BORN THIS WAY: HOW NEUROIMAGING WILL IMPACT JURY DELIBERATIONS

TANNEIKA MINOTT†

ABSTRACT

Advancements in technology have now made it possible for scientists to provide assessments of an individual's mental state. Through neuroimaging, scientists can create visual images of the brain that depict whether an individual has a mental disorder or other brain defect. The importance of these advancements is particularly evident in the context of criminal law, where defendants are able to dispute their culpability for crimes committed where they lack the capacity to form criminal intent. Thus, in theory, a neuroimage depicting defective brain functioning could demonstrate a defendant's inability to form the requisite criminal intent. Due to early successes in high-profile cases where advanced neuroimaging was used in this way, many researchers believe that the use of neuroimages to substantiate claims of diminished capacity and insanity is a viable option for criminal defendants. This Issue Brief argues, however, that though the use of neuroimages may have a positive effect on outcomes in theory, in actuality, the use of neuroimages will only have a negligible impact on sentencing outcomes.

INTRODUCTION

According to the Model Penal Code, individuals lack culpability for their criminal conduct when at the time of such conduct, they lack the ability either to appreciate the wrongfulness of their conduct or to behave in accordance with the law.[1] This requirement that voluntary actions be paired with a particular mental state, or *mens rea*, is a cornerstone of American criminal law stemming from the common-law view of "reserving punishment for those behaving wickedly."[2]

---

† Duke University School of Law, J.D 2014; Duke University, B.A. Psychology 2011.

[1] MODEL PENAL CODE § 4.01 (1962).

[2] Teneille Brown & Emily Murphy, *Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States*, 62 STAN. L. REV. 1119, 1128 (2010); *see* Diane E. Hoffman & Karen H. Rothenberg, *Judging Genes: Implications of the Second Generation of Genetic Tests in the Courtroom*, 66 MD. L. REV. 858, 871 (2007) (stating that in order to

In order to dispute the claim that defendants satisfy the *mens rea* requirements for specified crimes, defense attorneys typically introduce evidence that shows that the defendant was unable to form criminal intent and/or control his behavior.[3] One way to accomplish this is the insanity defense, which essentially requires jurors to determine if a defendant can be held responsible for his or her crimes after making an inquiry into whether the defendant was able to appreciate the gravity of his or her actions.[4] Another possibility is the diminished-capacity defense, which allows evidence to be admitted which shows that the defendant suffered from a mental defect that impaired the ability to form criminal intent.[5]

Generally speaking, jurors have been found to be more receptive to mitigating factors outside of the control of defendants, such as mental incapacity.[6] This receptiveness to mitigating factors outside of the defendant's control has resulted in a preference for life sentences for capital crimes.[7] In addition, research on juror decisionmaking has shown that mitigating evidence is more persuasive when it is presented in a concrete and specific way based on clinical opinion than when mitigating evidence is presented in the abstract.[8]

How jurors view mitigating evidence is important because technological advances now make it possible scientifically to support the claim that a defendant lacked the required *mens rea* for his or her criminal conduct.[9] Many jurors are skeptical of testimony in *mens rea* based defenses because they fear that "self-reported symptoms . . . are inherently falsifiable and that testimony that depends on such self-reports is inherently untrustworthy."[10] With the advent of sophisticated brain-imaging technology, it is now possible to generate digital images of the brain that corroborate testimony of diminished capacity to form intent by highlighting

---

establish *mens rea*, evidence of purposeful, knowing, or reckless behavior must be established).

[3] *See* Jennifer Kulynych, *Psychiatric Neuroimaging Evidence: A High-Tech Crystal Ball?*, 49 STAN. L. REV. 1249, 1257 (1997); Brown & Murphy, *supra* note 2, at 1129.

[4] Jessica R. Gurley & David K. Marcus, *The Effects of Neuroimaging and Brain Injury on Insanity Defenses*, 26 BEHAV. SCI. & L. 85, 86 (2008).

[5] MODEL PENAL CODE § 4.02 (1962).

[6] Edith Greene & Brian S. Cahill, *Effects of Neuroimaging Evidence on Mock Juror Decision Making*, 30 BEHAV. SCI. & L. 280, 282 (2012).

[7] *Id.*

[8] Gurley & Marcus, *supra* note 4, at 87.

[9] Hoffman & Rothenberg, *supra* note 2, at 871.

[10] Michael L. Perlin, "*His Brain has been Mismanaged with Great Skill": How Will Jurors Respond to Neuroimaging Testimony in Insanity Defense Cases?*, 42 AKRON L. REV. 885, 899–900 (2009).

how the brain is functioning as well as its relation to both voluntary and involuntary behavior.[11]

Successful outcomes achieved by criminal defendants in high-profile cases where neuroimaging was used have created hope among scholars that the use of neuroimages will provide a major advantage to future defendants.[12] Nevertheless, while the use of neuroimaging appears to benefit defendants in the abstract, it is more likely that these images will either have no effect or a negative effect on the outcomes of criminal defendants.

This Issue Brief proceeds as follows. Part I provides background information on brain imaging technology. Part II examines what neuroimages can tell us about brain function and behavior. Part III reviews landmark cases in which neuroimaging was used as a form of mitigating evidence to dispute the culpability of the defendant. Part IV discusses whether the use of neuroimages, as a form of mitigating evidence, will positively affect defendants in future cases. A brief Conclusion follows.

I. BRAIN IMAGING TECHNOLOGY

A. Structural Neuroimaging

Structural neuroimaging provides images of gross anatomical features without providing insight into metabolic activity in the brain.[13] Two commonly utilized methods of obtaining structural neuroimages are computerized-tomography (CT) scanning and magnetic-resonance imaging (MRI).[14] Both of these methods produce a snapshot of the soft-tissue structure of the brain at the moment that the scan occurs.[15]

CT scanning produces grayscale images that show the extent to which brain tissue absorbs and deflects X-ray beams.[16] By taking multiple X-ray images from different angles and fusing them, scientists are able to show a cross-sectional image of the brain.[17] Using computer programs,

---

[11] *See* Kulynych, *supra* note 3, at 1254–55.
[12] *See* United States v. Hinckley, 672 F.2d 115 (D.C. Cir. 1982); People v. Weinstein, 591 N.Y.S.2d 715 (N.Y. Sup. Ct. 1992).
[13] Brown & Murphy, *supra* note 2, at 1127.
[14] Kulynych, *supra* note 3, at 1255.
[15] *Id.*; Joseph H. Baskin, Judith G. Edersheim & Bruce H. Price, *Is a Picture Worth a Thousand Words? Neuroimaging in the Courtroom*, 33 AM. J. L. & MED. 239, 248 (2007).
[16] Kulynych, *supra* note 3, at 1255.
[17] Baskin, Edersheim & Price, *supra* note 15, at 248.

these images are then reconstructed, making it possible to digitally manipulate the images and view the brain along different planes.[18]

Rather than using the conventional X-ray, MRI images are created using powerful magnets that operate on the magnetic properties of cells.[19] MRI scanning produces grayscale images that are constructed from the electromagnetic signals emitted by the proton nuclei of hydrogen atoms.[20] By pulsing the atoms with radio frequency waves, the magnetic scanners are able to align the nuclei of atoms.[21] Because all tissues respond to the magnetic field differently, when the magnetic field is halted, cells return to their pre-magnetized state at different rates.[22] During the process of returning to their original form, the cells generate signals that are converted into images via computer.[23] These MRI images offer distinct advantages to CT images because (1) they provide higher resolution for soft tissue structures and (2) they do not require radiation, consequently allowing multiple scans of the same subject without the dangers that over-radiation would bring.[24]

B. Functional Neuroimaging

Unlike structural neuroimaging, functional neuroimaging allows scientists to measure brain activity.[25] Most of the reported cases that mention functional neuroimaging refer to Positron Emission Tomography (PET),[26] a procedure predicated on the imaging of blood flow, blood volume, and metabolism.[27]

With PET scanning, scientists first inject a radioactive isotope into the subject's body.[28] When the isotope reaches the brain, it is metabolized as the subject performs various tasks.[29] During this metabolic process, the isotope emits gamma rays, which are then captured by the PET scanner and converted into a 3D image of the brain.[30] This resulting image demonstrates

---

[18] *Id.*
[19] *Id.*
[20] Kulynych, *supra* note 3, at 1255.
[21] *Id.*; Baskin, Edersheim & Price, *supra* note 15, at 248.
[22] Baskin, Edersheim & Price, *supra* note 15, at 248.
[23] *Id.*
[24] Kulynych, *supra* note 3, at 1255 (noting that various scans of the same brain are an important means of obtaining baseline data and identifying variations in image quality).
[25] Brown & Murphy, *supra* note 2, at 1127.
[26] *Id.* at 1137.
[27] Baskin, Edersheim & Price, *supra* note 15, at 248.
[28] People v. Weinstein, 591 N.Y.S.2d 715, 717 (N.Y. Sup. Ct. 1992).
[29] *Id.*; Baskin, Edersheim & Price, *supra* note 15, at 248–49.
[30] Brown & Murphy, *supra* note 2, at 1136.

how well each region of the brain performs metabolically,[31] as well as blood flow to particular regions of the brain during the task[32] via variations in color patterns throughout the computer-generated brain image.[33]

Increasingly, PET scans are being replaced by Functional MRI (fMRI) scans.[34] fMRI imaging is ideal because it allows scientists to capture the high resolution of structural scans while simultaneously relaying information about brain activity that only functional scans are capable of providing.[35] This is made possible by superimposing changes in blood oxygenation upon an MRI image of the brain.[36]

The basic premise of fMRI is that mental processes (i.e. thoughts and emotions) are represented by patterns of neuronal activation in specific regions of the brain.[37] Because neurons do not have their own internal source of energy, when they are fired, oxygen-rich blood is transported to the brain.[38] In the process of activating the neurons and utilizing the oxygen, oxyhemoglobin is converted into deoxyhemoglobin.[39] The fMRI scanner can detect these changes because oxygenated blood has different magnetic properties than deoxygenated blood.[40] Because increase in oxygen use is linked to neuron activity,[41] by comparing blood-oxygen levels both before and after particular tasks are completed, scientists are able to provide information about brain activity.[42] By further manipulating this contrast, scientists can get a better understanding of the brain region studied because metabolic activity is detailed over time.[43]

C. Limitations

While neuroimaging allows scientists to know more about the brain than was possible in the past, it is not without its problems. A variety of factors can combine to produce different images when multiple laboratories

---

[31] *Weinstein*, 591 N.Y.S.2d at 717.
[32] Baskin, Edersheim & Price, *supra* note 15, at 249.
[33] Kulynych, *supra* note 3, at 1256.
[34] Brown & Murphy, *supra* note 2, at 1137.
[35] Kulynych, *supra* note 3, at 1256.
[36] *Id.*
[37] Emily Hughes, *The Empathic Divide in Capital Trials: Possibilities for Social Neuroscientific Research*, 2011 MICH. ST. L. REV 541, 546 (2011).
[38] Brown & Murphy, *supra* note 2, at 1138.
[39] Laura S. Khoshbin & Shahram Khoshbin, *Imaging the Mind, Minding the Image: An Historical Introduction to Brain Imaging and the Law*, 33 AM. J. L. & MED. 171, 180 (2007).
[40] Brown & Murphy, *supra* note 2, at 1138.
[41] Khoshbin & Khoshbin, *supra* note 39, at 180.
[42] United States v. Semrau, 693 F.3d 510, 517 (6th Cir. 2012).
[43] Baskin, Edersheim & Price, *supra* note 15, at 248.

scan the same brain.[44] One obvious factor that can lead to differences in quality and resolution of brain images is the strength of the particular scanner being utilized, whether it is CT, MRI, PET, or fMRI.[45] Likewise, variations in computer software used to create the scanned image also lead to differences in neuroimaging.[46]

Furthermore, subjective choices that scientists make also have an effect on the image that is generated.[47] Decisions on what type of task to have subjects perform, how detailed the tasks should be, and the degree of clarity that is sought in each test are important considerations because of their effect on brain activity.[48] Finally, differences in brain structure across the population can contribute to confusion about how to interpret neuroimages.[49]

II. CONNECTING BRAIN FUNCTION TO BEHAVIOR

Through sophisticated neuroimaging, scientists have the ability to "capture and display abnormalities that can be linked to and explain violent [offenses]."[50] One of the leading causes of brain abnormalities is traumatic brain injury (TBI), which typically occurs when objects strike the head[51] and affects about 1.5 million people in the United States each year.[52] Neuroimaging makes it possible to detect characteristics of TBI, including hemorrhages, axonal injuries, edemas, lesions,[53] and contusions.[54] Common consequences of TBI include "criminal and impulsive behavior . . . various forms of dissociative disorders, psychosis, and delusional disorders."[55]

Through neuroimaging, scientists can detect injuries to the frontal lobes of the brain, which control our ability to reason and plan.[56] Thus, damage to the frontal lobes often leads to decreases in judgment, insight, and foresight.[57] When the frontal lobes are damaged at a young age, the

---

[44] Kulynych, *supra* note 3, at 1255.
[45] Brown & Murphy, *supra* note 2, at 1144.
[46] Kulynych, *supra* note 3, at 1254–55.
[47] Baskin, Edersheim & Price, *supra* note 15, at 249.
[48] Greene & Cahill, *supra* note 6, at 281.
[49] Baskin, Edersheim & Price, *supra* note 15, at 249.
[50] Greene & Cahill, *supra* note 6, at 281.
[51] Gurley & Marcus, *supra* note 4, at 87.
[52] Baskin, Edersheim & Price, *supra* note 15, at 254.
[53] *Id.* at 261 (asserting that brain lesions have been linked to changes in "communication, comportment, memory, judgment, and emotional regulation").
[54] *Id.* at 254–55.
[55] Gurley & Marcus, *supra* note 4, at 87 (citations omitted).
[56] People v. Weinstein, 591 N.Y.S.2d 715, 722 (N.Y. Sup. Ct. 1992).
[57] *Id.* at 723.

ability to carry out executive functions never matures properly.[58] Likewise, when frontal lobe damage occurs after development of executive skills, the ability to perform such skills decreases.[59]

Furthermore, differences in brain structure have been associated with a variety of mental illnesses.[60] Schizophrenia, for example, has been linked with reduced brain volume in both the frontal and temporal lobes.[61] Psychopathy[62] has been associated with disrupted limbic structures and "decreased pre-frontal gray matter, decreased posterior hippocampal volume, and increased colossal white matter."[63]

While structural neuroimaging can show structural abnormalities that correlate to psychotic behavior, functional neuroimaging showing how the brain is working can also highlight issues with behavior. First, abnormal neurotransmitter levels have long been linked to violent crime.[64] Additionally, the cerebral cortex plays a role in controlling our inhibitions.[65] When the cortex is damaged or experiences decreased uptake of glucose, blood flow, or metabolic activity, the cortex loses control of its inhibitory powers and causes humans to behave primordially.[66] With a decrease in inhibitory powers, humans are prone to exaggerated responses to misperceived threats, often causing violent behavior.[67] Finally, scientists have been able to show that there is a decrease in metabolic processing in the temporal lobe of psychopaths.[68]

III. LANDMARK CASES

In *United States v. Hinckley*,[69] the defense technique of linking neuroimaging to violent behavior in high-profile criminal cases was born.[70]

---

58 Baskin, Edersheim & Price, *supra* note 15, at 257.
59 *Id.*
60 Gurley & Marcus, *supra* note 4, at 87.
61 *Id.*
62 Baskin, Edersheim & Price, *supra* note 15, at 264 (describing psychopathy as a as "a personality disorder characterized by superficiality, glibness, lack of empathy or remorse, and is associated with difficulties in processing and producing affective material").
63 *Id.* at 264–65.
64 Erica Beecher-Monas, *Symposium: Daubert, Innocence, and the Future of Forensic Science: Circumventing Daubert in the Gene Pool*, 43 TULSA L. REV. 241, 255 (2007).
65 *Id.* at 257.
66 *Id.*
67 *Id.*
68 Baskin, Edersheim & Price, *supra* note 15, at 264.
69 United States v. Hinckley, 672 F.2d 115 (D.C. Cir. 1982).
70 *See* Baskin, Edersheim & Price, *supra* note 15, at 245; Perlin, *supra* note 10, at 898.

In *Hinckley*, the defendant was charged with shooting the President of the United States, his Press Secretary, a Secret Service agent, and a police officer in an assassination attempt.[71] Hinckley's defense attorneys succeeded in their attempt to introduce a CT scan into evidence showing that the sulci in his brain were widening. This evidence supported their assertion that Hinckley was schizophrenic.[72] These CT scans were instrumental in Hinckley's eventual acquittal of the murder charges.[73]

Another case adding credence to the practice of introducing brain scans into evidence to dispute a defendant's culpability in murder crimes was *People v. Weinstein.*[74] There, Herbert Weinstein was charged with strangling his wife and then throwing her body out of his twelfth-floor apartment in an effort to make the murder look like a suicide.[75]

Weinstein's lawyers claimed that he lacked culpability for his crime and supported this position with PET scans that showed that an abnormal cyst existed in his arachnoid membrane and that metabolic imbalances existed in the surrounding area where the cyst was located.[76] Based on the scans, his psychiatrist came to the conclusion that Weinstein's cognitive ability was severely impaired when he killed his wife, causing him to lack either an appreciation of the consequences of his conduct or knowledge that his conduct was wrong.[77]

The District Attorney attempted to preclude the scans from entering evidence on the basis that PET technology was not a reliable device for determining brain abnormalities.[78] Ultimately, the court held that the brain scans could be admitted into evidence.[79] Nevertheless, introducing the scans to the jury was not necessary because shortly after the court's ruling, Weinstein agreed to a plea deal of manslaughter; a charge that carried a maximum sentence of twenty-one years as opposed to the twenty-five years to life sentence that he would have received with a murder conviction.[80] While the District Attorney's motivation in granting a plea deal will never

---

[71] *Hinckley*, 672 F.2d at 117.
[72] Perlin, *supra* note 10, at 897.
[73] *Id.*
[74] People v. Weinstein, 591 N.Y. S.2d 715 (Sup. Ct. 1992).
[75] Jeffrey Rosen, *The Brain on the Stand*, N.Y. TIMES, Mar. 11, 2007, *available at* http://www.nytimes.com/2007/03/11/magazine/11Neurolaw.t.html?pagewanted=all&_r=0.
[76] *Weinstein*, 591 N.Y. S.2d at 717–18.
[77] *Id.* at 720.
[78] *Id.* at 718.
[79] *See id.* at 726; Rosen, *supra* note 75.
[80] OWEN D. JONES, JEFFREY D. SCHALL & FRANCIS X. SHEN, LAW AND NEUROSCIENCE (forthcoming 2013).

be known for sure, many—including Weinstein's defense attorney—believe that the evidentiary support of the brain scans played a huge role.[81]

IV. FUTURE EFFECT ON JUROR DECISION MAKING

Mitigating factors are aspects of the defendants' character or circumstances of the offense that serve as a basis for giving a sentence less harsh than the death penalty.[82] Mitigating evidence can be presented as either within the control of defendants (i.e. drug addiction) or beyond the control of defendants (i.e. mental illness).[83] With breakthroughs in cases such as *Hinckley* and *Weinstein*, the perception among many is that the use of neuroimaging as a mitigating factor will continue to positively benefit criminal defendants.

Research by social scientists among mock jurors has supported the stance that neuroimaging will serve an important role in saving defendants from the death penalty.[84] Among mock jurors, the presence of neuropsychological exams in combination with neuroimages confirming brain deficiencies dramatically reduces the likelihood of the defendant being sentenced to death.[85] Defendants with mental disorders are viewed as more sympathetic and, likewise, less culpable for their actions.[86] Further, unlike relying on the raw testimony of psychiatrists that the defendant is mentally unstable, neuroimages provide tangible evidence that a mental disorder is at play.[87] Finally, many scientists speculate that the visual allure of neuroimages alone have a huge impact on jurors and sway their decisionmaking.[88] In their view, "brain images confer scientific credibility by providing a tangible physical explanation of hidden structures and functions."[89]

Nevertheless, a segment of the scientific community believes that the introduction of neuroimages could create additional problems for criminal defendants. During the penalty phase, many states require jurors to determine whether the defendant is likely to be dangerous in the future.[90]

---

[81] *See id.* at 82; Rosen, *supra* note 75.
[82] Greene & Cahill, *supra* note 6, at 280.
[83] *Id.* at 282.
[84] *See id.*; Gurley & Marcus, *supra* note 4, at 86.
[85] Greene & Cahill, *supra* note 6, at 290.
[86] *Id.* at 291.
[87] Gurley & Marcus, *supra* note 4, at, at 94.
[88] Perlin, *supra* note 10, at 892.
[89] Greene & Cahill, *supra* note 6, at 284.
[90] *See id.* at 283; Abraham S. Barth, *A Double-Edged Sword: The Role of Neuroimaging in Federal Capital Sentencing*, 33 AM. J.L. & MED. 501, 506 (2007) (defining future dangerousness as whether "the defendant is likely to commit

Interviews of capital jurors have shown that a significant percentage of deliberation revolves around a defendant's future dangerousness.[91] Furthermore, even when not explicitly asked to consider future dangerousness, jurors still allow it to influence their decisionmaking.[92]

Although defendants introduce neuroimages to bolster claims of diminished culpability, using neuroimages has the potential to backfire by creating the perception that defendants are damaged beyond repair.[93] Among mock jurors, defendants diagnosed with psychopathy were overwhelmingly more likely to be sentenced to death than other defendants.[94] Thus, there is a high likelihood that neuroimages can end up having a prejudicial impact on criminal defendants.[95]

After considering the universe of cases in which brain scans have been introduced as a form of mitigating evidence,[96] it would appear that on average, the introduction of these scans have no positive effect on outcomes of criminal defendants. This was true across the Courts of Appeal for the United States, United States District Courts, and various state supreme courts where neuroimages were introduced into evidence before the jury.

For the cases found in both state supreme courts and United States District Courts, the defendants were on trial for crimes ranging from murder,[97] kidnapping resulting in death,[98] and forcible sodomy on a child.[99] In these cases, the defense attorneys introduced PET and MRI scans that revealed extreme emotional disturbance and inability to act in accordance with the law,[100] brain damage,[101] and inability to control aggressive

---

criminal acts of violence in the future which would be a continuing and serious threat to the lives and safety of others").

[91] Greene & Cahill, *supra* note 6, at 283.

[92] *Id.*

[93] *Id.* at 285.

[94] *See* Gurley & Marcus, *supra* note 4, at 93.

[95] John F. Edens, Lori H. Colwell, Donna M. Desforges & Krissie Fernandez, *The Impact of Mental Health Evidence on Support for Capital Punishment: Are Defendants Labeled Psychopathic Considered More Deserving of Death?*, 23 BEHAV. SCI. & L. 603, 619 (2005).

[96] Cases were identified using LEXIS, U.S. federal and state-court cases library, and the following search string: (PET or SPECT or fMRI or MRI) w/15 (scan! or image!). This search was last updated on 2/24/13.

[97] *See* Smithers v. Sec'y Fla. Dep't of Corr., 2011 U.S. Dist. LEXIS 63570, at *9 (M.D. Fla. June 15, 2011); Lawrence v. McNeil, 2010 U.S. Dist. LEXIS 83454, at *4 (N.D. Fla. July 20, 2010); Johnston v. Florida, 70 So. 3d 472, 475 (Fla. 2011); Tennessee v. Reid, 213 S.W.3d 792, 808 (Tenn. 2006); People v. Holt, 937 P.2d 213, 226 (Cal. 1997).

[98] Fulks v. United States, 875 F. Supp. 2d 535, 541 (D.S.C. 2010).

[99] People v. Smith, 107 P.3d 229, 233 (Cal. 2005).

[100] *Smithers*, 2011 U.S. Dist. LEXIS 63570, at *11.

impulses.[102] Nevertheless, in all eleven cases the jury recommended a sentence of death.[103]

In the Courts of Appeal the defendants fared slightly better. Like the cases in the state Supreme Courts and United States District Courts, the defendants that were appealing their cases committed crimes including murder[104] and kidnapping resulting in death.[105] The defense attorneys introduced PET and CAT scans that revealed schizophrenia,[106] inability to make rational decisions and control emotions,[107] and pseudocyesis.[108] The cases reported in the Courts of Appeal are distinct because, at least for the earlier cases, the outcome was more favorable for the defendant.[109] For example, in *Trap v. Spencer*, despite being on trial for first-degree murder, the defendant was able to escape with only a sentence of life imprisonment.[110] In *McNamara v. Borg*, the defendant received a life sentence even though he was a mass murderer (several jurors admitted later that, after seeing the scans, they were motivated to be more lenient and to sentence the defendant to life imprisonment as opposed to the death penalty).[111] However, in three capital cases decided within the past two

---

[101] *See Fulks*, 875 F. Supp. 2d at 561; *McNeil*, 2010 U.S. Dist. LEXIS 83454, at *120; *Johnston*, 70 So. 3d at 479; *Reid*, 213 S.W.3d at 808; *Smith*, 107 P.3d at 234; State v. Marshall, 27 P.3d 192, 198 (Wash. 2001).

[102] *See* Hoskins v. State, 75 So. 3d 250, 255 (Fla. 2011); State v. Henretta, 325 S.W.3d 112, 123 (Tenn. 2010); Johnston v. Florida, 841 So. 2d 349, 354 (Fla. 2002); *Holt*, 937 P.2d at 231.

[103] *See Smithers*, 2011 U.S. Dist. LEXIS 63570, at *11; *Fulks*, 875 F. Supp. 2d at 541; *McNeil*, 2010 U.S. Dist. LEXIS 83454, at *4; *Hoskins*, 75 So. 3d at 254; *Johnston*, 70 So. 3d at 475; *Henretta*, 325 S.W.3d at 123; *Reid*, 213 S.W.3d at 808; *Smith*, 107 P.3d at 233; *Florida*, 841 So. 2d at 355; *Marshall*, 27 P.3d at 196; *Holt*, 937 P.2d at 233.

[104] *See* Lawrence v. Sec'y Fla. Dep't of Corr., 700 F.3d 464, 466 (11th Cir. 2012); United States v. Duncan, 643 F.3d 1242, 1244 (9th Cir. 2011); Trap v. Spencer, 479 F.3d 53, 56 (1st Cir. 2007).

[105] United States v. Montgomery, 635 F.3d 1074, 1078 (8th Cir. 2011).

[106] *See Lawrence*, 700 F.3d at 471; McNamara v. Borg, 923 F.2d 862 (9th Cir. 1991); Sonni Efron, *Judge to Allow Brain Test to Aid Salcido Defense*, L.A. TIMES, Oct. 12, 1989, *available at* http://articles.latimes.com/1989-10-12/news/mn-285_1_brain-damage.

[107] *See Duncan*, 643 F.3d at 1250; *Spencer*, 479 F.3d at 56.

[108] *Montgomery*, 635 F.3d at 1084.

[109] *See Spencer*, 479 F.3d at 53; *McNamara*, 923 F.2d 862.

[110] *Spencer*, 479 F.3d at 53.

[111] *See McNamara*, 923 F.2d 862; Dominique J. Church, *Neuroscience in the Courtroom: An International Concern*, 53 WM. & MARY L. REV. 1825, 1837 (2012).

years, the jury recommended a death sentence despite the inclusion of neuroimages.[112]

CONCLUSION

While the use of neuroimages in the courtroom seems like a good idea in theory, its actual utility has been overstated. In an overwhelming number of capital cases, juries still decide to give the death penalty despite scientific evidence reducing the defendant's culpability. One possible explanation for this could be that clear wrongdoing cannot be neutralized by neuroimages that suggest that defendants are less culpable. In a study testing the impact of neuroimages on mock juror sentencing, researchers found that jurors were unwilling to release a dangerous individual from custody, even if the defendant lacked the requisite *mens rea* for the crime committed.[113] In successive experiments, the researchers found that by reducing the seriousness of the crime committed from armed robbery and murder, to unarmed robbery and assault, and to accidental contact inflicting no serious injury, guilty verdicts fell from 94 percent to 82 percent to 75 percent.[114] Currently, the majority of criminal cases in which defendants attempt to utilize neuroimaging to reduce culpability involve particularly heinous crimes and the end result conforms with the results of the study, as defendants are typically found guilty and sentenced to death. Therefore, until defense attorneys begin diversifying the types of criminal cases in which neuroimaging is used, neuroimages will continue to serve little to no useful purpose for criminal defendants.

---

[112] *See* Lawrence v. Sec'y Fla. Dep't of Corr., 700 F.3d 464, 470 (11th Cir. 2012); *Duncan*, 643 F.3d at 1246; *Montgomery*, 635 F.3d at 1078.

[113] Nick J. Schweitzer, Michael J. Saks, Emily R. Murphy, Adina L. Roskies, Walter Sinnott-Armstrong & Lyn M. Gaudet, *Neuroimages as Evidence in a Mens Rea Defense: No Impact*, 17 PSYCHOL. PUB. POL'Y & L. 357, 372 (2011).

[114] *Id.* at 387.