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Abstract

Research suggests there are neurological predictors of violence, such as brain function abnormalities most frequently displayed by violent offenders who may suffer from a psychological phenomenon termed “psychopathy.”¹ Functional magnetic resonance imaging (fMRI) can detect signs of some of these brain abnormalities.² Neurological markers of violence, evident in a convicted individual’s fMRI results, could speak to that offender’s tendency to act violently in the future.³ Can fMRI play a meaningful role in estimating recidivism rates and in sentencing? Even if fMRI evidence meets legal thresholds for use in sentencing, should it be employed in light of many concerns, such as reliability, as the implications of predicting an individual’s dangerousness based on fMRI evidence are substantial, especially in the context of

¹ Kent Kiehl et al., “Limbic Abnormalities in Affective Processing by Criminal Psychopaths as Revealed by Functional Magnetic Resonance Imaging”, (2001) 50 Biological Psychiatry 677 at 682 (noting after using fMRI to examine neural systems in psychopathic offenders “The results support the hypothesis that criminal psychopathy is associated with abnormalities in the function of structures in the limbic system and frontal cortex while engaged in processing of affective stimuli”).
² Ibid.
³ Ibid.
defendant rights. Moreover, neurological indicators of violence may undermine a holistic approach to sentencing that considers the convicted individual’s particular story.

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4 See e.g. ibid.
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“Advances in neuroscience seem likely to cause major changes in our society in the next few decades, for better and for worse. And when society changes, the law must change – whether to guide those social changes or merely to respond to them.”

- Professor Henry T. Greely

Chapter 1

Introduction

Research suggests there are neurological predictors of violence, such as brain function abnormalities most frequently displayed by violent offenders who may suffer from a psychological phenomenon termed “psychopathy.”¹ Functional magnetic resonance imaging (fMRI) can detect signs of some of these brain abnormalities.² Neurological markers of violence, evident in a convicted individual’s fMRI results, could speak to that offender’s tendency to act violently in the future.³ As Professor Henry Greely explains, “Issues of psychopathy, frontal lobe damage, and other asserted ‘causes’ of criminal behavior may be used, not to reduce responsibility, but as predictive factors to increase sentences.”⁴ Greely asks “What if you could do a brain scan and determine to a high probability whether a criminal defendant was a psychopath with, for example, a 60-70 percent chance of recidivism … Would that make a

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² Kiehl et al., supra, note 1 (Kiehl’s team uses a mobilized fMRI scanning unit, traveling to and from prisons to study the brain activity of individuals who are presently incarcerated. For more information about Kiehl’s research and work, visit http://www.mrn.org/people/kent-a-kiehl/principal-investigators/).
³ Ibid (asserting: “Compared with criminal nonpsychopaths and noncriminal control participants, criminal psychopaths showed significantly less affect-related activity in the amygdala/hippocampal formation, parahippocampal gyrus, ventral striatum, and in the anterior and posterior cingulate gyri. Psychopathic criminals also showed evidence of overactivation in the bilateral fronto-temporal cortex for processing affective stimuli”).
⁴ Ibid.
⁵ Greely, supra note 4 at 1104.
difference to a judge or a jury? What if you were a juror in a capital case in the sentencing phase?"¹⁰

Questions such as these have become, in recent years, increasingly significant and common-place as neuroscience and legal scholarship have, in many areas of research, begun to intersect.¹¹ Indeed, advancements in the field of law and neuroscience have emerged at an alarming rate: in 2007 the John D. and Catherine T. MacArthur Foundation established the Law and Neuroscience Project,¹² in 2011 the Project was supplemented by the Foundation’s creation of the Research Network on Law and Neuroscience;¹³ a Law and Neuroscience casebook, published by some of the network’s leading scholars, is forthcoming;¹⁴ and “the press – print, television, and web – has recognized that ‘law and the brain’ stories are of increasing interest to their readers, and viewers.”¹⁵ Moreover, in recent years, jurors and judges have considered neuroscientific evidence in a wide variety of legal settings in both civil and criminal cases, and in the criminal context, in various stages of proceedings, from trial to sentencing, and beyond.¹⁶

This paper explores the role of one particular type of neuroscientific evidence, fMRI imagery speaking to an individual offender’s future dangerousness, within the American sentencing regime, and is especially concerned with the potential use of fMRI predictors of future violence in the capital sentencing context. First, the paper will provide a basic overview of fMRI technology, psychopathy, and the role of fMRI in predicting violent tendencies and

¹¹ See e.g. Jones & Shen, supra note 5.
¹² Ibid at 352.
¹³ Ibid.
¹⁵ Jones & Shen, supra note 5 at 352 (pointing to ample coverage of a variety of stories at the intersection of law and neuroscience whose sources include Science, The New York Times, NBC Nightly News, Scientific American, and the National Public Radio).
¹⁶ Ibid (discussing the use of neuroimaging in both civil and criminal contexts in court proceedings, and pointing to examples involving disability cases, contract cases, constitutional claims, and criminal contexts. The authors also note that “neuroscience has begun to appear … with increasing regularity” in a variety of criminal and civil proceedings and contexts).
behavior. Second, the legal standards governing the admission of mitigating and aggravating evidence during criminal sentencing and the role of dangerousness in the sentencing regime will be explored. Third, the paper will describe the legal standards governing the admission of fMRI evidence and the courts’ consideration of and approach to such evidence to date. Then, those reasons begging for the exclusion of fMRI dangerousness evidence to be used as an aggravating factor during sentencing will be laid out, with a particular focus on concerns relating to: reliability; relevance; prejudice to the convicted party; constitutional issues; and costs to the convicted individual of rebutting damaging fMRI evidence. Finally, the paper will propose and consider appropriate uses of fMRI results in the sentencing scheme apart from serving as an aggravating factor speaking to a convicted person’s likelihood of engaging in future violent acts.

Ultimately, this paper aims to persuade the reader that in its present state, fMRI evidence proffered as an aggravating factor suggesting an individual offender is likely to be a future danger to society should be excluded from the criminal sentencing process. Perhaps further neuroscientific developments will result in the enhanced reliability of neuroimaging tools, so that their admission in the sentencing process can be met with less scrutiny. Indeed, when fMRI technology exhibits a greater degree of reliability in predicting future violent behavior, courts may begin to develop the experience required to establish a sufficiently firm grasp of how best to approach, comprehend, and employ neuroimaging dangerousness evidence as an aggravating factor during the sentencing of individual convicted parties. However, bearing in mind the fundamental role of defendant rights, fairness concerns, and justice in the American criminal process, in its present state, fMRI evidence of dangerousness may unnecessarily label offenders as “wired” to commit criminal acts, undermine a holistic approach to sentencing that considers
the convicted individual’s particular story, and has no suitable role as an *aggravating* factor in the penal system.
Chapter 2
FMRI Technology, Psychopathy, and the Role of FMRI in Predicting Violent Tendencies

2.1. FMRI Technology

FMRI is not only a relatively new form of brain scanning technology, but is also a comparatively novel predictor of dangerousness and violent behavior, and as a whole, is “a novel source of legal evidence.” A thorough explanation of the mechanisms underlying the technology is beyond the scope of this paper, but any further discussion of fMRI evidence requires at the very least a brief and extremely simplified description of the inner workings of fMRI scanning.

FMRI scans detect changes in blood flow in the brain occurring in response to particular mental tasks in which the subject is engaged. When one brain region is more active than other areas, the engaged part of the brain draws more oxygen from the body. The fMRI scanner subsequently detects the changes in blood oxygenation levels as various brain regions are more or less active and accordingly demanding more or less oxygen. Through an exceptionally complex process, the fMRI machine interprets these variations in blood flow as indirect indicators of neural activity. FMRI technology can identify not only where in the brain greater

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18 Ibid.
20 Ibid.
21 Ibid.
22 Ibid (providing a more detailed and thorough explanation of the scientific and mechanical processes underlying fMRI technology, including information regarding the fMRI’s creation of a primary magnetic field; the spin and
levels of neurological activity occur (spatial resolution) but also when in time enhanced activity takes place (temporal resolution).

The test subject lays in a bed, which is inserted into an fMRI machine which appears to the subject to be a tube, making the scanning process a relatively non-invasive procedure. The fMRI images contain highlighted areas signifying disparities in statistical significance, and are the visual basis of fMRI evidence presented to the sentencing authority. Importantly:

“fMRI does not detect colors in the brain. fMRI images use colors – of whatever segment of the rainbow the researcher prefers – to signify the results of a statistical test … the brighter the color, the less likely it is that the differences in brain activity in that voxel or region, between two different cognitive tasks, was due to chance alone.”

2.2. Psychopathy and the Role of FMRI in Predicting Violent Behavior

Psychopathy is a psychiatric risk factor signaling an individual may be likely to commit a violent act in the future, and is significant to the sentencing process because “while estimated to affect just 1% of the adult male population, it is estimated that psychopaths make up 25% of the adult male prison population.” Traditionally, mental health experts employed social psychological and psychiatric tools involving interviews and questioning, such as the Hare Psychopathy Checklist-Revised (PCL-R), to diagnose psychopathy, but advances in neurological assessment methodology in recent years have allowed diagnosis to occur with the

direction of protons in response to the magnetic fields created; and the radio frequency pulses which are emitted by the fMRI administrator to the test subject).

23 Ibid.
24 Ibid.
25 Ibid.
26 Ibid at 9.
27 Ibid (continuing on to note that “By convention, the brighter the color (say, yellow compared to orange) the greater the statistical significance of the differences in brain activity between two conditions”).
29 Jones & Shen, supra note 5 at 365.
assistance of neuroscientific methods such as fMRI technology and other forms of neuroimaging.\textsuperscript{29}

Researchers have identified many neurological markers of psychopathy.\textsuperscript{30} Neuroimaging has revealed numerous neurological abnormalities unique to individuals previously diagnosed with antisocial disorders and psychopathy through traditional social assessment techniques in the prefrontal cortex, in particular.\textsuperscript{31} In one study, when individuals diagnosed with psychopathy engaged in a socially interactive game and tasks involving fear conditioning, fMRI demonstrated reduced activity in the orbitofrontal cortex.\textsuperscript{32} In another study, individuals who had been diagnosed with psychopathy demonstrated weaker activity when compared to control subjects in response to pictures illustrating various forms of violations of moral norms.\textsuperscript{33} Functional abnormalities have also been observed through a variety of neuroimaging techniques in various other brain regions, including: the amygdala; posterior cingulate;\textsuperscript{34} and, while psychopathic individuals engaged in a semantic processing task, in the angular gyrus.\textsuperscript{35} Kent Kiehl, a leader in the neurological underpinnings of psychopathic and antisocial behavior, has found neurological

\textsuperscript{29} Andrea L Glenn, Yaling Yang, & Adriane Raine, “Neuroimaging in Psychopathy and Antisocial Personality Disorder: Functional Significance and a Neurodevelopmental Hypothesis” in Joseph R Simpson, ed (Henry Greely Foreword), Neuroimaging in Forensic Psychiatry: From the Clinic to the Courtroom (John Wiley & Sons, Ltd., 2012) 81 at 83 (the authors also note that while many neurological abnormalities are evident across many individuals diagnosed with psychopathy, there are nonetheless abnormalities in structure and functioning in the regions of the brain which are not observable across all individuals diagnosed with psychopathy or antisocial disorders).


\textsuperscript{31} Glenn, Yang, & Raine, \textit{supra} note 31.


\textsuperscript{34} Glenn, Yang, & Raine, \textit{supra} note 31 at 86.

\textsuperscript{35} Kent Kiehl et al., \textit{supra} note 1.
abnormalities in psychopaths when compared to controls in both the left prefrontal cortex and anterior cingulate cortex.\textsuperscript{36}

Such neurological advancements have led scholars to highlight a link between the criminal sentencing process, psychopathy, neurological indicators of future violence, and neuroimaging: “If incorporating brain scan data into these future dangerousness assessments improves the predictive power of actuarial models it may have important implications in at least three sentencing contexts: (a) capital sentencing; (b) civil commitment hearings; and (c) detention hearings for so-called ‘sexual predators’”\textsuperscript{37} The following sections will explore how the courts have approached and considered dangerousness assessments and fMRI evidence and indicators of violent tendencies, in particular.

\textsuperscript{36} Ibid.

Chapter 3
Legal Standards Governing the Admission of Mitigating and Aggravating Evidence During Criminal Sentencing, and the Role of Dangerousness

3.1. Criminal Sentencing Outside of the Death Penalty Context

At the outset, it is necessary to note that fMRI evidence of a convicted individual’s neurological or mental abnormalities can be characterized as psychiatric evidence. Additionally, fMRI evidence can serve as an aggravating factor speaking to future dangerousness where neurological dysfunction reveals aggressive or violent tendencies or, alternatively, as a mitigating circumstance where fMRI scans show no neurological markers of antisocial or psychopathic behavior.38 Mitigating factors involving neuroimaging usually fall within one of three categories: “offender culpability, future dangerousness and general deserts or good character.”39

According to the United States Federal Sentencing Guidelines,40 a more flexible approach to evidence than is permitted during the trial phase is encouraged when determining whether evidence will be admitted by the court for the sentencing authority’s assessment.41 Thus, “in resolving any dispute concerning a factor important to the sentencing determination, the court may consider relevant information without regard to its admissibility under the rules of evidence applicable at trial, provided that the information has sufficient indicia of reliability to support its

38 See e.g. Jones & Shen, supra note 5.
41 Ibid.
probable accuracy.”

Some guidelines were also available in the Sentencing Reform Act, which requires sentencing to be based on a number of factors, one of which is the convicted individual’s history and characteristics.

To assess a convicted individual’s background, the sentencing authority should considering the offender’s mental state and any history of mental illness, disorder, or dysfunction. As one group of sentencing experts note, “To ignore relevant psychiatric evidence is to greatly increase the risk that a sentence will be utterly inappropriate … such evidence … ensures that the sentence imposed reflects the true circumstances of the offence and the offender. Where psychiatric material exists, it will inevitably be relevant to sentencing.” Thus, fMRI evidence relating to a particular offender’s neurological or psychiatric dysfunction is not only bound to be relevant to his or her sentencing, but is also likely to play a significant and central part in the sentencing authority’s decision-making process.

3.2. Death Penalty Cases

i. Introduction

In those states where the death penalty is employed, a phase independent from the trial occurs where sentencing assessments are made and the defendant and prosecution may produce mitigating and aggravating evidence for consideration in determining whether or not to impose the death penalty. An important purpose of this bifurcated process is to prevent arbitrariness;

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42 Ibid.
44 Ibid.
46 Ibid.
47 Ibid.
48 Edersheim, Brendel, & Price, supra note 41 at 170-176.
one phase dedicated solely to sentencing allows the sentencing authority to focus exclusively on sentencing, and receive a substantial degree of information to direct the decision-maker away from any random, illogical, or uninformed conclusion.\textsuperscript{49} Courts also historically believed that “because states had added consideration of aggravating and mitigating evidence, capital sentencing decisions were no longer arbitrary.”\textsuperscript{50} Many courts also consistently express concern with narrowing the number of convicted individuals who are eligible for the death penalty to a limited pool to ensure capital punishment is reserved for the most severe offences.\textsuperscript{51} Finally, courts perceive such narrowing as likely where the sentencing authority’s discretion is effectively limited.\textsuperscript{52}

Thus, during the sentencing phase, the sentencing authority must abide by certain directives in determining whether capital punishment is appropriate: first and foremost, the unique circumstances of the particular offender, including his or her character and record must be considered.\textsuperscript{53} Indeed, the Eighth Amendment mandates an assessment of the individual’s distinct story, circumstances, and characteristics “as a constitutionally indispensable part of the process of inflicting the penalty of death.”\textsuperscript{54} The sentencing authority is also required to consider both aggravating and mitigating factors, which may be either statutorily or non-statutorily mandated.\textsuperscript{55} Significantly, the Federal Death Penalty Act of 1994\textsuperscript{56} allows the sentencing

\textsuperscript{52} See Godfrey v. Ga., 446 U.S. 420, 428 (1980).
\textsuperscript{54} Ibid.
\textsuperscript{55} Subcommittee on Federal Death Penalty Cases of the Committee on Defender Services of the Judicial Conference of the United States, Federal Death Penalty Cases: Recommendations Concerning the Cost and Quality of Defense Representation (May 1998) at pt. I Sec B.
authority to impose a death sentence where merely one statutory aggravating factor is found.\footnote{57} Finally, improper influence is especially important in death penalty contexts, and “a death sentence may be reversed if the sentencing jury was influenced or misled by improper evidence, arguments, or instructions.”\footnote{58}

The courts and legal community have historically embraced psychiatric evidence as a valuable tool in capital sentencing.\footnote{59} A telling example is the American Bar Association (ABA)’s \textit{Guidelines for the Appointment & Performance of Defense Counsel in Death Penalty Cases},\footnote{60} which requires capital defense teams to include not only two lawyers, but also an investigator or mitigation specialist who is an expert in mental, psychiatric, and psychological health and disorders.\footnote{61} Because the sentencing phase is subject to fewer evidentiary restrictions than the trial stage, neuroimaging evidence, which may not otherwise meet reliability requirements at trial, is likely to be frequently admissible.\footnote{62} For this reason, “defense attorneys have been far more successful in introducing neuroimaging evidence at sentencing hearings than in support of diminished capacity claims.”\footnote{63}

\textbf{ii. Mitigating Factors}

In \textit{Lockett v. Ohio},\footnote{64} the Supreme Court held that almost any factor may be considered as mitigating evidence to prevent imposition of the death penalty:

\begin{quote}
“the Eighth and Fourteenth Amendments require that the sentencer, in all but the rarest kind of capital case, not be precluded
\end{quote}

\footnote{57 I\textit{bid}.}{I\textit{bid}.}
\footnote{59 See e.g. American Bar Association, \textit{Guidelines for the Appointment & Performance of Defense Counsel in Death Penalty Cases}, 2003, Sec 4.1.}{See e.g. American Bar Association, \textit{Guidelines for the Appointment & Performance of Defense Counsel in Death Penalty Cases}, 2003, Sec 4.1.}
\footnote{60 I\textit{bid}.}{I\textit{bid}.}
\footnote{61 I\textit{bid}.}{I\textit{bid}.}
\footnote{62 Edersheim, Brendel, & Price, \textit{supra} note 41 at 175.}{Edersheim, Brendel, & Price, \textit{supra} note 41 at 175.}
\footnote{63 I\textit{bid}.}{I\textit{bid}.}
from considering, as a mitigating factor, any aspect of a defendant’s character or record and any of the circumstances of the offense that the defendant proffers as a basis for a sentence less than death.”

The threshold standard for relevance of mitigating evidence is low, and relevance itself is essentially the only basis by which admission of mitigating evidence may be limited. Evidence that the convicted person does not pose a future danger to society can be presented during mitigation.

Relevant fMRI evidence can be included as a “defendant’s mental illness, cognitive or volitional deficits or evidence of extreme emotional disturbance, [all of which are] mitigating factors which cannot be excluded.” Traditionally, psychiatric mitigating evidence includes: “evidence of mental illness, character evidence, personal history, [and] evidence of treatability.” FMRI evidence showing neurological and psychiatric abnormal aggressive or violent tendencies is akin to many of the psychiatric evidence historically admissible for consideration in capital sentencing. This may be particularly so where fMRI evidence speaks to whether an individual is biologically prone to engage in behavior dangerous to others or is likely to benefit from treatment. Accordingly, “Neuroimaging evidence can play an important supporting role in the presentation of mitigation evidence.”

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65 Ibid at 605.
69 Edersheim, Brendel, & Price, supra note 41 at 176 (noting that neuroimaging evidence can play a significant role in mitigation strategy, and noting that any decision to introduce neuroimaging must engage strategic decision-making and consideration of the likelihood that admission of mitigating neuroimaging evidence could be considered as aggravating evidence by the sentencing authority); Melton et al., supra note 69.
70 Edersheim, Brendel, & Prince, supra note 41.
71 Ibid at 176.
iii. Aggravating Factors

Federal law mandates that states adopting the death penalty require the prosecution to prove at least one aggravating factor prior to asking the court to consider a capital sentence.\textsuperscript{72} Any aggravating circumstance indicating a party deserves the death penalty must be distinct from a characteristic of murder or violent individuals, generally, so that the aggravator “must not apply to every defendant of murder … [and] … the aggravating circumstance must not be unconstitutionally vague.”\textsuperscript{73} Although a capital sentence can not be imposed without at least one statutorily defined aggravating factor, the sentencing authority may nonetheless consider both statutorily and non-statutorily defined aggravating circumstances.\textsuperscript{74} Significantly, states may also make the death penalty mandatory once aggravating factors are equal or greater in weight to mitigating circumstances.\textsuperscript{75}

Traditionally, courts have allowed the sentencing authority to consider the future dangerousness of a convicted individual as an aggravating factor in sentencing, even in the capital context.\textsuperscript{76} As the United States Supreme Court asserted in \textit{Barefoot v. Estelle},\textsuperscript{77} it had previously “rejected the claim that it was impossible to predict future behavior, and that dangerousness was therefore an invalid consideration in imposing the death penalty.”\textsuperscript{78} Moreover, in \textit{Barefoot},\textsuperscript{79} the Supreme Court expressly accepted the use of psychiatric evidence to predict dangerousness: “The suggestion that no psychiatrist's testimony may be presented with

\begin{itemize}
\item[\textsuperscript{72}] \textit{Ibid}; 18 USC. §3592(a–c) (2006).
\item[\textsuperscript{73}] The Georgetown Law Journal, \textit{supra} note 53 at 820 (Referencing \textit{Tuilaepa}, \textit{supra} note 53).
\item[\textsuperscript{74}] \textit{Zant v. Stephens}, 462 U.S. 862, 876-79 & n.14 (1983); \textit{Tuilaepa}, \textit{supra} note 53.
\item[\textsuperscript{76}] \textit{Barefoot v. Estelle}, [1983] 463 U.S. 880 at 463 [\textit{Barefoot}].
\item[\textsuperscript{77}] \textit{Ibid}.
\item[\textsuperscript{78}] \textit{Ibid}.
\item[\textsuperscript{79}] \textit{Ibid}.
\end{itemize}
respect to a defendant's future dangerousness is somewhat like asking us to disinvent the wheel.”

The Supreme Court’s assertions are based on the assumption that psychiatric evidence is an effective predictor of future violence, as the Court asserted that “there is no merit to petitioner's argument that psychiatrists, individually and as a group, are incompetent to predict with an acceptable degree of reliability that a particular criminal will commit other crimes in the future, and so represent a danger to the community.” Like the Supreme Court, prosecutors have embraced psychiatric evidence as a predictor of dangerousness to strengthen their arguments for more severe sentences, and in the capital sentencing context, dangerousness “has been the subject of frequent but controversial testimony by psychiatric experts engaged by the prosecution.”

**iv. The Weighing Process**

The process of how aggravating and mitigating factors are compared and considered to reach a final decision regarding imposition of the death penalty depends on the state law for the state in which the convicted individual is sentenced. Some states employ a “weighing” process, in which the aggravating factors are weighed against the mitigating factors in assessing whether capital punishment may be validly applied. Alternatively, other states, appropriately referred to as nonweighing states, employ a different process, whereby after an aggravating factor is found,

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80 *Ibid* at 462.
81 *Ibid*.
82 Edersheim, Weintraub, & Brendel, *supra* note 41 at 175; Melton et al., *supra* note 69 at 288.
the sentencing authority considers all circumstances surrounding the offence and the individual offender.\textsuperscript{85}

\textsuperscript{85} \textit{Stringer v. Black, supra} note 85.
Chapter 4
The Legal Standards Governing the Admission of FMRI Evidence and the Courts’ Consideration of Such Evidence to Date

4.1. Introductory Note

It should be noted, at the outset that, unlike psychiatric testimony, fMRI evidence is relatively new to U.S. courts, meaning there are very few opinions regarding the use of fMRI evidence in any context in court. Nonetheless, neuroscientific evidence of brain imagery has been considered in a variety of different types of legal contexts.\textsuperscript{86} For example, courts have considered brain scan evidence demonstrating causation between watching violent video games and behaving violently,\textsuperscript{87} and as an indicator of mental incompetency.\textsuperscript{88} Additionally, courts have evaluated neuroimaging evidence offered in support of claims regarding injuries and medical issues pertaining to brain functioning in cases relating to disability claims\textsuperscript{89} and automobile accidents.\textsuperscript{90}

4.2. Lie Detection

FMRI evidence has been proffered as a novel substitute for the notoriously unreliable polygraph.\textsuperscript{91} In September, 2012, the United States Court of Appeals for the Sixth Circuit considered the admission of fMRI evidence pertaining to lie detection in \textit{United States v.}

\textsuperscript{86} Jones & Shen, \textit{supra} note 5.
\textsuperscript{87} \textit{Entertainment Software Assn v Blagojevic}, 2005 404 F. Supp 2d 1051 (N.D. Ill).
\textsuperscript{88} \textit{Middlesworth v Century Bank & Trust Co.}, 2000 (Michigan Court of Appeals).
\textsuperscript{89} \textit{Boyd v. Bert Bell/Pete Rozelle NFL Players Retirement Plan}, 2005 US Dist Crt (Maryland).
\textsuperscript{90} \textit{Fini v. General Motors Corp}, 2003 (Michigan Court of Appeals).
\textsuperscript{91} See e.g. \textit{United States v. Semrau} (U.S. Dis. Ct. for the W. Dis. Of Tenn. 07-10074 2010) [Semrau].
Semrau. There, the defendant, Dr. Semrau, presented evidence regarding fMRI lie detection technology, which he asserted demonstrated he acted in good faith as to billing practices in a case involving healthcare fraud charges filed against him.

The Court of Appeals reasoned that the fMRI evidence was properly excluded from consideration by the district court under Federal Rule of Evidence 702 “because the technology had not been fully examined in ‘real world’ settings and the testing administered to Dr. Semrau was not consistent with tests done in research studies.” In particular, the Court was concerned with the technology’s accuracy and reliability, since expert testimony revealed fMRI lie detection techniques suffer from a “‘huge false positive problem’ in which people who are telling the truth are deemed to be lying around sixty to seventy percent of the time.” The Court also emphasized that the accuracy of the technology to detect lies was substantially affected by confounding characteristics of the test subject, so that “‘accuracy rates drop by almost twenty-five percentage points when a person starts becoming fatigued.’” Even though the Semrau case focuses on fMRI lie detection techniques, the Court’s reasoning indicates that the presentation of fMRI evidence as a predictor of dangerousness is likely to be met with

92 Ibid.
93 Ibid at 6
94 Ibid.
95 Ibid at 9.
96 Ibid (The court also acknowledged other causes for concern related to reliability, including the test subject’s inadequate sleep, which can contribute to poor accuracy. Additionally, the court described many of the fMRI-based lie detection studies offered in support of Semrau’s claims, highlighting that they involved the offering of a monetary reward to subjects if they were able to deceive the fMRI machine by lying, and focusing on the fact that these tests were not in line with real-world instances of lying. Moreover, the court emphasized that the studies offered by the accused did not include real-world testing, because there had not been any real-world testing with fMRI lie detection technology to date. The court’s emphasis on the failure of studies to focus on real-world conditions suggests that future studies focusing on real-world circumstances may be better suited to support a court’s decision to admit fMRI evidence).
97 Ibid.
skepticism by a court concerned with the reliability of the technology and its accuracy as a prognostic tool.\textsuperscript{98}

Another case in which fMRI lie detection evidence was offered is the 2012 case of \textit{State of Maryland v. Gary Smith}.\textsuperscript{99} There, the defendant, accused of murder, sought to introduce fMRI lie detection evidence to verify his version of events.\textsuperscript{100} The court also rejected admission of the fMRI evidence, finding “the fMRI lie detection method of testing is not yet accepted in the scientific community.”\textsuperscript{101} The court rejected the fMRI evidence despite the defendant’s presentation of 25 peer-reviewed scientific journal articles regarding the use of fMRI as a lie detection technique, asserting that “The Court is not swayed by that number when considering the depth of scientific analysis done in a particular area.”\textsuperscript{102}

\section*{4.3. The Criminal Trial}

In the guilt phase of criminal trials, neuroimaging has only recently emerged as evidence to be considered.\textsuperscript{103} At the trial stage, the admission of fMRI evidence is governed by rules affecting the admission of scientific evidence generally, including, in federal courts, Federal Rule of Evidence 702 and Federal Rule of Evidence 403.\textsuperscript{104} Rule 702 allows an expert to speak to the meaning and significance of neuroscientific evidence in a given case if four conditions are met:

“(a) the expert’s scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or

\textsuperscript{98} Ibid.
\textsuperscript{99} \textit{State of Maryland v. Gary Smith} (2012) (Circuit Court for Montgomery County, Maryland Case No. 106589C) [\textit{Smith}].
\textsuperscript{100} Ibid at 1.
\textsuperscript{101} Ibid.
\textsuperscript{102} Ibid at 4.
\textsuperscript{103} Jones & Shen, \textit{supra}, note 5 at 354.
to determine a fact in issue; b) the testimony is based on sufficient facts or data; (c) the testimony is the product of reliable principles and methods; and (d) the expert has reliably applied the principles and methods to the facts of the case.\textsuperscript{105}

In \textit{People v. Weinstein},\textsuperscript{106} the accused offered fMRI evidence of a brain dysfunction to demonstrate that he lacked the requisite mens rea for the murder of his wife, with which he was charged.\textsuperscript{107} There, the accused acknowledged that he strangled his wife to death, but argued the brain abnormality rendered him not responsible.\textsuperscript{108} Similarly, in \textit{People v. Goldstein},\textsuperscript{109} the accused sought to prove an insanity defense by introducing neuroimagery suggesting he suffered from a neurological abnormality which caused him to murder a woman by pushing her in front of an oncoming subway car.\textsuperscript{110}

\textbf{4.4. Sentencing and Mitigation}

As to sentencing, the topic to which this paper is dedicated, fMRI evidence has to date been offered solely for mitigation purposes.\textsuperscript{111} As previously explained, the standards for admission of evidence for consideration in sentencing are less stringent than that required during trial,\textsuperscript{112} and “this difference in evidentiary standards is in part … why neuroscientific evidence has featured more prominently in the sentencing rather than liability/guilt phase of criminal trials.”\textsuperscript{113}

\textsuperscript{105} \textit{Fed R. Evid} 702 (2011).
\textsuperscript{106} \textit{People v. Weinstein} (1992), 591 N.Y.S. 2d 715 (Supreme Court, New York County).
\textsuperscript{107} \textit{Ibid}.
\textsuperscript{108} \textit{Ibid}.
\textsuperscript{109} \textit{People v Goldstein}, 2004 N.Y.S. 1d (Supreme Court, Appellate Division, NY).
\textsuperscript{110} \textit{Ibid}.
\textsuperscript{112} \textit{Federal Sentencing Guidelines} § 6A1.3(2011).
\textsuperscript{113} Jones & Shen, \textit{supra} note 5 at 359.
In *Oregon v Kinkel*, during sentencing, the convicted party offered neuroimages in an attempt to demonstrate neurological abnormalities suggesting his diminished responsibility for the murder of his parents and a high school shooting. Brain imagery has also been offered to demonstrate competence in the context of sentencing, where the offender offered the images to show he was incompetent and not eligible for capital punishment after conviction of first-degree murder.

Evidence of psychopathy has been employed as a mitigating factor more frequently in recent years as neuroscientific and genetic research has supplemented traditional social and clinical psychological and psychiatric research. Interestingly, “psychopathy, previously thought of as an aggravating circumstance for sentencing purposes, is increasingly being presented as a mitigating diagnosis at sentencing.” Findings linking brain and neurological abnormalities to psychopathy and criminal behavior are “being presented to judges and juries for the purpose of exculpation and/or mitigation, and include neuroimaging evidence as well as other measures of neuropsychological and neurologic dysfunction.”

Additionally, in recent years, defense teams have introduced neuroimaging as mitigating factors speaking to a variety of other dysfunctions beyond psychopathy, including those related to: frontal lobe disorders; brain injuries from trauma; lesions; neurodevelopmental issues; psychiatric illnesses; and substance abuse. Defense mitigation arguments in these cases tend to involve an assertion that the convicted party is less culpable because a mental or neurological

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114 *Kinkel, supra* note 111.
116 *Coe, supra* note 111.
117 *Edersheim, Brendel, & Price, supra* note 41 at 186.
120 *Edersheim, Brendel, & Price, supra* note 41 at 176.
defect rendered the offender unable to control his or her violent or aggressive impulses.\textsuperscript{121} Similarly, scholars note that “evidence of a biomechanism may reduce judgments of culpability because it identifies an internal and stable cause of behavior believed to be outside the individual’s control.”\textsuperscript{122}

In the capital context, the use of neuroimaging as a mitigating factor is becoming progressively more commonplace: “Defense attorneys in capital sentencing are increasingly arguing that their clients suffer from frontal lobe dysfunction, and therefore lack the ability to control impulses, to make socially appropriate judgments or to anticipate the consequences of their choices.”\textsuperscript{123} Defense teams are also increasingly employing psychopathy in the capital sentencing context as a mitigating factor.\textsuperscript{124}

One exemplary case which has received public attention is \textit{State v Brian Dugan}.\textsuperscript{125} There, defense counsel were able to admit fMRI evidence pointing to neurological abnormalities evident in psychopaths.\textsuperscript{126} Defense attorney Matthew McQuaid stated, in regard to the fMRI evidence of psychopathy he presented in defense of his client:

"The brain of a psychopath is not a normal brain … and that's based on the behavior and emotional disability that they suffer. This is going to be important science down the road. It's not some kind of voodoo or just showing color slides (of Dugan's brain) to try to mislead the jury."

\textsuperscript{121}\textit{Ibid.}
\textsuperscript{124}Edersheim, Brendel, & Price, \textit{supra} note 41 at 186.
\textsuperscript{127}Gutowski, \textit{supra} note 125 (quoting defense attorney Matthew McQuaid).
A final case worth mentioning is *State v. Nelson*, a capital case heard in 2010, in which a Florida state judge approved admission of neuroscientific evidence in the form of quantitative electroencephalography (qEEG) findings for consideration by jurors in the sentencing phase. There, the jurors did not believe Nelson, convicted of his wife’s murder and a child’s rape, deserved the death penalty, in part because of qEEG evidence speaking to underlying neurological abnormalities causing his violent behavior.

### 4.5. Sentencing and Aggravators

Despite the current trend toward employment of fMRI evidence for mitigation purposes, legal scholars recognize the potential role of neuroimaging to predict someone may act dangerously in the future. As neuroscience advances, neuroimaging technology will strengthen in reliability and accuracy, begging the question whether neurological predictors of violent behavior will be more frequently employed in dangerousness assessments. Indeed, “One can easily imagine the introduction of neuroimaging evidence about psychopathy to aid in the prediction of future dangerousness. Will the police request a warrant to search your brain?”

The potential use of fMRI evidence as an aggravating factor to indicate a convicted individual’s future dangerousness is thus a topic ripe for consideration by courts, which must grapple with the

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130 *Nelson, supra* note 128; Jones & Shen, *supra* note 5 at 151; David Ovalle, “Miami-Dade killer gets life sentence for murder, stabbing, rape,” *Miami Herald* (2 December 2010) at 1 (as Jones & Shen point out, one of the jurors was quoted in the *Miami Herald* article as stating “the technology really swayed me … After seeing the brain scans, I was convinced this guy had some sort of brain problem”).
132 *Ibid*.
133 *Ibid*. 

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notion of considering fMRI dangerousness predictors as neuroscientific developments continue to lead researchers toward investigating the use of fMRI to diagnose violent tendencies.\textsuperscript{134}

\textsuperscript{134} Ibid.
Chapter 5

The Need to Exclude FMRI Evidence from Consideration in Dangerousness Predictions

5.1. Reliability

i. Accuracy and Reliability Problems Inherent in FMRI Predictions of Future Dangerousness

FMRI evidence employed for the specific purpose of predicting an individual’s future dangerousness poses substantial reliability concerns.\textsuperscript{135} Firstly, many methodological issues contribute to the questionable reliability of fMRI technology for use in predicting future violence.\textsuperscript{136} A primary problem is that researchers are not able to identify exactly \textit{where} in the brain to search for functional abnormalities in a given individual.\textsuperscript{137} Neurological markers of dangerousness are not contained to a particular region of the brain:

\begin{quote}
“Psychopathy and ASPD are linked to abnormalities in a wide variety of brain regions. Although abnormal structure and functioning in the frontal and temporal cortices appear to be most consistently identified, abnormalities exist in several other regions as well, making it difficult to gain a clear picture of the dysfunction associated with antisocial and psychopathic traits.”\textsuperscript{138}
\end{quote}

Thus, a convicted individual may demonstrate abnormal functioning in one brain region associated with psychopathic tendency, but exhibit normal processing in another area, and

\textsuperscript{135} See e.g. Glenn, Yang, & Raine, \textit{supra} note 31 at 92; Jones & Shen, \textit{supra} note 5 at 356; Craig Stark & Larry Squire “When Zero is Not Zero: The Problem of Ambiguous Baseline Conditions in fMRI” 98 Proc. Nat’l. Acad. Sci. 12760 (2001); Law, \textit{supra} note 19.

\textsuperscript{136} See e.g. Glenn, Yang, & Raine, \textit{supra} note 31 at 92; Jones & Shen, \textit{supra} note 5 at 356; Stark & Squire, \textit{supra} note 134; Law, \textit{supra} note 19.

\textsuperscript{137} Glenn, Yang, & Raine, \textit{supra} note 31 at 92.

\textsuperscript{138} \textit{Ibid.}
accurately predicting future violent behavior while reconciling such discrepancies may be an exceptionally difficult, if not impossible, task.139

Moreover, researchers have yet to identify which areas of the brain are most engaged in violent tendencies,140 so that a juror or judge confronted with fMRI evidence of neurological abnormalities in one part of the brain will be unable to conclude with any certainty whether the specific dysfunction attended to is determinative of future psychopathic or antisocial acts. Accordingly, localization issues indicate that fMRI evidence has the potential to confuse the sentencing authority.

Additionally, fMRI technology is particularly subject to human inference; indeed, “there exists a long chain of inference from the fMRI scanner to the courtroom.”141 FMRI can accurately measure the changes occurring in oxygen and blood flow in the brain, but there are many inferential steps which the individual interpreting the fMRI results must take between analysis of oxygen and blood flow patterns, and behavioral predictions, and which may, unfortunately, detrimentally affect reliability.142 FMRI technology is subject to human error in the midst of these inferential steps: “images can be no better than the manner in which the researcher designed the specific task or experiment, deployed the machine, collected the data, analyzed the results, and generated the images.”143 The disconcerting reality is that the interim analysis between oxygen and blood flow changes and predictions regarding behavior or thoughts “requires a series of inferential steps that are not entirely straightforward,”144 and that are consequently difficult to meaningfully explain to a jury or judge.

139 Ibid.
140 Ibid.
141 Jones & Shen, supra note 5 at 356.
142 Ibid.
143 Ibid.
144 Ibid.
Further, in the process of these inferential steps, there are three choices test administrators must make: “the correction for multiple comparisons, the correction for nonindependence error, and the choice of baseline task,” and errors in choosing can lead to the production of a false positive. In fact, scholars emphasize that errors in fMRI prediction do occur; one group of researchers demonstrated that rest, which was used as a baseline task, had the potential to mask brain activity which was present in individuals when confronted with a novel or familiar image. Also, researchers have shown that the results of fMRI vary depending on the tasks employed, and seemingly insignificant acts can substantially distort fMRI results. For example, jaw movements or minor shifts in the skull can detrimentally affect the accuracy of fMRI findings. Other researchers draw attention to the difficulty in replicating many studies which indicate there are neurological dysfunctions specific to psychopathy and antisocial disorder.

Even if fMRI evidence were to be able to be used to identify a particular neurological abnormality with a high level of accuracy, the difficulty remains of determining whether the neurological dysfunction has a greater effect on behavior than other factors contributing to future conduct. Any neurological abnormality suggesting an individual is likely to act violently in the future can be counteracted by other circumstances contributing to behavior and having a positive effect on a person’s tendency to follow the law, such as family support, a strong social network,
therapy, or education, to name a few. Importantly, “functional neuroimaging is a tool to measure correlations between changes in brain activity and observable behaviors, nothing more."\textsuperscript{152}

Further, “advances in this field will also need to take increasing cognizance of the environmental context within which neurobiological predispositions give expression to antisocial behavior. There is initial evidence that environmental factors may moderate brain-violence relationships.”\textsuperscript{153} Thus, concluding that a correlation between an observable neurological abnormality and future violence necessarily indicates that the brain dysfunction will cause violent behavior in the future to occur is unfounded, but the sentencing authority may be unlikely to wholly appreciate this complication in assessing the significance of abnormal fMRI results.\textsuperscript{154}

Also, scholars have identified other causation issues as specifically affecting the reliability of fMRI diagnostic tools for psychopathy and antisocial disorders.\textsuperscript{155} Accordingly, while significant advancements have led to further understanding of the neurobiological underpinnings of psychopathic tendencies, “it is not yet clear … whether specific brain deficits lead to the development of psychopathy, or environmental factors and behaviors associated with psychopathy make subjects more vulnerable to these brain abnormalities.”\textsuperscript{156} A telling phenomenon is that neurological functioning abnormalities perceived in the prefrontal cortex and associated with psychopathic tendencies are not exhibited by all individuals suffering from psychopathy,\textsuperscript{157} begging the question whether the neuroimaging technology may speak to psychopathic tendencies generally or some other aspect of mental disorder not yet identified.\textsuperscript{158}

\textsuperscript{152} Law, supra note 19 at 28.
\textsuperscript{153} Ibid.
\textsuperscript{154} Ibid.
\textsuperscript{155} Edersheim, Weintraub & Price, supra note 41 at 186.
\textsuperscript{156} Ibid.
\textsuperscript{157} Raine et al., “Reduced prefrontal and increased subcortical brain functioning assessed using positron emission tomography in predatory and affective murderers” (1998) Behav Sci Law 16 at 319-332.
\textsuperscript{158} Ibid.

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These observations beg the question whether an individual demonstrating brain abnormalities associated with psychopathy is bound to act violently in the future; whether exhibited abnormalities are a result of behavior the psychopathic individual previously engaged in; or whether a third factor affecting both psychopathic and other groups of individuals has led to the development of abnormalities prevalent among cohorts.159

ii. The Problem of Employing FMRI Evidence in a Legal Setting

The manner in which the technology is analyzed in a court-room setting also contributes to faulty reliability.160 Scholars stress that predicting an individual’s behavior from group data linking patterns of neurological dysfunction to behavioral tendencies is dangerously subject to inaccuracies:161 “making individualized inferences, as law is typically required to do, from group-averaged neuroscientific data presents a particularly difficult problem for courts to overcome.”162 This problem has been termed the “group to individual inference problem”163 and Professors Owen Jones and Francis Shen warn it “will remain central in applying neuroscience to law.”164

An individual whose fMRI results demonstrate neurological abnormalities similar to those observed in dangerous parties suffering from psychopathy may not necessarily engage in similar behavior as those persons to whom his or her fMRI results are compared.165 In other words, individuals may exhibit brain pattern activity which is outside the boundaries of group-

159 Ibid.
160 See e.g. David Faigman, “Evidentiary incommensurability: a preliminary exploration of the problem of reasoning from general scientific data to individualized legal decision-making” (2010) 75 Brooklyn LR 1115-1136; Jones & Shen, supra note 5.
161 Faigman, supra note 159.
162 Jones & Shen, supra note 5 at 356; Faigman, supra note 159.
163 Jones & Shen, supra note 5 at 356.
164 Ibid.
165 Jones & Shen, supra note 5 at 356.
averaged data, and thus outside the norm, but nonetheless maintain normal neurological functioning.\textsuperscript{166} Thus, “just because a particular pattern of neural activity is associated, on average at the group level, with impaired decision making, it does not necessarily follow that a defendant before the court whose brain scans produce the same neural patterns necessarily has such a cognitive deficit.”\textsuperscript{167}

Indeed, much psychiatric and scientific evidence is not meant to be employed in settings to predict future individual behavior, and it was for this reason that the American Psychiatric Association submitted an amicus curiae brief in \textit{Barefoot},\textsuperscript{168} stressing that the psychiatric evidence in that case should not have been considered in assessments of dangerousness.\textsuperscript{169} Yet, the Supreme Court rejected the American Psychiatric Association’s perspective as to the use of psychiatric evidence generally for predictions of dangerousness, asserting “Nor, despite the view of the American Psychiatric Association supporting petitioner's view, is there any convincing evidence that such testimony is almost entirely unreliable, and that the factfinder and the adversary system will not be competent to uncover, recognize, and take due account of its shortcomings.”\textsuperscript{170}

Challenging the majority decision in \textit{Barefoot},\textsuperscript{171} Justice Blackmun, in dissent, shed light on some of the troubling concerns arising from the use of dangerousness evidence to indicate a greater sentence is warranted:

“\textit{The Court holds that psychiatric testimony about a defendant's future dangerousness is admissible, despite the fact that such testimony is wrong two times out of three. The Court reaches this result -- even in a capital case -- because, it is said, the testimony is}

\textsuperscript{166} \textit{Ibid.}
\textsuperscript{167} \textit{Ibid.}
\textsuperscript{168} \textit{Barefoot, supra note 78.}
\textsuperscript{169} \textit{Ibid at 463.}
\textsuperscript{170} \textit{Ibid.}
\textsuperscript{171} \textit{Barefoot, supra note 78.}
subject to cross-examination and impeachment. In the present state of psychiatric knowledge, this is too much for me … when a person's life is at stake -- no matter how heinous his offense -- a requirement of greater reliability should prevail. In a capital case, the specious testimony of a psychiatrist, colored in the eyes of an impressionable jury by the inevitable untouchability of a medical specialist's words, equates with death itself.”

In fact, there is much evidence to indicate that the majority’s assumption in Barefoot that the criminal justice system can adequately safeguard against arbitrary or unfair outcomes from less-than reliable dangerousness evidence should be re-assessed. As professors Gary Edmond and Kent Roach highlight, “experimental work in the social sciences casts doubt on the ability of the modern adversarial criminal trial (and appeal) to handle unreliable expert evidence.” Edmond and Roach’s discussion centers on the use of scientific, forensic, and medical evidence during the trial phase, but there is no reason to believe that their concerns are not equally applicable to the consideration of scientific and expert evidence during sentencing.

Significantly, research also suggests that judges are not any better at evaluating scientific evidence with poor reliability than jurors: “Experimental work in the social sciences … reinforces the need for incriminating expert evidence to be reliable because the various trial safeguards, along with lay jurors, trial, and appellate judges, have not performed well in response to prosecutions and convictions incorporating unreliable expert evidence.”

Other sources indicate there is cause for concern regarding the ability of the legal system to adequately account for unreliable evidence. The Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council, published a 2009 report emphasizing

172 Ibid (Blackmun, J. dissenting).
173 Ibid.
175 Ibid.
176 Ibid.
177 Ibid at 367.
“the potential danger of giving undue weight to evidence and testimony derived from imperfect
testing and analysis. Moreover, imprecise or exaggerated expert testimony has sometimes
contributed to the admission of erroneous or misleading evidence.”178 Significantly, the report
acknowledged the disturbing revelation that “in some cases, substantive information and
testimony based on faulty forensic science analyses may have contributed to wrongful
convictions of innocent people,”179 confirming that reliability concerns are of the utmost
importance.180

Moreover, it is a legitimate concern whether jury members will be able to sufficiently
appreciate the complexity inherent to making any inference regarding individual behavior from
group-averaged data. 181 Thus, scholars have pointed out that “courts must ask whether jurors are
capable of assessing presumably with the aid of cross-examination and opposing expert
witnesses, the inferential chain for themselves.”182 Further, fMRI images may convey a degree of
scientific fact to the fact-finder unworthy of the evidence.183 Indeed, fMRI images fail to
adequately convey to the viewer: the complexity inherent in the process of their production; the
number of inferences required to create the imagery based on statistical discrepancies; and the
test administrator’s discretion to choose particular statistical data to create the colored mapping
evident on an fMRI image, to name a few.184 The Supreme Court itself “has reiterated on
numerous occasions that there is substantial dispute within the mental health professions about
diagnoses, that psychiatry is not an exact science, and that the law is not bound by extra-legal

178 Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council,
“Strengthening Forensic Science in the United States: A Path Forward” (August 2009) at 4 online:
179 Ibid.
180 Ibid.
181 Jones & Shen, supra note 5 at 357.
182 Ibid.
183 See generally ibid.
184 Ibid.
Many of the concerns to which Justice Blackmun attended in his dissent in *Barefoot* are heightened when considering the troubling reality that the sentencing authority is unlikely to adequately appreciate the degree to which human choice and error could affect the appearance of fMRI images and the results of fMRI scans.

Reliability issues are especially important in capital sentencing, where the use of dangerousness as a whole to enhance sentencing should be met with caution: “Despite the Supreme Court’s willingness to accept admittedly inaccurate predictions in *Barefoot*, one would hope that an extremely high level of accuracy would be required before increasing a sentence or putting a capital offender to death on the basis of a dangerousness prediction.”

Indeed, in the criminal sentencing context as a whole, any risk of human error in the administration of fMRI testing has significant and dangerous consequences worthy of thorough consideration:

> “unlike law, where the ‘truth’ can have life-changing consequences on liberty or livelihood, the cost of a false positive in science is the time and energy to repeat the experiment. While this cost is substantial, it is rare that a scientist is locked up for choosing the wrong parameters for a statistical test.”

### 5.2. Prejudice

Determining whether a factor employed in sentencing is prejudicial is significant, and in the capital context, a nonstatutory aggravating factor whose probative value is outweighed by

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186 *Barefoot*, supra note 78.

187 See Jones & Shen, supra note 5.

188 *Barefoot*, supra note 78.

189 Morse, supra note 184 at 944.

190 Law, supra note 19 at 19.
unfair prejudice can be excluded.\textsuperscript{191} FMRI technology is likely to be prejudicial to the defendant and to confuse the jury because the issues affecting reliability and the manner in which fMRI images are created are especially complex and difficult to understand, but the images themselves appear so simplistic that jurors are likely to jump to improper conclusions.\textsuperscript{192} Professor Jones has acknowledged this danger: “brain imaging represents a perfect storm of power, to be used or abused. It combines the authoritative patina enjoyed by scientific evidence generally, and the allure of all-modern brain science … with the seductive power of visual images.”\textsuperscript{193}

Other scholars have noted that neuroscientific evidence may have a more powerful influence on the assessor of such evidence than deserved: “Scientific data can be overwhelming. Without careful attention to detail, it is persuasive to anyone – scholars, judges, attorneys, jurors … it has become clear that neuroimaging data is unduly persuasive. Pictures of brains confer credibility to data, regardless of whether the scientific reasoning has obvious errors.”\textsuperscript{194} Thus, where fMRI evidence is employed against the accused to enhance the call for a more severe sentence, it has the potential to significantly prejudice the convicted party, and must be carefully considered along with the complex reliability issues and technical details involved in its creation.\textsuperscript{195}

\textbf{5.3. Constitutional Challenges}

Constitutional concerns further the need to approach the use of fMRI evidence to indicate future dangerousness with caution. During sentencing, the constitutional safeguards attaching to

\textsuperscript{191} 18 U.S.C. § 3593(c) (2006).
\textsuperscript{192} See Jones et al., supra note 21.
\textsuperscript{193} Ibid.
\textsuperscript{194} Law, supra note 19 at 45.
\textsuperscript{195} See ibid; Jones et al., supra note 21.
other phases of the criminal process apply,\textsuperscript{196} so that “at issue are the protections offered by the U.S. Constitution against state use of brain imaging on an unwilling or unaware citizen.”\textsuperscript{197} A particular issue which scholars have shed light on is whether fMRI evidence is testimonial or physical, since this problem is as of yet unresolved and self-incrimination protections apply to testimonial but not physical evidence.\textsuperscript{198} Prior to admitting fMRI evidence to signify dangerousness, courts should resolve the issue of whether neuroimaging scans are testimonial or physical to determine which constitutional protections attach where a convicted party does not wish to undergo an fMRI scan but the prosecution seeks to conduct neurological testing to show the individual exhibits neurological markers of violence.\textsuperscript{199}

Another significant issue to address in this area is the scientific community’s reference to fMRI technology as “brain fingerprinting.”\textsuperscript{200} Fingerprints are physical evidence, and as such those constitutional protections against self-incrimination discussed above do not attach to them.\textsuperscript{201} The scientific community should use care in employing the term “brain fingerprinting” prior to a court’s characterization of fMRI technology as testimonial or physical to avoid confusion among legal and policy decision-makers.

5.4. Costs

The criminal process must account for the substantial costs convicted individuals will necessarily face in hiring experts to rebut fMRI evidence of dangerousness presented by the

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\textsuperscript{198} 
Jones & Shen, supra note 5 at 360.

\textsuperscript{199} 
See \textit{ibid}.

\textsuperscript{200} 
See e.g. \textit{ibid}.

\textsuperscript{201} 
Fox, supra note 196.

\textsuperscript{202} 
See e.g. Jones & Shen, supra note 5 at 360.
prosecution. As Professor Stephen Morse points out “Although either the defense or prosecution can succeed with or defeat a claim involving mental disorder without using expert witnesses, as a practical matter it is extremely difficult and perhaps impossible for the defense.” Unfortunately, rebutting expert evidence of dangerousness is costly because hiring experts is expensive, so that rebutting dangerousness evidence:

“is not a problem for wealthier defendants who can retain an expert, but it is a major problem for indigent defendants. Unless an indigent defendant has access to an expert paid for by the state, the defendant will seldom have a fair chance of succeeding with his or her claims.”

In *Ake v. Oklahoma*, the Supreme Court acknowledged the unfairness which can result when indigent convicted individuals or offenders from modest means are faced with the prospect of rebutting expert mental health evidence. In *Ake*, mental illness was the convicted party’s primary defense and mitigating circumstance, since he had been diagnosed as suffering from paranoid schizophrenia. However, because he was indigent, he was unable to provide sufficient psychiatric testimony regarding his mental disorder, and was found guilty of capital murder by the jury, a result which may have been different had he had the funding to hire a psychiatric expert. Further, because the convicted party could not afford to hire a psychiatric expert, he was unable to offer meaningful mitigating evidence of mental disturbance at the sentencing hearing.

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203 Morse, *supra*, note 184.
204 *Ibid* at 905.
205 *Ibid*.
207 *Ibid*.
208 *Ibid* at 470.
209 *Ibid*.
210 *Ibid*.
211 *Ibid*. 

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The Supreme Court held that the convicted petitioner’s due process rights were violated, in large part because “future dangerousness was a significant factor at the sentencing phase, so as to entitle him to a psychiatrist's assistance on this issue,” but he was denied access to a psychiatric expert because of his financial status. The Supreme Court consequently required convicted parties to be entitled to a psychiatric expert where the prosecution introduces psychiatric evidence of dangerousness:

“without a psychiatrist's assistance, the defendant cannot offer a well-informed expert's opposing view, and thereby loses a significant opportunity to raise in the jurors' minds questions about the State's proof of an aggravating factor. In such a circumstance, where the consequence of error is so great, the relevance of responsive psychiatric testimony so evident, and the burden on the State so slim, due process requires access to a psychiatric examination on relevant issues, to the testimony of the psychiatrist, and to assistance in preparation at the sentencing phase.”

The Ake decision is significant to the present discussion, because it implies that before fMRI evidence of future dangerousness can be admitted for consideration in sentencing, courts must be prepared to offer financial support to indigent defendants who must hire an expert to rebut the fMRI evidence speaking to dangerousness. Moreover, fMRI evidence is likely to be particularly costly, as any such evidence offered by the prosecution may require the defendant to not only hire an expert to rebut the imagery, but also to undergo another assessment by an fMRI technician delivering another scan, which can be substantially more expensive than many of the traditional psychiatric assessment techniques involving interviews and social assessment tools.

As Morse highlights, establishing a proper regime for indigent convicted persons to adequately respond to psychiatric evidence of dangerousness is a complex and difficult task,

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212 Ibid.
213 Ibid.
214 Ibid.
215 Ibid.
216 Ibid.
which the courts must adequately prepare themselves for, as there is also a potential for a conflict of interest where the convicted party is not entitled to an independent assessor: “the defendant may be assigned a mental health professional who is an employee of the state and the prosecution may immediately have access to the report. A state employee inevitably has a conflict of interest. The indigent defendant should be entitled to an independent professional, as some jurisdictions hold.” 217 As previously discussed, fMRI imagery is particularly subject to the influence of the fMRI administrator’s choices and discretion regarding statistical testing and results to employ in crafting the images, enhancing the need for the offender’s access to an independent fMRI test administrator. 218 Courts should sufficiently attend to all of the potential costs posed by the use of fMRI dangerousness evidence in sentencing.

218 Jones & Shen, supra note 5.
Chapter 6

Alternative Uses of fMRI Evidence in Sentencing

6.1. Intervention

Treatment programs for psychopathy exist, and it is important to take note that “at least some treatment programs have reported and replicated findings of reduced likelihood of recidivism in a population of violent male adolescents.” Research shows neurological abnormalities associated with psychopathy emerge early in life, and some experts posit early markers of psychopathy indicate the condition might be neurodevelopmental in nature. Accordingly, one group of offenders for which treatment efforts may be particularly fruitful is juvenile parties, for whom fMRI scans could be offered as an optional part of probationary or rehabilitation efforts to identify neurological markers of psychopathy or antisocial disorder signaling particular types of therapy might be helpful. Any therapeutic component of rehabilitation should be adjusted to account for exhibited neurological abnormalities, and to assist in focusing therapeutic measures on psychopathic or antisocial characteristics.

Researchers have also identified treatment as a plausible use of fMRI indicators of violent tendencies: “In the future, it may be possible to develop individualized treatments that target specific neurobiological risk factors.” Moreover, treatment options should focus on the availability and efficacy of environmental factors acting to counter the effects of any biological

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219 Jones & Shen, supra note 5 at 366 (these programs were described in studies by Caldwell et al. “Treatment response of adolescent offenders with psychopathy features: a 2-year-follow-up” (2006) Crim Just Behav 33 at 571-596; Caldwell et al. “Evidence of treatment progress and therapeutic outcomes among adolescents with psychopathic features” Crim Just Behav 34 at 573-587).
221 Glenn, Yang & Raine, supra note 31 at 93.
predispositions toward violence, as there is, as previously mentioned “initial evidence that environmental factors may moderate brain-violence relationships.” Sentencing authorities employing treatment as part of sentencing should further investigate the availability of environmental factors in the particular convicted individual’s life to assist in reducing the likelihood of aggressive or violent tendencies.

6.2. Mitigation

As previously mentioned, in the capital sentencing context, there are essentially very few limits, beyond threshold levels of relevance, to the types of evidence admissible as mitigating factors which the sentencing authority may consider, suggesting that fMRI evidence, even if questionable in reliability, may be appropriately considered as a mitigating factor in capital sentencing. Courts have consistently encouraged and even required capital defense attorneys to employ as many forms of mitigating evidence and pursue as many mitigating circumstances as possible. Thus, in Williams v. Taylor, the Supreme Court insisted that defense lawyers have a duty to present mitigation evidence and explore the convicted person’s social, psychological, and cultural background to determine whether any mitigating factors are relevant and should be presented during the sentencing phase.

In the context of mitigation, fMRI evidence can demonstrate a convicted individual lacks culpability or should not be held responsible for his or her actions because of a neurological or psychiatric dysfunction or other otherwise suffers from a mental disorder which the sentencing

\[\text{\textsuperscript{222}} \text{Ibid.}\]
\[\text{\textsuperscript{223}} \text{Todd Haugh, “Can the CEO Learn from the Condemned? The Application of Capital Mitigation Strategies to White Collar Case” (2012) 62 Am U LR 1 at 12; Lockett, supra note 66; Quarterman, supra note 68; Sumner, supra note 68.}\]
\[\text{\textsuperscript{224}} \text{See e.g. Williams v. Taylor, [2000] 529 U.S. 362 [Taylor].}\]
\[\text{\textsuperscript{225}} \text{Ibid.}\]
\[\text{\textsuperscript{226}} \text{Ibid.}\]
authority should consider. Legislatures and courts should consider requiring defense lawyers in capital cases to investigate whether their clients may suffer from a neurological dysfunction warranting fMRI testing and presentation of fMRI evidence to the sentencing authority as a mitigating factor.

Nonetheless, even fMRI mitigating evidence must be presented with caution to address a phenomenon known as the “double-edged sword” problem relating to the use of fMRI evidence for mitigating purposes. Where neuroimaging evidence is presented to show a convicted individual’s lessened responsibility or culpability during sentencing, the sentencing authority may actually treat the fMRI evidence offered as a mitigating factor as an aggravating circumstance, believing “a brain too broken may be simply too dangerous to have at large, even if it is somehow less culpable.” Indeed, research indicates the double-edged sword issue is a real problem worthy of attention: “many jurors consider evidence of a defendant’s mental illness an aggravating circumstance, even when the defense team presents such evidence as mitigating.”

Yet, other scholars assert the double-edged sword problem is over-stated, and insist the presentation of mitigating neuroimaging to demonstrate decreased culpability is a powerful tool in reducing the likelihood a jury will impose a harsh sentence. Indeed, some legal experts argue “in post-sentencing interviews, jurors have reported giving great weight to neuroimages in their decisions to forego the death penalty.” Thus, with the proper safeguards in place, use of fMRI evidence may be an effective resource for convicted individuals to use in supporting their

227 Jones & Shen, supra note 5 at 360.
228 Ibid.
229 Ibid at 362.
232 Edersheim, Weintraub & Price, supra note 41 at 176 (referring to the research and work of J Kulynych, supra note 223).
case, but any use of neuroimaging for mitigation must nonetheless be met with the utmost care and caution.

A major issue which arises if fMRI evidence is admissible as a mitigating factor is that its admission seems to indicate exclusion of fMRI evidence as an *aggravating* factor is inappropriate. Yet, given the potential for poor reliability to unfairly detrimentally affect the accused where fMRI evidence is employed as an aggravating factor, if fMRI evidence is admissible in its present state for mitigating purposes, it should nevertheless remain excluded if it is sought to be employed for aggravating reasons. Professors Gary Edmond and Kent Roach offer one means of justifying the disparate treatment of the same evidence offered for aggravating and mitigating purposes. Edmond and Roach propose different evidentiary admission standards should be applied for forensic and medical evidence offered against the accused and that proffered by the accused in favor of his or her case:

“We are supportive of more demanding standards for the admissibility of incriminating expert evidence. Indeed, we go beyond current legal practice and proposals for reform to argue for demonstrable reliability whenever the state adduces expert evidence to support a criminal conviction … At the same time we would recommend that expert evidence adduced by the defence need only satisfy a basic reliability threshold.”

Edmond and Roach’s proposal is thus asymmetrical and “places higher standards on the state.”

While Edmond and Roach’s model is presented in the context of Canadian jurisprudence, it is equally applicable to American admission standards governing neuroscientific evidence. Additionally, much of their argument focuses on standards relating to

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233 Edmond & Roach, supra note 173.
234 Ibid at 346.
235 Ibid.
236 Ibid.
the admission of evidence to establish guilt, but again, is equally applicable in the sentencing context. Indeed, Edmond and Roach describe their perspective as grounded in a variety of rationales, including: “criminal-justice values … [and] fairness,” two of the most fundamental concerns in assessing whether to deprive an individual of his or her freedom during sentencing. Moreover, criminal-justice and fairness are at the height of importance in the capital sentencing context, where any harmful unfairness against the accused could lead to the imposition of a death sentence. The courts should thus consider adopting an asymmetrical model to the admission of fMRI evidence in the sentencing process in the hope of addressing some of those reliability concerns stemming from the use of fMRI evidence as an aggravating indicator of dangerousness.

237 Ibid.
238 Ibid.
Chapter 7

Conclusion

This paper has aimed to demonstrate that in its present state, fMRI evidence should be excluded from the sentencing authority’s consideration as an aggravating factor speaking to future dangerousness. Perhaps scientific progress and further court engagement with fMRI evidence suggesting an offender will act violently in the future will someday render fMRI dangerousness evidence a valid aggravating factor to consider during sentencing. However, presently, numerous concerns, particularly those relating to reliability, warrant the exclusion of fMRI aggravating evidence from the sentencing authority’s consideration, especially in the capital context, when concerns regarding justice, fairness, and defendant rights are at their apex. Further, courts allowing the admission of fMRI evidence for alternative purposes, such as mitigation, during sentencing, must nevertheless do so with the utmost degree of caution and care.

Returning to the sound words of Professor Henry Greely presented at the beginning of this paper, “when society changes, the law must change.”239 In this instance, the law must adapt to protect those convicted individuals from the harsh consequences of unworthy judgments based on less-than-reliable novel scientific evidence. After all, as Professor Greely himself acknowledges, “the danger is that people's lives can be changed in bad ways because of mistakes in the technology … The danger for the science is that it gets a black eye because of this very high profile use of neuroimaging that goes wrong.”240

239 Greely, supra note 4 at 245.
240 Gary Stix, “Lighting Up the Lies: Will Brain Scans Ever Be Able to Tell if You’re Really Being Deceptive” Scientific American 299 (August 2008) 18 at 20 (quoting Stanford Law Professor Henry Greely) (emphasis added) (the concerns expressed by Greely are particularly important considering that many of the fMRI lie detection
companies discussed in this article claim to have accuracy rates as high as 90 percent, while, as the article points out, there are many neuroscientists and legal thinkers who doubt the veracity of these companies’ claims, and whether fMRI will ever be useful in any context outside of research and medical environments).
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