰² *Scheffer*, 523 U.S. at 309.

²⁰³ *Id.* at 311 n.7.

²⁰⁴ *Id.* at 312 (“We cannot say, then, that presented with such widespread uncertainty, the President acted arbitrarily or disproportionately in promulgating a *per se* rule excluding all polygraph evidence.”). Justice Thomas also justifies the Court’s decision on the Province of the Jury doctrine. *Id.* at 312-15. See also *infra* Part III.D.

polygraphs inaccurate and as revitalizing the polygraph's Province of the Jury concern.²⁰⁵

Thus, many courts have acknowledged that *Daubert* mandated re-examining polygraph evidence. The new analysis, however, has been no more welcoming of the technology.

2. Applying *Daubert* to fMRI Lie Detection

At some point in the near future, if not at present, a reasonable doctrinal analysis should allow fMRI lie-detection technology to be admissible in court. Many of the *Daubert* factors can be met, and, given an appropriate (albeit limited) set of circumstances, the evidence would be relevant under Rule 403 and sufficiently outside the narrow Province of the Jury. Furthermore, the technology, though young, tests better than commonly permitted evidence.

a. Testability/Falsifiability

The first *Daubert* factor, testability (or falsifiability), requires that one be able to verify that the same test performed the same way will lead to consistent results. While many believe further testing is required, at some point in the near future, a court could reasonably find that fMRI's are testable. Scholars interpret this factor to mean whether a scientific theory has been tested and is capable of being tested in the future.²⁰⁶ *Daubert* requires judges "to distinguish the methods of science from those methods that merely imitate science."²⁰⁷ While the Supreme Court did not indicate how trial courts should determine testability,²⁰⁸ in practice, courts tend to require testability rather than weigh it as one of many factors.²⁰⁹ One scholar has suggested that "a judge must find that the general principles and theories underlying an expert's opinion are reliable and valid. This responsibility includes an evaluation of the methodology used to make a specific inference

²⁰⁵ At least one scholar disapproves of the revitalization. Bush, *supra* note 23, at 552 ("Multiple federal circuit courts cited the decision as approving of per se rules against polygraph admissibility as well as for the general proposition that polygraph evidence is unreliable. The Seventh Circuit even misconstrued *Scheffer* to stand for the proposition that courts should exclude polygraph evidence because it infringes on the jury's responsibilities." (footnotes omitted)).

²⁰⁶ 1 FAIGMAN ET AL., *supra* note 86, § 1:15.

²⁰⁷ *Id.* § 1:16.

²⁰⁸ *Id.* § 1:15.

²⁰⁹ *Id.*

since the validity of such methodologies . . . depend[s] on general principles and theories.”²¹⁰

The fMRI technology is capable of being tested because (1) the procedure is repeatable and (2) the results can be validated, at least in a clinical setting.²¹¹ Any number of subjects can be submitted to precisely the same technology, and results may be analyzed by a single computer algorithm. Because three aspects of the fMRI exam are more automated than the traditional polygraph exam, a court should find the fMRI to be a more “testable” technology.²¹²

First, the questions during an fMRI are presented to the subject on a computer screen and not by a human interviewer. One major flaw in testing polygraphs is that some interviewers are better than others. What a polygraph exam measures is the subject’s precise physiological reaction during question and answer.²¹³ Nervousness, stress, anxiety, and fear inform one’s psycho-physiological reaction.²¹⁴ Therefore, how the question is asked and who the examiner is affect the test results.²¹⁵ For example, the examiner’s tone of voice, intonation, attitude, physical posture, and eye contact may all lead one subject to be more nervous than if the interrogator were to ask the question differently.²¹⁶ Moreover, an examiner’s bias might cause the examiner to use subtle techniques to bring about a particular result.²¹⁷

Second, the fMRI presents the questions in a random order. While this is thought to be helpful in thwarting

²¹⁰ *Id.* § 1:17. (“If a body of data supports both valid generalizations and the methods employed to determine specific propositions, the jury should evaluate what weight to accord the testimony. . . . In short, judges should evaluate under Rule 104(a) the general principles or methods by which experts derive their opinions about specific causation. . . . [O]nce the court has determined that [such] methods are sufficiently valid and that they were employed in the particular case, the trier of fact must assess the weight the evidence receives.”).

²¹¹ *Id.* § 1:15. However, it is difficult to test the technology under real-world conditions because real-world incentives, such as avoiding prison or receiving a windfall, are hard to mimic and may affect a subject’s cognitive activity far beyond an imposed clinical incentive.

²¹² In both the fMRI and the polygraph exams the particular practitioner composes the questions.

²¹³ Willing, *supra* note 11, at 5A.

²¹⁴ See *supra* text accompanying notes 79-83.

²¹⁵ See *supra* text accompanying notes 85-88.

²¹⁶ A base line reading is taken during a polygraph so that any overarching anxiety or intimidation from the exam itself or the interrogator may be taken into account. See *supra* text accompanying note 85.

²¹⁷ See *supra* text accompanying note 88.

countermeasures,²¹⁸ it also standardizes the exam. Any strategy employed in the sequencing of questioning would have to be tested. If every facility employed a different strategy, each strategy would have to be tested. Furthermore, the strategy would be hard to specify given the variety of fact patterns and, thus, would make the technique especially hard to test for accuracy.

Third, the fMRI results are interpreted by a computer algorithm, whereas traditional polygraphs require the examiner to interpret the test results. Error, in a polygraph analysis, may result from mistake or bias.²¹⁹ There is concern even from within the polygraph community regarding the proper training of examiners.²²⁰ Additionally, any examiner is subject to personal feelings and may be influenced by his subjective impressions.²²¹ Since it is interpreted by a computer, the fMRI is less susceptible to “confirmation bias.”²²² The computer first does a number of preliminary tasks such as correcting for small head movements that affect picture quality.²²³ Then, the computer determines which brain regions

²¹⁸ This is all highly speculative because little research has been done regarding fMRI countermeasures. However, one underlying principle of fMRI lie detection is that people have an initial impulse to tell the truth, which must be suppressed in order to concoct and tell a lie. If there were some particularly imaginative or deceptive state that one could maintain during an exam that would lessen the initial truthful impulse, the random question order would presumably make this more difficult to keep up. See Laken Transcript, *supra* note 9, at 4:21-24, 22:14-23:3. The subject does not know whether the upcoming questions are going to pertain to the lie or to some innocuous subject (used to establish baseline readings, such as “Is your name Bob?”) that would require a truthful answer. See *id.* at 20:23-21:13.

²¹⁹ “Remaining controversy about [polygraph] test accuracy is almost unanimously attributed to variations in the integrity of the testing environment and the qualifications of the examiner.” *United States v. Posado*, 57 F.3d 428, 434 (5th Cir. 1995).

²²⁰ Giannelli, *Polygraph Evidence*, *supra* note 85, at 923 (“the [Department of Defense, Polygraph Institute] trains all federal polygraph examiners. It ‘is the only program known to base its curriculum on forensic psychophysiology, and conceptual, abstract, and applied knowledge that meet the requirements of a master’s degree-level of study.’ The qualifications standards include a college degree (or equivalent), two years’ experience as an investigator, and a six-month internship In addition, 80 hours of continuing instruction are required annually. Outside of federally trained examiners, few have such qualifications.” (citations omitted)).

²²¹ It is important to note that subjective determinations are routinely permitted in expert evidence such as fingerprint analyses, toolmark evidence, and handwriting identification. Roger C. Park & Michael J. Saks, *Evidence Scholarship Reconsidered: Results of the Interdisciplinary Turn*, 47 B.C. L. REV. 949, 982 n.146 (2006).

²²² See Paul C. Giannelli, *Daubert Challenges to Fingerprints*, 42 CRIM. L. BULL. 5 (2006) (“a well-established phenomenon that is frequently ignored in forensic work”).

²²³ Laken Transcript, *supra* note 9, at 55:9-16.

were activated during each question.²²⁴ A simple comparison of area activation across control and non-control questions indicates deception because it directly correlates to the added mental effort involved.²²⁵ A well-tested computer program is likely to interpret results more reliably than a single practitioner.²²⁶

b. Peer Review and Publication

The Supreme Court noted that peer review and publication is a factor to consider in determining whether a particular scientific method is worthy of admission under FRE 702.²²⁷ The Court suggests that peer reviewed publications indicate that the scientific principles have been subjected to scientific scrutiny by those best suited to judge their legitimacy.²²⁸ Even publications that are not peer reviewed are helpful towards a *Daubert* analysis because they disseminate the ideas to the scientific community who may then seek to challenge or confirm the results.²²⁹ The Supreme Court found, however, that the scientific theory need not be beyond reproach. Flaws detected during peer review “do not necessarily equate to a lack of scientific validity,” but may simply affect the testimony’s weight.²³⁰

When the Sixth Circuit considered the admissibility of DNA evidence soon after *Daubert*, the government produced six publications, each dealing with a specific aspect of DNA technology. The court also considered the extensive publications on DNA matching and the “general procedures

²²⁴ See *supra* Part II.A.

²²⁵ See Laken Transcript, *supra* note 9, at 40:10-12, 43:2-24.

²²⁶ Question composition is not done by a machine and may present a variable. In real-world situations, it is much more difficult to determine whether a statement is actually true or false. Giannelli, *Polygraph Evidence*, *supra* note 85, at 912. Furthermore, while the fMRI has been tested by several teams of scientists, critics may point out that most of these scientists have commercial interest in the technology. See *supra* note 125.

²²⁷ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593-94 (1993); *United States v. Bonds*, 12 F.3d 540, 559 (6th Cir. 1993) (finding DNA evidence admissible under *Daubert*).

²²⁸ *Daubert*, 509 U.S. at 593-94; *Bonds*, 12 F.3d at 559. To be published in a true peer review scientific journal, authors submit work, receive comments from the journal’s outside scientists who evaluate the results, and make appropriate changes sufficient to satisfy the journal’s editors. *Id.* at 559 n.16.

²²⁹ “[S]ubmission to the scrutiny of the scientific community is a component of ‘good science,’ in part because it increases the likelihood that substantive flaws in methodology will be detected.” *Daubert*, 509 U.S. at 593.

²³⁰ *Id.* at 593-94; *Bonds*, 12 F.3d at 559.

used to come up with the forensic results” as further evidence of peer review.²³¹ Even though some of the publications offered by the prosecution were not technically peer reviewed scientific journals, the court acknowledged their value in exposing the procedures to the larger scientific community.²³²

The fMRI scholarship on deception has been subjected to peer review and published in scholarly journals in at least twenty instances.²³³ All twenty articles have been published within the last six years, and five have come out since the beginning of 2006. Even if a test case is only one or two years away, by that time there will likely be even more publications available.

²³¹ *Bonds*, 12 F.3d at 560.

²³² *Id.* at 559 n.16.

²³³ See generally Nobuhito Abe et al., *Deceiving Others: Distinct Neural Responses of the Prefrontal Cortex and Amygdala in Simple Fabrication and Deception with Social Interactions*, 19 J. COGNITIVE NEUROSCIENCE 287 (2007); C. Davatzikos et al., *Classifying Spatial Patterns of Brain Activity with Machine Learning Methods: Application to Lie Detection*, 28 NEUROIMAGE 663 (2005); M. Gamer et al., *Covariations Among fMRI, Skin Conductance, and Behavioral Data During Processing of Concealed Information*, 28 HUMAN BRAIN MAPPING ___ (forthcoming 2007); G. Ganis et al., *Neural Correlates of Different Types of Deception: An fMRI Investigation*, 13 CEREBRAL CORTEX 830 (2003); N.J. Gordon et al., *Integrated Zone Comparison Polygraph Technique Accuracy with Scoring Algorithms*, 87 PHYSIOLOGY BEHAV. 251 (2006); Kozel et al., *Detecting Deception*, *supra* note 48, at 605; F. Andrew Kozel et al., *A Pilot Study of Functional Magnetic Resonance Imaging Brain Correlates of Deception in Healthy Young Men*, 16 J. NEUROPSYCHIATRY CLINICAL NEUROSCIENCES 295 (2004); Kozel, et al., *Neural Correlates of Deception*, *supra* note 47, at 852; Daniel D. Langleben et al., *Telling Truth From Lie in Individual Subjects with Fast Event-Related fMRI*, 26 HUMAN BRAIN MAPPING 262 (2005); D.D. Langleben et al., *Brain Activity During Simulated Deception: An Event-Related Functional Magnetic Resonance Study*, 15 NEUROIMAGE 727 (2002); Tatia M. Lee et al., *Neural Correlates of Feigned Memory Impairment*, 28 NEUROIMAGE 305 (2005); Tatia M.C. Lee et al., *Lie Detection by Functional Magnetic Resonance Imaging*, 15 HUMAN BRAIN MAPPING 157 (2002); Donald H. Marks et al., *Determination of Truth from Deception Using Functional MRI and Cognitive Engrams*, 5 INTERNET J. RADIOLOGY (2006), <http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijra/vol5n1/engram.xml>; Feroze B. Mohamed et al., *Brain Mapping of Deception and Truth Telling About an Ecologically Valid Situation: Functional MR Imaging and Polygraph Investigation—Initial Experience*, 238 RADIOLOGY 679, 679 (2006); J. M. Nunez et al., *Intentional False Responding Shares Neural Substrates with Response Conflict and Cognitive Control*, 25 NEUROIMAGE 267 (2005); K. Luan Phan et al., *Neural Correlates of Telling Lies: A Functional Magnetic Resonance Imaging Study at 4 Tesla*, 12 ACAD. RADIOLOGY 164 (2005); Sean A. Spence et al., *A Cognitive Neurobiological Account of Deception: Evidence From Functional Neuroimaging*, 359 PHIL. TRANSACTIONS OF THE ROYAL SOC'Y LONDON B: BIOLOGICAL SCI. 1755 (2004); Sean A. Spence et al., *Behavioural and Functional Anatomical Correlates of Deception in Humans*, 12 NEURO REPORT 2849 (2001); Donald T. Stuss et al., *The Frontal Lobes Are Necessary for 'Theory of Mind.'* 124 BRAIN 279 (2001); Yaling Yang et al., *Prefrontal White Matter in Pathological Liars*, 187 BRITISH J. PSYCHIATRY 320 (2005). This list does not include publications in scientific journals on the bioethics and legal implications of fMRI lie-detection efforts.

Furthermore, the science that underlies fMRI lie detection has been subjected to rigorous peer-evaluation by the larger scientific community.²³⁴ Many of the nation's leading institutions have become centers for both fMRI tests and brain-mapping—these technologies were not only scrutinized in the past, but they serve as the foundation for a broad, new frontier of study.²³⁵ Scientists are using fMRI technology to understand from where in the brain a disabled person's seizures emanate, to steer clear of important neurological regions during brain surgery, to better promote stroke recovery, and to diagnose pre-symptom Alzheimer's.²³⁶ Each of these fMRI applications has been subjected to peer reviewed publication.²³⁷ If the court finds publications on fMRI lie detection too sparse,²³⁸ it might consider publication on other aspects of the same technology. As the admission of DNA evidence indicates, technology spawned by major scientific fields carries considerable weight.

c. Error Rate

The *Daubert* Court listed error rate as a consideration for admissibility of scientific evidence.²³⁹ Several fMRI studies have produced error rates for determining whether a subject was telling a truth or falsehood. The largest study yielded an error rate of only 7% to 10%.²⁴⁰ While the Supreme Court did not specify what error rates would be acceptable,²⁴¹ this error-

²³⁴ Ongoing peer-evaluation, the scrutiny of the entire scientific community, occurs post-publication and is distinct from the limited peer review done prior to publication in a journal.

²³⁵ The Functional Magnetic Resonance Imaging Center at Columbia University and the Athinoula A. Martinos Center for Biomedical Imaging at Harvard University are two of the centers engaged in a wide variety of fMRI studies. See Columbia University, Columbia Functional MRI Research Center, <http://www.fmri.org/> (last visited Mar. 30, 2007); Athinoula A. Martinos Center for Biomedical Imaging, <http://www.nmr.mgh.harvard.edu/martinos/flashHome.php> (last visited Mar. 30, 2007). See also The fMRI Data Center, <http://www.fmriddc.org/fmriddc> (maintained by Dartmouth College) (last visited Mar. 30, 2007); Functional Magnetic Resonance Imaging, http://www.fmrib.ox.ac.uk/fmri_intro/fmri_intro.php (maintained by Oxford University) (last visited Mar. 30, 2007).

²³⁶ Parry & Matthews, *supra* note 36.

²³⁷ Kozel et al., *Detecting Deception*, *supra* note 48, at 605.

²³⁸ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593-94 (1993) (acknowledging “[s]ome propositions, moreover, are too particular, too new, or of too limited interest to be published.”).

²³⁹ *Id.* at 594.

²⁴⁰ Kozel et al., *Detecting Deception*, *supra* note 48, at 605.

²⁴¹ 1 FAIGMAN ET AL., *supra* note 86, § 1:20.

rate is certainly helpful to the jury.²⁴² Moreover, this error-rate is more *calculable* than that of many other types of admissible forensic evidence, including fingerprint analyses, for which there is “surprisingly little conventional science . . . to support the claims of the fingerprint examination community,”²⁴³ and firearm identification.²⁴⁴ Furthermore, it should be noted that ordinary eyewitness testimony²⁴⁵ is routinely presented to juries despite problematic error rates—it is the leading cause of false convictions.²⁴⁶ Therefore, a scientifically measurable error rate of approximately 10% should not disqualify fMRI evidence.²⁴⁷

Justice Blackmun specified that “the existence and maintenance of standards controlling the technique’s operation” should also be a factor in judging a technology.²⁴⁸ The computerization of the fMRI test allows considerable standardization.²⁴⁹ The presentation of the questions, the speed at which they are administered, and the timing of the MRI imaging can all be administered, monitored, and analyzed by a

²⁴² FED. R. EVID. 702. Any evidence that is better than chance is presumably helpful.

²⁴³ 4 FAIGMAN ET AL., *supra* note 86, § 34:1 (“Today, a thoughtful and scientifically literate proponent of expert fingerprint identification testimony, compelled . . . to demonstrate the validity of fingerprint identification claims in front of a thoughtful and scientifically literate judge, would face a number of serious difficulties. . . . Proficiency testing does not support the claimed error rate of zero or of the unanimity of opinion asserted by fingerprint examiners.” (citations omitted)). One “court found that “[e]ven allowing for the possibility of individual error, the error rate with latent print identification is vanishingly small when it is subject to fair adversarial testing and challenge.” *Id.* § 1:29 (quoting *U.S. v. Havvard*, 117 F. Supp. 2d 848, 854 (S.D. Ind. 2000)). However, “[t]he court never explained how it knew this to be so.” *Id.*

²⁴⁴ See Adina Schwartz, *A Systemic Challenge to the Reliability and Admissibility of Firearms and Toolmark Identification*, 6 COLUM. SCI. & TECH. L. REV. 1, 24-25 (2005) (“[I]t is questionable whether a meaningful error rate for the subjective method of firearms and toolmark examination can even be calculated. Proficiency tests may indicate particular examiners’ ability to reach correct identity conclusions at a given time. However, unless examiners commit themselves to specific, articulable criteria for determining when the resemblances between toolmarks are so great that they must have come from the same tool, a given examiner’s proficiency at a certain time is no guarantee of similar proficiency in the future.” (footnote omitted)).

²⁴⁵ An eyewitness’s testimony is not considered expert evidence and therefore avoids a *Daubert* analysis.

²⁴⁶ 1 FAIGMAN ET AL., *supra* note 86, § 1:34.

²⁴⁷ Some argue that the error rate of a technology that goes directly to credibility should be more stringent than for other types of evidence. See *infra* Part III.B.2.

²⁴⁸ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 594 (1993).

²⁴⁹ See Laken Transcript, *supra* note 9, at 48:3-16.

software package.²⁵⁰ A voxel count, which indicates the extent of the blood oxygenation, is also numeric and could thus be standardized.²⁵¹

d. General Acceptance

Despite overruling *Frye*, the Court kept “general acceptance” a factor in determining admissibility of scientific evidence.²⁵² Here, fMRI lie detection would probably stumble because the technology is new and rather shocking. Nevertheless the fMRI technology used in this technique might still be seen as generally accepted by scientists because it is used so extensively at the highest levels of various medical research fields. While this is not an explicit consideration under *Daubert*, it does seem to affect judges because one of *Daubert*’s principles was to exclude “junk science.”²⁵³ The Three Tesla magnetic resonance imaging machines working in concert with intricate computer algorithms and cutting-edge brain-mapping all produced by scientists associated with such institutions as Columbia University, the Massachusetts Institute of Technology, and Harvard University seem a far cry from snake oil.

B. Other Rules

1. Applying Federal Rule of Evidence 403 to fMRI Lie-Detection Technology

Even if a court finds that polygraphs satisfy *Daubert* and Rule 702, the test is vulnerable to a Federal Rule of Evidence 403 analysis.²⁵⁴ Rule 403 allows a trial judge to exclude evidence when its prejudicial effect outweighs its probative value.²⁵⁵ The prejudicial effect could come from “unfair prejudice, confusion of the issues, or misleading the

²⁵⁰ See *id.* at 15:25-16:8, 48:14-49:11 (comparing this to events in the famous Wen Ho Lee spy scandal in which two government agencies disagreed about the subject’s polygraph results).

²⁵¹ *Id.* at 38:16-20.

²⁵² *Daubert*, 509 U.S. at 594.

²⁵³ Marc T. Treadwell, *Evidence*, 57 MERCER L. REV. 1083, 1097 (2006).

²⁵⁴ *United States v. Cordoba*, 194 F.3d 1053, 1062-63 (9th Cir. 1999).

²⁵⁵ FED. R. EVID. 403 (“Although relevant, evidence may 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 evidence.”).

jury.”²⁵⁶ For example, jurors might overvalue polygraph results despite warnings of the test’s limited accuracy, or the court may determine that the evidence’s reliability (or lack thereof) could simply confuse or mislead the jury. In either case, the court could exclude the evidence under Rule 403.

While fMRI evidence is also subject to an error rate and might be overvalued by the fact-finder, the same could be said for many admissible forms of evidence such as fingerprint evidence, toolmark analysis, and eyewitness testimony.²⁵⁷ The vividness of some of the fMRI images might lead a trial judge to be more concerned with prejudice because any false sense of familiarity with the science could increase the evidence’s undue prejudice.²⁵⁸ However, it is difficult to justify such an exclusion given the opportunity to cross-examine. In addition, eyewitness testimony, which is routinely admitted, is similarly powerful evidence and subject to substantial error. The jury is simply trusted to weigh the testimony accordingly. Therefore, while courts might use Rule 403 to exclude fMRI results because the error rates are confusing or the technology is too seductive, there are few distinct characteristics of fMRI evidence to warrant the exclusion. Any such decision may more readily suggest a court’s vague uneasiness with this “mind reading” technology rather than a specific prejudice.²⁵⁹

2. Applying the “Province of the Jury” Doctrine to fMRI Lie-Detection Technology

Even if the judge determines that testimony is admissible under Federal Rules of Evidence 702 and 403, the offering party may face an objection that lie-detection

²⁵⁶ *Id.* Courts have found that polygraphs fail a 403 analysis for this reason. *See, e.g., United States v. Cordoba*, 194 F.3d 1053, 1062-63 (9th Cir. 1999).

²⁵⁷ *See supra* text accompanying notes 244, 280-83.

²⁵⁸ Jennifer Mnookin argues that one reason fingerprint evidence is so powerful is because the jury can see the evidence for itself. Jennifer L. Mnookin, *Fingerprint Evidence in the Age of DNA Profiling*, 67 BROOK. L. REV. 13, 26-27 (2001) (“[T]he fingerprints themselves, as much as the expert opinion about the fingerprints, seem to constitute the evidence.”).

²⁵⁹ The next section will separately address the Province of the Jury doctrine although courts sometimes deal with this under a 403 analysis. *See United States v. Scheffer*, 523 U.S. 303, 314 (1998) (finding that “jurisdictions may legitimately determine that the aura of infallibility attending polygraph evidence can lead jurors to abandon their duty to assess credibility and guilt”); *United States v. Cordoba*, 104 F.3d 225, 228 (9th Cir. 1997) (finding that “polygraph evidence has grave potential for interfering with the deliberative process”).

testimony invades the Province of the Jury.²⁶⁰ For the last 150 years, the Province of the Jury doctrine has kept witnesses from testifying about their own inferences and opinions unless they arose from a specialized skill that would aid the jury in its decision.²⁶¹ The reasoning stemmed from the notion that the jurors ought to use their own opinions and inferences to make a decision and that third party opinion testimony might cloud the jury's perspective.²⁶² The courts recognized that jurors still needed expert advice in fields such as engineering, medicine, or business to "enable [them] to draw conclusions from the facts more accurately."²⁶³ However, over time, courts have increasingly permitted expert evidence in more areas.²⁶⁴ Presently, "experts have gained the right to assist the jury on almost every issue."²⁶⁵

One major fear in allowing lie detectors into court proceedings is that they will take away from the jury its role as fact-finder, specifically in the witness-credibility arena.²⁶⁶ One might argue that a jury will no longer have to watch a witness testify, hunt for deceptive behavior, and decide whether or not to believe the witness, because the fMRI will indicate who is lying and who is not.²⁶⁷ Some might even imagine that many

²⁶⁰ See Simmons, *supra* note 178, at 1019, 1032 (discussion of court's similar treatment of eyewitness experts: "Courts generally cited one of two reasons for precluding the testimony: either the expert could not provide any information beyond what could be provided by cross-examination and the jurors' common sense (and therefore the testimony was not helpful), or the proffered testimony impermissibly infringed on the jury's traditional role of determining credibility.").

²⁶¹ *Id.* at 1018-19.

²⁶² *Id.* at 1019.

²⁶³ *Id.*

²⁶⁴ *Id.* at 1015.

²⁶⁵ *Id.* See also Carlson, *supra* note 179, at 1126-27 ("An expert on mental states of accused persons cannot categorically announce that the defendant had the mens rea to commit a specific crime. Nor may an expert invade the province of the jury in a civil or criminal case. She does so, among other ways, by attempting to testify that a testator lacked mental capacity to sign a will, in a will contest case." (footnote omitted)).

²⁶⁶ Giannelli, *Polygraph Evidence*, *supra* note 85, at 916.

²⁶⁷ Justice Thomas wrote:

Jurisdictions, in promulgating rules of evidence, may legitimately be concerned about the risk that juries will give excessive weight to the opinions of a polygrapher, clothed as they are in scientific expertise and at times offering, as in respondent's case, a conclusion about the ultimate issue in the trial. Such jurisdictions may legitimately determine that the aura of infallibility attending polygraph evidence can lead jurors to abandon their duty to assess credibility and guilt. Those jurisdictions may also take into account the fact that a judge cannot determine, when ruling on a motion to

trials, specifically those revolving around which party is telling the truth, might not require a jury at all—simply have the parties or witnesses submit to an fMRI exam.²⁶⁸ While the Province of the Jury doctrine has eroded as reliance on expert testimony has grown, courts have most strongly guarded the jury's witness credibility task.²⁶⁹ Despite arguments that there is reasonable justification for such effort,²⁷⁰ the fMRI will not take credibility determination from the jury, nor will it greatly alter the trial process as it stands today.²⁷¹ Rather, fMRI evidence will help the jury determine who is telling the truth, but at the same time require juries (as they often must) to parse various reasons why proffered evidence may not be convincing in a particular case.²⁷²

There has been much confusion²⁷³ and controversy²⁷⁴ surrounding the Province of the Jury concerns. Nevertheless, courts regularly cite the doctrine with respect to credibility testimony.²⁷⁵ Some scholars argue that exclusion of credibility testimony on Province of the Jury grounds is inappropriate.²⁷⁶ First, many courts found that Rule 704 implicitly abolished the Province of the Jury doctrine along with explicitly rejecting the "Ultimate Issue" principle.²⁷⁷ In *United States v. Scheffer*, Justice Kennedy discussed Rule 704 and professed he "had thought this tired [Province of the Jury] argument had long since been given its deserved repose as a categorical rule of

admit polygraph evidence, whether a particular polygraph expert is likely to influence the jury unduly.

United States v. Scheffer, 523 U.S. 303, 313-14 (1998).

²⁶⁸ The constitutional right to a trial by jury would, of course, prohibit such a procedure. See U.S. CONST. amend. VI.

²⁶⁹ *Simmons*, *supra* note 178, at 1029.

²⁷⁰ See *infra* note 281 and accompanying text.

²⁷¹ *Pardo*, *supra* note 10, at 305.

²⁷² This may, however, lead to the problematic battle of the experts. See, e.g., Michelle M. Mello, *Of Swords and Shields: The Role of Clinical Practice Guidelines in Medical Malpractice Litigation*, 149 U. PA. L. REV. 645, 684-85 (2001) ("in which hired guns clash with opposing opinions, neither of which is any more empirically supportable than the other").

²⁷³ See *Simmons*, *supra* note 178, at 1020 & n.39.

²⁷⁴ Wigmore argued that excluding evidence based on Province of the Jury had no merit. *Id.* at 1020, 1022.

²⁷⁵ Ironically, some confusion over the term comes from charges of *judges* invading the Province of the Jury by excluding evidence the jury should hear. *Id.*

²⁷⁶ *Id.* at 1015-16.

²⁷⁷ *Id.* at 1033 n.107. See FED. R. EVID. 704(a) ("[T]estimony in the form of an opinion or inference otherwise admissible is not objectionable because it embraces an ultimate issue to be decided by the trier of fact.").

exclusion.”²⁷⁸ He also referred to it as “outmoded,” and quoted Wigmore’s characterization of the doctrine as “empty rhetoric.”²⁷⁹

Furthermore, courts have begun to accept eyewitness expert testimony regarding the accuracy of a witness’s identification.²⁸⁰ State and Federal courts have found such expert evidence “helpful”²⁸¹ under Rule 702 and distinguished the evidence sufficiently from the Province of the Jury.²⁸² The rationale some courts were using to let in these experts could be argued to apply equally to polygraph examiners.²⁸³

However, in *Scheffer*, Justice Thomas employed the doctrine regarding polygraphs:²⁸⁴

By its very nature, polygraph evidence may diminish the jury’s role in making credibility determinations. The common form of polygraph test measures a variety of physiological responses to a set of questions asked by the examiner, who then interprets these physiological correlates of anxiety and offers an opinion to the jury about whether the witness—often, as in this case, the accused—was deceptive in answering questions about the very matters at issue in the trial. Unlike other expert witnesses who testify about factual matters outside the jurors’ knowledge, such as the analysis of fingerprints, ballistics, or DNA found at a crime scene, a polygraph expert can supply the jury only with another opinion, in addition to its own, about whether the witness was telling the truth.²⁸⁵

Scholar Louise A. Jacobs argues that Thomas’s opinion advances the Province of the Jury argument in flagrant disregard of *Daubert* and thus encourages abandoning a

²⁷⁸ 523 U.S. 303, 319 (1998) (Kennedy, J., concurring).

²⁷⁹ *Id.*

²⁸⁰ Simmons, *supra* note 178, at 1032-34 (one court dismissing the Province of the Jury doctrine as “no more than a shibboleth”). See Mark S. Brodin, *Behavioral Science in the Age of Daubert: Reflections of a Skeptic*, 73 U. CIN. L. REV. 867, 891 (2005) (“[T]he frequent exclusion of expert testimony on eyewitness identification despite its scientific reliability, contrasting sharply with the widespread admission of evidence of such dubious reliability as ‘future dangerousness’ and the various syndromes discussed above, strongly suggests that factors other than reliability are playing the determinative role.”).

²⁸¹ Simmons, *supra* note 178, at 1034.

²⁸² *Id.*

²⁸³ *Id.* at 1032-34. One “court found that the testimony would ‘assist the trier of fact’ because ‘[w]e cannot assume that the average juror would be aware of the variables concerning identification and memory about which [the expert] was qualified to testify.’” *Id.* at 1033. Another wrote “although ‘personal experience and intuition’ can guide jurors in assessing witness credibility, ‘other factors bearing on eyewitness identification may be known only to some jurors, or may be imperfectly understood by many, or may be contrary to the intuitive beliefs of most.’” *Id.* at 1033-34.

²⁸⁴ Albeit with only minority support.

²⁸⁵ *United States v. Scheffer*, 523 U.S. 303, 313 (1998) (citations omitted).

rigorous reliability and relevance inquiry while reviving a facile, unpersuasive, antiquated reasoning.²⁸⁶ The adversary process, she argues, as it exists today—with *in limine* and *Daubert* hearings, as well as discovery, voir dire, and jury instructions—is well suited to allow experts to discuss issues that touch on a case's ultimate issues.²⁸⁷

One weakness in Justice Thomas' assertion is that studies have shown that people are not good at determining another's truthfulness.²⁸⁸ Second, distinguishing in this aspect between the evidence presented by a fingerprint analyst and a polygraph examiner is delicate indeed. Granted, a jury could not be expected to know whether a crime scene fingerprint bore any similarity to that of the defendant without the testimony of an expert. However, a jury would also be unable to know the minute changes in the defendant's vital signs during questioning without the help of a polygraph examiner. While the fingerprint specialist is testifying as to an opinion on the fingerprint, the polygraph examiner is testifying as to an opinion on the autonomic reaction. Moreover both fingerprint and psycho-physiological evidence help the jury determine facts.²⁸⁹

However, even if the Province of the Jury doctrine applies to polygraphs, fMRI technology can be sufficiently distinguished from polygraphs and should evade exclusion on this ground. Justice Thomas seems to think that the jury is in just as good a position to detect a lie as is a technician with a polygraph machine. The jury can watch the defendant testify and, with the naked eye, catch sight of quickened breathing or a glistening brow. Perhaps the jury could see even more outward indications of nervousness and stress that are not

²⁸⁶ Louise A. Jacobs, *Giving Lie to Antiquated Notions of Scientific Evidence*, 22 AM. J. TRIAL ADVOC. 507, 508-10 (1999) (criticizing Thomas' argument that juries will be distracted by debate over the technology).

²⁸⁷ *Id.* at 520-21.

²⁸⁸ *E.g.*, *Penasquitos Vill., Inc. v. NLRB*, 565 F.2d 1074, 1084-85 (9th Cir. 1977) (Duniway, J., concurring in part and dissenting in part) ("[I]t is not unusual for an accomplished liar to fool a jury (or, even, heaven forbid, a trial judge) into believing him because his demeanor is so convincing. . . . Conversely, many trial lawyers, and some trial judges, will admit that the demeanor of a perfectly honest but unsophisticated or timid witness may be—or can be made by an astute cross-examiner to be—such that he will be thought by the jury or the judge to be a liar."); Aldert Vrij et al., *Detecting Lies in Young Children, Adolescents and Adults*, 20 APPLIED COGNITIVE PSYCHOL. 1225 (2006) (finding police officers, social workers, and laypersons all detect accuracy at a rate of approximately 60%, slightly better than chance).

²⁸⁹ *See* FED. R. EVID. 702.

measured on a typical polygraph, such as fidgeting,²⁹⁰ vocal tension, eye contact, and facial gestures. Therefore, polygraph testimony would be unnecessary.

Because both the fMRI and the polygraph purport to detect lies, there is a strong tendency to analogize the two scientific techniques.²⁹¹ Nevertheless, in analyzing the Province of the Jury issue, a trial judge ought to liken fMRI technology more closely to fingerprint or DNA evidence. While both the polygraph and the fMRI shed light on the alleged lie, the fMRI, like DNA, measures data far less manifest. No matter how closely a jury pays attention, it would not be able to determine which brain region the defendant used to answer a question. Therefore, fMRI testimony, unlike polygraph results, would be more clearly “outside the jurors’ knowledge.”²⁹²

IV. WHY COURTS MAY EXCLUDE fMRI DESPITE ITS TECHNOLOGICAL PROMISE

Despite the promise of fMRI lie detection, courts may reject proffers to introduce the evidence, not because it fails doctrinally, but because cultural impressions of a technology often find their way into the *Daubert* analysis,²⁹³ and “mind reading”-like devices²⁹⁴ carry a negative cultural suspicion.

²⁹⁰ Some polygraphers incorporate observable physical movements or “body language” into the ultimate analysis. Giannelli, *Polygraph Evidence*, *supra* note 85, at 909.

²⁹¹ Judge Jed Rakoff, in his remarks to a panel, likened fMRIs to polygraphs in that the former are “more likely to cause mischief than be a real help.” Ireland, *supra* note 18.

²⁹² *United States v. Scheffer*, 523 U.S. 303, 313 (1998). Michael Pardo makes a distinction between criterial and inductive evidence, further demonstrating why the Province of the Jury doctrine ought not to be invoked with respect to this technology. Pardo, *supra* note 10, at 316-17.

²⁹³ Vickers, *supra* note 32, at 110.

²⁹⁴ The media often refers to the technology as a “mind reading” device. This reflects both the public perception that it is such a device (when, of course, it is far more limited) and the titillating effect such language has on consumers upon which the media attempts to capitalize. See Jerry Adler, *Mind Reading*, NEWSWEEK, Aug. 9, 2004, available at <http://www.msnbc.msn.com/id/5304846/site/newsweek/> (regarding fMRI lie detection); *Brain Scan ‘Sees Hidden Thoughts’: Scientists Say They Can Read a Person’s Unconscious Thoughts Using a Simple Brain Scan*, BBC NEWS, Apr. 25, 2005, available at <http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/2/hi/health/4472355.stm> (bearing the sub-heading “Mind-reader” and reporting: “This is the first basic step to reading somebody’s mind’ [said Researcher Dr. Geraint Rees]. ‘You could use it to detect people’s prejudices’ [said Dr. Adrian Burgess of Imperial College London].”). Cephos denies that the technology “reads minds” on a web page for “frequently asked questions.” Cephos Corp., *Frequently Asked Questions*, http://www.cephoscorp.com/fmri_deception.htm (last visited Mar. 30, 2007).

While *Daubert* established a list of factors meant to analyze the reliability and relevance of scientific evidence, studies show, in practice, admissibility decisions are usually not based on applications of those factors.²⁹⁵ Furthermore, the decision itself significantly enhanced judicial scrutiny of “junk science,” raising the admissibility bar for scientific evidence.²⁹⁶ In addition, since *Frye*, lie detectors (albeit polygraph machines) have been the very symbol of junk science.²⁹⁷ Finally, courts may turn to the malleable Federal Rule of Evidence 403, or the nearly defunct Province of the Jury doctrine²⁹⁸ to resist this evidence. Therefore, even if fMRI technology could fully deliver on its potential, hopes of being welcomed in the courtroom are exceptionally hamstrung.

Several of the problems scholars have raised about the *Daubert* decision involve the difficulty in successfully applying the holding because it leaves judges vulnerable to improper influences.²⁹⁹ First, *Daubert* requires judges to make decisions regarding science that they generally are not trained to make.³⁰⁰ Second, *Daubert* is often incorrectly interpreted to require satisfaction of *all* the listed factors, such that the technology is excluded if a piece of scientific evidence falls short in only one or two areas.³⁰¹ Third, the vast discretion permitted under *Daubert* leads to “arbitrary, and unpredictable results.”³⁰²

Judges are not scientists. The Supreme Court surely recognized this, but asserted nevertheless that they “are

²⁹⁵ Studebaker, *supra* note 175, at 330; *see also* Jennifer L. Groscup et al., *The Effects of Daubert on the Admissibility of Expert Testimony in State and Federal Criminal Cases*, 8 PSYCHOL. PUB. POL'Y & L. 339, 368-69 (2002) (“Lower courts are trying to determine the reliability of expert evidence mainly by a rigorous application of the Rules.”).

²⁹⁶ Studebaker, *supra* note 175, at 330. *See* Groscup, *supra* note 295, at 363-64.

²⁹⁷ *See generally* Giannelli, *Polygraph Evidence*, *supra* note 85.

²⁹⁸ *See* *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 592-93 (1993). *See also* Simmons, *supra* note 178, at 1018-23 (discussing origins of Province of the Jury).

²⁹⁹ *See* Vickers, *supra* note 32, at 143 (“By straying from the reliability factors, judges may be applying inappropriate criteria and rendering inconsistent judgments.”).

³⁰⁰ Neil Vidmar & Shari Seidman Diamond, *Juries and Expert Evidence*, 66 BROOK. L. REV. 1121, 1169-71 (2001) (citing Gary Wells, *Naked Statistical Evidence of Liability: Is Subjective Probability Enough?*, 62 J. PERSONALITY & SOC. PSYCHOL. 739 (1992)) (noting that judges were no better than jurors at “mak[ing] correct inferences from probability data”).

³⁰¹ *See* Vickers, *supra* note 32, at 120 (citing Carl F. Cranor et al., *Judicial Boundary Drawing and the Need for Context-Sensitive Science in Toxic Torts After Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 16 VA. ENVTL. L.J. 1, 10 (1996)).

³⁰² *Id.* (citing Cranor, *supra* note 301, at 5).

confident that federal judges possess the capacity to” assess “whether the reasoning or methodology underlying the testimony is scientifically valid and . . . whether that reasoning or methodology properly can be applied to the facts in issue.”³⁰³ While they tend to have more education, on average, than the typical juror, judges are surprisingly weak on some of the basic scientific concepts required to carry out a *Daubert* analysis.³⁰⁴ In fact, one study showed that only 71% of state judges³⁰⁵ grasped the significance of peer review.³⁰⁶ Astonishingly, only 6% understood what falsifiability was, and only 4% knew what an error rate was.³⁰⁷ These concepts represent three of the four principal *Daubert* factors.

Granted, the *Daubert* list of factors is not exclusive and judges may choose to rely on factors they more fully understand.³⁰⁸ However, the Court makes clear that the criteria it specifies in the decision represent many of the most fundamental aspects of reliability and relevance.³⁰⁹ For example, the decision refers to falsifiability as a “key question,”³¹⁰ and tends to treat it as a pre-requisite for reliable science.³¹¹ It is difficult to grasp how a proper *Daubert* inquiry can take place when 96% of state judges do not understand this benchmark criterion.

Studies have also shown that many judges are using the *Daubert* factors as “a definitive checklist or test,” despite the opinion’s explicit instructions to the contrary.³¹² Approaching the *Daubert* factors as a “cookbook recipe for good science”

³⁰³ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 592-93 (1993).

³⁰⁴ Sophia Gatowski et al., *Asking the Gatekeepers: A National Survey of Judges on Judging Expert Evidence in a Post-Daubert World*, 25 LAW & HUM. BEHAV. 433, 452 (2001).

³⁰⁵ State judges employ *Daubert* when their jurisdiction has adopted *Daubert*. See, e.g., *State v. Porter*, 698 A.2d 739, 746 (Conn. 1997) (“[W]e conclude that the *Daubert* approach should govern the admissibility of scientific evidence in Connecticut.”).

³⁰⁶ Gatowski, *supra* note 304, at 447.

³⁰⁷ *Id.* at 444, 447.

³⁰⁸ *Daubert*, 509 U.S. at 593.

³⁰⁹ *Id.*

³¹⁰ *Id.*

³¹¹ 1 FAIGMAN ET AL., *supra* note 86, § 1:15.

³¹² *Daubert*, 509 U.S. at 593 (“Many factors will bear on the inquiry, and we do not presume to set out a definitive checklist or test.”). See Vickers, *supra* note 32, at 133-34; Carl F. Cranor *supra* note 301, at 25 (“The *Daubert* opinion stressed the need for a flexible set of criteria to determine the admissibility of scientific evidence. Nevertheless, it left the door open for, and perhaps even invited the use of, overly simple, ‘cookbook’ admissibility rules.”).

underestimates the sophistication of the analysis³¹³ and misapprehends the “flexible” inquiry the Court intended.³¹⁴ A proper analysis involves judging the particular type of evidence, given the context, thus weighing all factors to various extents.³¹⁵ Instead, there is a tendency to “enshrine one or more of the criteria enunciated in *Daubert* as determinative, thus creating a bright-line standard with which to evaluate proffered testimony based upon a novel scientific methodology.”³¹⁶ For example, the RAND study demonstrated that, after *Daubert*, judges excluded evidence based on general acceptance *at least as* frequently as they did prior to *Daubert*.³¹⁷

In addition, judges have begun to employ factors in the *Daubert* analysis that were not set down by the Supreme Court, and to use these to exclude scientific evidence.³¹⁸ A RAND Corporation study found that since the *Daubert* decision, “judges are increasingly examining the *clarity and coherence* of an expert’s explanation of the theory, method, and procedures underlying his or her findings.”³¹⁹ Arbitrary, unpredictable results surely ensue not only when judges are meant to follow fundamental criteria that they do not understand, but especially when they add criteria to the analysis at will.³²⁰

Furthermore, it has been shown that the *Daubert* factors are not always the reasons that judges exclude particular pieces of evidence.³²¹ Rather some judges rely principally on the more ethereal requirements of the Federal Rules of Evidence: whether scientific evidence is helpful to the jury, whether the expert is qualified, whether substantial prejudice may result, and whether the testimony is based on reliable data, methods and application.³²² In fact, while judges have increasingly exercised their gate-keeping powers since

³¹³ Cranor, *supra* note 301, at 25 (“Because of the complexity of scientific issues, lower courts may shrink from the subtle but difficult task of evaluating and weighing the various kinds of scientific evidence for the context in question.”).

³¹⁴ *Daubert*, 509 U.S. at 597. See Cranor, *supra* note 301, at 25.

³¹⁵ Cranor, *supra* note 301, at 25.

³¹⁶ *Id.*

³¹⁷ LLOYD DIXON & BRIAN GILL, RAND INST. FOR CIV. JUST., CHANGES IN THE STANDARDS FOR ADMITTING EXPERT EVIDENCE IN FEDERAL CIVIL CASES SINCE THE *DAUBERT* DECISION 37 (2001).

³¹⁸ *Id.*

³¹⁹ *Id.* (emphasis added).

³²⁰ See Vickers, *supra* note 32, at 143.

³²¹ Groscup, *supra* note 295, at 354.

³²² *Id.* at 354.

Daubert, one study found surprisingly that opinions evaluating expert evidence post-*Daubert* do not mention the suggested factors any more than the pre-*Daubert* opinions.³²³

Finally, a sweeping criticism of *Daubert* has been that the opinion has led to the exclusion of too much evidence.³²⁴ Empirical studies have shown that *Daubert* has led to a wholesale increase in the amount of evidence withheld from juries. The RAND Study showed that challenges based on evidentiary reliability have increased since *Daubert*, as has the percentage of such challenges that succeeded.³²⁵ A study conducted by the Federal Judicial Center confirmed this trend.³²⁶ As a result, critics opine that *Daubert* has granted too much power to trial court judges.³²⁷

In sum, judges often do not understand *Daubert* factors, exclude evidence less frequently on *Daubert* factors than on non-*Daubert* factors, and otherwise misapply *Daubert*. Yet, at the same time, they scrutinize and exclude more evidence since *Daubert* was decided.

Because *Daubert* provides a trial judge with a great deal of power in determining admissibility of scientific testimony, and yet (either due to ignorance or misunderstanding) the judge often does not analyze properly under *Daubert*, he or she must evaluate on other criteria. One scholar suggests that “judicial reluctance to rock the prosecutorial boat may partially explain” judges’ systemic failure to correctly execute *Daubert*.³²⁸ A leading treatise asserts that at least one *Daubert* factor acts merely “as a proxy for [judges’] confidence in the expert’s

³²³ *Id.* at 365 (“These findings suggest that judges understand the importance of the *Daubert* decision, but they pay only passing attention to the suggested criteria.”).

³²⁴ Brennan, *supra* note 33, at 565-66 (noting excessive exclusion of evidence in toxic torts). See also Vickers, *supra* note 32, at 109.

³²⁵ Dixon & Gill, *supra* note 318, at xv.

³²⁶ Studebaker, *supra* note 175, at 330.

³²⁷ Vickers, *supra* note 32, at 114 (citing David M. Malone & Paul J. Zwier, *Epistemology After Daubert, Kumho Tire, and the New Federal Rule of Evidence 702*, 74 TEMP. L. REV. 103, 106 (2001)). Malone and Zwier state:

[T]he Court empowers the trial judge to cross the line between making a legal determination and making a final fact determination. . . . A court can determine that no reasonable jury could find certain facts to be true. The judiciary has that power, but it is carefully exercised because we recognize that incautious use of such power runs counter to the very foundations of the jury system.

Malone & Zwier, *supra*, at 106.

³²⁸ Schwartz, *supra* note 244, at 41-42 (arguing all firearm and toolmark identification evidence should be excluded under *Daubert* due to lack of scientific foundation).

opinion.”³²⁹ Carl F. Cranor discusses widespread judicial misunderstanding of *Daubert*; recognizing the effect of “prejudicial tendencies in both science and legal procedure.”³³⁰

This Note suggests that in the case of fMRI lie detection, trial judges, consciously or not, may look to the cultural perception of “mind reading”-type devices to inform the evidentiary evaluation. A judge’s resistance to and lack of confidence in such a science-fictional technology may inform the decision. Several news articles announcing the successes of this technology have, in their very headlines, described the fMRI as virtually being able to read minds even though that formulation far overstates the test’s ability.³³¹ The press seems to bank on the titillation associated with telepathy. As a culture we are deeply divided over tests that betray the workings of the mind because they threaten our deepest notions of privacy as much as they promise insight.³³² For example, the fMRI has raised extensive concerns about privacy interests in thoughts.³³³

Entwined with concern over its “mind reading” implications is considerable doubt that such a device is within the realm of possibility. While many reasonable arguments can be leveled at the reliability of fMRI lie detection at this early stage,³³⁴ one need only raise this issue at a water cooler or cocktail party to see the skepticism’s unusual fervor. Perhaps we think our minds are too opaque to ever be laid bare by a machine, or perhaps we so desperately cling to this last frontier of privacy that we are willing it to be impossible. In either case, there is resistance to “mind reading” technology, even one as primitive as the fMRI lie detector.

The polygraph has gotten a raw deal compared with other technologies perhaps because of a cultural stigma. Some

³²⁹ 1 FAIGMAN ET AL., *supra* note 86, § 8:15 (the error-rate factor).

³³⁰ Brennan, *supra* note 33, at 566. (critiquing judicial application of *Daubert* in toxic tort context).

³³¹ *See supra* note 294.

³³² “Little if any attention has been paid to potential misuse and the devastating impact it would have on our civil liberties.” Willing, *supra* note 11, at 5A (quoting Barry Steinardt, director of the ACLU’s technology and liberty project). Earlier this year, the ACLU filed a Freedom of Information Act request to government agencies including the Pentagon, CIA, NSA, FBI and Department of Homeland Security. ACLU, *supra* note 2.

³³³ Rosen, *supra* note 17, at 53. *See generally* Stacey A. Tovino, *The Confidentiality and Privacy Implications of Functional Magnetic Resonance Imaging*, 33 J.L. MED. & ETHICS 844 (2005).

³³⁴ Willing, *supra* note 11, at 5A.

scholars assert “more science and more research exist concerning polygraph examination than about most or all of the traditional forensic sciences.”³³⁵ Nevertheless, DNA evidence was “accepted blindly,” even though the underlying procedures at the time were deeply flawed.³³⁶ Furthermore, legal professionals are realizing that many of the courtroom’s most trusted forensics fare poorly under a true *Daubert* analysis.³³⁷ The “all but unquestioned [technologies,] under older admissibility tests, appear[] to have startling weaknesses when viewed through the lens of the new test.”³³⁸ Nevertheless, in some instances, the courts are using their discretion and *Daubert*’s flexibility to hold on to particularly prized techniques.³³⁹ For example, despite mounting evidence that latent fingerprint analyses is simply not reliable, courts are “manipulating the law” to continue admitting such evidence.³⁴⁰ Such observations invite speculation that something beyond the pure, legal analysis is at play.

Jennifer Mnookin argues in the context of fingerprinting that an age-old, yet faulty, notion about the reliability of a forensic field may cause a court to overlook *Daubert*’s methodical inquiry.³⁴¹ At the very least, “[d]islodging such a prior belief will require, at a minimum, a great deal of evidence, more than the quantity needed to generate doubt about a technique in which people have less faith.”³⁴² Likewise, perhaps a field such as lie detection, so plagued with concern and skepticism, may require enormously high accuracy rates and an extensive track record, beyond what a court would ask of a less stigmatized field. Perhaps the higher standard demanded of lie detection has less to do with the Province of the Jury or the stigma of the polygraph, and more to do with the stubborn dislike of mind reading. In other words, just as judges find that *Daubert* is satisfied for deeply entrenched

³³⁵ Park & Saks, *supra* note 221, at 982.

³³⁶ *Id.*

³³⁷ *Id.* at 981-82.

³³⁸ *Id.*

³³⁹ See, e.g., Mnookin, *supra* note 258, at 66.

³⁴⁰ Park & Saks, *supra* note 221, at 983.

³⁴¹ Mnookin, *supra* note 339, at 67.

³⁴² *Id.* See also 1 FAIGMAN ET AL., *supra* note 86, § 1:29 (“An excellent, albeit deeply troubling, example of a court straining scientific credulity for the sake of a venerable forensic science comes from the area of fingerprinting. . . . The court . . . applied the *Daubert* factors in a way that approaches a caricature of the scientific culture.”).

technologies, despite little, actual scientific support, it may be dissatisfied with novel and innovative technologies, despite what appears to be a high measure of reliability.

Michael Pardo encourages courts to learn from history, likening the fMRI to the once-frightening photograph.³⁴³ “Photography, it was thought, potentially could usurp the power of courts to determine facts by shifting power to photography experts, and away from courts, to determine the true nature of reality. None of this happened, of course, because the evidence was eventually assimilated.”³⁴⁴ Fact-finders have come to learn in which circumstances photographs might be helpful and in which they might not.³⁴⁵ Pardo suggests that the same evolution is likely with fMRIs.³⁴⁶ He puts forward the following scenario: “there may be an initial divergence in the willingness of courts to admit the evidence, but (perceived) reliable use for limited purposes in some initial cases may lead to an increased willingness of other courts to exercise their discretion and admit it.”³⁴⁷

Pardo underestimates, however, the implications of early failures at trial. If the first set of attempts to admit fMRI lie detection tests fail, it is likely that courts hearing subsequent requests will follow the precedents rather than defend a new, complicated, and controversial technology.³⁴⁸ Early rejections might not only stall, but doom the technology’s admissibility for years to come. One need only look at *Frye* to see the devastating effect an early rejection could have on the science’s fate in the courtroom, even though the 1923 opinion *left the door open for subsequent advances in polygraphy*.³⁴⁹ Furthermore, early failures might dry up the private funding financing the research and development for companies such as Cephos and No Lie MRI.³⁵⁰

³⁴³ Pardo, *supra* note 10, at 311.

³⁴⁴ *Id.*

³⁴⁵ *Id.*

³⁴⁶ *Id.*

³⁴⁷ *Id.* at 320.

³⁴⁸ Brooklyn Law School Professor Edward K. Cheng suggested this point.

³⁴⁹ The closing lines of the opinion read: “We think the systolic blood pressure deception test has not *yet* gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments *thus far made*.” *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923) (emphases added).

³⁵⁰ Although federal funding, specifically from the defense department might not be affected. *See supra* note 16.

Pardo also underestimates the cultural stigma associated with this type of technology. The polygraph is a closer analogy to fMRI lie detection than the photograph because the polygraph, like the fMRI, looks beyond what the eye can see and into the machinations of the brain. In fact, the fMRI technology goes even further into these troublesome areas than the polygraph. Any uneasiness toward the polygraph is likely to be triggered in the fMRI debate as well. Therefore the polygraph's troubled fate is a more appropriate predictor for what the fMRI must combat in the years to come.

There are several worrisome consequences to unjustifiably excluding fMRI evidence. First, helpful and reasonably accurate evidence regarding truth telling will not get to the jury. The scope of this concern includes any trial that revolves around the fact-finder believing the person testifying. Given the average juror's mediocre ability to distinguish the truth from a lie,³⁵¹ this is likely a significant cost.

Another problem that will result from over-exclusion of fMRI evidence, given a culturally influenced *Daubert* analysis, is its effect on a race to the courthouse. Even presuming it is aware of the court's predisposition, a company such as No Lie MRI cannot reasonably anticipate the extent of the obstacles to admissibility. Attempting too early to admit fMRI evidence may fail and further exacerbate the technology's chances of future admittance. Attempting too late deprives courts of the best evidence available in the meantime. Furthermore, the inability to anticipate the court's response to a new technology disincentivizes commercial developers who may be in the best position to develop and package the technology for courts. Therefore, while this cultural effect is conceptually understandable, it poses a significant obstacle to the introduction of the best new forms of scientific evidence.

The final problem is the resulting evidentiary law's opacity. Judges have found so many various reasons to exclude lie detection, that it will be difficult to prepare a new technology for trial.³⁵² Federal courts have excluded polygraphs for reasons including validity concerns, fear of overvaluing the evidence, Province of the Jury doctrine, and "the possibility that the trial will degenerate into a time-consuming trial of the

³⁵¹ See *supra* note 288.

³⁵² Giannelli, *Polygraph Evidence*, *supra* note 85, at 916, 918-19.

technique.”³⁵³ (In at least one case, the judge thought that the specific examination questions were too broad and excluded the evidence as irrelevant.³⁵⁴) The decisions, moreover, have resulted not just in doctrinal inconsistencies throughout the country,³⁵⁵ but in paradoxes,³⁵⁶ unusually shifting standards,³⁵⁷ and hazy *Daubert* analyses.³⁵⁸

Laken, the CEO of Cephos, opined that his company had been working hard to pass the *Daubert* analysis: testing, publishing, and improving accuracy.³⁵⁹ That may not be enough. Assuming that fMRI litigation will draw comparisons from the polygraph, how can Cephos, or No Lie MRI, be confident entering this fray? Even though the two companies will go to great pains to distinguish themselves from any legal precedent of the polygraph, a cultural distrust of lie detectors may well cause them trouble.

Therefore, the typically loose *Daubert* analysis will likely endanger technologies like the fMRI, because cultural prejudice against new and contentious disciplines can easily, even innocently, color the evidentiary decision. The result: helpful and reliable evidence is excluded, the technology’s developers are disincentivized, and the precedents are hard to interpret.

V. CONCLUSION

The companies vying to win market share in fMRI lie-detection technology have a treacherous road ahead. While *Daubert* gave a glimmer of hope to the fMRI’s crude cousin, the

³⁵³ *Id.*

³⁵⁴ *United States v. Kwong*, 69 F.3d 663, 668 (2d Cir. 1995).

³⁵⁵ *See supra* text accompanying notes 181-201.

³⁵⁶ Giannelli, *Polygraph Evidence*, *supra* note 85, at 899 (“For example, many jurisdictions admit polygraph evidence upon stipulation, even though the stipulation does nothing to enhance the reliability of the evidence, which is the principal reason for exclusion. Similarly, courts have admitted polygraph evidence in suppression hearings, sentencing hearings, motions for new trial proceedings, and prison disciplinary hearings. Moreover, some courts have enforced plea bargains based on polygraph evidence. Third, the extensive use of the polygraph by the government raises another paradox—especially for prosecutors challenging its admissibility.” (footnotes omitted)).

³⁵⁷ *Simmons*, *supra* note 178, at 1016 (The Polygraph “is the current (and perhaps final) battleground for the admissibility of evidence that was once thought to invade the province of the jury.”).

³⁵⁸ Giannelli, *Polygraph Evidence*, *supra* note 85, at 916, 919-24 (stating courts allude to but do not articulate the research, procedure, and examiner qualification upon which they base the decisions).

³⁵⁹ Laken Transcript, *supra* note 9, at 10:16-11:8, 44:8-45:4.

polygraph, it remains generally excluded. The fMRI should fare far better under a proper *Daubert* analysis. Reasonable objections, however, could be raised regarding accuracy and general acceptance considering the technology's youth. Moreover, a substantial number of trial courts exclude scientific evidence for reasons not set down in *Daubert*.³⁶⁰ If judges, in making their evidentiary decisions, were to allow themselves to be influenced by the skeptical cultural ethos towards "mind reading" technologies, they will exclude it. Alternatively, a court may determine that fMRI results satisfy *Daubert*, but then immediately turn to either the Province of the Jury Doctrine or Rule 403 to keep this perplexing technology at bay.

While *Daubert* permits a court to weigh the relevant scientific community's opinion of "mind reading" evidence, it gives no such weight to the public's opinion at large. A frank discussion of society's fears and suspicions of these technologies is necessary.

Policy makers should understand that when it comes to issues as controversial as these, judges' evidentiary decisions may be permeated by societal doubts and cultural attitudes. Trial courts are not immune from such deeply held beliefs and will find countless ways, under the available doctrines, to allow them to sway an evidentiary decision. Any lawyer seeking admissibility for these techniques would be well-advised to specifically address such powerful suspicions. To rely only on what is specifically demanded by the relevant doctrines is a mistake.

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³⁶⁰ See discussion *supra* Part IV.

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