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## BEOS Test: A Defendant's Nightmare

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## **BEOS Test: A Defendant's Nightmare**

### **INTRODUCTION**

The use of brain electrical oscillation signature profiling (BEOS) test in criminal cases to show whether an alleged criminal participated in a crime is a highly contested. While no court in the United States has admitted BEOS brain imaging scans as evidence of criminal culpability (or innocence), two courts in India have utilized the technology in criminal proceedings.<sup>1</sup> The following is the story of an Indian woman who was sentenced to life in prison for purportedly committing a murder in Pune, India in a case in which the court admitted BEOS evidence.<sup>2</sup>

Aditi met the love of her life, Udit, as a first-year student at Engineering College in Jammu, India.<sup>3</sup> After a year-long courtship, Aditi's and Udit's parents agreed that the pair could marry after they earned their Masters of Business Administration degrees<sup>4</sup>. In 2006, Udit and Aditi moved to Pune, India to attend IIMM College and work toward their graduate degrees<sup>5</sup>.

While attending IIMM College, Aditi met Pravin and they fell in love.<sup>6</sup> Soon, Aditi ended her relationship with Udit and pursued a relationship with Pravin.<sup>7</sup> In December 2006, Aditi and Pravin eloped and moved to a different state in India.<sup>8</sup> On April 22, 2007, Aditi secretly obtained Udit's phone number and requested that he meet her at a nearby McDonald's.<sup>9</sup> There, Aditi offered Udit prasad (sanctified food that was offered to God first), which was laced with arsenic.<sup>10</sup> At 2:30 a.m. that night, Udit was taken to the emergency room.<sup>11</sup>

The next day, doctors found an opaque substance in Udit's x-ray that they suspected was heavy metal poisoning.<sup>12</sup> The doctors informed the police and Udit's parents about their suspicions.<sup>13</sup> Udit's friends came to visit him in the hospital and noticed a call from an unknown

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<sup>1</sup> Anand Giridharas, India's use of brain scans in courts dismays critics, New York Times, September 15, 2018, <https://www.nytimes.com/2008/09/15/world/asia/15iht-15brainscan.16148673.html>.

<sup>2</sup> *State of Maharashtra v. A. B. Sharma and P. P. Khandelwal*, C.C. 508 of 2007, D & S.C. Mum., 6 December 2008; Angela Saini, *The brain police: judging murder with an MRI*, The Wired, May 27, 2009, <https://www.wired.co.uk/article/guilty>; Giridharas, *supra* note 1.

<sup>3</sup> *Supra* note 1.

<sup>4</sup> *Sharma*, 508 at 2.

<sup>5</sup> *Id.*

<sup>6</sup> *Id.* at 3.

<sup>7</sup> *Id.*

<sup>8</sup> *Id.*

<sup>9</sup> *Id.* at 33.

<sup>10</sup> *Id.* at 34.

<sup>11</sup> *Id.*

<sup>12</sup> *Id.* at 36.

<sup>13</sup> *Id.*

number on his phone.<sup>14</sup> The friends knew of his meeting with Aditi, so they went on a hunt to match a name to that unknown number.<sup>15</sup> The friends contacted the phone company, which informed them that the phone call was made from a nearby hotel where Aditi had stayed.<sup>16</sup>

One friend confronted Aditi regarding the food she had given to Udit.<sup>17</sup> Aditi claimed that she gave Udit the food and he ate some but felt uneasy afterward.<sup>18</sup> The friends took the food from Aditi's purse and gave it to a doctor to analyze.<sup>19</sup> Aditi left the town and headed towards Mumbai with her lover, Pravin.<sup>20</sup> Udit died on April 24, 2007.<sup>21</sup>

The contents of Udit's stomach revealed that he had a fatal amount of arsenic.<sup>22</sup> The police arrested Aditi and Pravin.<sup>23</sup> The police gave Aditi a polygraph test, which revealed that she was involved in the murder of Udit.<sup>24</sup> Then, the authorities gave Aditi a BEOS test, which revealed she had experiential knowledge of the crime.<sup>25</sup> Aditi's responses to all relevant questions such as "Did the prasad given to Udit have arsenic in it?" revealed deception.<sup>26</sup> Pravin also took a polygraph test, but his results were inconclusive and, therefore, he was not required to take a BEOS test.<sup>27</sup> Aditi's defense was that Udit was so madly in love with her that he could not bear the thought of living without her and, thus, committed suicide.<sup>28</sup>

The judge spoke at great lengths about the weight of the BEOS test during the trial.<sup>29</sup> An expert from the forensic laboratory, Mr. Joseph, testified about Aditi's BEOS test.<sup>30</sup> Mr. Joseph testified that the BEOS is programmed to detect and differentiate between conceptual and experiential knowledge.<sup>31</sup> Mr. Joseph then asked Aditi three different types of probes split into categories.<sup>32</sup> Probes are short phrases that elicit cognitive activity depending on whether the the

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<sup>14</sup> *Id.* at 34.

<sup>15</sup> *Id.* at 41.

<sup>16</sup> *Id.*

<sup>17</sup> *Id.*

<sup>18</sup> *Id.*

<sup>19</sup> *Id.*

<sup>20</sup> *Id.*

<sup>21</sup> *Id.* at 7.

<sup>22</sup> *Id.* at 35.

<sup>23</sup> *Id.* at 7.

<sup>24</sup> *Id.* at 57.

<sup>25</sup> *Id.*

<sup>26</sup> *Id.* at 58.

<sup>27</sup> *Id.*

<sup>28</sup> *Id.* at 8.

<sup>29</sup> *Id.* at 63-68.

<sup>30</sup> *Id.* at 56.

<sup>31</sup> *Id.*

<sup>32</sup> *Id.* at 59.

person experienced the information contained in the sentence or had knowledge of the incident through a third-party source.<sup>33</sup> The first category consisted of neutral probes to get a base line for cognitive process (i.e., the sky is blue).<sup>34</sup> The second category included control probes about personal information (i.e., I live in Pune, India).<sup>35</sup> The final category consisted of relevant probes regarding the incident (i.e., the prasad contained arsenic).<sup>36</sup> The test did not required Aditi to respond verbally to any probe.<sup>37</sup> The BEOS analyzes the relevant probes compared to the base line probes for each individual probe.<sup>38</sup> This means that the first category probes are compared to the relevant probes.<sup>39</sup> If the results are similar, that means there is experiential knowledge.<sup>40</sup> The test then generates a report that shows what kind of cognitive processing occurred on the test taker at each probe.<sup>41</sup> Basically, the test shows electrical activation that suggests a related memory to the probe (experiential knowledge).<sup>42</sup>

Aditi's BEOS results showed experiential knowledge on many probes related to the murder of Udit.<sup>43</sup> The BEOS test should electrical activation in Aditi's brain in regard to her affair with Pravin, relationship conflict between her and Udit, her plan to murder Udit by arsenic poisoning, her going to temple and getting prasad then going to a store to buy arsenic, and her calling Udit and giving him the poisoned food.<sup>44</sup> Using these indications, Mr. Joseph concluded that the BEOS findings were a clear indication that Aditi had murdered Udit.<sup>45</sup> The judge hesitated in allowing the BEOS test results, because the BEOS test is not conclusive in nature since it is a new field of science.<sup>46</sup> The judge dismissed this concern on the grounds that Mr. Joseph had conducted many polygraph and BEOS tests, and, therefore, was an expert was knowledgeable in the field.<sup>47</sup>

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<sup>33</sup> *Id.*

<sup>34</sup> *Id.*

<sup>35</sup> *Id.*

<sup>36</sup> *Id.*

<sup>37</sup> *Id.*

<sup>38</sup> *Id.*

<sup>39</sup> *Id.*

<sup>40</sup> *Id.*

<sup>41</sup> *Id.*

<sup>42</sup> *Id.*

<sup>43</sup> *Id.* at 60.

<sup>44</sup> *Id.*

<sup>45</sup> *Id.* at 61.

<sup>46</sup> *Id.*

<sup>47</sup> *Id.* at 61-62

While polygraph tests are deemed inconclusive, Mr. Joseph testified that neither the computer nor analog polygraph tests create a high degree of false positives.<sup>48</sup> He further testified that Aditi was not under stress, anxiety, nervousness, or anger during the test.<sup>49</sup> Thus, her deceptive answers could not be attributed to her autonomic nervous system.<sup>50</sup> The court noted that the American Medical Association has concluded that the polygraph test's success rate is only 70%, depending on the skill of the evaluator.<sup>51</sup> Mr. Joseph countered this claim by contending that there was no human error in Aditi's evaluation because both the polygraph and BEOS tests are computerized.<sup>52</sup> The judge ruled that the tests did not constitute testimonial compulsion and, thus, were admissible as evidence.<sup>53</sup> The judge noted that two other cases in India were decided against the accused based on BEOS findings.<sup>54</sup> Ultimately, the judge sentenced Aditi to life in prison for the murder of Udit.<sup>55</sup>

This paper proceeds in five parts. Part I provides an overview of brain imaging and BEOS testing. Part II explains the use of brain imaging and BEOS in the United States and other countries. Part III discusses the Federal Rules of Evidence applicable to the admissibility of BEOS in federal criminal trials. Part IV examines arguments for and against the use of BEOS as evidence in criminal proceedings. It also analyzes whether warrants can be issued to conduct a BEOS test on an accused. Finally, Part V states that the BEOS test should not be admitted in the US court system.

### **Part I: An overview of brain electrical oscillation signature profiling.**

Brain electrical oscillation signature profiling (BEOS) is a test that can show an accused's participation in a crime through electrophysiological impulses.<sup>56</sup> It can differentiate whether a person has first-hand knowledge of the crime or knew of the crime through a third person.<sup>57</sup> It has not been admitted in the US yet.

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<sup>48</sup> *Id.* at 62.

<sup>49</sup> *Id.* at 63.

<sup>50</sup> *Id.*

<sup>51</sup> *Id.*

<sup>52</sup> *Id.*

<sup>53</sup> *Id.* at 64.

<sup>54</sup> *Id.* at 65-67.

<sup>55</sup> *Id.* at 67.

<sup>56</sup> CR. Mukundan, Brain Electrical Oscillations Signature Profiling (BEOS) for Measuring the Process of Remembrance, *EC Neurology Review Article*, 217, 221 November 11, 2017, available at <https://www.ecronicon.com/ecne/pdf/ECNE-08-00256.pdf>.

<sup>57</sup> *Id.*

#### A. How brain electrical oscillation signature profiling works.

The BEOS uses an electroencephalogram (EEG) technique which records brain wave patterns through the use of electrodes; it analyzes whether the test taker has experiential knowledge of the crime.<sup>58</sup> Champadi Raman Mukundan, a neuroscientist from India, invented the BEOS.<sup>59</sup> BEOS testing is a noninvasive procedure where a test subject wears a cap with electrodes (thin metal wires) that sends signals to a computer.<sup>60</sup> Then, an examiner states to the test subject short sentences to which no verbal response is necessary.<sup>61</sup> The sentences range from neutral sentences to incriminating sentences.<sup>62</sup> The examiner asks the probes in a sequential manner in which the event actually occurred.<sup>63</sup> This chronological questioning is implemented to ensure the test taker is reliving the moment without having to distort reality with an unorganized timeline.<sup>64</sup> Before stating the probes, the examiner must decide which answer she/he expects to elicit: visual sensory imagery or motor imagery.<sup>65</sup>

The three (sometimes four) probe categories are: neutral, control, Target A, and Target B probes.<sup>66</sup> The neutral probes are not related to the event in question nor are they personal knowledge questions; rather, they are factual questions such as “today is Monday.”<sup>67</sup> Control probes are statements about the test taker’s life that are unrelated to the crime.<sup>68</sup> An example is, “I was born in San Diego.” A positive indication of the control probes means the probes are experiences the test taker went through thus, allowing the examiner to use the data as a baseline for the more incriminating probes.<sup>69</sup>

Target A probes are about the crime and events surrounding the crime.<sup>70</sup> Target A probes are generally stated in a chronological order including hypothesized activities in which the

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<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> *Id.* at 218.

<sup>61</sup> Aggarwal, *infra* note 234.

<sup>62</sup> Mukundan, *supra* note 56 at 222.

<sup>63</sup> *Id.* at 221.

<sup>64</sup> *Id.*

<sup>65</sup> *Id.*

<sup>66</sup> *Id.* at 222.

<sup>67</sup> *Id.*

<sup>68</sup> *Id.*

<sup>69</sup> *Id.*

<sup>70</sup> *Id.*

examiner believes the test taker may have participated.<sup>71</sup> An illustration of a Target A probe is, “I quietly climbed through Jack’s window and stole his phone.” Note that Target A probes based on the assumption the test taker committed the crime; Target A probes are accusatory so the test can reveal any knowledge of the crime.<sup>72</sup> Finally, Target B probes<sup>73</sup> are statements about the test taker’s own version of events.<sup>74</sup> An example of a Target B probe is, “I used Jack’s phone to order food.” Mukundan contends that Target B probes are statements that the test taker believes will serve as immunity to probe her/his innocence.<sup>75</sup>

The test then analyzes the brain signals triggered by each sentence to ascertain the subject’s experiential knowledge, which is knowledge that can only be gained from personal experience.<sup>76</sup> Please note, the author has not found any information regarding the test taker’s belief of committing an act and its effect on the results. Experiential knowledge is not acquired from a third-party source.<sup>77</sup> Experiential knowledge measured is by having an emotional response to a probe.<sup>78</sup> As mentioned previously, this emotional response is shown by an impulse detected through electrodes. The baseline is an emotional response to a control probe; an emotional response to a target probe (especially Target A probes) is an indicator of experiential knowledge and participation.<sup>79</sup> Usually, if there is experiential knowledge indicators in Target B probes but absent in Target A probes, it would indicate that the person is innocent.<sup>80</sup> This is because Target B probes are about the test taker’s version of events whereas Target A probes are about the factual events of the crime.

An example of BEOS detection of experiential knowledge would go as follows. Nik and Larry commit a robbery. Larry then tells Vrata about it the next day. If Vrata were to take a BEOS test regarding the robbery, the test would show Vrata lacked experiential knowledge of the crime. However, if Nik or Larry were to take the BEOS test, the results would show that they both have experiential knowledge of the crime because they participated in it. After each probe, the BEOS

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<sup>71</sup> *Id.*

<sup>72</sup> *Id.*

<sup>73</sup> Some examiners lump Target B probes with Target A probes and simply call these statements Target probes.

<sup>74</sup> *Id.*

<sup>75</sup> *Id.*

<sup>76</sup> Experiential Knowledge, <https://simplyphilosophy.org/study/experiential-knowledge/>.

<sup>77</sup> *Id.*

<sup>78</sup> Mukundan, *supra* note 56.

<sup>79</sup> *Id.* at 222-23.

<sup>80</sup> *Id.* at 224.

test report would indicate the following reactions: “primary processing present, presence of inattention, encoding present, and experiential knowledge present.”<sup>81</sup>

With regard to the accuracy of such test, it is important for the reader to note that the BEOS test’s creator, Mukundan, has conducted the majority of the research concerning the test.<sup>82</sup> The author has not found any published material to confirm Mukundan’s claims about the test’s. According to Mukundan, the BEOS test is 95 percent accurate.<sup>83</sup> An Indian study found that both the BEOS control group and experimental group had 94 percent specificity (accuracy) rate.<sup>84</sup> Mukundan notes that investigators require high specificity rates as to not incriminate an innocent person.<sup>85</sup> He further emphasizes the importance of not examining a single instance of experiential knowledge as a sign of guilt.<sup>86</sup> It only after a series of probes that result in experiential knowledge, can the test be used as an indicator of guilt.<sup>87</sup> Isolated experiential knowledge probes can lead the examiner to reframe the probe to see if firsthand knowledge is still present.<sup>88</sup> Mukundan claims that BEOS has helped investigators in dozens of crimes over the past few years.<sup>89</sup> The BEOS test was used as a supplement to other evidence and has been able to exonerate many persons accused of a crime; the test has also allowed investigators to pinpoint which person played what role in a crime that involves multiple people.<sup>90</sup>

### B. The difference between knowledges.

A key indicator of involvement in a crime is the existence of experiential knowledge when the examiner states the probes. As one can deduce, experiential knowledge can only be acquired through participation (it is an experience).<sup>91</sup> Experiential knowledge has particulars; particulars are things, events, and characteristics.<sup>92</sup> Furthermore, experiential knowledge is knowledge

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<sup>81</sup> *Id.* at 223.

<sup>82</sup> *Id.*

<sup>83</sup> David Cox, Your brainwaves never lie. Or at least that’s the story believed by a growing number of police and law courts worldwide – the truth is more complicated, BBC Future, January 25, 2016, <https://www.bbc.com/future/article/20160125-is-it-wise-that-the-police-have-started-scanning-brains>

<sup>84</sup> Mukundan, *supra* note 81.

<sup>85</sup> *Id.*

<sup>86</sup> *Id.*

<sup>87</sup> *Id.*

<sup>88</sup> *Id.*

<sup>89</sup> *Id.*

<sup>90</sup> *Id.*

<sup>91</sup> *Supra* note 76.

<sup>92</sup> *Id.*

through perception.<sup>93</sup> For instance, one knows a sunflower is yellow because one has seen it. Mukundan suggests the BEOS test can detect that if one sees a sunflower in real life (experiential knowledge), or through other means such as a picture (nonexperiential knowledge). Unsurprisingly, nonexperiential knowledge is knowledge not gained from firsthand experience.

Gamma oscillation is another test that can distinguish true memories from false memories.<sup>94</sup> In the gamma oscillation study, the examiners studied 52 patients that recalled a list of words (either a list of fifteen words or twenty words).<sup>95</sup> The results were that of the recalled words, around 73 percent of the words were correctly recalled.<sup>96</sup> The study found that increased gamma power during encoding could predict whether that word would be recalled at a later time.<sup>97</sup> The reserachers then examined whether there was a correlation between oscillations predicting successful encoding and predicting correct recall.<sup>98</sup> The study proved that increased oscillations immediately before a response would result in a true memory.<sup>99</sup> The study hypothesizes that increased oscillations can occur due to increased attention or arousal that indicate memory encoding and retrieval.<sup>100</sup>

## **Part II: The use of brain scans in courtrooms.**

Courts rarely admit brain imaging scans in American criminal trials.<sup>101</sup> There is evidence, however, that it would significantly change the way the criminal justice system now functions if they changed course.<sup>102</sup> This paper argues that it would be hurtful to criminal defendants to admit BEOS scans as evidence. There is a journal note about generally admitting all functional brain imaging scans into the criminal court systems, which discusses the use of all scans.<sup>103</sup> This paper

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<sup>93</sup> *Id.*

<sup>94</sup> Per Sederberg, et. al., *Gamma Oscillations Distinguish True From False Memories*, Psychol. Sci. 2007, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2897900/>.

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

<sup>97</sup> *Id.*

<sup>98</sup> *Id.*

<sup>99</sup> *Id.*

<sup>100</sup> *Id.*

<sup>101</sup> *Infra* note 198.

<sup>102</sup> James Gaines, *Brain Scans in the Courts: Prosecutor's Dream or Civil Rights Nightmare?*, Inside Science, March 14, 2018, <https://www.insidescience.org/news/brain-scans-courts-prosecutors-dream-or-civil-rights-nightmare>

<sup>103</sup> Adam Teitcher, note, *Weaving Functional Brain Imaging Into the Tapestry of Evidence: A Case for Functional Neuroimaging in Federal Criminal Courts*, 80 Fordham L. Rev. 355 (2011).

is distinguished from that note because it specifically discusses the admissibility of BEOS results as evidence in federal and state criminal cases.

A recent case involving [similar technology?] saved Grady Nelson's life. Nelson's case marked the first time an American court admitted a quantitative electroencephalography (QEEG) test.<sup>104</sup> This Florida case's jury verdict garnered attention in the media. QEEG is an analysis of brain mapping; it is a tool used to understand brain functioning and changes in the brain function.<sup>105</sup> It shows EEG results in pictorial form.<sup>106</sup>

Grady Nelson was a 53-year-old man that escaped a death sentence with the help of QEEG scans.<sup>107</sup> In 2000, Nelson was allowed to work in a Miami human services department despite his conviction for raping a seven-year-old girl.<sup>108</sup> Then, in 2005, he was charged with raping his wife's eleven-year-old daughter.<sup>109</sup> The State dropped the charges.<sup>110</sup> On his release day from jail, Nelson decided to slaughter his entire family.<sup>111</sup> Prosecutors sought the death penalty.<sup>112</sup> Nelson had stabbed his wife 61 times and stabbed and raped her two daughters (gratefully, the daughters survived).<sup>113</sup> He was found standing over his dead wife's body while still holding a butcher knife.<sup>114</sup> Nelson confessed to the murder.<sup>115</sup>

With this brutal case at hand, Nelson had to find a way to escape the death penalty. His defense counsel sought to admit the QEEG scans.<sup>116</sup> It also came to light that when Nelson was younger, he was sexually abused and he was abandoned by his mother.<sup>117</sup> Nelson's traumatic childhood led to his substance abuse of cocaine which damaged his brain.<sup>118</sup> The Eleventh Circuit

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<sup>104</sup> Greg Miller, *Brain Exam May Have Swayed Jury in Sentencing Convicted Murderer*, Science Mag, December 14, 2010, <https://www.sciencemag.org/news/2010/12/brain-exam-may-have-swayed-jury-sentencing-convicted-murderer>.

<sup>105</sup> What is qEEG / Brain Mapping?, <https://qeegsupport.com/what-is-qeeg-or-brain-mapping/>

<sup>106</sup> *Id.*

<sup>107</sup> Terry Lenmon, *QEEG Brain Mapping Evidence and Mitigation in South Florida's Grady Nelson Trial*, Death Penalty, December 7, 2010, <https://www.deathpenaltyblog.com/qeeg-brain-mapping-evidence-and-mitigation-in-south-floridas-grady-nelson-trial/>.

<sup>108</sup> [http://www.floridacapitalcases.state.fl.us/Documents/Enewsletter/2010\\_Articles\\_December/Novel%20defense%20helps%20spare%20perpetrator%20of%20grisly%20murder.pdf](http://www.floridacapitalcases.state.fl.us/Documents/Enewsletter/2010_Articles_December/Novel%20defense%20helps%20spare%20perpetrator%20of%20grisly%20murder.pdf).

<sup>109</sup> *Id.*

<sup>110</sup> *Id.*

<sup>111</sup> *Id.*

<sup>112</sup> *Id.*

<sup>113</sup> *Id.*

<sup>114</sup> *Id.*

<sup>115</sup> *Id.*

<sup>116</sup> *Supra* note 108.

<sup>117</sup> *Id.*

<sup>118</sup> *Supra* n. 107.

allowed the defenses request to allow jury to consider the QEEG scans as mitigating factors for Nelson during the sentencing phase of his capital case.<sup>119</sup>

Robert Thatcher, who is a leading expert on QEEG, testified as to the reliability of the scans during the penalty phase and during defense's motion to allow the brain scans in as evidence.<sup>120</sup> The judge admitted the scans.<sup>121</sup> The jury was split in half which resulted in an automatic death penalty.<sup>122</sup> Doctor Thatcher claimed that Nelson had an abnormal left frontal lobe.<sup>123</sup> Nelson's brain scans revealed sharp waves which are indicative of epilepsy.<sup>124</sup> Nelson's scan showed a damaged left frontal lobe which makes it hard for people to suppress their actions and do not understand the consequences of their actions.<sup>125</sup> Doctor Thatcher also testified that he had never seen injuries like Nelson's before.<sup>126</sup> The jury believed Doctor Thatcher's testimony.<sup>127</sup> As a result, Nelson was sentenced to life in prison instead of the death penalty.<sup>128</sup>

While brain scans are useful in the courtrooms, the scans may not always sway the jury; that is a risk that defendants and prosecutors must take.<sup>129</sup> In Brian Dugan's criminal case, his defense counsel sought to admit fMRI scans that showed his abnormal brain.<sup>130</sup> In 1983, Dugan kidnapped and killed Jeanine Nicarico.<sup>131</sup> Dugan was already serving life sentences for two previous murders, but this the prosecutors in this case sought the death penalty.<sup>132</sup> Dugan's fMRI showed that he had abnormalities in his brain that are akin to the abnormalities seen in psychopaths.<sup>133</sup> Kent Kiehl, a neuroscientist, testified to the results of Dugan's fMRI and informed the jury that he could not conclude that Dugan committed the crimes because he has an abnormal brain; Doctor Kiehl simply stated that Dugan's scan exhibits the brain abnormalities.<sup>134</sup> Doctor Kiehl was claiming that these brain scans are not conclusive in proving innocence or guilt, but just

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<sup>119</sup> *Id.*

<sup>120</sup> *Id.*

<sup>121</sup> *Id.*

<sup>122</sup> *Id.*

<sup>123</sup> Miller, *supra* note 104.

<sup>124</sup> *Id.*

<sup>125</sup> *Id.*

<sup>126</sup> *Id.*

<sup>127</sup> *Id.*

<sup>128</sup> *Id.*

<sup>129</sup> *Id.*

<sup>130</sup> Greg Miller, *fMRI Evidence Used in Murder Sentencing*, Science Mag, November 23, 2009, <https://www.sciencemag.org/news/2009/11/fmri-evidence-used-murder-sentencing>.

<sup>131</sup> *Id.*

<sup>132</sup> *Id.*

<sup>133</sup> *Id.*

<sup>134</sup> *Id.*

a piece of evidence.<sup>135</sup> Doctor Kiehl was reluctant to state that the scans proved Dugan committed the crime.<sup>136</sup> The jury heard the testimony and saw the scans but still sentenced Dugan to death.<sup>137</sup>

In *Harrington v. State*, an expert testified about brain fingerprinting scans.<sup>138</sup> The case was later dismissed by prosecutors.<sup>139</sup> In *State v. Weinstein*, defense claimed that Weinstein lacked criminal responsibility in killing his wife.<sup>140</sup> To show this, defense counsel called upon an expert to discuss brain scans that showed a cyst in Weinstein's brain.<sup>141</sup> The judge limited the expert's testimony to a description of Weinstein's brain scans; the expert could not discuss the correlation between the cyst and the propensity of violence.<sup>142</sup> While the expert could not discuss the link between the cyst and the defendant's likelihood of violence, this was a major jump in legal neuroscience.<sup>143</sup>

### **Part III: Evidence rules do not permit the use of BEOS in courtrooms.**

Federal Rule of Evidence 401 provides the definition of relevant evidence.<sup>144</sup> The rule characterizes evidence as relevant if it "has a tendency to make a fact more or less probable than it would have been without the evidence; and the fact is of consequence in determining the action."<sup>145</sup> Relevance is important as it is the foundation of evidence.<sup>146</sup> Admitted evidence has to be relevant.<sup>147</sup>

Federal Rule of Evidence 403 explains that not all relevant evidence is admissible.<sup>148</sup> Even relevant evidence must be excluded when it is unduly prejudicial, confusing, wasteful, or upon other reasons.<sup>149</sup> Rule 403 states "the court may exclude relevant evidence if its probative value is substantially outweighed by a danger of one or more of the following: unfair prejudice, confusing

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<sup>135</sup> *Id.*

<sup>136</sup> *Id.*

<sup>137</sup> *Id.*

<sup>138</sup> *Harrington v. State*, 659 N.W.2d 509, 512 (Iowa 2003).

<sup>139</sup> *Id.*

<sup>140</sup> *People v. Weinstein*, 156 Misc. 2d 34, 35 (N.Y. Sup. Ct. 1992).

<sup>141</sup> *Id.* at 43.

<sup>142</sup> *Id.* at 47.

<sup>143</sup> *Id.*

<sup>144</sup> Fed. R. Evid. 401.

<sup>145</sup> *Id.*

<sup>146</sup> Paul Bergman, Relevant Evidence in Criminal Trials, NOLO, <https://www.nolo.com/legal-encyclopedia/relevant-evidence-criminal-trials.html>.

<sup>147</sup> *Id.*

<sup>148</sup> Fed R. Evid. 403.

<sup>149</sup> *Id.*

the issues, misleading the jury, undue delay, wasting time, or needlessly presenting cumulative evidence.”<sup>150</sup>

Rule 702 is regarding testimony by an expert witness.<sup>151</sup> Rule 702 states that a qualified expert may testify to their opinion or findings if:

- (a) the expert’s scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or 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.<sup>152</sup>

Rule 704 is about an expert’s opinion on an ultimate issue.<sup>153</sup> The relevant portion of the Rule 704 is in a criminal case, an expert witness cannot state whether the defendant had the mental capacity to commit the crime; only the trier of fact can decide such.<sup>154</sup> Essentially, the expert may give an opinion on a fact but cannot reach a legal conclusion.

The *Daubert* test established the following factors to admit evidence: the technique can be tested, the technique has been subject to review and publication, the technique has a known rate of error, and there is general acceptance of this technique in the scientific community.<sup>155</sup> The *Daubert* test is used in the federal system.<sup>156</sup> Minority of states still use the *Frye* test. Under the *Frye* test, a there is a general acceptance test: whether or not the scientific community generally accepts the method used.<sup>157</sup>

In *Blotcher*, the court noted that *Daubert* was not meant to be a restrictive rule in admonishing expert testimony or evidence from the courtrooms; rather, it was meant to be the opposite.<sup>158</sup> *Daubert* and Rule 702 was a more relaxed standard in allowing evidence in and expert testimony about the evidence than the *Frye* test.<sup>159</sup> It is important to note that,

A key but sometimes forgotten principle of Rule 702 and *Daubert* is that Rule 702, both before and after *Daubert*, was intended to relax traditional barriers to admission of expert opinion testimony. Accordingly, courts are in agreement that Rule 702 mandates a liberal standard for the admissibility of expert testimony. As

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<sup>150</sup> *Id.*

<sup>151</sup> Fed. R. Evid. 702.

<sup>152</sup> *Id.*

<sup>153</sup> Fed. R. Evid. 704.

<sup>154</sup> *Id.*

<sup>155</sup> *Blotcher v. Stewart*, 45 F. Supp. 3d 1274, 1279 (D. Colo. 2014).

<sup>156</sup> *Id.*

<sup>157</sup> *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

<sup>158</sup> *Blotcher*, 45 F. Supp. 3d at 1278.

<sup>159</sup> *Id.*

the Advisory Committee to the 2000 amendments to Rule 702 noted with apparent approval, "[a] review of the caselaw after *Daubert* shows that the rejection of expert testimony is the exception rather than the rule."<sup>160</sup>

The *Blotcher* case admitted single-photon emission computerized tomography (SPECT) scans as evidence based on the theory that any of the weaknesses found in the brain tests can be detected and made public via cross examination.<sup>161</sup> SPECT scans show how the brain works.<sup>162</sup> SPECT scans show areas of the brain that healthy, overactive, and underactive.<sup>163</sup>

The *Blotcher* court found that the SPECT scans were relevant therefore, can be admitted as evidence.<sup>164</sup> The court notes that the point of allowing evidence is not about proving causation, rather to provide insight for the jury to decide if the evidence aids them in their decision.<sup>165</sup> The court further stated that any inaccuracies can be challenged via cross examination of the expert.<sup>166</sup> Having debates about the accuracy of the test goes against the weight of the evidence, not against its admissibility.<sup>167</sup> The judge allowed the doctor's testimony that was limited to only show the traumatic traumatic injury and did not conclusively state that the injury was linked to the crime committed. This meant that the expert testimony was bound to the Rule 704.<sup>168</sup> The expert doctor stated the rate of error on the SPECT test is between five to twelve percent.<sup>169</sup> Note, Mukundan states the BEOS test has a rate of error of 5%.<sup>170</sup> In *Blotcher*, the judge was careful to examine the SPECT brain tests under Rule 704's broad and expansive standard.<sup>171</sup>

The *Donnellan* case is under *Frye* standard in which it was also about the admissibility of SPECT brain scans.<sup>172</sup> The *Donnellan* court states that the *Frye* test is the general acceptance test in which the underlying methodology is about the soundness of the test among the general field rather than the actual conclusions reached.<sup>173</sup> This court, again, emphasizes the role of the juries

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<sup>160</sup> *Id.* (citing *Cook v. Rockwell Intern. Corp.*, 580 F. Supp. 2d 1071, 1082 (D. Colo. 2006)).

<sup>161</sup> *Id.* at 1279.

<sup>162</sup> <https://www.amenclinics.com/the-science/why-spect/>

<sup>163</sup> *Id.*

<sup>164</sup> *Blotcher*, 45 F. Supp. 3d at 1279.

<sup>165</sup> *Id.*

<sup>166</sup> *Id.* at 1283.

<sup>167</sup> *Id.*

<sup>168</sup> *Supra* n. 166.

<sup>169</sup> *Id.*

<sup>170</sup> *Id.*; Mukundan *supra* note 56 at 224; Mukundan is the only person that has tested the BEOS's error rate. There is no further corroboration from other scientists.

<sup>171</sup> *Supra* n. 166.

<sup>172</sup> *Donnellan v. First Student, Inc.*, 891 N.E.2d 463, 480 (Ill. App. Ct. 1<sup>st</sup> Dist. 2008).

<sup>173</sup> *Id.* at 479.

when determining whether the abnormalities existed and if they affected the way the defendant behaved.<sup>174</sup> Here, even the expert testimony was unable to conclude whether the traumatic injury was connected to the defendant in committing the crime.<sup>175</sup> The judge also states that even under a *Daubert* analysis, the evidence would have been admitted.<sup>176</sup> This is suggestive of that both *Daubert* and *Frye* were meant to allow evidence and expert testimony in and aid the jury in determining whether the defendant had an abnormality that mitigating her/his crimes. In this case, it is noted that the expert witness testified that the SPECT scans were widely used in the profession and medical schools study such scans.<sup>177</sup> In the end, the judge allowed the scans and the expert testimony in *Donnellan*.<sup>178</sup> This is a distinguishable point because the BEOS is not widely used and this writer was unable to find any publication that suggests that medical schools study such scans.

The *Todd* case is an example of how a test does not have to be absolutely correct, but the test has to be reliable enough.<sup>179</sup> The court finds that the seeking party must prove that the evidence is reliable but need not be scientifically correct.<sup>180</sup> Weaknesses of the evidence can be found through robust cross examination, producing contradicting evidence, instruction on burden of proof, and attacking of shaky but reliable evidence.<sup>181</sup> The expert witness testified that the scans show traumatic brain injury and the defendants may perform a cross examination to show the reliability of such scans; the jury will solve the problem.<sup>182</sup> The judge further noted that even if the SPECT results may seem misleading, the jury can decide to use the evidence or not, but this is not an enough reason to preclude the evidence.<sup>183</sup> In addition, the judge acknowledges that it is not necessary for the SPECT scans to be used in regular treatment (general acceptance), but, it is up to the jury to find if the SPECT scans are relevant to their finding if the abnormality present in the scans are consistent with head trauma.<sup>184</sup> The judge concluded by allowing the SPECT scans in

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<sup>174</sup> *Id.* at 481.

<sup>175</sup> *Id.* at 480.

<sup>176</sup> *Id.* at 481.

<sup>177</sup> *Id.*

<sup>178</sup> *Id.* at 484.

<sup>179</sup> *Todd v. Baker*, No. CV 10-127-M-DWM, 2012 U.S. Dist. LEXIS 77375, at \*3 (D. Mont. June 4, 2012).

<sup>180</sup> *Id.*

<sup>181</sup> *Id.*

<sup>182</sup> *Id.* at 10.

<sup>183</sup> *Id.* at 12-13.

<sup>184</sup> *Id.* at 15.

and stated that the weakness of the SPECT scans can be brought out during cross examination of the expert witness.<sup>185</sup>

A. Warrants cannot be issued to force defendants to undergo brain tests.

The Fourth Amendment states: “The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.”<sup>186</sup> Under the Fourth Amendment, there police must have probable cause in order to obtain a warrant.<sup>187</sup> Probable cause is defined as having reasonable belief based on circumstances that a crime has occurred or will occur. Probable cause needs to be established through evidence.<sup>188</sup> Probable needs to be established in order for an offer to get a warrant to make a defendant undergo a BEOS test. If the police have witnesses or other evidence suggesting that the defendant is a participant of the crime, this may be enough for a judge to sign off on a warrant.

Besides getting a warrant, there are exceptions to the warrant requirement. The first exception is exigent circumstances. This is usually imminent threat to the police’s safety. Another exception is consent. This is the obvious one in regard to BEOS testing. Currently, BEOS test can only be obtained through the consent of the defendant.<sup>189</sup> The next exception is search incident to arrest.<sup>190</sup> This search is limited to the environment in the defendant’s immediate control and for the purpose to find weapons or evidence.<sup>191</sup> In search incident to arrest, the question then becomes, is the defendant’s memory in defendant’s immediate control? The writer has not found any publications that discuss this. However, this issue may be resolved below in the self-incrimination discussion.

B. Admitting the BEOS test would violate the Fifth Amendment of Self- Incrimination.

The next question turns to whether these scans will be admitted as physical evidence or testimony. If it is used as testimony, there will be an argument against admitting this type of

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<sup>185</sup> *Id.* at 17.

<sup>186</sup> U.S. Const. amend. IV.

<sup>187</sup> *Id.*

<sup>188</sup> *Carroll v. United States*, 267 U.S. 132, 149 (1925).

<sup>189</sup> Saini, *supra* note 2.

<sup>190</sup> *Chimel v. California*, 395 U.S. 752 (1969).

<sup>191</sup> *Id.*

testimony because it would violate the Fifth Amendment of self-incrimination.<sup>192</sup> One cannot simply refuse to give one's fingerprints, in the same way, one may be forced to undergo a BEOS test.<sup>193</sup> There is an argument that because BEOS is noninvasive, it may be allowed in courts, but it is up to the judge to see if she/he allows it.<sup>194</sup> This paper argues that admitting the BEOS scans as evidence would be a violation of the Fifth Amendment. More specifically, it would be detrimental to criminal defendants.

The 10<sup>th</sup> circuit has ruled that asking incriminating question on the polygraph tests violates the defendant's fifth Amendment rights.<sup>195</sup> The defendant, Von Behren, had to complete a sex offender treatment program before he was eligible for probation.<sup>196</sup> One part of the program is the polygraph test.<sup>197</sup> There were a few mandatory questions on past sexual history that the defendant needed to answer.<sup>198</sup> Von Behren refused to answer the questions claiming those questions violated his Fifth Amendment rights.<sup>199</sup> The trial court held that the questions did not violate Von Behren's Fifth Amendment rights.<sup>200</sup> The 10<sup>th</sup> circuit reversed and found that the questions did violate Fifth Amendment right of self-incrimination.<sup>201</sup>

The 10<sup>th</sup> circuit held that some of the questions in the polygraph test could be used against him at trial.<sup>202</sup> Moreover, there is a Fifth Amendment issue when a statement could lead the prosecutor to link chain of evidence together.<sup>203</sup> Thus, Von Behren's potential affirmative answers to his past sexual history could do just that.<sup>204</sup> There was no police investigation being conducted on Von Behren at that time but if there was an investigation in sex crimes, Von Behren's affirmative answers could place the focus of the investigation on him.<sup>205</sup> Therefore, the 10<sup>th</sup> circuit found the

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<sup>192</sup> James Caines, *Brain Scans in the Courts: Prosecutor's Dream or Civil Rights Nightmare?*, Inside Science, (March 14, 2018), <https://www.insidescience.org/news/brain-scans-courts-prosecutors-dream-or-civil-rights-nightmare>.

<sup>193</sup> *Id.*

<sup>194</sup> Carrie Dahlberg, *A Search Warrant for your Brain?*, Inside Science, (February 4, 2015), <https://www.insidescience.org/news/search-warrant-your-brain>.

<sup>195</sup> Jonny Bonner, *Forced Polygraph of Sex Offender Unconstitutional*, Courthouse News (May 11, 2016), <https://www.courthousenews.com/forced-polygraph-of-sex-offender-unconstitutional/>.

<sup>196</sup> *Id.*

<sup>197</sup> *Id.*

<sup>198</sup> *Id.*

<sup>199</sup> *Id.*

<sup>200</sup> *Id.*

<sup>201</sup> *Id.*

<sup>202</sup> *Id.*

<sup>203</sup> *Id.*

<sup>204</sup> *Id.*

<sup>205</sup> *Id.*

polygraph violates the Fifth Amendment.<sup>206</sup> Note, the court ruled this way because Von Behren invoked his Fifth Amendment rights during the polygraph tests.<sup>207</sup>

Nita Farahany, a law professor at Duke University, suggests brain scans will first be allowed in the courtroom through the test taker's consent.<sup>208</sup> That is, the defendant wants to introduce the brains scans to advance his/her case.<sup>209</sup> Farahany concedes that to force someone to undergo a brain test would be considered a search.<sup>210</sup> Courts are likely to decide it as such as well.<sup>211</sup> A person will be protected against unreasonable brain searches which could lead to authorities needing a warrant to search the person's brain.<sup>212</sup> Farahany further states that a court may draw parallels between brain tests and fingerprinting.<sup>213</sup>

Farahany draws an innacurate comparison between physical tests and a brain test. Fingerprinting is a test done to match the defendant's fingerprint to a crime.<sup>214</sup> There are two types of fingerprints: latent and patent.<sup>215</sup> Patent fingerprints are made by covering the finger in ink and leaving a print; it is visible.<sup>216</sup> Latent fingerprints are invisible left on surfaces where powder is needed to make the fingerprint visible.<sup>217</sup> Fingerprints are physical evidence.<sup>218</sup> In *Rivas*, the defendant challenged the use of fingerprints because he disputed the reliability of using current latent prints to match with other old prints.<sup>219</sup> The court found the defendant's argument to be unfounded.<sup>220</sup> Fingerprinting is reliable because it is not a scientific novelty.<sup>221</sup> The court further found that fingerprinting matching is less rigorous work than matching DNA evidence.<sup>222</sup> The court also stated eye witness testimony is not scientific at all even though eyewitness testimony is

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<sup>206</sup> *Id.*

<sup>207</sup> *Id.* The court is not holding that all polygraphs violate the Fifth Amendment.

<sup>208</sup> Dahlberg, *supra* note 194.

<sup>209</sup> *Id.*

<sup>210</sup> *Id.*

<sup>211</sup> *Id.*

<sup>212</sup> *Id.*

<sup>213</sup> *Id.*

<sup>214</sup> *People v. Rivas*, 238 Cal. App. 4th 967, 979 (2015).

<sup>215</sup> *Id.*

<sup>216</sup> *Id.*

<sup>217</sup> *Id.*

<sup>218</sup> *Id.*

<sup>219</sup> *Id.*

<sup>220</sup> *Id.* at 980.

<sup>221</sup> *Id.* at 976.

<sup>222</sup> *Id.* 980.

admitted as evidence.<sup>223</sup> The court found that the fingerprint evidence can be admitted because under the *Frye* test there has been a general acceptance of fingerprinting.<sup>224</sup>

In *Diamond*, the court held that providing a fingerprint to unlock a cellphone does not violate a person's Fifth Amendment rights.<sup>225</sup> Providing a fingerprint did not constitute as providing testimonial communication.<sup>226</sup> Further, an act is not testimonial if it is only sought to measure physical properties.<sup>227</sup> The court reasoned that there is no Fifth Amendment self incrimination compulsion regarding fingerprinting, photographing, or other measurements that seek physical evidence.<sup>228</sup> There is a difference between compelling acts that elicit testimonial responses and compelling acts that make the accused the source of physical evidence.<sup>229</sup> The court further held that the fingerprint was not afforded Fifth Amendment rights because it was not testimonial as it *did not reveal the contents of the defendant's mind* (emphasis added).<sup>230</sup> The Fifth Amendment is intended to protect the accused from revealing his knowledge of the facts relating to the crime.<sup>231</sup> The *Diamond* court also conceded that other courts have found that compelling a fingerprint to unlock a cellphone does reveal the contents of the defendant's mind.<sup>232</sup>

From the above analysis, the courts have admitted fingerprints because there is no contestability in regard to its reliability. Fingerprinting is generally accepted in the scientific field. What is of importance is the *Diamond* court's analysis in allowing to compel fingerprints to unlock a cellphone. The court made it a point to reason that the Fifth Amendment protects the contents of the defendant's mind.<sup>233</sup> Applying this analysis to the BEOS test, it would be detrimental to the defendant because the brain scans are self incriminating. The BEOS test would reveal the inner workings of the defendant's mind through the probes. The Target A and B probes are designed to elicit incriminating information from the test taker's brain. It is akin to the defendant involuntarily admitting to his/her guilt.

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<sup>223</sup> *Id.*

<sup>224</sup> *Id.*

<sup>225</sup> *State v. Diamond*, 905 N.W.2d 870, 874 (Minn. 2018).

<sup>226</sup> *Id.*

<sup>227</sup> *Id.*

<sup>228</sup> *Id.* at 875.

<sup>229</sup> *Id.*

<sup>230</sup> *Id.* at 876.

<sup>231</sup> *Id.* (citing *Doe v. United States*, 487 U.S. 201, 212 (1988))

<sup>232</sup> *Id.*

<sup>233</sup> *Id.*

#### Part IV: Arguments for and against BEOS use in the courts.

There have been many critics, especially American critics, that do not agree with the use of BEOS scans in courtrooms.<sup>234</sup> Moreover, there is not a generally accepted method of using BEOS.<sup>235</sup> It is critical to note that the reason why there is not a standardized method is because the BEOS test has not been replicated by independent sources (sources not affiliated with Mukundan).<sup>236</sup> In addition, BEOS has not gone through peer review in academic journals.<sup>237</sup> There has been widespread acknowledgement that scientists do not know how to fully evaluate the results of neuroimaging in a forensic setting.<sup>238</sup> There are many factors that are present in a test taker during a brain scan such as hormone levels, age, nutrition, among many others.<sup>239</sup> The effects of these factors in a brain scan are difficult to analyze.<sup>240</sup>

In addition, brain scans cannot explain intentionality: why a person committed the crime.<sup>241</sup> Neuroimaging scans can explain the surrounding reasons of activity such as what abnormality caused what behavior, but it cannot discern whether the defendant intended to commit the crime.<sup>242</sup> There is also an ethical question of when to use brain imaging scans in court. Admitting brain scans as evidence may distort the view of free will when committing the crime.<sup>243</sup> This essentially questions the legal argument of whether free will existed when the crime was committed. The drawback of using brain scans is that they can explain the central nervous system, but they cannot explain personal responsibility regarding the alleged crime.<sup>244</sup>

Mukundan is aware of the drawbacks and has noted that there is an argument that the test takers can cheat the BEOS test the way test takers cheat on polygraph tests.<sup>245</sup> However, Mukundan states that the test taker cannot take countermeasures because the test does not require the test taker

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<sup>234</sup> Neil Aggarwal, *Neuroimaging, Culture, and Forensic Psychiatry*, J AM ACAD PSYCHIATRY LAW, (November 2, 2009), <https://pdfs.semanticscholar.org/6c3a/9aa69322bca7bf357ef1ebd1eb47175b2a56.pdf>.

<sup>235</sup> Jennifer Kulynych, note, *Psychiatric Neuroimaging Evidence: A High-Tech Crystal Ball?*, 49 Stan. L. Rev. 1249 (1997).

<sup>236</sup> Robin Palmer, *Time to Take Brain-Fingerprinting Seriously? A Consideration of International Developments in Forensic Brainwave Analysis (FBA) in the Context of the Need For Independent Verification of FBA's Scientific Validity, and the Potential Legal Implications of its Use in New Zealand*, N.Z. Criminal Law Review, 330 (2018).

<sup>237</sup> Mukundan, *supra* note 56 at 239.

<sup>238</sup> *Id.* at 240.

<sup>239</sup> *Id.*

<sup>240</sup> *Id.*

<sup>241</sup> *Id.*

<sup>242</sup> *Id.*

<sup>243</sup> *Id.*

<sup>244</sup> *Id.*

<sup>245</sup> *Id.* at 223.

to verbally or physically answer the probe.<sup>246</sup> Though, the test takers can counteract the BEOS test by meditating, which allows them to ignore what the examiner is saying, effectively, disqualifying the test.<sup>247</sup> Mukundan states that the neuro signature system that records the BEOS measures, has an online EEG that detects an alternate state of mind that would alert the examiner.<sup>248</sup> Mukundan, the creator of the BEOS test, is the only neuroscientist that claims that test takers cannot truly cheat the BEOS test.

The negative effects of admitting BEOS scans as evidence outweigh the scan's benefits. There is an argument that allowing BEOS scans in as evidence can show abnormalities that may help destigmatize the negativity around drug abuse and mental illness.<sup>249</sup> Furthermore, further scientific studying of how abnormalities affect behavior may help determine the defendant's intent.<sup>250</sup> In the BEOS test, probes can be asked to determine the defendant's intent and motive.<sup>251</sup> However, Mukundan and other neuroscientists have not provided further information on how to ask probes that would determine intent and motive. The author has not found any scientific article or journal that provides examples of intent-based and motive-based probes.

Farahany found that case opinions that mentioned neuroscience had doubled between 2005 and 2012.<sup>252</sup> Farahany also noted that almost 400 competency claims used neuroscience scans regarding defendants' mental illnesses.<sup>253</sup> Competency claims are to figure out if the defendant is competent to stand trial.<sup>254</sup> Defendants have the right to understand the court proceedings therefore, mentally incompetent people cannot stand trial.<sup>255</sup> Competency is different when determining the defendant's culpability. Culpability is the accused's blameworthiness of a crime.<sup>256</sup> Culpability has a mens rea (intent) element.<sup>257</sup> It would make sense to admit neuroimaging scans as evidence in competency claims to prove mental incapacity. However, to admit the BEOS brain scans to prove guilt would violate Fifth Amendment self-incrimination.

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<sup>246</sup> *Id.*

<sup>247</sup> *Id.*

<sup>248</sup> *Id.*

<sup>249</sup> Mukundan, *supra* note 56 at 242.

<sup>250</sup> *Id.*

<sup>251</sup> *Id.*

<sup>252</sup> Greg Miller, *The Brain Gets its Day in Court*, The Atlantic, March 1, 2016, <https://www.theatlantic.com/science/archive/2016/03/neuro-law-brain-scans-court/471615/>.

<sup>253</sup> *Id.*

<sup>254</sup> Competency to Stand Trial, <https://www.nolo.com/legal-encyclopedia/competency-stand-trial.html>.

<sup>255</sup> *Id.*

<sup>256</sup> Culpable Law and Legal Definition, <https://definitions.uslegal.com/c/culpable/>.

<sup>257</sup> *Id.*

Furthermore, there is some suggestion that brain scans can help free those who are innocent.<sup>258</sup> Farahany corroborates this by finding that defendants who introduced neuroimaging scans saw a reduction of sentencing, new hearing, or another favorable outcome granted 20 to 30 percent of the time.<sup>259</sup> In other words, this was a 70-80 percent failure rate. This statistic points to the reasoning that brain scans do not help defendants as theorized by Mukundan.

While the BEOS test has never been used in the United States, admitting brain scans as evidence has been increasing. When MRIs and CAT scans showed abnormalities and brain damage, the defendants were granted leniency in about five percent of the murder cases at the appellate level.<sup>260</sup> In death penalty cases, defendants were granted leniency to an astounding 25 percent of the cases.<sup>261</sup> With the use of scans, there is a higher chance of hospitalization rather than imprisonment.<sup>262</sup> Please note that there has been an adverse effect cited when juries are shown that the neurological deficiency present in the brain scans is untreatable; this resulted in juries forcing defendants to involuntary hospitalization with a 155 percent longer prison term.<sup>263</sup> This is damning for those defendants.

Another argument is that not allowing BEOS scans (and generally, all brain scans) would be a disservice to defendants because their probative value far outweighs their prejudicial value.<sup>264</sup> It is the lack of a bridge between science and law that allows courts to be reluctant in admitting BEOS.<sup>265</sup> As mentioned previously, a few courts in the United States have stated that brain scans should not be used as a definitive source of guilt, rather, brain scans are for juries to balance the evidence and aid them in reaching a verdict.

#### **Part V: BEOS Scans Should Not be Admitted as Evidence.**

Before BEOS scans can be admitted, there needs to be reformation within the scientific and legal communities. The first way to have to allow BEOS scans in as evidence, is to have the American Medical Association standardize the way BEOS is administered and analyzed. Congress

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<sup>258</sup> Mukundan, *supra* note 56 at 223.

<sup>259</sup> Caines, *supra* note 192.

<sup>260</sup> Cory Allen, et. al., *Brain scan evidence in criminal sentencing: A blessing and a curse*, The Conversation, April 2, 2019, <http://theconversation.com/brain-scan-evidence-in-criminal-sentencing-a-blessing-and-a-curse-113088>.

<sup>261</sup> *Id.*

<sup>262</sup> *Id.*

<sup>263</sup> *Id.*

<sup>264</sup> Frederick Shauer, Et. Al., essay, *Can Bad Science Be Good Evidence? Neuroscience, Lie Detection, and Beyond*, 95 Cornell L. Rev. 1191 (2010).

<sup>265</sup> *Id.*

has formed many entities and councils to evaluate forensic science.<sup>266</sup> Congress can also form a committee to advance BEOS testing in courtrooms.<sup>267</sup> This is needed to eliminate subjective interpretation of the data. Scientists need to come together and computerize BEOS results and objectively interpret the results.

There is an argument that if eyewitness testimony can be admitted as evidence, then brain scans should also be admitted.<sup>268</sup> However, that argument is moot. Research shows that seventy-five percent of false convictions is due to bad eyewitness testimony.<sup>269</sup> Moreover, eyewitness testimony is the main evidence in twenty percent of cases.<sup>270</sup> As noted in the *Diamond* case, eyewitness testimony is not a scientific evaluation yet it is regularly admitted. A key reason as to why eyewitness testimony is bad evidence is the suggestability aspect.<sup>271</sup> Eyewitness are suggestably and will admit to a false fact if it seems true.<sup>272</sup> The same parallels can be drawn to the BEOS test. The incriminating probes can create false positives if the person truly believes s/he participated in the crime when in fact, s/he did not.

In addition, if BEOS scans were allowed as evidence, it is more likely that the scans would be admitted as evidence for the prosecution and not the defense.<sup>273</sup> In case review done by Mercury News, judges allowed questionable evidence from the prosecutor and limited the evidence for the defendant in fourteen percent of cases.<sup>274</sup> In another seven percent of the cases, judges failed to give proper jury instructions that led jurors to more likely believe the prosecution and doubt the defense's theory.<sup>275</sup> This paper is not suggesting there is a pact between judges and prosecutors. This paper merely suggests that the criminal justice system is usually not fair to the defendants from the start therefore, allowing contested BEOS scans as evidence is extremely prejudicial towards defendants.

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<sup>266</sup> Teitcher, *supra* note 103.

<sup>267</sup> *Id.*

<sup>268</sup> *Id.*

<sup>269</sup> Dara Mojtamedi, *New research reveals how little we can trust eyewitnesses*, The Conversation, July 13, 2017, <https://theconversation.com/new-research-reveals-how-little-we-can-trust-eyewitnesses-67663>.

<sup>270</sup> *Id.*

<sup>271</sup> *Id.*

<sup>272</sup> *Id.*

<sup>273</sup> Fredric Tulsky, *How judges favor the prosecution*, Mercury News, January 31, 2007, <https://www.mercurynews.com/2007/01/31/part-four-how-judges-favor-the-prosecution/>.

<sup>274</sup> *Id.*

<sup>275</sup> *Id.*

Aditi's case is a perfect example of how the state can be overreaching when providing evidence. As noted previously, in Aditi's case, the police had the physical arsenic as evidence, had Aditi's testimony that she had the arsenic laced food, and the arsenic laced food was found in her purse. All of that evidence added together was enough for the jury to reach the conclusion that Aditi may have been guilty of murder. There was no necessity to invade Aditi's brain and admit the scans in as evidence. Aditi's brain scans were only analyzed by the examiner himself. No other scientist analyzed the scans as a second opinion. Especially when there has been no corroboration within the scientific community on how the BEOS test should be analyzed. The only scientist that ardently believes the BEOS test is infallible is Mukundan, the creator of the BEOS test.

In conclusion, the BEOS test should not be admitted as evidence in criminal cases. The BEOS test fails the *Daubert* and *Frye* tests. The only scientist that deems the BEOS test to be accurate is the creator of the BEOS test himself. Mukundan himself concedes that test takers can cheat during the BEOS test by meditating. The most glaring reason why the BEOS test should not be admitted is that it violates the Fifth Amendment self-incrimination. The BEOS test is not a verbal test but it does map the brain. During the incriminating probes, the defendant's brain function may be testimonial. As in, even though the test taker is not speaking during the BEOS test, the test taker's brain's response to the probes can be treated as testimony. The Fifth Amendment protects defendant's inner workings of his/her mind. Finally, questionable evidence is granted in favor of the prosecution. Thereby, already further prejudicing the defendant. To ensure a fair criminal justice system, the BEOS test must be kept out of the courtroom.