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How Functional Magnetic Resonance Imaging (fMRI) Will Change the Legal Profession –

A View from the United States of America

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A. Introduction

The United States Congress declared the 1990s to be the "Decade of the Brain," and provided funding for research that would attempt to solve its many mysteries.[1] The term neuroethics first made its appearance in scientific literature during the beginning of this decade. These publications generally described the role of the neurologist as a neuroethicist who was faced with issues relating to patient care, end of life decisions, and philosophical questions involving how the brain is related to the self. Neuroethics as a distinct discipline was officially born when The Dana Foundation brought together 150 neuroscientists, scholars, lawyers, policy makers, and members of the media at a conference called "Neuroethics: Mapping the Field" in San Francisco in May of 2002.[2]

At this conference, William Safire called for the creation of a new discipline called neuroethics, whose main purpose would be to examine the ethical issues created by new brain research technologies.[3] The existence of the separate field of neuroethics is necessary because the ethical problems faced by neuroscience are vast enough to warrant a distinct domain within the broader area of bioethics.[4] Neuroscience is defined as the science that is concerned with the development, structure, function, chemistry, pharmacology, and pathology of the human nervous system. Neuroethics is therefore defined as the study of the ethical, legal, and social implications of neuroscience.[5]

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1 L. Reid, *Brains, Genes, and the Making of the Self*, 5(2) The American Journal of Bioethics 21 (2005).

2 J. Illes, *Neuroethics in a New Era of Neuroimaging*, 24 AJNR 1739 (2003).

3 Reid, *supra* note 1, at 21.

4 J. Kulynych, *Legal and Ethical Issues in Neuroimaging Research: Human Subjects Protection, Medical Privacy, and the Public Communication or Research Results*, 50 Brain and Cognition 345 (2002).

5 Association of the Bar of the City of New York, *The Committee on Science and Law, Are Your*

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The growth of research utilizing functional magnetic resonance imaging (fMRI) over the last decade has been exponential. In 1991, there were approximately 5 articles published in scientific journals that contained fMRI studies, but in the year 2001 there were almost 900 published fMRI studies. The nature of these studies has also changed over time. Initially, fMRI was used to examine basic sensorimotor and cognitive processes. Today fMRI studies typically explore moral emotions that are linked to societal values and the welfare of others, such as motivation, reasoning, and social attitudes. Many of these studies have societal and political implications because they examine the differences between the brains of violent and normal people, and examine how genetic differences affect brain structure and function.[6] fMRI could also be used to identify structural, metabolic, or other abnormalities involving brain activation patterns, which could help doctors prescribe the correct medicine, cognitive therapy, or lifestyle changes.[7]

The development of fMRI technology will most likely have a serious impact upon the legal community because the American legal system is largely based upon the notion of free will and personal responsibility. As the technology increases in sophistication, it is foreseeable that attempts will be made to use fMRI as a lie detector test, or to predict future violent or illegal behavior in an individual. Brain Fingerprinting, a primitive forerunner of fMRI that can allegedly detect whether or not a particular piece of information is stored within an individual's brain, has recently been ruled admissible as evidence in the case *Terry Harrington v. State of Iowa*.[8] As a result, criminal defendants are beginning to request permission to undergo Brain Fingerprinting in the hopes that negative results will help reopen their case and exonerate them of their crime.[9]

Most judges today are not prepared to handle increasingly complex scientific evidence. Based upon the current state of technology, Brain Fingerprinting and fMRI are not reliable enough to be admitted in a court of law, despite the ruling in *Harrington*. When looking ahead to the future, it is difficult to determine whether fMRI technology will ever be successfully used as a lie detector, but it is wise to establish standards and guidelines for its use before fMRI becomes widely used outside the research setting. The purpose of this paper is to explain how the unabated use of fMRI could possibly affect the rights and freedoms of American citizens, and to suggest reforms that will safely allow judges and juries to consider novel scientific evidence when making a decision.

Thoughts Your Own?: "Neuroprivacy" and the Legal Implications of Brain Imaging, 2005 (June) New York Law Journal, at 1.

6 J. Illes, *From Neuroimaging to Neuroethics*, 6 Nature Neuroscience 205 (2003).

7 T. Canli & Z. Amin, *Neuroimaging of Emotion and Personality: Scientific Evidence and Ethical Considerations*, 50 Brain and Cognition 428 (2002).

8 Terry Harrington *v.* State of Iowa 659 N.W.2d 509, 516 (2003).

9 Elvin Lebron *v.* Thomas Sanders 2005 WL 3534794 (S.D.N.Y.).

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B. The Technology

Brain Fingerprinting, a primitive technology that is arguably a forerunner to fMRI, was largely developed and patented by Dr. Lawrence Farwell's Brain Fingerprinting Lab, and was ruled admissible as evidence in the case *Terry Harrington v. State of Iowa*.[10] Anything you think, imagine, sense, feel, or experience produces changes in your brain's electrical activity and can be detected by an electrode placed upon the scalp. In his experiments, Dr. Farwell studied the brain's EEG by presenting a subject with a specific event and then recording the response, which is called the Event Related Potential (ERP). According to Dr. Farwell, familiar images will elicit a response called a MERMER. A MERMER will not occur when a subject is presented with a novel image or situation. Dr. Farwell makes the claim that the MERMER is an extension of the widely discussed and studies P-300 brainwave. A P-300 shows a peak electrical response after a stimulus, but the MERMER is longer and more complex, comprising of both a peak and valley of electrical events occurring 300-800 ms after the stimulus and another response 800+ ms after the response. The technology is designed to detect the brain activities that occur when a person is exposed to a stimulus, thereby allowing an examiner to conclude whether or not the stimulus consists of new or familiar information. The major question is whether Brain Fingerprinting can be used to help determine the guilt or innocence of a defendant. Brain Fingerprinting cannot directly tell if someone is lying or telling the truth, it just determines if that particular piece of information is found within the brain.[11]

fMRI is much more sophisticated than Brain Fingerprinting because the technology allows the investigator to examine a subject's true thoughts and feelings.

fMRI uses radio waves and a strong magnetic field to measure the quick, tiny, metabolic changes that take place within the active part of the brain. An image of the brain is created by an instrument that records the changes in regional levels of oxygenated blood without the use of any ionizing radiation or invasive procedures. fMRI images are called BOLD contrasts, which measure the consequences of neural activation, not the activation itself. The technology creates images by relying on the fact that increases in neural activation causes that region of the brain to have a greater demand for oxygenated blood. Oxygenated and deoxygenated blood have different magnetic properties: diamagnetic v. paramagnetic, respectively. This difference in magnetic fields creates a loss in fMRI signal strength whenever deoxygenated blood enters a region of the brain, which is used to indicate that that particular region of the brain has a low level of activity. fMRI is growing in popularity because it is technically superior to the other imaging techniques. For example, fMRI has a spatial resolution, temporal resolution, and a signal-to- noise ratio that is superior to PET technology. In addition, although EEG and

[10] www.brainwavescience.com.
[11] Interview with Dr. Farwell on www.brainwavescience.com.

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MEG scanners have a superior temporal resolution because they are able to acess the neurons of the brain more directly, fMRI continues to have the advantage over these imaging techniques because they are unable to produce true 3-D images.[12]

Presently, fMRI is performed using a conventional MRI unit where the patient lies on a table and is asked to perform a series of tasks or answer a group of questions. A round of tests usually lasts between 15-45 minutes, during which the subject is not subjected to any pain or discomfort except for the fact that they cannot move during the imaging. Some movement is allowed, however, in-between the actual testing periods. A brace or special pillows may be used, if necessary, to keep the head still.[13] Upon the completion of the procedure, a radiologist who is trained in interpreting MRI exams will read the brain scans and send a signed report to the referring doctor.

Though fMRI currently has limited use outside the laboratory, numerous scientific studies have used this technology to investigate the relationship between bran function and thought processes, emotion and personality. fMRI is making great contributions to the social sciences by studying the neural basis of emotional recognition, experience, memory, regulation, and the differences between the brains of individuals.[14] Before fMRI, the functions of the human prefrontal cortex were largely unknown. Today, many different types of mental subprocesses are believed to be frontally localized, including the ability to "mentalize" or engage in a theory of mind that is able to understand the thoughts and feelings of others.[15] Over time, this technology may be further developed to become an unbeatable lie detector test, be used to predict violent behavior caused by an individual, or be used to reveal the identity of future terrorists. fMRI may also shed light upon questions that have long plagued the criminal justice system, such as whether biological determinism causes some people to become psychopaths or be prone to violence, whether people are truly capable of change, and whether people should be held accountable for their actions.[16]

C. Scientific Evidence

The frontal lobes have long been considered to play a key role in human behavior. Patients with frontal lobe defects often have deficits in higher-level cognitive functions, social behavior, personality, memory, and self-awareness.[17] A recent fMRI study concluded that lesions of the frontal lobe impair a person's ability to infer mental states in others, take in visual perspectives, and detect deceptive

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[12] J. E. Desmond & S. H. A. Chen, *Ethical Issues in the Clinical Application of fMRI: Factors Affecting the Validity and Interpretation of Activations*, 50 Brain and Cognition 482 (2002).

[13] Radiological Society of North America, *Functional MR Imaging*, RadiologyInfo, available at http://www.radiologyinfo.org/content/functional_mr.htm, at 3. Last visited on 25 November 2005.

[14] Canli & Amin, *supra note* 7, at 415.

[15] D. T. Stuss *et al.*, *The Frontal Lobes are Necessary for "Theory of Mind"*, 124 Brain 279 (2001).

[16] Canli & Amin, *supra note* 7, at 416.

[17] Stuss *et al.*, *supra note* 15, at 279.

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behavior in others. All of these functions are necessary for a person to function successfully in society. Previous studies had suggested that damage to the left or tight orbitofrontal/ventral medial areas of the brain caused these changes, but they did not indicate which areas in particular are essential. This current study tested 32 patients with frontal lobe lesions on their ability to detect deception performed by research assistants during simple perspective taking tasks.[18] The results showed that more frontal lobe patients made one or more errors than any other group, and further analysis showed that patients with right frontal lesions in particular made more errors than the control subjects. The results of this study indicate that these patients have a disorder that prevents them from using their memories and prior experiences to help interpret the thoughts and perceptions of other people. These subjects were unable to use their past emotional experiences to guide them during the experiment, causing them to fail to realize that the research assistants were trying to deceive them.[19]

Current evidence from evolutionary biology, neuroscience, and experimental psychology have shown that morality is grounded in the brain, and that human behavior is implicitly moral and results from multiple psychological and neurobiological processes.[20] It is estimated that approximately one half of all prison inmates suffer from at least one neuropsychiatric disorder, such as antisocial personality, alcoholism, or drug dependency. A condition called acquired sociopathy can occur when damage to the brain destroys particular neural networks in certain combinations. For example, kleptomania and a propensity towards committing acts of robbery have been found to occur as a result of frontal lobe damage. In addition, it is known that sociopathy has been caused by frontopolar damage, and incidences of mania have arisen from orbitofrontal cortex damage.[21] These patients typically lack the callousness and evil intent found in developmental psychopaths, but like true psychopaths, they are often socially inadequate, impulsive, and have a lack of foresight.[22]

Researchers have used fMRI to investigate the paradox of an individual who "talks good but acts badly."[23] These people retain the ability to tell right from wrong and to articulate moral statements and social mores, but their actions in real life contradict these beliefs.[24] In one fMRI study, the subjects were instructed to make categorical judgments of right or wrong during an audio presentation of short statements consisting of either factual or moral content. When the results regarding the moral condition were contrasted with the factual condition, the FPC and the medial frontal gyrus were activated during the moral condition across all subjects. In addition, the left medial orbitofrontal cortex (OFC) and posterior superior temporal sulcus were activated by moral judgments, while the amygdala,

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18 *Id.* at 280.
19 *Id*. at 286.
20 J. Moll & P. J. Eslinger, *Morals and the Human Brain: A Working Model*, 14 NeuroReport 299, at 300 (2003).
21 *Id*. at 302.
22 *Id.* at 303.
23 *Id*. at 300.
24 *Id*.

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basil forebrain, and visual cortex were activated during non-moral judgments involving unpleasant emotions. Previous studies involving patients with OFC lesions indicated that these people are unable to inhibit their motivations regarding aggression and sexual desire. In addition, damage to the anterior cingulated cortex (aCC) has been shown to decrease the level of behavioral spontaneity, while superior temporal sulcus (STS) damage has been indicated to impair social intercourse by preventing the integration of visual and linguistic cues during that person's appraisal of social situations. Finally, damage to the basal forebrain is believed to pervert a person's instinctual motivations, thereby causing crude moral violations, and damage to the amygdala is thought to impair perceptions of fear, anger and distrust, which gives an explanation as to why psychopaths are typically unresponsive when confronted with distressful stimuli. The main lesson to be taken from this experiment is that it is possible to identify key regions of the brain that are vital to moral behavior and reasoning, therefore it could be assumed that disruptions in social and moral behavior would be likely to follow the destruction of certain brain networks.[25]

It was previously believed that our ability to engage in higher levels of reasoning and cognition eventually allowed us as a species to develop the capacity to undergo moral rationalization. fMRI studies, however, have shown that moral judgments of a personal nature, the outcomes of which cause direct harm to others, are actually driven largely by emotional responses, while impersonal moral judgments that inflict indirect harm are driven more by cognitive processes. It is now believed that the brain areas associated with emotion and cognition are activated during personal, moral judgments, while areas associated with memory and cognitive processes are active during impersonal moral judgments.[26] In the most difficult personal moral dilemmas, however, a synthesis occurs, during which a person's immediate response is driven by rapid, intuitive reactions, which are later followed by a period of deliberative reasoning that provides rational justifications for the initial decision.[27]

People are faced with making wide ranges of moral decisions. Ethical dilemmas can range from simple questions that have clear answers, to complex problems that do not have one correct "answer." To further define which brain regions are responsible for the both the emotional and the cognitive aspects of moral reasoning, as opposed to which are engaged in the actual ethical decision making, subjects in an fMRI study were scanned during both simple and complex ethical decision making tasks.[28] Complex moral decisions, when compared to simple decisions (yes/no), were found to activate the left posterior STS, MTG, bilateral temporal pole, left bilateral PFC, and bilateral vmPFC.[29] The results of the study

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[25] *Id*. at 303.

[26] J. D. Greene, L. Nystrom *et al*., *The Neural Bases of Cognitive Conflict and Control in Moral Judgment*, 44 Neuron 389 (2004).

[27] *Id*. at 397.

[28] H. R. Heekeren *et al*., *An fMRI Study of Simple Ethical Descision-Making*, 14 Cognitive Neuroscience and Neuropsychology 1215 (2003).

[29] *Id.* at 1218.

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illustrate that it is possible to detect regions in the brain that are responsible for making complex moral decisions. These regions apparently join together to create a network whose purpose is to enable these decisions to be made.[30]

It is estimated that psychopathology is found in only 1% of the total population, but 15-25% of the prison population is believed to be affected by this mental condition. In addition, when compared to the rest of the prison population, psychopathic inmates are responsible for committing a greater amount of repetitive, violent acts. Psychopathy is characterized by glibness, superficiality, and the lack of empathy, guilt or remorse, which appears to result from an inability to properly process emotional cues and feedback.[31] Furthermore, these people are typically selfish, unable to learn from punishment, manipulative, superficial, unable to form long lasting relationships, impulsive, and often engage in sensation seeking behavior.[32]

fMRI studies have begun to study why psychopaths have difficulty in responding to certain emotional stimuli. A study involving psychopathic criminals, non-psychopathic criminals, and normal controls revealed that when compared to the other groups, psychopaths activate a greater number of neural networks when evaluating emotional stimuli. These results seem to infer that because psychopaths have to utilize greater amounts of brainpower in order to process this type of information, these people have trouble processing and interpreting emotional stimuli. There is also strong evidence that psychopaths tend to have defects in their frontal cortex. Studies show that when compared to normal subjects, psychopaths have much less activity in the areas of the frontal cortex that are related to affect, and also have greater activation levels in the areas associated with attentional, semantic, and decision making processes.[33] These results suggest that when processing emotional information, psychopaths utilize cognitive strategies that are not present in the normal population.[34] In addition, these abnormalities often show up at an early age, and are particularly perplexing because they are not evidenced by any detectable brain defects.[35]

Additional fMRI studies have found a network of areas in the brain that activate in reaction to emotional stimuli: the orbifrontal cortex, dorsolateral prefrontal cortex, cingulate gyrus hippocampus, and the amygdala.[36] A fMRI study which showed a group of psychopaths and normal controls a series of emotionally charged pictures, discovered that both groups had increased activation in the right and prefrontal regions, anterior cingulated, and amygdala in response to the "negative" pictures, while the "positive" pictures increased activation in the left

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30 *Id.* at 1219.

31 K. A. Kiehl *et al*., *Limbic Abnormalities in Affective Processing by Criminal Psychopaths as Revealed by Functional Magnetic Resonance Imaging*, 50 Society of Biological Psychiatry 677 (2001).

32 J. L. Muller *et al.*, *Abnormalities in Emotion Processing Within Cortical and Subcortical Regions in Criminal Psychopaths: Evidence from a Functional Magnetic Resonance Imaging Study Using Pictures with Emotional Content*, 54 Society of Biological Psychiatry 152 (2003).

33 Kiehl *et al*., *supra note* 31, at 667.

34 *Id.* at 682.

35 *Id.* at 682.

36 Muller, *supra note* 32, at 152.

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gyrus frontalis.[37] When compared to normal test subjects, however, psychopaths had reduced activity in the right subgenual cingulate, right medial temporal gyrus, left lobulus paracentralis, left dorsal cingulate and left parahippocampal gyrus when viewing the negative pictures.[38] These results are important because they illustrate that psychopaths have abnormal brain circuitry in the areas that are responsible for processing emotional stimuli, which further indicates that the causes of their mental illness are biological in nature.[39]

Adult patients with psychopathy often retain intellectual knowledge of right from wrong, but it is not known whether early onset brain damage would prevent the acquisition of this knowledge, or if further brain development would reduce the effects of the injury.[40] In a study that followed two young patients with prefrontal brain damage through adulthood, both children had behavior problems, did not properly learn normal social rules, approached moral dilemmas from an egocentric perspective in order to avoid punishment, and were interested in obtaining immediate gratification despite the long-term consequences or social implications.[41] These results can be contrasted with adult patients, who can still retrieve social norms and solve moral problems inside the lab. It appears that emotional knowledge shapes a person's reasoning process, and when it cannot be retrieved, the recall of social mores either does not occur or is too weak to influence behavior. The children participating in the study needed these damaged systems in order to acquire and retain knowledge of proper social behavior, but since brain lesions prevented these individuals from ever acquiring such knowledge, they developed traits typically associated with psychopaths.[42] This further exemplifies that psycopathy is a result of the abnormal functioning of the prefrontal cortex.[43]

Lying, according to Saint Augustine, is the intentional negation of subjective truth.[44] In order to be an effective liar, an individual must utilize numerous thought processes, such as recalling learned social norms, analyzing the context of the situation, and monitoring the response to the lie.[45] There are theorists who claim that fMRI has the potential to become the perfect lie detector. For example, one recent fMRI study has detected the difference in brain activation between lying and telling the truth during a card game. Because the researchers in this study found regions of the brain that were more active during lying than telling

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37 *Id*. at 156.
38 *Id.* at 157.
39 *Id*. at 160.
40 S. W. Anderson *et al.*, *Impairment of Social and Moral Behavior Related to Early Damage in Human Prefrontal Cortex*, 2 Neuroscience 1032 (1999).
41 *Id.* at 1033.
42 *Id.* at 1035.
43 *Id*. at 1036.
44 D. D. Langleben *et al.*, *Brain Activity During Simulated Deception: An Event Related Functional Magnetic Resonance Study*, 15 NeuroImage 727 (2002).
45 S. A. Spence, T. F. D. Farrow *et al*., *Behavioral and Functional Anatomical Correlates of Deception in Humans*, 12 NeuroReport 2849 (2001).

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the truth, but found no regions that were more active during telling the truth than telling a lie, they concluded that telling the truth is a person's baseline state of existence.[46]

Another fMRI study attempted to expose the actual structures involved in the lying process and minimize the effects of any outside social influences by asking subjects to withhold truthful responses to yes/no questions in a laboratory setting.[47] Researchers discovered that not only did lying significantly increase response times during questioning, but it also activated the bilateral, ventrolateral, prefrontal and medial premotor cortices.[48] Researchers had previously believed that these areas of the brain inhibit impulsive acts, so a logical conclusion would be that they are activated during a liar's inhibition of the truth. Lying increases response times to questioning not because the individual is devising new strategies of lying, but because the person is exerting energy to suppress the truth and give the opposite answer by constructing a new piece of information. If this skilled control of information is successfully learned and utilized early in life, a person might become a pathological liar in adulthood. It is necessary to conduct follow up studies to this experiment, however, because the questions that were used were simple and were lacking in emotional content.[49]

One fMRI study that attempted to expand upon this experiment investigated whether or not brain activation during feigned memory loss is distinguishable from normal memory recall.[50] Participants were trained how to fake memory impairment, and were then instructed to answer the memory tasks correctly, incorrectly, randomly, and purposely faking the answer.[51] Researchers hypothesized that the brain areas involved in cognitive control, selection of retrieval strategies, and calculation would be greatly activated.[52] The results showed that the prefrontal and frontal regions responsible for manipulating information into integrated strategies were activated during feigned memory impairment, suggesting that previously stored information is being retrieved and processed. Also, the sub cortical regions that inhibit learned rules and monitor mistakes and errors were also activated, suggesting that the people who were trained to cheat beforehand have to expend energy in order to inhibit the correct response and monitor their performance.[53] The results of this study suggest that it is impossible for a person to control their cerebral activity in order to avoid detection during an fMRI exam.[54]

Evidence shows that fMRI can possibly reveal what a person is thinking, even if the thoughts are held at the subconscious level. When study participants were shown several series of patterns on a screen, and each series contained one image

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46 Langleben *et al*., *supra note* 44, at 731.
47 Spence, Farrow *et al*., *supra note* 45, at 2849.
48 *Id*. at 2851.
49 *Id*. at 2852.
50 T. M. C. Lee *et al.*, *Lie Detection by Functional Magnetic Resonance Imaging*, 15 Human Brain Mapping 157 (2002).
51 *Id*. at 159.
52 *Id*. at 158.
53 *Id*. at 162.
54 *Id*. at 163.

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that was shown too quickly to be seen, brain scans were able to detect the patterns of brain activity created by the unseen image. In addition, when the test subjects were shown a series of stripes tilted in different directions, the changes in the pattern created small differences in the brain scan. By using a computer program that was designed to recognize these differences, researchers could predict which pattern of stripes had been shown to the study participant. "This is the first basic step to reading somebody's mind," says researcher Dr. Geraint Rees. "If our approach could be expanded upon, it might be possible to predict what someone was thinking or seeing from their brain activity alone."[55]

Another fMRI study scanned people who either viewed portraits or landscapes. A week later, the researchers asked these subjects to imagine the same image while undergoing a second brain scan. The researchers discovered one area in the brain that responds strongly to faces, and another area that responds to landscape images. The same areas of the brain were activated regardless if the person was viewing the object or only imagining it, the only difference being that the activation levels were less intense for the imagined images. In addition, the researchers were able to predict with 85% accuracy whether the study participant was looking at a portrait or a landscape by merely looking at the brain scan.[56]

Furthermore, researchers who scanned subjects while viewing various movie clips were able to tell which scene a person was watching by reading their brain scan. The leader of the research team, Dr. John-Dylan Haynes of the UCL Institute of Neurology, commented: "We could tell from a very limited subset of possible things the person is possibly seeing. One day, someone will come up with a machine in a baseball cap. Our study represents an important but very early stage step towards eventually building a machine that can track a person's consciousness on a second by second basis," but added "We are still a long way off from developing a universal mind-reading machine."[57] Eventually, brain scanning technology could be used to predict a person's preferences, attitudes, sexual orientation, tendencies toward aggression, and the likelihood of suffering from various forms of mental illness during their lifetime.

D. fMRI and the War Against Terror

There are researchers who claim that brain imaging techniques are already capable of identifying criminals and thwarting terrorists. Steve Kirsch, founder of InfoSeek and CEO of Propel Software, believes that technology companies could presently deliver a working combination of a brain fingerprinting and iris scanning system that could be used to detect potential terrorists before they board

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[55] *Brain Scan Sees Hidden Thoughts*, BBC News, 25 April 2005. Transcript viewed on 17 November 2005 at http://news .bbc.co.uk/2/hi/health/4472355.stm.

[56] Baycrest Center for Geriatric Care, *Brain Imaging Technology Can Reveal What a Person is Thinking About*, available at http://www.sciencedaily.com/Releases/2000, visited on 20 November 2005.

[57] *Thoughts Read via Brain Scans*, BBC News, Aug. 7, 2005. Transcript viewed on 15 November 2005 at http://news.bbc.co.uk/2/hi/health/4715327.stm.

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a plane. A traveler would create a security risk profile of himself/herself before reaching the airport by watching a ten-minute video that contains images that would only be found within the brains of active terrorists. The profile would then be linked to that person's iris image, and after a quick iris scan would be used to either permit or deny access to the airport terminal.[58]

The effectiveness of this technology is partly due to the efforts of Daniel Langleben and his colleagues at the University of Pennsylvania School of Medicine, who claim to have created an algorithm that can detect false statements with 99% accuracy. The previous technology allowed researchers to discover which areas of the brain were activated during the act of lying, but it was not able to tell if a particular individual was lying because the results were averaged together with the other participants in the study. A member of Langleben's team claims that "Now we can tell when an individual lies on a specific question."[59]

The United States has been greatly criticized for employing apparently barbaric interrogation techniques against detainees held captive in the War Against Terrorism. Brain scanning technology would resolve many of these issues, while at the same time create new ones. According to international law, detainees are placed within one of three categories according to legal status and physical location: POWs and civilians detained during an international armed conflict, unlawful combatants held within US territory, and unlawful combatants held outside US territory. The purpose of the law in these situations is to predetermine how much pain an interrogator may inflict upon these individuals. The law grants each category of detainee varying levels of protection during interrogation. POWs and civilians qualify for the most extensive level of protection under International Humanitarian Law, which prohibits the use of "coercion" during interrogation upon these individuals. The United States military currently defines coercion as "the elimination of an individual's free will." Using fMRI to verify voluntary statements made by POWs would probably be permissible, but using it to gather information involuntary would most likely be coercive because the technology would be used in a way that would restrict the individual's free will.[60]

International Humanitarian Law does not apply to the second category of detainees, who are unlawful combatants being held within US territory. These detainees are protected under International Human Rights Law, however, which prohibits torture and cruel, inhuman, or degrading treatment.[61] Using fMRI to interrogate these people would not constitute torture because the UN has defined torture to occur only when "severe pain or suffering, whether physical or mental, is intentionally inflicted on a person for such purposes as obtaining information from

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[58] Th. Greene, *Brain Scans Can Defeat Terrorism, InfoSeek Founder Claims*, The Register, 3 October 2001. Available at http://theregister.co.uk/2001/10/03.

[59] J. Wild, *Brain Imaging Ready to Detect Terrorists, Say Neuroscientists* (2005), available at www.nature.com/news. Last visited 20 November 2005.

[60] S. K. Thompson, *The Legality of the use of Psychiatric Neuroimaging in Intelligence Interrogation*, 90 Cornell L. Rev 1601, at 1603 (2005).

[61] *Id.* at 1604.

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him."[62] In addition, the United States has attached a specific intent requirement to the statute which requires that either the torturer must intend to inflict severe pain upon the subject, or the mental pain and suffering must be a prolonged mental harm.[63] Brain scanning procedures are painless and not physically intrusive. The subject would be lying down in the apparatus, and pain could only arise as a result of fighting against the restraints. The restraints, however, are not uncomfortable, and it is possible to immobilize the head with foam pillows. In addition, even a claustrophobic detainee would not remain in the device long enough to experience prolonged mental harm.[64]

In order to determine whether fMRI is cruel, inhumane, or degrading, a court under the Due Process Clause would use a three-part test in order to determine if the procedure "shocks the conscience." The court would analyze the conduct surrounding the government's personal invasion, analyze the inherent invasiveness of the personal invasion, and determine whether the governmental interest justifies the invasion. This standard typically only protects a person against the most abusive forms of governmental conduct. fMRI is physically harmless and would probably not shock the conscience of a court, but it is certainly mentally intrusive and quite possibly degrading to the individual, therefore in order for the government to use the procedure upon an unwilling detainee, the government must show it has a legitimate reason to use the exam.[65]

The third category of detainees not only have no protection under International Humanitarian Law, but because these people are incarcerated outside of US territory, the US government argues that its officials do not have to follow any signed human rights treaties when dealing with these individuals. The US's current policy is stated under 18 USC. 2340-2340B, the Federal Torture Statute, which prohibits torture, but not cruel, inhumane and degrading treatment.[66] As a result, nothing could legally prevent the use of brain scanning technology upon detainees located outside of the United States.

Despite numerous technological advances, and regardless of the fact that Brain Fingerprinting has been ruled admissible in an Iowa court, fMRI is a long way from satisfying the Daubert criteria that are used to determine the admissibility of novel scientific evidence in federal court. Even if fMRI develops to the point where it can be used as an effective and reliable lie detector, its use against unwilling participants in criminal or terrorist investigations may still be ruled as being impermissible. Furthermore, there are many reasons as to why Brain Fingerprinting should have been ruled inadmissible by the judge in *Harrington v. Iowa* in the first place.

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[62] Convention Against Torture, Part I Article I, G.A. res. 39/46, annex, 39 UN GAOR Supp. (No 51) at 197, UN Doc. A/39/51 (1984).

[63] Thompson, *supra note* 60, at 1622.

[64] Harvard Medical School, *Sample Consent Form*, www.nmr.mgh.harvard.edu/sampleconsent form.htm. Visited on 10 February 2006.

[65] Thompson, *supra note* 60, at 1604.

[66] *Id*.

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E. A Critique of Brain Fingerprinting and the Decision in *Harrington v. Iowa*

When one visits Dr. Lawrence Farwell's website, they cannot help but notice the glowing reviews of his work that have been posted from various media sources, and the descriptions of results from numerous scientific studies where Brain Fingerprinting apparently achieved a remarkable 100% accuracy rate: "Farwell Brain Fingerprinting is a revolutionary new technology for solving crimes, with a record of 100% accuracy in research with US government agencies and other applications."[67] In addition, Dr. Farwell touts *Harrington v. Iowa* as a great scientific and legal breakthrough, and claims that he is presently involved with 400 cases nationwide where Brain Fingerprinting has proven effective in more than 170 tests.[68] However, when one bothers to carefully examine the case, Brain Fingerprinting played a very minor role in reversing the conviction of Terry Harrington.

The Iowa Supreme Court granted Harrington a new trial due to the fact that there was evidence suppressed at the original trial, and one of the main witnesses against Harrington recanted his testimony. The Iowa Supreme Court stated: "We also think the reports were "suppressed" within the meaning of the Brady rule … We conclude Harrington did not have the "essential facts" of the police reports so as to allow the defense to wholly take advantage of this evidence … Upon our de novo review of the record and consideration of the totality of the circumstances, our collective confidence in the soundness of the defendant's conviction is significantly weakened."[69] Brain Fingerprinting only received one passing mention in the Court's entire decision: "Because the scientific testing evidence is not necessary to a resolution of this appeal, we give it no further consideration."[70]

When examined by the state's attorney, Dr. Farwell was forced to admit that even though the existence of the P300 brain wave is well established in scientific literature, there is no independent, published, peer reviewed literature documenting the MERMER brain wave.[71] In fact, despite Dr. Farwell's claims that the results of MERMER testing are the same whether the subject lies or tells the truth, there have been several published studies that indicate that truthful subjects produce larger P300s than dishonest respondents answering the same questions.[72] In addition, Dr. Farwell has maintained a great amount of secrecy over Brain Fingerprinting by placing a patent on his MERMER technology, by

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67 www.brainwavescience.com.
68 *Id.*
69 Harrington *v.* State, *supra note* 8.
70 *Id.*
71 J. P. Rosenfeld, *"Brain Fingerprinting:" A Critical Analysis*, 4 The Scientific Review of Mental Health Practice 4 (2005).
72 *Id.* at 13.

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keeping the details of his studies secret, and by publishing articles only on his website, not in any major scientific journals.[73]

Dr. Farwell claims that his techniques have a 100% accuracy rate because they are "based upon the principle that the brain is central to all human acts. In a criminal act, there may or may not be many kinds of peripheral evidence, but the brain is always there, planning, executing, and recording the crime. The fundamental difference between a perpetrator and a falsely accused, innocent person is that the perpetrator, having committed the crime, has the details of the crime stored in his brain, and the innocent suspect does not."[74] This statement assumes that criminals are constantly planning their crimes, and that the brain is capable of storing undistorted details of the act that can be detected through Brain Fingerprinting. Numerous studies have described how the fragile nature of memory causes the details of various activities to either be inaccurately recorded by the brain, or not recorded at all. Many serious crimes occur during the use of alcohol or drugs that could affect memory, or could create such a state of anxiousness within the individual that they are unable to notice any details about the crime scene.[75]

The validity of Terry Harrington's Brain Fingerprinting results are further compromised due to the fact that the test was administered more than 20 years after the event.

When Farwell first posted Harrington's test results and analysis on his website, the charts showed two peaks where the P300 brainwave normally appears. If Farwell had chosen to analyze the region that contained both peaks, the results would have been incriminating, but he apparently only analyzed the region between these peaks, which enabled him to make the assertion that Harrington was innocent.[76] It is not known if an impartial, unbiased researcher would have made the same decision to not include both peaks. As long as the reading of Brain Fingerprinting results remains highly subjective, the validity of the test should remain in doubt. When debating the validity of fMRI, this same argument could be made because both tests operate upon similar principles, and both require a great amount of subjective interpretation during the creation of their results.

On his website, Dr. Farwell states that his research has gained the attention and approval of the CIA, and claims that the agency donated a million dollars to his company in a show of support for its mission.[77] In reality, after reviewing Brain Fingerprinting, the federal government decided not to pursue the use of this technology because of its limited applicability:

> CIA, DOD, FBI and Secret Service do not foresee using the Brain Fingerprinting technique for their operations because of its limited application. Both CIA and DOD officials, for example, expressed the need for a tool for screening purposes, for which Brain Fingerprinting is not designed. The Secret Service indicated that the agency has had a high success rate with the polygraph as an interrogative and

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73 *Id.* at 14.
74 www.brainwavescience.com.
75 Rosenfeld, *supra note* 71, at 8.
76 *Id.* at 15.
77 www.brainwavescience.com.

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> screening tool and therefore saw limited use of the technique. Within FBI, the Laboratory Division concluded that Brain Fingerprinting had limited applicability to FBI's investigative and screening functions and identified other research and operational concerns that would preclude its usefulness.[78]

In addition, the government had concerns about the validity of Farwell's scientific theories, the difficulty of finding specific details for use in counterintelligence missions because it is not always certain when spying has taken place, and the cost of finding and training skilled workers to use and read the equipment.[79]

F. Methods to Ensure the Accuracy and Validity of fMRI Interrogation

If the use of fMRI eventually becomes widespread and commonplace, institutions and standards of practice designed to protect the public would need to be established. For inspiration, brain scan advocates should look to the current institutions and regulations that have been created to ensure the quality of polygraph examinations and protect the public from being harmed by the use of polygraph technology. The Department of Defense recently established a Polygraph Institute, whose purpose is to provide a central governing body that is responsible for developing standards within the polygraph community, ensure consistency in the administration, application, and quality control of screening polygraphs, to conduct research on developing valid and reliable screening tests, and to find ways to prevent the effectiveness of countermeasures. The Institute also is designed to offer students a curriculum in polygraphy, which consists of 520 hours of comprehensive courses that prepare them for a career in law enforcement or counterintelligence. In addition, every federal polygraph examiner is required to attend at least 80 hours of continuing education every two years.[80]

The American Polygraph Association, an organization dedicated to the proper administration of polygraph tests, requires its members, in addition to following any local, state, and federal laws regarding polygraphs, to adhere to the APA Standards of Practice and the APA Code of Ethics. These standards describe the training, type of instruments, quality control procedures, and testing procedures that APA polygraphers are required to undergo and utilize.[81] Finally, the federal government passed the Employee Protection Act, which protects workers from being subjected to involuntary polygraph exams by their employer, unless specific conditions have been met.[82] In other words, there are already institutions and

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[78] United States General Accounting Office, *Investigative Techniques: Federal Agency Views on the Potential Application of "Brain Fingerprinting"*, (2001) at 2.

[79] *Id*. at 9.

[80] United States Department of Defense Polygraph Institute, *DoDPI Programs and Courses Offered*, visited at 10 February 2006 at http://www.dodpi.army.mil/Courses_offered.asp.

[81] American Polygraph Association, *APA Standards of Practice*, (1999). Visited on 10 December 2005 at http://www.polygraph.org/Browser%20Files/007%20APA%20Standards%20of.htm.

[82] American Polygraph Association. *The American Polygraph Protection Act*, visited on 10 December 2005 at http://www.polygraph.org/eppa.htm.

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regulations in place that could possibly serve as good models for the regulation of brain scanning technology.

The interrogation methods that are generally accepted by the forensic community, however, may not be reliable when used with fMRI. The guilty knowledge test (GKT) has gained increasing levels of acceptance among scientific experts over the last 40 years. This test presents the subject with the correct answer during a series of answers that are similar, yet incorrect.[83] According to theory, the suspect is found guilty if the correct responses have greater physiological responses than the incorrect control responses, because the correct responses would be shown to have a special, more meaningful significance for the suspect.[84] An innocent person who lacks the detailed knowledge about the crime that only the perpetrator would know would be expected to have almost the same brain scan results for all of the responses.[85]

It is extremely difficult to create a valid GKT test because doing so requires accurate crime scene investigations, proper handling of the evidence, and assurances that facts that the suspect could have obtained from hearsay, media reports, or the interrogation process are not used.[86] One scientific study indicated that when the GKT was applied to innocent subjects that had been informed about the relevant details of a crime, the test had a false positive rate between 25% and 50%.[87] In order to fully implement the GKT test as a standard forensic procedure within the United States, this country could adopt techniques that are already prevalent in Japan and Israel. These countries train police investigators how to identify and conceal critical details of the crime at the beginning of the investigation and to specifically look for features that can be used as probes during questioning.[88] Despite these problems, most psychologists and psyco-physiologists believe that the GKT has a sound logical basis.[89] As a result, if the test was proven accurate and reliable for use during criminal investigations, the technique might become admissible as evidence.[90] This contrasts greatly with the Control Questions Test (CQT), which is the method still preferred by most American investigators , because it compares responses between relevant, confession inducing questions ("Did you do the crime?") and control questions. Most experts believe, however, the CQT technique has no solid basis in science or logic.[91]

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83 V. V. MacLaren, *A Quantitative Review of the Guilty Knowledge Test*, 86 Journal of Applied Psychology 674 (2001).

84 G. Ben-Shakhar & E. Elaad, *The Validity of Psychophysiological Detection of Information with the Guilty Knowledge Test: A Meta-Analytic Review*, 88 Journal of Applied Psychology 131, at 132 (2003).

85 MacLaren, *supra note* 83, at 674.

86 *Id*.

87 Ben-Shakhar & Elaad, *supra note* 84, at 146.

88 *Id*. at 147.

89 *Id*. at 132.

90 MacLaren, *supra note* 83, at 679.

91 Ben-Shakhar & Elaad, *supra note* 84, at 131.

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The GKT has a high level of validity, as shown by a recent analysis of 15 mock crime GKT studies which ranged from 81% to 96% in accuracy.[92] These studies, however, also revealed several factors that could affect the validity of the test. In the laboratory, the subjects were typically tested immediately after performing their simple tasks, during which the researchers were assured that they had been exposed to and learned the incriminating information. Therefore, the results did not take into account the delicate nature of a suspect's memory. Actual crimes often involve complex situations, and as a result it is difficult for an investigator to tell which details are noticed, processed, and stored in the memory of the perpetrator. Additionally, the suspect may be tested weeks, months, or even years after the crime was committed. One mock crime GKT experiment that tested subjects several days after committing a mock crime found that a significant number of people did not remember at least one of the four incriminating items that were used as probes.[93] This study indicates that it is necessary to study how the passage of time affects the accuracy of the GKT.

G. Countermeasures and Other Factors Affecting the Validity of fMRI

In addition to accounting for any flaws that are inherent in the interrogation process, examiners have to be able to account for the use of countermeasures that could greatly reduce the chances of obtaining an accurate reading. Despite the fact that the weight of scientific evidence shows that polygraph tests are not effective when used for making important national security decisions, such as granting an individual access to government secrets, cryptology, and nuclear command and control, the use of polygraph tests for this type of screening in the US Department of Defense rose 586% between 1986 and 1990. In addition, there were also proposals during the 1990s to expand the use of polygraph tests on all people who have top-secret security clearances, and all individuals who are involved in the war on drugs.[94] This indicates that the United States has a strong desire to obtain and utilize lie detectors that are accurate and effective.

The accuracy of the polygraph is called into question, however, by the results of a scientific study during which the researchers trained a group of subjects in simple physical countermeasures, such as biting the tongue or pressing their toes to the floor, and mental countermeasures, such as counting backwards from 200 by sevens, during the control questions. The purpose of these countermeasures was to increase the physiological reactions to the control questions.[95] The results of the study showed that while the examiners correctly identified 72.5% of the control subjects as being either innocent or guilty, with 15% of the remaining

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92 *Id*. at 133.
93 *Id*. at 146.
94 Ch. R. Honts *et al*., *Mental and Physical Countermeasures Reduce the Accuracy of Polygraph Tests*, 79 Journal of Applied Psychology 252 (1994).
95 *Id*.

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subjects incorrectly identified, and 12.5% having inconclusive results, only 41.2% of the subjects trained in countermeasures were correctly identified, with 47.5% being incorrectly identified, and 11.3% having inconclusive results.[96] When the results were examined on an individual basis, both the physical and mental countermeasures were approximately 50% effective.[97] In addition, the examiner was only correct in identifying the members of the physical countermeasure group 12% of the time, and none of the members of the mental countermeasure group produced behavior that caused them to be detected.[98]

The results of this study are remarkable because the guilty test subjects were able to greatly reduce the accuracy of the polygraph test with only 30 minutes of countermeasure training. There was very little difference in the results created by either the physical or mental countermeasures, which indicates that both methods may be controlled by the same psychophysiological mechanisms.[99] It is currently believed that through the use of covert physical responses, countermeasures make the irrelevant questions task relevant by increasing the amount of attention and mental energy that are exerted during the answering of the control questions, which causes both the relevant and irrelevant questions to have similar detectable results. By using countermeasures, the subject places all stimuli on a more equal level as far as probability and meaningfulness are concerned.[100] This suggests that any mental or physical task that increases the energy required to answer a control question would be an effective countermeasure.

The effectiveness of the mental countermeasures used in this study greatly undermines the supposed accuracy of lie detector tests, especially since they are a form of countermeasure that would be undetectable by the movement sensors that are currently used by examiners to detect tampering. There have already been reports of countermeasures being used successfully outside the laboratory. Hostile intelligence agents have apparently been using countermeasures for years to repeatedly beat polygraph tests during federal security screening programs, and one notorious double-homicide case involved a confessed murder who described how he used biofeedback and hypnosis to defeat a lie detector test.[101] Studies and anecdotes like these have caused the National Research Council to conclude in a recently published a report that "Countermeasures pose a serious threat to the performance of polygraph testing because all the physiological indicators measured by the polygraph can be altered be conscious efforts though cognitive or physical means."[102]

If P300 based Brain Fingerprinting and fMRI are ever to become suitable replacements for the traditional polygraph, more needs to be known about the effectiveness of countermeasures that could affect their validity. A report written

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96 *Id*. at 255.
97 *Id*. at 257.
98 *Id*. at 256.
99 *Id*. at 257.
100 J. P. Rosenfeld *et al.*, *Simple, Effective Countermeasures to P300-based Tests of Detection of Concealed Information*, 41 Psychophysiology 205, at 217 (2004).
101 Honts, *supra note* 94, at 258.
102 Rosenfeld, *supra note* 100, at 205.

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by The National Research Council was of the opinion that these new technologies appear to have some promise because "there is an established tradition of using brain electrical activity measures to make inferences about neural correlates of cognitive and affective processes," and this "provides a potentially powerful tool for investigating the neural correlates of deception," but the Council qualified this statement by stating that "it is not known whether simple countermeasures could potentially defeat this approach by generating brain electrical responses to comparison questions that mimic those that occur with relevant questions."[103] One study using P-300 based lie detection showed that counting backwards by sevens was generally ineffective as a countermeasure, however, subjects that used physical countermeasures, such as pressing fingers against their legs or wiggling their toes, were able to deceive the examiner.[104] The group of "guilty" subjects that were trained in the use of countermeasures was able to reduce the accuracy of the lie detector test from 82% to 18%.[105] In addition, there is evidence that countermeasures are able to affect test results even when they are not explicitly being used. A week after the initial study, a group of 12 "guilty" subjects were expressly told not to use any countermeasures before being tested again, and 5 of these subjects still managed to beat the test.[106]

An advocate of P300 testing stated: "Because such potentials are derived from brain signals that occur only a few hundred milliseconds after the GKT alternatives are presented, and because as yet no one has shown that humans can alter these brain potentials at will, it is unlikely that countermeasures could be used successfully to defeat a GKT derived from the recording of cerebral signals."[107] The above studies have shown that a P300 based test can in fact be defeated by countermeasures that are virtually undetectable by professional examiners. In order for the countermeasure to be successful, however, the suspect would have to successfully predict the questions that would be used as probes during the interrogation, and would probably need to spend time practicing their technique.[108] It might be possible for criminals to predict the probe questions because they would have firsthand knowledge of the incident, but it is unlikely that they would find an expert that would be willing to train them in countermeasure techniques. It might be easy for them to acquire this knowledge on their own, however, since the amount of training needed appears to be minimal. Highly trained and motivated terrorists would probably be able to acquire this expertise even easier because they have greater resources and quite possibly have a large number of influential sympathizers.

Another factor which compromises the validity of fMRI is the fact that there has been no baseline established for the blood oxygen-level-dependent (BOLD) signal that is created by the MRI technology. This is because fMRI is

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103 *Id*.
104 *Id*. at 209.
105 *Id*. at 210.
106 *Id*. at 213.
107 *Id*. at 217.
108 *Id*. at 218.

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a contrastive methodology that has no true baseline signal.[109] Researchers have typically used 10 to 30 second rest periods to establish a baseline that can be compared to the neural activity that occurs during the mental task being studied, but further studies have shown that the brain is actually more active during rest than in several alternative baseline conditions. This activity can cause a reduction or even eliminate the signal caused during the task activity. The activity that occurs during rest might occur as a result of the unconstrained thought that occurs during rest, so an optimal baseline condition would be one that restricts cognitive activity during this period of time.[110] Possible solutions might consist of reducing the length of resting periods to only 2 to 4 seconds, or to present the subject with a series of digits or a field of white noise during the resting period.[111] The failure to establish a valid baseline is a serious limitation that is embedded in within the fMRI technology.

In the near future, it still will not be possible to use fMRI technology to read people's thoughts and emotions. Many of the studies that have been conducted have used a small number of subjects, employed different techniques, machinery and data formats, and have been conducted by a wide range of professionals, such as psychiatrists, neurologists, and radiologists. No standards have been set to counteract these differences, or to account for the fact that the interpretation of brain scans may be heavily influenced by social, cultural, and anthropological frameworks.[112] In addition, due to the fact that lying is complex and varies greatly from situation to situation, the ability to detect simple deception in a laboratory environment may not be replicated in unstructured real life situations where only the test subject knows if and when he will be lying.[113] There has yet to be established a set definition of "lying," and a lie in one culture might not be considered a falsehood in another.[114] Currently, the results from fMRI studies are averaged together to yield results by warping the brain scan around a model brain. This technique distorts the results because even in the absence of pathology, individuals have brain structures that vary widely in shape, size and orientation to each other, therefore it is extremely difficult to compare functional and anatomical data from large groups of people.[115] In addition, a lie could possibly be told in a millisecond, which might not even create a distinct brain scan pattern. In order to create a brain scan, the current technology needs several minutes to average

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[109] C. E. Stark & L. R. Squire, *When Zero is not Zero: the Problem of Ambiguous Baseline Conditions in fMRI*, 98 PNAS 12760, at 12765 (2001).
[110] *Id*. at 12760.
[111] *Id*. at 12763.
[112] J. Illes & E. Racine, *Imaging or Imagining? A Neuroethics Challenge Informed by Genetics*, 5 The American Journal of Bioethics 5, at 6 (2005).
[113] P. R. Wolpe *et al.*, *Emerging Neurotechnologies for Lie-Detection: Promises and Perils*, 5 The American Journal of Bioethics 39, at 42 (2005).
[114] T. Buller, *Can We Scan for Truth in a Society of Liars?*, 5 The American Journal of Bioethics 58, at 59 (2005).
[115] A. W. Toga, *Imaging Databases and Neuroscience*, 8 The Neuroscientist 423, at 428 (2002).

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the signals detected from the blood flow, which causes fMRI to have inadequate temporal resolution as a lie detector.[116]

Researchers until recently have used the brains of college aged or middle aged subjects when creating bran templates for use in fMRI studies. The shape of a person's brain is not static, which means that the brains of young children and older individuals would differ greatly from the template brain. For example, older brains have been shown to loose gray and white matter, and experience a widening of the ventricles. These developmental changes have already been shown to affect the validity of fMRI testing, as studies have shown that significant errors occurr when the brains of children younger than 6 are compared to models based upon adult brains. In addition, brain lesions, the removal of brain tissue through surgery, or any tissue loss that causes the firing pathways of neuronal networks to change, could create errors in creating a brain scan. When these brains are compared to a normal template, it would not be known if the remaining brain tissue increased its level of activation in order to compensate for the loss of tissue, maintained its previous level of activation, or experienced a decrease in its level of activation.[117]

The Governing Council of the Organization for Human Brain Mapping (OHBM), which is the primary international organization dedicated to neuro-imaging research, wishes to improve the quality of fMRI research by constructing more sophisticated and complete models of brain function through facilitating the sharing of standardized data among neuroimaging laboratories. The organization foresees the creation of a number of databases that are specifically designed to store many different types of data, but questions remain as to what format the data should be archived in, whether the raw data should be stored, how quality controls should be established and enforced, and what type of data inquiries should be deemed permissible by researchers and the public.[118]

Due to the complex and varied nature of the human brain, however, it may be impossible to catalogue brain imagery in a multisubject database, but a "brain atlas" might be created that would be capable of demonstrating how brain scans from different populations vary from one another.[119] Brain atlases are superior to databases because instead of just identifying patterns and elements among experimental data, brain atlases use warping tools and statistical analysis to provide coordinate systems for multisubject comparisons, and are also able to integrate diverse data formats. In addition, brain atlases would be able to highlight the relationships between genotype, phenotype, and behavior by comparing task performance and genetic information to brain structure.[120]

Currently, 3-D deformable atlases are being created that will be able to assess differences in brain shape by analyzing a deformation tensor field which calculates

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[116] R. L. Fischbach & G. Fischbach, *The Brain Doesn't Lie*, 5 The American Journal of Bioethics 54, at 55 (2005).
[117] Desmond & Chen, *supra note* 12, at 488.
[118] The Governing Council of the Organization for Human Brain Mapping (OHBM), *Neuroimaging Databases*, visited on 15 January 2006 at http://weblinks1.epnet.com/DeliveryPrintSave.asp?
[119] Toga, *supra note* 115, at 423.
[120] *Id*. at 423.

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the amount of expansion or contraction that is needed to fit one brain region into another. The atlas would include normal brain variations; therefore the system would be better able to detect abnormalities.[121] Brain atlases specifically designed to study relatively homogenous patient subpopulations, such as fetal alcohol syndrome, schizophrenia, and dementia, are currently under development, and 4-D brain maps that use algorithms to view structural changes in volume, surface area, orientation, and distance over time, might eventually become a reality.[122]

The continued success of fMRI depends upon the theory that each voxel registered within the brain scan corresponds to one neuron. As of today, there has been no verification of the link between the strength of the image and neuronal activity.[123] The brain scan might possibly be altered if the fMRI signal also includes subthreshold activities such as simultaneous excitation and inhibition, or detects energy that is consumed by non-synaptic sources.[124] In order for fMRI to achieve its maximum accuracy and validity, it must be proven that the bran scan patterns are definitely related to levels of neuronal activity.[125]

Joy Hirsch, the Director of the Functional Magnetic Resonance Imaging Research Center at Columbia University, states that fMRI "enables us for the first time to probe the workings of a normal human brain. It's really opening the black box," but the technology "falls short when we want to ask about more detailed processes. We're not learning that much about how neurons are doing local computing."[126] There are an estimated 100 billion neurons within the brain, and it is believed that fMRI is currently able to detect the activation of tens of thousands, making it highly improbable that fMRI will develop a resolution fine enough to detect the activity of an individual neuron.[127] Many of the finer points of human thought would probably remain a mystery to researchers. Even if it was possible for brain scans to detect the activation patterns of every neuron in the brain, it would still be necessary to learn how to interpret these neural firing patterns into recognizable, individual thoughts. This is a problem that cannot be solved through advances in technology alone because its solution will largely depend upon the interpretive skills of the researchers themselves.[128]

There are members of the scientific community who believe that the latest neuroimaging techniques are nothing more than postmodern phrenology which uses vividly colored pictures of the brain to dazzle viewers with images that are in reality virtually useless for diagnostic or predictive purposes. These people argue that it is not useful to merely know what areas of the brain light up during scanning. The best fMRI experiments, however, attempt to go beyond just

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[121] *Id*. at 429.
[122] *Id*. at 433.
[123] A. J. Smith *et al.*, *Cerebral Energetics and Spiking Frequency: the Neurophysiological Basis of fMRI*, 99 PNAS 10765 (2002).
[124] D. J. Heeger *et al.*, *Spikes versus BOLD: what does Neuroimaging Tell Us About Neuronal Activity?* 3 Nature Neuroscience 631 (2000).
[125] *Id*. at 633.
[126] R. Robinson, *fMRI Beyond the Clinic: Will it Ever be Ready for Prime Time?*, 2 PloS Biology 715 (2004).
[127] *Id*.
[128] *Id*. at 716.

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establishing where the brain activity occurs, but ask why the activity occurs by combining information gathered over a period of time to create a brain scan that is much more informative than an ordinary map.[129]

H. Concerns Regarding the Effective Regulation of fMRI Technology

Even though it might be years before fMRI is used outside the laboratory on a regular basis, legislators should begin thinking about ways to properly regulate this technology, because as Arthur Caplan, renowned bioethicist and Director of the University of Pennsylvania Center for Ethics, states: "the ethical hot potato of this coming century is … knowledge of the brain, its structure, and function."[130] He also believes that

> it is very likely that advances in our ability to 'read' the brain will be exploited … for such purposes as screening job applicants, diagnosing and treating disease, determining who qualifies for disability benefits … Others have expressed concern that one's brain will be used against them.[131]

A good starting point would be to look at the regulations that have been designed to protect the privacy of genetic information, because both DNA and brain scans involve issues regarding privacy, personal identity, and the predicting of disease. Both brain scans and genetic sequencing are able to provide unique, personal, uncontrollable, and recently undetectable data to an observer.[132] Genetic privacy statutes, however, are not equipped to regulate brain scans that are capable of revealing a person's thoughts in real time. Both brain scans and DNA have the potential to predict disease and behavior in third parties, such as family members. They also run the similar risk, however, that the indication of a propensity for a particular disease may not always mean that the person will actually suffer from the disease because numerous internal and external factors influence how both the brain and DNA function.[133]

Most human behavior originates from the brain, causing it to be even more closely tied to the formation and structure of personal identity than genetics. Since brain scans have the potential to reveal the very nature of a person's thoughts, this type of information deserves to be given at least as much privacy as genetic information.[134] Unlike the Human Genome Project, which devoted 3-5% of its budget towards studying the ethical, legal, and social issues of the

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[129] D. L. Donaldson, *Parsing Brain Activity with fMRI and Mixed Designs: what Kind of a State is Neuroimaging in?*, 27 Trends in Neurosciences 442 (2004).
[130] S. A. Falkenheimer, *Brain Monitoring: An Ethical Assessment*, (2003) visited on 20 November 2005 at http://www.cbhd.org/resources/biotech/falkenheimer_2003-06-20_print.htm.
[131] The Committee on Science and Law, *supra note* 5, at 10.
[132] *Id*. at 11.
[133] *Id*. at 12.
[134] Illes & Racine, *supra note* 112, at 11.

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project, the Human Brain Project, a major research project whose purpose is to gather information about the brain, has shown little interest in starting a similar program.[135]

There are four main areas of concern regarding genetic privacy: the collection of genetic information, the disclosure of genetic information, the use of genetic information by employers, insurers and the government to discriminate against individuals, and the right not to know one's genetic information.[136] It is feared that DNA testing will permit authorities to use genetic information to deny employment, restrict access to health care and insurance, predict behavior and ability, and to identify people through the use of national DNA databases. Many of these health care concerns are covered by The Health Insurance Portability and Accountability Act of 1996 (HIPPA), which prevents the release of health information in certain situations.[137] Under HIPPA, "Protected health information" is defined as demographic data; information about the individual's past, present, or future physical or mental health condition; the provision of health care to the individual; the past, present, or future payment of health care; and information that identifies the individual or for which there is a reasonable basis to believe that it can be used to identify the individual.[138]

This broad definition would most likely include brain scans as long as they are used for medical purposes, and the entity requesting the exam falls within the scope of the statute. Under HIPPA, a covered entity may only use or disclose protected health information according to the methods and purposes afforded under HIPPA's Privacy Rule, or according to what the individual or their personal representative authorizes in writing. In addition, protected health information may be disclosed for research purposes without the individual's consent only if certain conditions are met. At first these regulations appear to be extensive, but according to the statute, HIPPA only applies to providers, payers, information clearinghouses, and business associates of covered entities, making it easy for medical information to be spread by employers or non-covered entities. In order to increase the levels of privacy protection, HIPPA could be amended to allow states to pass restrictive legislation that would prevent non-covered entities from improperly obtaining or using medical records, but this method of regulation would most likely create a patchwork of incompatible legislation.[139]

Despite the protections granted under HIPPA, the case *Whalen v. Roe* is an example of how the right to medical privacy is far from absolute, and can be outweighed by competing governmental interests. The Court, when it upheld the State of New York's plan to create a database of all Schedule II drug prescriptions, ruled that patients have diminished privacy rights in general, and that the intrusion upon these rights was minimal:

> Disclosures of private medical information to doctors, to hospital personnel, to insurance companies, and to public health agencies are often an essential part of

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135 The Committee on Science and Law, *supra note* 5, at 10.
136 *Id.*
137 *Id.* at 9.
138 45 C.F.R. 160.103.
139 The Committee on Science and Law *supra note* 5, at 9.

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> modern medical practice even when the disclosure may reflect unfavorably upon the character of the patient. Requiring such disclosures to representatives of the State having responsibility for the health of the community, does not automatically amount to an impermissible invasion of privacy.[140]

Under *Whalen*, the release of information obtained from brain scans would likely be permitted if the government can show that the health of the community would benefit as a result.

It is not uncommon for brain scans to contain incidental findings that reveal previously unknown medical conditions. In one survey, 82% of the participating fMRI investigators responded that they have encountered incidental findings during brain imaging, but only 53% have established a protocol that specifically deals with such findings. The remaining 47% handle these situations on a case-by-case basis. It is estimated that 40% of healthy brain scan subjects exhibit some sort of brain abnormality, of which 2-8% need urgent medical attention for tumors, aneurisms, or other serious diseases.[141] US courts are increasingly likely to hold researchers legally responsible for the welfare of their subjects, therefore researchers might be pressured into revealing the incidental findings that are found during the course of their studies. For example, in the case *Grimes v. Kennedy-Krieger Institute*, a court of appeals held that researchers studying lead abatement procedures in Baltimore were liable for failing to inform at risk children that they had high levels of lead in their blood.[142]

If fMRIs are admissible in court, these incidental findings would provide attorneys with many unique opportunities to help defend or convict an individual. If the brain scans are not used in court, people who undergo fMRI interrogation should have the results of their test remain confidential in order for their medical information to remain private. Certain brain scanning formats make it possible to reconstruct the subject's face from the pixel matrix, so further efforts would need to be taken in order to maintain a person's privacy in these instances.[143] It also needs to be determined whether defendants should be given the opportunity for their brain scans to undergo an independent medical review, or whether their brain scans should be used only for legal purposes that are relevant to the criminal investigation.[144]

The amount of financial resources and the number of qualified radiologists who are trained to discover incidental findings are probably not great enough to meet the potential demand. It might be possible, however, to create an intervention program that provides medical screenings for youthful offenders in order to provide them with appropriate treatment. If the legislature chooses to mandate the disclosure of medical information obtained by fMRI, it would need to be determined how that person would be notified, and whether any family members who could possibly

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[140] Whalen *v*. Roe 429 US 589.

[141] J. Illes, M. Kirschen *et al*., *Discovery and Disclosure of Incidental Findings in Neuroimaging Research*, 20 Journal of Magnetic Resonance Imaging 743 (2004).

[142] Grimes *v*. Kennedy-Krieger Institute 366 Md. 29 (2001).

[143] Kulynych, *supra note* 4, at 353.

[144] R. I. Grossman & J. L. Bernat, *Incidental Research Imaging Findings: Pandora's Costly Box*, 62 Neurology 849 (2004).

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be affected by the findings should be notified. To complicate things further, fMRI can detect many conditions, such as Alzheimer's and Huntington's disease that have no known cure. Due to the stress and anxiety caused by such a diagnosis, the individual might be better off not knowing about these incidental findings, and should be given the chance to refuse such information.

I. Attempts by the United Kingdom to Manage Individuals who have Dangerous Severe Personality Disorders

Another major concern about the development of fMRI technology is whether or not it can be used to predict violent or criminal behavior in an individual. The United Kingdom has already proposed legislation that would allow authorities to detain people with dangerous severe personality disorders for an indeterminate amount of time. fMRI could one day be used to help make the diagnosis that incarcerates these individuals. In July of 1999, the UK Home Office and the Department of Health released "Managing Dangerous People With Severe Personality Disorder (DSPD)," which discussed ways to protect the community from people with DSPD who are being released from secure hospitals or prison, and from dangerous individuals who are already at large in the community.[145]

The Department proposed legislation that would grant authorities the power to detain people with severe personality disorders for an indeterminate period of time through the issuance of a court order that would initiate a civil proceeding.[146] Individuals suffering from DSPD who are convicted of a criminal offense and have been sentenced to a prison term would remain detained after their prison term expires, while noncriminals with DSPD would be held in secured health care facilities.[147] The proposal would prevent the release of individuals with DSPD from prison or a hospital, even if they would otherwise be free to leave the institution.[148] In addition, the proposal would do away with the requirement which states that before a person can be detained indefinitely in a hospital against their will, a treatment needs to exist that is both likely to alleviate or prevent the deterioration of that person's condition, and be readily available.[149]

DSPD is not a condition that is officially recognized by the psychiatric community, and the official document fails to provide its readers with a definition of the term, but it appears to apply to people who have been diagnosed with

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[145] A. Buchanan & M. Leese, *Detention of People with Dangerous Severe Personality Disorders: A Systematic Review*, 358 The Lancet 1955 (2001).

[146] *Id*.

[147] ADSS, *ADSS Response to the Home Office/Department of Health Consultation Document-Managing Dangerous People with Severe Personality Disorder*, at 1. Visited on 28 December 2005 at http://www.adss.org.uk/publications/consresp/1999/dangerous.html.

[148] Buchanan & Leese, *supra note* 145, at 1955.

[149] The National Council for Civil Liberties (Liberty), *Liberty Response to Home Office Consultation, Managing People with Dangerous Severe Personality Disorder*, at 4 (2000). Available at http://www.liberty-human-rights.org.uk/pdfs/policy00/jan-severe-pesonality-disorders.pdf

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antisocial personality disorder and have at least one other type of personality disorder along with six or more unspecified risk factors.[150] The proposal sparked a debate within the United Kingdom as to whether it was legal to detain innocent people in prisons or in hospitals. The official estimate is that 400 male patients in secure hospitals, 1422 adult male prisoners, and 300-600 people in the community would be affected by such legislation, but the detention of these people would prevent 200 serious crimes each year.[151] The answer to this debate largely depends upon how accurately we can predict who will become violent in the future.[152]

The government report estimated that in order to prevent one act of violence during one year, six people with DSPD would have to be detained, and that for every ten people with DSPD who would commit violent acts, only five would be identified and detained. In addition, it is estimated that for every ten people with DSPD who would not be violent, seven would be identified and released, but three would be identified and detained. In order to implement such a preventative detention program, an acceptable rate of error needs to be established that is based upon the likely number of false positives and negatives, and standards would need to be put in place that would ensure that the detainees would be subjected to conditions that consisted of a certain minimum level of quality and care. The public will be more willing to accept the concept of preventative detention if the detainees are able to receive proper therapeutic treatment that makes a positive change in their lives.[153]

The response from the British psychiatric community to the proposal has been extremely negative. The Critical Psychiatry Network, a group of senior level psychiatrists who gather to discuss proposed changes to governmental mental health policy, mailed out a questionnaire to all Consultant Psychiatrists working with adult patients in England and Wales. Only 19% of the respondents supported the preventative detention plan, 60% said they were opposed to the plan, 18% were undecided on the issue, and 3% believed that the proposal would not affect their practice. In addition, 30% of the respondents stated that if preventive detention became law, they would refuse to comply with the policy, only 27% said that they would implement it, and 40% remained undecided on the issue.[154]

Many health care professionals believe that it is morally wrong to indefinitely detain an individual who has not yet committed a criminal offense, and that detention is proper only when a person commits a crime, or when treatment exists that can help cure their psychiatric disorder.[155] In particular, there is a concern that this program would medicalise unsavory human characteristics such as amorality

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[150] Association of Therapeutic Communities, *Response to: Managing Dangerous People with Severe Personality Disorder. Proposals for Policy Development*, July 1999, at 9. Visited on 10 December 2006 at http://www.therapeuticcommunities.org/dpspd.htm.

[151] Buchanan & Leese, *supra note* 145, at 1956.

[152] *Id*. at 1955.

[153] *Id*. at 1958.

[154] Critical Psychiatry Network, *Managing Dangerous People with Severe Personality Disorder Proposals for Development: A Response by "The Critical Psychiatry Network*." Nov. 1999, at 2. Visited on 28 December 2005 at http://www. critpsynet.freeuk.com/DSPDFinal.htm.

[155] Liberty, *supra note* 149, at 1.

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and violence to create the notion that people suffering from DSPD, who until recently were viewed as being "evil" or "wicked," were merely suffering from a medical condition that could be treated, when the problem may in fact be moral or social.[156] Critics argue that unlike mental illnesses, which are typically only one part of a person's being, personality disorders are integrated within the person as a whole.[157] In fact, there are experts who argue that psychopathy is not a medical condition at all: "personality disorder appears to be psychiatry's equivalent to tonsillitis-widely disputed, denied even to be a medical concern by some, yet for others lurking around every clinical corner."[158]

It is also feared that by focusing upon the small subset of people who have personality disorders, the majority of mentally ill people will face greater levels of stigma.[159] Preventative detention would also undermine the level of trust that citizens have in the therapeutic community. People would either refuse to seek treatment, or attempt to hide suspicious behavior in order to prevent an inquiry into their level of dangerousness.[160] Furthermore, the results of a British study indicated that violent psychopaths are made even more dangerous when forced into therapeutic treatment against their will. While the related scientific evidence is not yet conclusive, it shows that therapeutic communities may be beneficial for people with severe personality disorders, but there is a significant chance that they will not work for dangerous people with personality disorders.[161] The compulsory nature of the detention weakens the therapeutic elements of the program because treatment typically has better results when it is sought voluntarily because the patients have been given a certain level of empowerment and choice.[162]

DSPD is extremely difficult to define, let alone manage and treat. fMRI may be useful in predicting behavioral characteristics of large populations, but it has not yet proven that an "abnormal" brain scan will automatically lead to abnormal behavior in an individual. In order to detain a person, it should seem perfectly clear that the individual is certain to commit a specified offense against a specific person or persons, but it may not be likely that fMRI will be able to predict such events with great accuracy.[163] In addition to brain scans, experts should also look for signs and symptoms of a recognizable clinical syndrome, review the personal medical history, and use internationally recognized criteria when making a diagnosis.[164] Furthermore, just because an individual's mind contains violent thoughts does not mean that the person will act on those thoughts. In certain circumstances it might even be advantageous for a person to have a certain level of aggression in order to successfully navigate through difficult situations.

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156 Critical Psychiatry Network, *supra note* 154, at 3.
157 *Neuroscience and the Law*, All in the Mind, Radio National, July 7, 2002, Transcript at 3. Visited on 15 November 2005 at http://www.abc.net.au/rn/science/mind/s598783.htm.
158 Association of Therapeutic Communities, *supra note* 150, at 8.
159 Liberty, *supra note* 149, at 11.
160 Association of Therapeutic Communities, *supra note* 150, at 8.
161 *Id*. at 5.
162 *Id.* at 9.
163 Liberty, *supra note* 149, at 7.
164 *Neuroscience and the Law*, *supra note* 157, at 3.

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Despite these arguments, the British government wishes to incarcerate people who have committed no criminal offense simply because they have the potential to cause future harm.[165] Many of these people are already in hospitals or prison, but the British government is seeking ways to indefinitely detain these untreatable individuals based upon the risk they present to the community, rather than from the result of any actual criminal conviction. In order safeguard the rights of individuals, the state should have to satisfy a high burden of proof during the commitment hearing, and procedures need to be established to ensure that the detainee's status is reviewed at least on an annual basis.[166] One needs only to look at the former Soviet Union for examples of how psychiatry can be used to persecute dissidents and individuals whose behavior falls outside accepted norms.[167]

J. fMRI Interrogation Under the United States Constitution

The privacy of an individual is protected by the 4th and 5th Amendments to the Constitution. It remains to be seen whether these amendments will be able to protect people from unwanted invasions of privacy from fMRI technology. The 4th Amendment ensures the security of people, places, and things by stating that people have a right to:

> be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated; and no warrants shall issue but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.[168]

According to the 4th Amendment, the government must act reasonably when it searches for information and seizes people and things. Under the Amendment, a search occurs when the government infringes upon a reasonable expectation of privacy during an investigation whose purpose is to gather information.[169] The case *California v. Hodardi D*. stated that in order for a seizure to occur, there must either be some application of physical force, however slight, or a submission to an officer's show of authority. During this time, the suspect has to believe that he is not free to leave.[170] If a search has been deemed to occur, a court must then determine if the search is proper by first asking whether the search is unreasonable. If the answer to this question is no, it must then be asked whether or not the search attempted to compel incriminating evidence from the mind of a suspect.[171]

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165 Liberty, *supra note* 149, at 1.
166 *Id*. at 3.
167 Critical Psychiatry Network, *supra note* 154, at 5.
168 US Const. Amend IV.
169 M. S. Pardo, *Disentangling the 4th Amendment and the Self-Incrimination Clause*, 90 Iowa L. Rev. 1857 (2005), at 1859.
170 California *v.* Hodari D. 499 US 621, 625 (1991).
171 Pardo, *supra note* 169, at 1860.

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Reasonable searches are typically conducted pursuant to a warrant that has been issued after probable cause has been established, but this requirement may be waived under exceptional circumstances. In order to conduct a search without a warrant, police officers can detain a suspect in order to determine probable cause only when they have a reasonable suspicion of criminal conduct.[172] According to the ruling in *Welfare of J.W.K.*, medical tests, such as the taking of blood samples, may be performed on a suspect without a warrant when exigent circumstances are present. In this case, it was necessary to draw the blood because there was reason to believe that the condition of the suspect's blood would be used as evidence, and by the fact that the level of alcohol in the bloodstream diminishes over time.[173] Any questioning of an individual that occurs during exceptional situations needs to be reasonably related to the circumstances at hand. A search that is reasonable at its inception, however, may later violate the 4th Amendment due to its intensity and scope.[174]

Individualized suspicion of wrongdoing, however, is not required when a search under the 4th Amendment serves special governmental needs beyond the normal need of law enforcement. When determining the validity of a warrantless search, the court is required to balance the privacy expectations of the individual against the special governmental needs that are promoted by the search. In addition, a search may not be valid if the court determines that the primary purpose of the search is to seize evidence that will help further the State's general law enforcement interest.[175] In the case *Terry v. Ohio*, the court ruled that a police pat down for weapons did not exceed the scope of a reasonable search on a person who was suspected of potential criminal activity, and that the purpose of the 4th Amendment is to deter lawless police conduct and preserve judicial integrity:

> No right is held to be more sacred, or is more carefully guarded, by common law, than right of every individual to possession and control of his own person, free from all restraint or interference unless by clear and unquestionable authority of the law.[176]

For most of the 20th century, a search was defined as the physical entry of law enforcement officials onto a subject's private property. In 1967, however, the case *Katz v. US* created a new test that requires the court to determine whether or not the police infringed upon a reasonable expectation of privacy.[177] The court ruled that whatever information a person knowingly exposes to the public, even in his own home or office, is not a subject of 4th Amendment protection, and that minimal intrusions upon privacy, such as DNA testing and face recognition, are not searches and do not violate a person's privacy.[178] Other courts have ruled that

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[172] *Id*. at 1860.
[173] *In Re Welfare of J.W.K.* 583 N.W.2d 752 (Minn. 1988).
[174] *Terry v. Ohio* 392 US 1, 17 (1968).
[175] B. Quarmby, *The Case for National DNA Identification Cards*, 2003 Duke L. & Tech. Rev. 2, at 5 (2003).
[176] Terry *v*. Ohio 392 US 1, 7 (1968).
[177] R. Boire, *Searching the Brain: the 4th Amendment Implications of Brain-Based Deception Detection Devices*, 5 The American Journal of Bioethics 62 (2005).
[178] Quarmby, *supra note* 175, at 3.

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law enforcement officials may seize abandoned property without violating the previous owner's constitutional rights, but more than bare suspicion is needed in order to physically detain a person for the purpose of obtaining evidence. In order for a piece of information or personal item to remain private, there needs to be a reasonable expectation of privacy that is recognized by society in general for that item. The court must examine the level of intent a person has in maintaining privacy over that particular piece of personal information.[179]

In *Katz*, the court ruled that a person has a reasonable expectation of privacy while making phone calls in a public phone booth, but other courts have reasoned that it is legal for police officers to go through a person's garbage, have trained dogs sniff for drug odors in public, and read the outside of envelopes, because all this information has been revealed to the public.[180] It has yet to be determined whether or not fMRI brain scans are public or private information. Justice Scalia, in the majority opinion of *Kyllo v. United States*, which ruled that the use of a thermal imager upon Mr. Kyllo's home was a warrantless search that infringed upon the defendant's reasonable expectation of privacy and his 4th Amendment guarantee against unreasonable searches, wrote:

> it would be foolish to contend that the degree of privacy secured to citizens by the 4th Amendment has been entirely unaffected by the advance of technology … The question is what limits there are upon the power of technology to shrink the realm of guaranteed privacy.[181]

Until recently, notions of privacy have assumed that it is impossible to read another person's mind. It is reaching the point where standards of neuroprivacy will need to be established in order to ensure mental freedom.[182] An individual's thoughts are not involuntarily released to the public, which causes the skull to resemble a house whose privacy must be granted certain levels of protection and integrity, rather than DNA, which is revealed to the public as it is constantly sloughing off a person's body.

The 5th Amendment to the US Constitution grants the individual a privilege against self-incrimination. This privilege is limited to testimonial communications that are both compelled and incriminating. Unlike the 4th Amendment, there is no standard of reasonableness for searches to uphold; therefore it is impermissible for authorities to use even reasonable efforts to probe an individual's mind in an effort to obtain evidence for use at trial.[183] In order for the self-incrimination privilege to be upheld, courts look for the satisfaction of three elements: compulsion, incrimination, and testimony.[184]

An individual who wishes to assert the privilege must first be a participant in a criminal proceeding. When considering whether an individual was compelled to testify, a court looks to see how much pressure was exerted during the

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[179] H. Fernandez, *Genetic Privacy, Abandonment, and DNA Dragnets: Is 4th Amendment Jurisprudence Adequate?* 35 Hastings Center Report 21 (2005).
[180] Boire, *supra note* 177, at 62.
[181] Kyllo *v*. United States, 533 US 27 (2001).
[182] Wolpe *et al.*, *supra note* 113, at 46.
[183] Pardo, *supra note* 169, at 1859.
[184] *Id*. 1868.

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interrogation process in order to determine if the person's free will of the person was overpowered.[185] It has been determined that compulsion does not include mere trickery.[186] The proffered testimony must also be of the sort that might expose the individual to criminal charges. Finally, there has to be actual testimony that discloses incriminating knowledge and beliefs. This last requirement is often fraught with difficulty because physical evidence has been ruled to have no protection under the Amendment, making it common for courts to spend a great amount of time deliberating on whether a particular piece of information constitutes real or physical evidence.[187]

For example, courts have ruled that DNA, blood, hair, fingerprints, breath, voice and handwriting samples are physical characteristics that are not protected by the 5th Amendment because they are not testimonial in nature.[188] It has yet to be decided, however, whether brain scans are physical or testimonial in nature. They should be considered to be primarily testimonial because the detected brain activity is a direct by-product of a person's thoughts.[189] Previously unknown facts and opinions are retrieved from responses to outside stimuli in tests that have been specifically designed for that purpose. fMRI should be considered testimonial in nature because it works at even a more personal level than DNA, which is used mostly for identification and predictive purposes, not for reading thoughts in real time.

The purpose of the 5th Amendment is to protect the contents of the mind and to ensure the integrity of the judicial system. Justice Goldberg in 1964 wrote that the privilege against self-incrimination is "one of the great landmarks in man's struggle to make himself civilized."[190] The United States strives to maintain an enlightened criminal justice system that is accusatorial in nature, as opposed to conducting a medieval judicial system that is inquisitorial in nature.[191] A certain level of fair play is guaranteed by the fact that the government does not interfere with the life of an individual until it can gather enough evidence to prove a case.[192] The 5th Amendment is designed to preserve a sense of human dignity and individuality within the criminal justice system, and places limits upon the Government's ability to gather relevant information, because it is believed to be cruel to make someone testify against himself. In addition, the Amendment prevents an accused individual from being subjected to charges of perjury or contempt.[193]

Despite these positive characteristics, there are critics who would like to see the privilege against self-incrimination eliminated. Justice Benjamin Cardozo

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185 R. Allen & M. K. Mace, *The Self-Incrimination Clause Explained and its Future Predicted*, 94 J. Crim. L. & Criminology 243, at 249 (2004).
186 Pardo, *supra note* 169, at 1868.
187 Allen & Mace, *supra note* 185.
188 Pardo, *supra note* 169, at 1877.
189 Allen & Mace, *supra note* 185, at 261.
190 D. Dolinko, *Is There a Rationale for the Privilege Against Self-Incrimination*?, 33 UCLA L. Rev. 1063 (1986).
191 *Id.* at 1064.
192 *Id.* at 1116.
193 *Id.* at 1090.

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stated that "Justice … would not perish if the accused were subject to a duty to orderly inquiry."[194] The identification and punishment of criminal offenders is inherently cruel, therefore the compulsion of testimony would not make the process that much more inhumane.[195] In many cases, it is permissible for the same information to be obtained from other sources, such as third parties, but in certain types of crime, there are often few witnesses or traces of any wrongdoing left behind, so there is a need to compel testimony from a suspect or else there will be no evidence.[196] In everyday situations, people are regularly asked to explain their actions, so members of the public are used to defending their behavior. Furthermore, because the state can override privacy interests by showing it has a strong interest in the disclosure of information, it cannot be said with certainty that that a person has absolute control over their personal information, or has exclusive control over their moral development.[197] It is likely that proponents of these arguments would see nothing wrong with the use of fMRI during criminal investigations.

Hopefully these people would be able to change their opinions regarding fMRI once they realize that this technology could prove to be more coercive and abusive than physical torture. fMRI compromises a detainee's choice to keep personal information private because it takes away a person's right to remain silent under questioning. Even under conditions where physical torture is applied to detainees, a person is still able to choose whether or not to endure more physical abuse, but fMRI renders the option of enduring more physical pain irrelevant by making that person's thoughts easily accessible without their consent.[198]

There is a great amount of caselaw that supports a person's right to remain silent. In the case *Malloy v. Hogan*, the court looked to see if the defendant's confession was free, voluntary, not extracted by any sorts of violence or threats, and not obtained through the use of any improper influence. The court ruled that the federal and state governments have to establish guilt by evidence that is freely and independently secured, and the charges may not be proven by coercing a confession out of the accused's own mouth.[199] In addition, the Fourteenth Amendment prohibits states from inducing people to confess through the use of false sympathy, or through the use of other, similar inducements that fall far short of torture, and protects people from state invasion upon the right to remain silent, unless that person chooses to speak of his own free will.[200]

The court in *US v. Rivera* stated that Miranda warnings assure that a defendant's silence will carry no penalty, and any silence is ambiguous because of what that person has been advised to do.[201] Furthermore, *US v. Savoy* explained that the right to remain silent attaches before the institution of formal adversarial proceedings,

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194 Palko *v.* Connecticut 302 US 319, 326, (1937).
195 Dolinko, *supra note* 190, at 1100.
196 *Id.* at 1139.
197 *Id.* at 1125.
198 Thompson, *supra note* 60, at 1617.
199 Malloy *v.* Hogan. 378 US 1, 7 (1964).
200 *Id*. at 9.
201 US *v.* Rivera, 944 F.2d 1563 (1991).

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and neither the prosecutor nor the court may invite the jury to draw an inference of guilt from the accused's failure to take the stand. While the government may use the defendant's silence for impeachment purposes, it may not argue that the defendant's silence is inconsistent with a claim of innocence.[202]

The nature and scope of the 5th Amendment is described in *Coppola v. Powell*, where it was determined that the privilege against self-incrimination needs to be given a liberal construction in order to ensure that it is able to be asserted by any suspect who is questioned during an investigation of a crime: "Even the most feeble attempt to claim a 5th Amendment privilege must be recognized."[203] According to *Garner v. US*, a disclosure of information will not be "compelled" if a knowing and intelligent waiver of the privilege is made, and there is no factor depriving the person of the free choice to refuse to answer.[204] According to the above cases, the involuntary use of fMRI in criminal investigations would violate the 5th Amendment, because even though the procedure itself is typically quick, painless, and noninvasive, it would effectively deny the individual the right to assert and maintain his or her right against self-incrimination due to the fact that the procedure can reveal a person's innermost and private thoughts without his or her consent.

The Court in *Fisher v. United States*, however, ruled that the 5th Amendment only protects the accused against being compelled to make incriminating testimonial communications, not from the disclosure of private information or private incriminating statements if they were not compelled at the time that they were uttered.[205] The court ordered the taxpayer's lawyer to produce the requested documents, because in doing so, the taxpayer would not be compelled to do anything, including be a witness against himself.[206] The court also stated that it is widely acknowledged that pre-existing documents, which could have been obtained by court process when the client was in possession, can also be obtained from the client's attorney by similar processes following their transfer by the client in order.[207] To justify it's ruling, the court distinguished the requested tax records from private, personal papers that are inadmissible as evidence: "a compulsory production of the private books and papers of the owner of goods sought to be forfeited … is compelling him to be a witness against himself, within the meaning of the Fifth Amendment of the Constitution."[208] Justice Brennan wrote in his concurring opinion that

> An individual's books and papers are generally little more than an extension of his person. They reveal no less than he could reveal upon being questioned directly. Many of the matters within an individual's knowledge may as easily be retained within his head as set down on a scrap of paper. I perceive no principle which does not permit compelling one to disclose the contents of one's mind but does permit

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202 US *v*. Savoy 38 F. Supp.2d 406 (D. Md. 1998).
203 Coppola *v*. Powell, 878 F.2d 1562 C.A. 1 (N.H.) 1989.
204 *Id.*
205 Fisher *v*. United States, 425 US 391, 399 (1976).
206 *Id.* at 395.
207 *Id.* at 401.
208 *Id.* at 406 (quoting Boyd *v.* United States).

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> compelling the disclosure of the contents of that scrap of paper by compelling its production … The ability to think private thoughts, facilitated as it is by pen and paper, and the ability to preserve intimate memories would be curtailed through fear that those thoughts or events of those memories would become the subjects of criminal sanctions however inwardly imposed.[209]

The Court also described how it had previously denied 5th Amendment privileges to the forced giving of blood, voice, and handwriting samples, and the wearing of an article of clothing in court, because even though the evidence was an incriminating product of compulsion, it was neither testimony nor evidence relating to some communicative act or writing by the accused.[210] fMRI, like blood and handwriting samples, does not compel oral testimony, or cause the individual to repeat or affirm the truth of the obtained evidence. As a result, in order for brain scans to fall within the protection of the 5th Amendment, defendants would likely have to successfully argue that they resemble "private papers" that describe a person's innermost thoughts, rather than impersonal blood, handwriting, and voice tests.

It is well established that a court does not violate the constitutional rights of a defendant when it orders the person to undergo compulsory physical exams and tests for the purpose of obtaining evidence. This notion is settled on the grounds that courts may require a physical exam whenever one is needed to resolve an issue, and due to the fact that the 5th Amendment only applies to actual testimony, not real or objective evidence.[211] Courts have successfully ordered suspects to undergo a wide array of exams: blood tests, urinalysis, breath tests, mental exams, bodily examinations in the courtroom, hair samples, voice samples, the removal of narcotics from the rectum, HIV tests, smears of the genitals in a rape case, taking impressions of teeth in order to compare them to bite marks, and placing electrodes in the brain as part of a neurological exam. The case *Ronchin v. California* is a rare example of a court being overruled because it improperly ordered a physical exam. In *Ronchin*, the court looked at the totality of the violence, illegality, and compulsion involved when it declared that the use of a stomach pump to obtain drugs from the stomach of a suspect is impermissible.[212] In a similar case, however, the administration of an emetic to induce vomiting was ruled permissible when the defendant allegedly swallowed a bag of heroin.[213]

Courts and law enforcement officials are also permitted to order the administration of physical exams and medical procedures when faced with a clear, present, grave, and immediate threat to public health.[214] For example, courts have allowed prisons to x-ray nonconsenting prisoners to screen for tuberculosis, and have ordered psychopaths to undergo psychological exams. The case *Archer v. Commonwealth* further expanded this rule by stating that a prison could use a jaw screw to remove a bag of marijuana from the mouth of a prisoner if there is

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209 *Id.* at 420.
210 *Id.* at 406.
211 25 A.L.R.2d Section 1[b].
212 Ronchin *v.* California 342 US 165 (1952).
213 *Id*. 25 A.L.R.2d.
214 *Id.*

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probable cause, exigent circumstances, and the instrument involved is a proper medical device used in its intended manner by properly trained personnel.[215] The imposition of brain scanning upon an individual would most likely be a less violent and intrusive affair than a jaw screw. If fMRI is successfully able to detect and even predict mental illness and violent behavior, and proper guidelines and procedures have been established for its use, and the test is conducted by people properly trained in brain scanning procedures, then it could be argued that the administration of fMRI upon nonconsenting individuals, whether in the prison or general population, is valid when it furthers a legitimate public health interest.

K. A Look at the Admissibility of fMRI Under the Daubert Standard

Despite the fact that it is quite possible to imagine how fMRI may be used to infringe upon the constitutional rights of individuals, it has not yet been determined whether brain scans are admissible in court. The current test for determining whether expert testimony is admissible as evidence is described in the case *Daubert v. Merrel Dow*. Daubert created a nonexclusive four part test that is to be used by judges when making a determination regarding the admissibility of novel scientific evidence: 1) testability, 2) the technique has been subjected to peer review, 3) there is a known rate of error, and 4) there is a widespread acceptance of the technique in the scientific community.[216]

fMRI's effectiveness as a lie detector has been investigated during the course of numerous scientific studies that have been published for peer review in leading scientific journals. These experiments, however, have currently failed to establish a unified theory about the biological basis of lying, or establish an acceptable rate of error for brain scanning. In addition, there are still many members of the scientific community who believe that fMRI will never be suitable as a lie detector. The validity of fMRI in forensic situations has yet to be determined because there is currently no way for examiners to separate true recognition from the false memories that can affect the accuracy of the procedure. False memories include situations where people claim to have encountered a novel object, face, word, or other stimulus during a prior episode. One scientific study showed that the true recognition and false recognition of related items have similar patterns of neural activity, but that the false recognition of unrelated items activates completely different regions of the brain.[217] This study shows that there are not only more than one type of false memories, but that some of these memories

[215] Archer *v.* Commonwealth 455 SE2d. 280 (1995).
[216] Daubert *v*. Merrell Dow 509 US 579 (1993).
[217] R. Garoff-Eaton *et al.*, *Not All False Memories are Created Equal: the Neural Basis of False Recognition*, 16 Cerebral Cortex 1645 (2006).

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may be indistinguishable from true recognition.[218] Until the science behind fMRI develops to the point where the test can be administered with much greater certainty, brain scans should not be admissible as evidence in the courtroom.

Brain Fingerprinting was ruled admissible in a non-jury hearing on a Post Conviction Petition. As a result, the decision is not binding on any court, and most likely is not even persuasive because the judge did not grant the defendant a new trial, or even discuss Brain Fingerprinting in the opinion.[219] In addition, the MERMER brain wave, which is the key component to Brain Fingerprinting, has not been widely studied and subjected to peer review because Dr. Farwell has a patent on the technology and has not granted other researchers permission to use or even have access to his techniques.[220] Only time will tell if Brain Fingerprinting develop into a reliable lie detector, but the behavior of Dr. Farwell should make judges wary of his methods. Science is a group activity that is based on trust, and displays of partisanship help to undermine this trust.[221] Scientific experts should be expected to provide unbiased testimony, but researchers like Dr. Farwell who have a great amount of self interest in their research appear biased towards wanting their client to win, unable to share and even willing to hide data, and willing to make claims that are beyond the scope of their empirical research.[222]

The *Daubert* standard makes the assumption that judges are qualified to determine whether or not an expert's testimony has a sound scientific basis. Under *Daubert*, the role of the judge is to act as a gatekeeper by rationally determining whether the scientific method was properly followed when the expert developed the theory in question, and to keep out testimony that is not based upon sound scientific principles and methodology.[223] It is virtually impossible to assume that judges, or anyone else outside the scientific community, can properly decide whether or not science has actually been performed.[224] *Daubert* assumes that judges are not influenced by personal biases when making their decision, and that a rational extra-scientific standpoint actually exists which they can base their decision upon.[225] The standard also assumes that science is rational only if non-scientists are able to apply rules to determine if the scientists are using the scientific method properly, even when scientists undertake years of training to

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[218] *Id.* at 1652.
[219] A. Moenssens, *Brain Fingerprinting: Can it be Used to Detect the Innocence of Persons Charged with a Crime?*, 70 UMKC L. Rev. 891, 914 (2002).
[220] *Id*. at 917.
[221] D. M. Risinger & M. J. Saks, *A House with No Foundation: Forensic Science Needs to Build a Base of Rigorous Research to Establish its Reliability*, 2003(Fall), Issues in Science and Technology 35.
[222] *Id.* at 37.
[223] A. Schwartz, *A "Dogma of Empiricism" Revisited: Daubert v. Merrell Dow Pharm. And the Need to Resurrect the Philosophical Insight of Frye v United States*, 10 Harv. J.L. & Tech. 149 (1997).
[224] *Id.* at 153.
[225] *Id.* at 158.

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learn the scientific method.[226] It is too much to ask judges to make determinations about error rates, accuracy, and scientific techniques, when even the leading scientists are unable to do so.[227]

Advances in biotechnology are moving far too quickly for the legal system to keep up with them. According to one self described "simple country judge," most judges are unprepared for this scientific boom because they "tend to have no particular training in statistical analysis as it relates to scientific research, unless they worked through doctoral programs in science before making the career switch to law," and "they tend to be scientifically ignorant, which means they are not acquainted, let alone conversant, with scientific practice or language."[228] One remedy to this situation would be to overturn *Daubert* and replace it with a ruling that establishes a standard that is similar in nature to its predecessor, the Fr*ye* standard. Under *Frye*, testimony is ruled admissible by a judge if it is generally accepted within the relevant scientific community. Frye has a more realistic outlook upon scientific testimony because it accepts that there is no extra scientific viewpoint to base a rational opinion on, and the standard does not allow laypeople to resolve issues that experts cannot.[229]

The major difficulty with the original *Frye* standard was that it could be extremely difficult to find the proper scientific community. Scientists, not judges, determine who is a member of a scientific community, but judges must ensure that a scientific expert is not just a mere technician who has no theoretical understanding of the technique, and that the expert has experience in forensic settings, not just in research and diagnostic laboratories.[230] Judges must also ensure that the expert is disinterested and has no commercial investment in the work. The court in *People v. Wesley* ruled: "the opinions of two scientists, both with commercial interests in the work under consideration and both the primary developers and proponents of the technique of forensic DNA analysis, were insufficient to establish a "general acceptance" in the scientific field."[231] The *Wesley* test did not make a distinction between forensic scientists whose professional and economic ties are too entwined with a particular technique to be considered separate, and those who have significant outside interests and income.[232] Therefore, the court in *People v. Young* ruled that "a certain degree of interest must be tolerated if scientists familiar with the theory and practice of a new technique are to testify at all," so the current test determines whether the scientist's "livelihood is intimately connected with the new technique."[233]

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[226] *Id.* at 193.
[227] *Id.* at 161.
[228] M. A. Rothstein, *The Impact of Behavioral Genetics on the Law and the Courts*, 83 Judicature 116, 120 (1999).
[229] Schwartz, *supra note* 223, at 193.
[230] *Id.* at 197.
[231] People *v.* Wesley 633 N.E.2d. 451, 468 (N.Y. 1994).
[232] Schwartz, *supra note* 223, at 201.
[233] People *v*. Young 391 N.W.2d. 270, 276-77 (Mich. 1986)..

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The basic premise of the American criminal trial system is that the jury acts as a lie detector when it assesses the weight and credibility of a witness.[234] Polygraphs have long been considered inadmissible due to concerns about their reliability, but it has recently been ruled that courts should have the discretion to admit polygraph results because a per se rule in favor of exclusion violates the *Daubert* standard.[235] For example, New Mexico is the only state where polygraphs are generally admissible, even in the absence of prior stipulation, but several states, such as Indiana, have ruled that polygraphs are admissible as long as the defendant was read his Miranda rights before the exam and had signed a stipulation which stated that any statements made during the exam would be admissible.[236]

In New Mexico for a polygraph to be admissible, the exam must have been conducted according to an approved manner by a qualified instructor.[237] A polygraph exam using control question procedures has been determined to be sufficiently reliable, and therefore, admissible in court. If the reliability of the results from a particular polygraph test are in issue, opposing council may use argumentation, cross examination, and the presentation of rebuttal evidence in order to remedy the situation. In addition, New Mexico courts have ruled that when the admissibility of scientific evidence is in doubt, the dispute should be resolved in favor of admission.[238]

Scientific evidence may be excluded if it will waste time, confuse, or not materially assist the trier of fact, but it is not necessary for the scientific tests in question to have attained 100% accuracy. In *US v. Hicks*, the court allowed PCR results into evidence despite the fact that there was a possibility of contamination because "the possibility of human error does not prevent scientists from relying on scientific analysis if safeguards against such errors exist and are followed."[239]

In addition, when a court is exercising its discretion to admit scientific evidence, the novelty of the underlying science should not prevent the court from admitting such evidence once a proper *Daubert* ruling has been made.[240] Unusual scientific evidence, such as bite mark identification on a piece of cheese, has been ruled admissible as long as the underlying methodology is sound.[241] When looking at the above cases, it would appear that brain scans would be admissible if they were conducted by properly trained personnel who followed procedures that have been deemed to be sufficiently reliable. In addition, since perfection is not a prerequisite for admissibility, brain scans might be ruled admissible even if there is a reasonable margin of error or level of uncertainty to the procedure.

Even if fMRI fails the *Daubert* admissibility test, it may be ruled admissible in cases involving charges of specific intent, such as murder or assault, because psychiatric evidence is necessary to provide the defendant with an adequate

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234 US *v.* Scheffer, 118 S. Ct. 1261, 1266 (1998).
235 *Id.* at 1261.
236 Davis *v.* State of Indiana, 149 N.E. 2d 552 (Ind. App. 2001).
237 Lee *v.* Martinez, 136 N.M. 166 (2004).
238 *Id.* at 180.
239 US *v.* Hicks, 103 F.3d. 837, 846 (1996).
240 *Id.*
241 Seivewright *v.* State of Wyoming, 7 P.3d. 24, 29 (2000).

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defense. Testimony relating to post traumatic stress disorder was ruled admissible in *US v. Berri* because it disproved specific intent through the indication of a lack of mental responsibility, and showed a failure to appreciate the nature, quality, or wrongfulness of the acts.[242] Due to the seriousness of the charges, it was necessary for the psychological testimony to be admitted because the defendant needed to disprove the presence of mental responsibility by clear and convincing evidence.[243]

PET scans, a procedure that is similar in nature to fMRI brain scans, have been ruled admissible to prove a lack of criminal responsibility in a murder case.[244] PET scans of the defendant in *People of New York v. Weinstein*, indicated the presence of a cyst in his brain's protective covering. The attorneys for the defendant argued that their client was not criminally responsible for the murder of his wife because the cyst caused metabolic disturbances in his brain that made the defendant unaware of his actions. Despite the state's argument that the PET scan had not yet been proven to be a sufficiently reliable diagnostic device, the court ruled that when a defendant pleads insanity, he may offer psychiatric evidence to support the claim, even if that evidence does not meet *Frye* standards. This is because a psychological expert can offer "any" explanation for the diagnosis, including tests that do not have general acceptance, as long as it reasonably serves to clarify the diagnosis of a mental disease or syndrome that is generally accepted by psychiatrists.[245] The court just needs to ask if it was reasonable for the psychiatrist to use this information when making the diagnosis.[246] The state is given ample opportunity to attack the credibility of any psychiatric evidence because its attorneys are allowed to both cross examine the expert witness, and to offer their own experts who will propose alternate interpretations to the testimony. It is foreseeable that like the PET scans in *Weinstein*, fMRI scans would be admissible in situations where they would assist a psychiatrist make a diagnosis of a defendant who is charged with a specific intent crime, regardless of whether or not they have been proven reliable.

At this point in time, judges need to be especially cautious when determining the admissibility of brain scans because the quality of their predictive capabilities is still very much uncertain, interrogation techniques using fMRI have not been standardized or accepted as being accurate, and the number of experts who are qualified to interpret the brain scans may be very small. A taskforce funded by the European Federation of Neurological Societies found that "there are huge educational tasks to be handled now and in the future, in order to secure that future neurology residents receive sufficient training in neuroimaging. Even more demanding will be the continuing medical education, which must keep already educated neurologists up-to-date in this field."[247] It takes years of specialized

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[242] US *v*. Berri, 33 M.J. 337, 338 (1991).
[243] *Id.* at 343.
[244] People of New York *v*. Weinstein, 156 Misc. 2d. 34 (1992).
[245] *Id.* at 38.
[246] *Id.* at 44.
[247] P. Lasjaunias, *The Specialty of Neuroimaging in Neurology: A Counter-revolution in Europe*?, 41 Neuroradiology 153 (1999).

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training and experience to learn how to properly interpret brain scans because fMRI technology is complex and not easily mastered.[248] When evaluating an expert's credentials, a judge must make sure that the individual has been trained to read these types of images in a forensic setting, and is not basing his testimony on pure conjecture.

If fMRI is to be properly used in forensic settings, it will be necessary to provide funding for the creation of a brain-scanning network and to train and retain workers who are skilled in the use of the equipment. Hopefully this network would be run more efficiently than the DNA based CODIS system that is currently in use. Despite having some measure of success, CODIS has a backlog of over 1.3 million samples, one million of which have not even been collected from convicted offenders, creating an estimated backlog of six years.[249] In order for fMRI to become successful within the courtroom, enormous amounts of money would have to be invested to fund the laboratories.

L. Judicial Reforms Regarding Scientific Evidence

In order to prevent juries from being misled, deceived, or confused by ever increasing levels of complex scientific testimony, efforts need to be taken to create a learning environment within the courtroom. Juries often mistakenly believe that scientific tests are infallible and completely accurate, and as a result often give expert opinions unwarranted levels of respect.[250] To prevent the jury from being dazzled by colorful brain scans, they need to be informed that the images created by fMRI are currently based upon averages of information obtained from numerous individuals, and that even though they look "scientific," the final product is often heavily dependent upon exercises of the examiner's judgment, or as put by one neuroimager: "Probably the only thing worse than having people successfully reading your mind with brain imaging is having people unsuccessfully reading your mind with brain imaging and thinking that they can trust that information."[251] In addition, many lawyers fail to object to unsound scientific evidence simply out of ignorance, which causes them to blindly accept the validity of the expert's opinions.[252] For example, scientific experts are frequently allowed to testify beyond the scope of their expertise, such as when forensic pathologists are questioned about the caliber and characteristics of weapons, and firearms examiners are questioned about the wounds resulting from the handling of firearms.[253]

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[248] *Id*. at 154.
[249] Ch. H. Asplen, *Integrating DNA Technology into the Criminal Trial System*, 83 Judicature 144, at 147 (1999).
[250] S. Olson, *Brain Scans Raise Privacy Concerns*, 307 Science 1548, at 1550 (2005).
[251] *Id.*
[252] A. A. Moenssens, *Novel Scientific Evidence in Criminal Cases: Some Words of Caution*, 84 J. Crim. L. & Criminology 1, 5 (1993).
[253] *Id.* at 7.

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The state of Arizona has already implemented some interesting judicial reforms that are designed to make scientific testimony more accessible to judges and juries. Some of these reforms include juror note taking, providing juries with pretrial instructions that define the elements of the alleged crime or the legal terms that are going to be used, such as "negligence," allowing juror discussion during civil trials, and the greater use of independent court appointed experts.[254] The goal of these reforms is to cause jurors to become more actively involved in the trial process.[255] Instead of replacing the jury system with a panel of experts, courts could make the jury's job easier by appointing independent experts who will conduct educational sessions to explain the scientific theories that will be relied upon by the expert witnesses.[256]

Critics might argue that the expanded use of independent experts will interfere with the adversarial nature of the justice system, but this might actually have a positive effect. Studies show that jurors do not give much weight to cross-examinations of expert witnesses because they view cross-examination as merely a lawyer's attempt to discredit the expert through the use of any means possible, instead of a legitimate effort to point out flaws in the testimony.[257] So far these reforms have had mostly positive results, and their implementation has not had any adverse effects upon the outcome of trials.[258] Judges across the nation already have been given the tools to implement similar reforms. Rule 611 of the Federal Rules of Evidence permits the judge to control the methods used to question witnesses and present evidence, and Rule 706 allows judges to appoint expert witnesses for testimonial purposes.[259] It is imperative that if fMRI is ever used in a forensic setting, measures are available to accurately inform judges and juries about the capabilities of the procedure.

M. How fMRI Will Change Our Notions of Free Will and Criminal Responsibility

Criminal law presumes that most human behavior is voluntary, therefore people should only be held accountable for their conscious acts. In order for a person to be held criminally liable, there needs to be an internal, mental event, an external, physical act, and a connection between the internal and external events.[260] Criminal liability cannot be imposed upon a person merely for having "evil" thoughts. Debates involving free will and personal responsibility have a lengthy history in the American courtroom. In one of the first cases in the United States to involve

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[254] R. Myers *et al.*, *Complex Scientific Evidence and the Jury*, 83 Judicature 150, at 154-155 (1999).
[255] *Id.* at 152.
[256] *Id.* at 155.
[257] *Id.* at 156.
[258] *Id.* at 155.
[259] *Id.* at 156.
[260] D. Denno, *Crime and Consciousness: Science and Involuntary Acts*, 87 Min. L. Rev. 269, 275 (2002).

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psychiatric testimony, the court in *Fain v. Commonwealth* had to decide whether or not a person should be held responsible for a murder that was committed during a period of somnambulism. The court, after listening to medical experts explain the medical history of the defendant and give a description of somnambulism in general, ruled that the law only punishes for overt acts done by responsible moral agents, and since the defendant was unconscious during the incident, he should not be punished.[261] Modern neuroscience and fMRI, however, have apparently destroyed this dualist view of mind and body by allowing researchers to view the mind in action, and observe both the structure and activity levels in various parts of the brain.[262] Psychologists now believe that consciousness is not binary, but consists of a single brain activity during which consciousness moves from the unconscious, to preconsciousness, to settled consciousness, therefore negating any sound legal basis for dividing behavior into voluntary and involuntary acts.[263]

fMRI is based upon the philosophy of neuroscience essentialism, which assumes that states of mind are generated by brain events that can be measured and assessed. This belief leads to neuroscience exceptionalism, in which information about the brain is believed to be more determinable than it is in fact.[264] It is not yet proven that fMRI can provide clear, causal evidence of this level and magnitude. Even if neuroscience does reveal that all our mental activity is predetermined by one large system, responsibility is a social construct and should exist in the rules and laws of society. Currently, there is evidence pointing to the fact that our brains know the decisions we are going to make before we are even conscious of them, but also there is a brief period during which our conscious mind can override the unconscious decision, giving us "free won't" rather than "free will." Even though fMRI may help in assessing a person's level of rationality, it most likely will not be able to tell experts how much control is needed before a court may impose responsibility.[265]

Many judges and lawyers may argue that the current legal system can adequately accommodate fMRI, but this argument trivializes the effects of the new technology by judging it from the existing moral framework.[266] It is likely that many adjustments will have to be made in order to contain fMRI. fMRI may create evidence that provides a certainty that attorneys are not used to. Typically, physical evidence only suggests guilt or innocence. Lawyers may decide not to appeal a case, or may try to get a different result from a different jury, based upon the results of a brain scan.[267] In addition, in many civil and criminal cases, a person's conduct is compared to that of a reasonable person who exhibits that

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[261] Fain *v*. Commonwealth 78 Ky. 183 (1879).
[262] A. I. Leshner, *It's Time to go Public with Neuroethics*, 5 The American Journal of Bioethics 1 (2005).
[263] Denno, *supra note* 260, at 310.
[264] M. Fischer, *Book Review: Neuroscience and the Law: Brain, Mind and the Scales of Justice*, 2005 Federal Lawyer 61.
[265] *Id.* at 62.
[266] J. Keulartz *et al.*, *Ethics in Technological Culture: A Pragmatic Proposal for a Pragmatist Approach*, 29 Science, Technology, and Human Values 3, at 11 (2004).
[267] Asplen, *supra note* 249, at 146.

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community's idea of reasonable behavior in similar circumstances. fMRI could replace this objective, unitary legal standard with a subjective standard that reflects the innate characteristics of specific individuals.[268]

Even if it is possible for the current legal system to accommodate fMRI technology, it may alter assumptions about free will and responsibility in such a way that punishment will have to be administered from a consequentialist approach, rather than according to the traditional retributive viewpoint. The purpose of criminal punishment, according to consequentialist philosophy, is to promote the welfare of society through the deterrence of future crimes and through the detention of dangerous people. In contrast, retributive justice is designed to punish people according to the severity of their prior actions. It is possible that brain scans under the current retributive model of justice could be treated as just another form of evidence due to the fact that the legal system presently is not based upon the biochemical causes of criminal behavior, but this ignores the fact that fMRI will change our views about free will in such a way that changes to the law will become necessary.[269] While the success of retributivism is contingent upon the existence of free will, consequentialism works even in the absence of free will because any infringements upon the rights of the individual will be offset by the benefits bestowed upon society.[270]

Many of the issues created by fMRI have already been encountered by the judicial system on chance occasions, but judges have never had to wrestle with a scientific procedure that can upend large sections of the criminal code. Over forty years later, the decision in *State of New Jersey v. Sikora* seems extremely prophetic. The court refused to admit the testimony of Dr. Galen, a psychiatrist who specialized in psychodynamics. These specialists believe that people are a product of their own life history and genetic patterns, which causes everyone to react to the stress of everyday life differently. In addition, mental disorders are classified according to gradients, and everyone should be considered normal except for those who have severe distortions of reality.[271] Dr. Galen was prepared to testify that the defendant's behavior was a psychologically predetermined conduct emanating from a severe personality disorder, but the court ruled that criminal responsibility must be judged at the level of consciousness, and the criminality of the defendant's conduct cannot be denied because his genes, environment, and unconscious influenced his consciousness. The court was wise enough to realize that if Dr. Galen's theories were considered to be valid, the legal doctrine of mens rea would disappear, and a new legal system would have to be created because criminal responsibility would disappear as we know it.[272] Justice Weintraub in his concurring opinion reasoned that

> the psychiatric view expounded by Dr. Galen is simply irreconcilable with the basic thesis of our criminal law, for while the law requires proof of an evil-meaning

[268] Rothstein, *supra note* 228, at 118.
[269] J. Greene & J. Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 Phil. Trans. R. Soc. Lond. B 1775 (2004).
[270] *Id*. at 1777.
[271] State of New Jersey *v*. Sikora, 210 A.2d 193, 197 (1965).
[272] *Id*. at 202.

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> mind, this psychiatric thesis denies there is any such thing. To grant a role in our existing structure to the theme that the conscious is just the innocent puppet of a nonculpable unconscious is to make a mishmash of the criminal law, permitting-indeed requiring-each trier of the facts to choose between the automaton thesis and the law's existing concept of criminal accountability. It would be absurd to decide criminal blameworthiness upon a psychiatric thesis which can find no basis for personal blame. So long as we adhere to criminal blameworthiness, mens rea must be sought and decided at the level of conscious behavior.[273]

N. Conclusion

In conclusion, fMRI brain scans and Brain Fingerprinting results should not be considered admissible in court because their reliability and margin of error has yet to be determined, and there have been no guidelines or standards set for use of this equipment. Years from now, a machine might exist with a resolution capable of monitoring and analyzing every neuron in the brain, but such a machine should be used only sparingly, in exceptional situations, or else cognitive liberty could be placed in severe jeopardy. To quote Justice Frankfurter, "without freedom of thought there can be no free society."[274] The Supreme Court has a history of looking towards the Constitution when upholding the right of the individual to control his or her own consciousness. In a landmark privacy case, Justice Brandeis wrote in his dissent:

> The makers of our Constitution undertook to secure conditions favorable to the pursuit of happiness. They recognized the significance of man's spiritual nature, of his feelings and of his intellect. They knew that only a part of the pain, pleasure and satisfactions of life are to be found in material things. They sought to protect Americans in their beliefs, their thoughts, their emotions. They conferred, as against the Government, the right to be let alone-the most comprehensive of rights and the right most valued by civilized man.[275]

Several years later, Justice Benjamin Cardozo further described and supported intellectual freedom when he wrote: "… freedom of thought … one may say … is the matrix, the indispensable condition, of nearly every other form of freedom. With rare aberrations a pervasive recognition of that truth can be traced in our history, political and legal."[276] Furthermore, Justice Felix Frankenfurter eloquently explained why it is important that the government should not be allowed to interfere with the thought processes of the individual:

> Free speech, free exercise, free association, a free press and the right to assemble are all moot if the thought that underlies these actions has already been constrained by the government. If the government is permitted to prohibit the experiencing of certain thought processes, or otherwise manipulate consciousness at its very roots-via drug prohibitions, religious indoctrination, monopolizing media, or any

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[273] *Id.* at 206.
[274] Kovacs *v*. Cooper 366 US 77, 97 (1949).
[275] Olmstead *v*. United States 277 US 438, 478 (1928).
[276] Palk *v*. Connecticut 302 US 319, 326-327 (1937).

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> number of methods-it need not even worry about controlling the expression of such thoughts. By prohibiting the very formation of mind states-by strangling the free mind itself-free expression is made meaningless … Indeed, the First Amendment was infused with the principle that each individual-not the government-ought to have control over his or her own mind, to think what he or she wants to think, and to freely form and express opinions based on all the information at his or her disposal. The First Amendment, in other words, embraces cognitive liberty not simply as the desired outcome of the articulated guarantees (i.e. a right to express one's ideas), but also as a necessary precondition to those guaranteed freedoms (i.e. a right to form one's own ideas).[277]

As recently as 2003, Justice Anthony Kennedy wrote: "Liberty presumes an autonomy of self that includes freedom of thought, belief, expression, and certain intimate conduct."[278] fMRI has the potential to reveal a person's innermost thoughts, causing the "essence" of that person to be revealed to investigators. When fully developed, it would be extremely easy for this technology to be used in a way that could infringe upon the intellectual and spiritual development of the individual, causing many of the rights Americans take for granted to be denied.

[277] Kovacs *v*. Cooper 336 US 77, 97 (1949).
[278] Lawrence *v*. Texas 539 US 558 (2003).