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Neuronal Testimonial: Brain-Computer Interfaces and the Law

Jessica L. Haushalter

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Neuronal Testimonial:
Brain-Computer Interfaces and the
Law

Scientific researchers have developed a method of using brain-scanning technology to determine if patients in a coma-like condition, known as a “vegetative state,” are conscious despite their inability to communicate verbally or via motor actions. While in a brain scanner, patients “answer” yes-or-no questions by envisioning specific scenarios that activate different parts of the brain. A researcher interprets a brain scan image as a yes-or-no response based on which areas of the brain demonstrated activation. Exciting as this technology may be, there are difficulties in terms of the ability to use it within the legal system. This Note considers those difficulties as they pertain to three contexts: (1) allowing conscious vegetative-state patients to “testify,” (2) providing police with an investigative tool for “questioning” conscious vegetative-state patients, and (3) assessing conscious vegetative-state patients’ healthcare wishes. It concludes that use of this technology as a way to allow patients to testify in court is unlikely under the current legal framework. However, there is a better chance of employing this technology for police investigations and healthcare decisionmaking.

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INTRODUCTION

Advancements in science and technology have provided society with the ability to communicate with conscious patients who are outwardly in a vegetative state. Specifically, brain-scanning technology allows patients who are unable to communicate verbally or via motor actions to answer questions. After interpreting the brain scans, researchers can tell family members, medical professionals, and legal actors how the patient answered the questions. Of course, the technology has limitations, and for now patients are only able to answer binary (e.g., yes-or-no style) questions with the technique; but this advancement in communication gives patients who were previously condemned to silence a new voice—both in their own lives and within the confines of the legal system.

As the technology develops, new questions will arise about its use within the legal system. Might individuals in a vegetative state be able to testify in court using this brain-scanning technology? Could they aid police investigations? Is it possible for them to share their healthcare wishes with a judge? Many existing frameworks—including evidentiary rules, constitutional rights, and current medical practices—may eventually govern how to use this kind of evidence in criminal trials, investigations, and civil lawsuits. This Note explores three scenarios involving brain-scanning technology, analyzing the obstacles it may face if: (1) presented as evidence in a trial, (2) used as the basis of probable cause in a police investigation, and (3) employed as a vehicle for understanding a patient's current wishes regarding her own medical care.

Part I describes the vegetative state and how functional magnetic resonance imaging (“fMRI”) technology is used to communicate with conscious vegetative-state (“CVS”) patients. It also addresses the current limitations of this technology. Parts II, III, and IV each begin with a hypothetical scenario that lays out a possible use of this technology within a specific facet of the legal system. Part II examines whether brain-computer interface communication could ever be presented as testimony or evidence in court, specifically within the

criminal context. Part III analyzes whether this kind of communication could be used as the basis for probable cause for an arrest warrant or a search warrant. Part IV considers how this communication may be used in end-of-life care, refusal of life-sustaining treatment, and other medical decisions. Finally, this Note concludes with a brief look into the future of brain-computer interface communication as it relates to these areas of legal practice.

I. BRAIN-COMPUTER INTERFACE COMMUNICATION

The vegetative state—how it should be defined and what it means for patients—is not well understood in today’s medical community.¹ While a layperson may equate the vegetative state with a coma, the medical definitions of the two terms differ. The vegetative state often results from cardiac or respiratory arrest, which causes a lack of blood flow (and, thus, a lack of oxygen) to the brain.² Generally though, the brain stem will remain relatively intact, since it is resistant for a short period of time to a lack of blood flow or oxygen.³ Therefore, CVS patients are not truly “brain dead” and can retain conscious awareness if they receive medical treatment before destruction of the brain stem.⁴

Despite retaining conscious awareness, patients in this state show no physical signs of consciousness; they are unable to communicate either verbally or via motor actions, though at times they *appear* to be awake and aware.⁵ For instance, CVS patients may demonstrate cycles of sleep and wakefulness; ability to breathe on their own; maintenance of blood pressure; responses to light; sporadic movements of (nonparalyzed) facial muscles and limbs; gag and cough reflexes; and eyesight and auditory capabilities.⁶ Even with the retention of these behaviors, many of these patients remain unable to make purposeful motor movements in response to stimuli due to a loss of certain brain functions.⁷ However, vegetative-state patients do

1. Adrian M. Owen et al., *Detecting Awareness in the Vegetative State*, 313 SCIENCE 1402, 1402 (2006).

2. Robyn S. Shapiro, *The Case of L.W.: An Argument for a Permanent Vegetative State Treatment Statute*, 51 OHIO ST. L.J. 439, 441 (1990).

3. *See id.*

4. *See id.*

5. *See* Owen et al., *supra* note 1, at 1402.

6. Shapiro, *supra* note 2, at 441.

7. Maxine H. Harrington, *Advances in Neuroimaging and the Vegetative State: Implications for End-of-Life Care*, 36 HAMLINE L. REV. 213, 215 (2013).

exhibit reflexive or automatic movements in response to pain or loud noises.⁸

The vegetative state is not a terminal condition, and as long as patients receive proper healthcare, they can live for an extended period of time.⁹ Indeed, depending on factors such as age, pre-injury state of health, and quality of healthcare, patients may survive for decades.¹⁰ And today, there are an estimated ten thousand to twenty-five thousand adult vegetative-state patients in the United States, with annual medical costs of up to seven billion dollars.¹¹ Moreover, improvement in condition over time may be unlikely, and the medical community generally considers a vegetative state to be permanent if the patient remains in the condition for at least twelve months postinjury.¹² Since CVS patients may be living for decades in a state that does not permit them physical communication with the outside world, facilitating their ability to participate in society is of the utmost importance.

Until now, CVS patients were unable to engage firsthand in the legal system, in part because most medical professionals assumed no vegetative-state patients were conscious. Moreover, even if any were, there was no way to communicate with them. Now though, researchers are beginning to use neuroscience technology to communicate with CVS patients.¹³ For instance, researchers can use fMRI to interpret the neural activity of CVS patients by measuring blood oxygenation throughout the brain to identify changes in neural activity.¹⁴ Changes in the brain's blood flow track changes in brain activity, and areas of the brain that are working harder (i.e., using more energy), and thus needing more oxygen, receive more of the blood supply.¹⁵ Detecting these changes in blood flow allows researchers to assess which regions of the brain a person is using during particular tasks.¹⁶ The subsequent Section delves further into understanding fMRI technology.

8. *Id.*

9. *Id.*

10. See Shapiro, *supra* note 2, at 441–43 (“It is not uncommon for a patient in a permanent vegetative state to survive for five to twenty years.”).

11. Dalia B. Taylor, Note, *Communicating with Vegetative State Patients: The Role of Neuroimaging in American Disability Law*, 66 STAN. L. REV. 1451, 1454 (2014).

12. Nancy L. Childs & Walt N. Mercer, *Late Improvement in Consciousness After Post-Traumatic Vegetative State*, 334 NEW ENG. J. MED. 24, 24 (1996).

13. See Owen et al., *supra* note 1, at 1402.

14. David M. Eagleman, *Neuroscience and the Law*, HOUS. LAW., Mar./Apr. 2008, at 36, 38; Owen et al., *supra* note 1, at 1402.

15. Shaun Cassin, Comment, *Eggshell Minds and Invisible Injuries: Can Neuroscience Challenge Longstanding Treatment of Tort Injuries?*, 50 HOUS. L. REV. 929, 941–42 (2013).

16. Francis X. Shen & Owen D. Jones, *Brain Scans as Evidence: Truth, Proofs, Lies, and Lessons*, 62 MERCER L. REV. 861, 865 (2011); see also Cassin, *supra* note 15, at 942.

A. The Science of fMRI

fMRI and similar brain-scanning technologies are likely to become more commonplace in the legal system as these techniques continue to develop.¹⁷ Thus, it is important for legal actors to understand the science and mechanisms behind the technology—the following study depicts why. A decade ago, researchers put a patient who had sustained a severe traumatic brain injury (“TBI”) during a car accident in an fMRI scanner to better understand her brain function.¹⁸ The patient fulfilled all of the international guidelines criteria for a diagnosis of “vegetative state” and she remained unresponsive for several months following her accident.¹⁹ To test the patient’s level of consciousness, researchers measured her neural responses during the presentation of spoken sentences, as compared to random noises that acoustically matched the sentences but did not constitute sentences themselves.²⁰ The point of the noise sequences was to assess whether the patient was actually comprehending speech or whether she was merely reacting to sound.²¹ Her resulting brain images were equivalent to those observed in healthy (i.e., fully conscious and nonvegetative) volunteers listening to the same sentences and noise sequences.²² Additionally, for sentences incorporating ambiguous words (e.g., creak vs. creek, ceiling vs. sealing), the patient’s brain scans showed a response similar to that observed in the brains of healthy participants, further indicating that the patient was truly engaging in language comprehension.²³

Neuroscientists refer to this as the BOLD (blood oxygen level dependent) signal. An fMRI scan will result in a colorful depiction of BOLD response over time, allowing a visible, objective measurement of brain activity. The BOLD signal is widely accepted to be a reliable determination of fluctuating activity in the brain.

17. Andrew Peterson et al., *Assessing Decision-Making Capacity in the Behaviorally Nonresponsive Patient with Residual Covert Awareness*, *AJOB NEUROSCIENCE*, Oct.–Dec. 2013, at 3, 10 (noting the advancements in brain-imaging technology due to “reduced costs of imaging equipment, a larger patient population, and several recent innovations in [brain-computer interface] neuroimaging”).

18. Owen et al., *supra* note 1, at 1402.

19. *Id.*

20. *Id.* An example of a sentence spoken to the participant is: “There was milk and sugar in his coffee.” *Id.*

21. *Id.*

22. *Id.*

23. *Id.* Moreover, in research with healthy volunteers under anesthesia, the participants did not exhibit neural signs “of high-level speech comprehension, strengthening the conclusion that activations in response to semantically ambiguous words indicate awareness.” Carl E. Fisher & Paul S. Appelbaum, *Diagnosing Consciousness: Neuroimaging, Law, and the Vegetative State*, 38 *J.L. MED. & ETHICS* 374, 377 (2010) (citation omitted).

To better assess whether she was consciously aware, researchers then gave the patient instructions to perform two mental imagery tasks while in the fMRI scanner—(1) imagine playing a game of tennis and (2) imagine visiting all of the rooms of her house—as these mental imagery tasks stimulate distinct parts of the brain.²⁴ Researchers found that the patient's brain scans during the mental imagery tasks were *indistinguishable* from those of healthy volunteers following the same instructions.²⁵ These results confirmed that the patient had the ability to understand spoken commands and respond to them through brain activity, even though she was unable to respond through speech or movement.²⁶ Furthermore, the act of performing the tasks in itself demonstrated the patient's consciousness, as it was a “clear act of intention.”²⁷

In another study, researchers asked twenty-three vegetative-state patients to perform the same mental imagery tasks as in the study described above while undergoing an fMRI scan.²⁸ The scans showed that at least four of these patients were able to follow researchers' directions by imagining the described tasks.²⁹ These results demonstrate that at least a portion of patients in a vegetative state have brain activity that reflects some awareness and cognition.³⁰ In fact, a

24. Owen et al., *supra* note 1, at 1402. Those skeptical of this research postulate that the words “tennis” and “house” may simply trigger automatic brain responses even in unconscious participants. However, there is “no data supporting the inference that such stimuli can unconsciously elicit sustained [blood flow] responses in these regions of the brain.” Adrian M. Owen, *Using Functional Magnetic Resonance Imaging to Detect Covert Awareness in the Vegetative State*, 64 ARCHIVE NEUROLOGY 1098, 1099–1100 (2007) (“[I]maging playing tennis and imagining moving around the house elicit reliable, robust, and statistically distinguishable patterns of activation in specific regions of the brain.”); Heidi Ledford, *Brain Scan Allows Unconscious Patient to Communicate*, NATURE (Feb. 3, 2010), <http://www.nature.com/news/2010/100203/full/news.2010.53.html> [<https://perma.cc/U5V8-QJLP>].

25. Owen et al., *supra* note 1, at 1402; *see also* Owen, *supra* note 24, at 1100 (comparing brain scan images of a patient's neural activation during the tennis imagery and spatial navigation imagery tasks with those of healthy volunteers).

26. Owen et al., *supra* note 1, at 1402.

27. *Id.*

28. *See* Martin M. Monti et al., *Willful Modulation of Brain Activity in Disorders of Consciousness*, 362 NEW ENG. J. MED. 579, 580 (2010).

29. *Id.* at 585. Researchers could not determine why the other patients did not show evidence of performing the mental imagery tasks. Of course, it may be that those patients have not retained conscious awareness, although a failure to perform the mental imagery tasks in this instance does not conclusively prove a lack of consciousness. For example, it may be that the research method was not sensitive enough to detect small effects or that the patients are only conscious at some points in time (but happened not to be during the study). Furthermore, some patients may retain consciousness but lack the cognitive capabilities (e.g., language comprehension, working memory, etc.) to carry out the task. It may also be that some patients consciously chose *not* to engage in the task, for whatever reason, even if they had the ability to follow instructions. *See id.* at 588.

30. *Id.* at 588.

separate study found that forty-one percent of the vegetative-state patients that were examined showed some signs of consciousness.³¹

There is also research regarding a CVS patient responding to yes-or-no questions via fMRI technology.³² Researchers asked the patient to imagine playing tennis when the answer to a question was yes, and to imagine walking through a house when the answer to a question was no.³³ To communicate via a brain scan, researchers cannot ask people undergoing an fMRI to simply imagine answering “yes” or “no,” as there are no established brain patterns for such thoughts.³⁴ Importantly, the accuracy of using mental imagery such as playing tennis and walking through a house to signify “yes” or “no” has been tested with healthy volunteers, which provides a necessary baseline with which to compare the brain scans of patients in a vegetative state.³⁵ Healthy volunteers were asked yes-or-no questions with verifiable answers (e.g., “Do you have any brothers?”) and instructed to imagine whichever mental imagery indicated the correct answer.³⁶ Researchers were able to determine whether the healthy volunteers intended to answer “yes” or “no” with *one-hundred percent accuracy*—indicating that evaluating whether someone is answering “yes” or “no” in an fMRI machine via the mental imagery method is an objective, rather than subjective, task.³⁷

In the study with the CVS patient, researchers asked him yes-or-no questions involving his personal history, such as “Is your father’s name Alexander?”³⁸ The patient answered five of six questions correctly; no brain activity was observed in response to the sixth question (rather than an observation of brain activity indicating the

31. Caroline Schnakers et al., *Diagnostic Accuracy of the Vegetative and Minimally Conscious State: Clinical Consensus Versus Standardized Neurobehavioral Assessment*, 9 BMC NEUROLOGY, no. 35, 2009, at 1, 3.

32. See Ledford, *supra* note 24.

33. *Id.*

34. *Id.* (“[I]t is difficult—if not impossible—to determine whether someone is thinking yes or no” (internal quotation marks omitted)).

35. See Monti et al., *supra* note 28, at 581.

36. *Id.*

37. *Id.* at 583 (In total, forty-eight questions were asked of the healthy volunteers and researchers were able to determine the correct answer based on the participant’s brain scans for all forty-eight.); see also Owen, *supra* note 24, at 1101 (“[H]ealthy volunteers were instructed to . . . imagine playing tennis or navigating around their homes without informing the investigators of their choice. It was possible to determine with 100% accuracy which task was being performed by each participant [solely based on brain activity].”). To view imagery comparing the yes-or-no brain scans of CVS patients with those of healthy volunteers, see Stuart Fox, *Brain Scan Shows Vegetative Patient Responding to Yes-or-No Questions*, POPULAR SCI. (Feb. 4, 2010), <https://www.popsci.com/science/article/2010-02/brain-scan-shows-vegetative-patient-responding-yes-or-no-questions> [<https://perma.cc/V3JT-LB9F>].

38. See Monti et al., *supra* note 28, at 584–85.

incorrect answer).³⁹ The fMRI technology is not sophisticated enough to indicate why the patient did not answer the final question; some possibilities are that the patient did not hear it, elected not to answer it, fell asleep, or lost consciousness.⁴⁰ Notably, instances where patients do not appear to answer questions or follow directions via their brain activity—whether in response to one question or the entire task—cannot be taken as conclusive proof of a lack of consciousness, in part because false negatives in functional neuroimaging studies have been found even in healthy volunteers, and in part because CVS patients may go in and out of consciousness at different times.⁴¹

The next step for research will be asking patients in a vegetative state questions with unverifiable answers.⁴² As the technology continues to develop, especially in the context of questions that lack a verifiable answer, it will likely be proffered more often in legal proceedings. Thus, judges must be prepared to assess this technology for an array of different uses, and legal actors must be prepared to make the most convincing arguments for (or against) its use. Addressing the current limitations of this technology is an important first step to understanding how judges and legal actors will begin their analyses.

39. *Id.* at 585 (“For example, in response to the question ‘Is your father’s name Alexander?’ the patient responded ‘yes’ (correctly) In response to the question ‘Is your father’s name Thomas?’ the patient responded ‘no’ (also correctly) [F]or [the five answered questions,] the [brain] pattern produced always matched the factually correct answer.”).

40. *Id.*

41. Owen et al., *supra* note 1, at 1402. This may suggest that it is imperative to use brain-scanning technology to test vegetative-state patients for consciousness multiple times, not just once, if the first results come back negative. People in a vegetative state may go in and out of consciousness for a variety of reasons, so we should search for the windows of consciousness that are available—just because a patient was not experiencing consciousness at the moment of the test does not indicate that they would *never* be able to use this method to communicate. See Charles Weijer et al., *Ethical Considerations in Functional Magnetic Resonance Imaging Research in Acutely Comatose Patients*, 139 *BRAIN* 292, 292 (2016) (“The dynamic nature of brain injury and the potential for confounding factors, such as medication and metabolic disturbance, must be taken into account during patient assessment. Indeed, these features highlight the importance of repeated examination and integration of findings from diverse diagnostic modalities.”). Additionally, some patients may be conscious but unable to engage in motor imagery, unable to hear task instructions due to deafness, and so on—thus, a verbally instructed motor mental imagery task would not be an adequate measure of consciousness for such patients. See Adam Hampshire et al., *Assessing Residual Reasoning Ability in Overtly Non-communicative Patients Using fMRI*, 2 *NEUROIMAGE: CLINICAL* 174, 183 (2013); Peter C. Harman, Note, “Locked-In” to Their Decisions: Investigating How the States Govern Revocation of Advance Directives and How Three States Make Revocation Impossible for People with Locked-In Syndrome, 3 *HASTINGS SCI. & TECH.* L.J. 193, 198 n.37 (2011). Furthermore, it is possible that some patients may have diminished capacity only in certain areas of the brain—thus, if a patient has diminished capacity in one or more areas of the brain required for a specific mental imagery task, that patient would not be able to successfully complete that particular task. See Taylor, *supra* note 11, at 1458.

42. See Ledford, *supra* note 24.

B. The Limitations of fMRI and Potential Alternatives

The critiques of fMRI technology are pertinent to the legal system, as parties opposed to admitting such evidence will bring up the technology's shortcomings in court, and parties interested in admitting such evidence must know how to defend against those shortcomings. Notably, the use of this technology may at times be prohibitively expensive, affecting which parties can rely on it and thus creating equity concerns in cases where the parties have disparate resources. However, cost has become less of a concern as more versatile technologies are developed and creative solutions are implemented. For instance, Dr. Kent Kiehl, a professor at the University of New Mexico, uses a portable fMRI—built inside of a tractor-trailer—to conduct neuroscience research with prison inmates.⁴³ Since the inmates cannot come to Dr. Kiehl, he brings the fMRI to them; perhaps the same thing could be done for CVS patients who reside in a medical facility that lacks an fMRI machine. This option also helps alleviate another common critique of fMRI, which is that transferring patients to an fMRI-equipped facility can be physically stressful on the patient. Another criticism of fMRI is that patient movements while in the machine can disrupt the accuracy of results (i.e., someone undergoing an fMRI must keep their head completely still in order for the scanner to output accurate brain scan results). Additionally, patients with metal implants (common in many traumatically-injured populations) cannot undergo fMRI scanning since it operates via an extremely powerful magnet.⁴⁴ Finally, fMRI technology does not provide a *direct* measure of neural activity, but rather measures changes in blood flow within the brain, and those changes are then used to *infer* a person's actual neural activity.⁴⁵

To mitigate some of the criticisms of fMRI, researchers have turned to electroencephalography ("EEG") as an alternative brain-scanning technique in part because it is cheaper and more portable than fMRI technology.⁴⁶ An EEG operates by attaching electrodes to a person's scalp to measure the electrical currents that brain activity

43. John Seabrook, *Suffering Souls: The Search for the Roots of Psychopathy*, NEW YORKER (Nov. 10, 2008), <https://www.newyorker.com/magazine/2008/11/10/suffering-souls> [<https://perma.cc/7L3E-Q6AJ>].

44. See Damian Cruse et al., *Bedside Detection of Awareness in the Vegetative State: A Cohort Study*, 378 LANCET 2088, 2088 (2011).

45. Taylor, *supra* note 11, at 1457 ("These changes in blood flow are assumed to be 'tightly coupled in both space and time' with brain activity." (quoting David A. Leopold, *Pre-emptive Blood Flow*, 457 NATURE 387, 387 (2009))).

46. *Id.* at 1457–58.

produces.⁴⁷ In one EEG study, sixteen patients in a vegetative state were asked to imagine either wiggling their toes, which causes increased brain activity in one portion of the brain, or to imagine making hand movements, which causes increased activity in a different portion of the brain.⁴⁸ Patients were asked to partake in these mental imagery tasks whenever they heard a tone (the time in between tones was interspersed with alternating periods of instructed relaxation).⁴⁹ The researchers used the tone to eliminate any claims that the patients' brain activity was just a subconscious response to trigger words; by having participants wait to engage in the mental imagery task until they heard the tone, researchers knew that any participants who showed brain activity in the predetermined areas at the time of the tone were consciously performing the tasks.⁵⁰

Three of the sixteen patients were able to complete the experiment successfully, meaning these patients could engage in sustained attention, language comprehension to understand the prompts, and short-term memory capabilities to remember the instructions, as well as could determine which task to perform in response to certain prompts.⁵¹ Each of these brain functions are associated with consciousness, suggesting that at least these three patients experienced some level of conscious awareness during the experiment.⁵² In turn, researchers have recently begun using EEG to communicate with patients using a yes-or-no system similar to that used with fMRI.⁵³ In the study, patients were connected to an EEG machine at various times over a number of weeks, during which

47. Adam Teitcher, *Weaving Functional Brain Imaging into the Tapestry of Evidence: A Case for Functional Neuroimaging in Federal Criminal Courts*, 80 FORDHAM L. REV. 355, 365 (2011).

48. Cruse et al., *supra* note 44, at 2088–89. Imagining wiggling one's toes causes increased brain activity in the premotor cortex, while imagining making hand movements causes increased brain activity in the lateral premotor cortex. *Id.*

49. *Id.* at 2089. The specific instructions were:

Every time you hear a beep, try to imagine that you are squeezing your right-hand into a fist and then relaxing it/wiggling all of the toes on both your feet, and then relaxing them. Concentrate on the way your muscles would feel if you were really performing this movement. Try to do this as soon as you hear each beep.

Id. (internal quotation marks omitted).

50. *Id.* at 2092; *see also* Taylor, *supra* note 11, at 1461–62.

51. Taylor, *supra* note 11, at 1456 (quoting Cruse et al., *supra* note 44, at 2092–93).

52. *Id.*

53. Jacqueline Howard, *Decoding the Thoughts of Patients Who Can't Even Blink*, CNN (Feb. 1, 2017, 11:16 AM), <http://www.cnn.com/2017/01/31/health/locked-in-als-brain-computer-study/> [<https://perma.cc/LW9W-GJ35>]. Note that the patients in this study were diagnosed with locked-in syndrome, which presents similarly to patients in a vegetative state, but has slightly different diagnostic criteria. For more information on locked-in syndrome, *see* Steven Laureys et al., *The Locked-In Syndrome: What Is It Like to Be Conscious but Paralyzed and Voiceless?*, 150 PROGRESS BRAIN RES. 495 (2005).

researchers repeatedly asked patients verifiable yes-or-no and true-or-false questions.⁵⁴ Overall, the patients responded with correct answers at a rate of about seventy percent.⁵⁵ The researchers then asked patients questions without verifiable answers such as “are you happy?” and discovered that patients repeatedly gave a response of “yes” to this and similar questions—suggesting that the patients had a positive outlook on life.⁵⁶

EEG technology may therefore provide an alternative means of communication with CVS patients when fMRI scanning does not prove viable. This is important for the legal system for many reasons. First, it would theoretically be possible to do an EEG in a courtroom in front of jurors and a judge, whereas the machine required for an fMRI scan is not suitable for a courtroom due to its size and magnetic properties. The portability of the technology may change the legal analysis, as explored more in-depth below. Second, EEG technology is cheaper to use, therefore parties with a limited budget would have better access to EEG than fMRI. Third, EEG can be used with a wider variety of patients, such as those with metal implants, enlarging the number of people in a vegetative state who could make use of this communication system.

Of course, EEG has its own limitations. These include difficulty reading neural activity in deeper parts of the brain (since the electrodes for the EEG are placed on the scalp), which may be especially troubling for CVS patients, as many of the areas critical for consciousness are in the subcortical parts of the brain.⁵⁷ Since the bulk of the current research with CVS patients has been done with fMRI rather than EEG, this Note primarily discusses the use of fMRIs in legal contexts. Still, regardless of the technology used, legal actors ought to be aware of the steady advancements neuroscience is making because as the technologies and techniques improve, the legal analysis will change.

II. TESTIFYING NEURONS AND POSSIBLE IN-COURT USES

Imagine you are the key government witness in a felony case. You are prepared to testify at the trial, which is coming up in a few months. As you are heading back to your apartment from work you

54. Howard, *supra* note 53.

55. *Id.*

56. *Id.*

57. John R. Hughes, *Limitations of the EEG in Coma and Brain Death*, 315 ANNALS N.Y. ACAD. SCI. 121, 121, 126, 131 (1978). This is not an issue for fMRI scanning since fMRI machines can detect blood flow changes throughout the brain, even in the deeper subcortical parts. See Cassin, *supra* note 15, at 942.

encounter a shadowy figure in a dark alley. Now you lie in a hospital bed—unable to speak, move your limbs, or communicate with those around you in any way—despite the fact that you have retained consciousness. You ended up here because you were the victim of a brutal attack, carried out in an attempt to silence your testimony, and it has now left you in a vegetative state. Is there any way for you to still provide your testimony to the court? Using this scenario as a guide, this Part explores the obstacles to admissibility for brain-scanning technology when used for a CVS witness providing testimony in a criminal trial.

A. Preliminary Concerns

Initially, it is important to note that while much of criminal law is governed by state law, federal law (such as the Federal Rules of Evidence) strongly influences state laws and practices. Thus, this Section focuses on how federal law, rather than any specific state law, would apply to the hypothetical scenario above.

Preliminary concerns in admitting brain scans as evidence involve the quality, reliability, and validity of the technology used to capture the brain scans. Notably, brain scans conducted in different machines or by different researchers may not produce the exact same results, since the technological parameters of the machine can be adjusted by the researcher.⁵⁸ Similarly, differences in the computer software of the technology (such as two machines using different versions of the software) can affect the output of the machine.⁵⁹ This is relevant because the prosecution and defense in the same case might separately have the witness undergo an fMRI scan with different machines and different researchers (much like in cases where each side has the defendant undergo a session with a different psychologist); the variations in the technology and the people operating it means that each side of the case might end up with different results.⁶⁰ Luckily, neuroscience researchers are beginning to take evidentiary concerns into account and are refining the technology and techniques to better suit the courtroom.⁶¹

58. Sally Terry Green, *The Admissibility of Expert Witness Testimony Based on Adolescent Brain Imaging Technology in the Prosecution of Juveniles: How Fairness and Neuroscience Overcome the Evidentiary Obstacles to Allow for Application of a Modified Common Law Infancy Defense*, 12 N.C. J.L. & TECH. 1, 21 (2010).

59. *See id.*

60. *See id.*

61. *See id.* at 21–22. For instance, “The Biomedical Information Network,” an initiative led by the National Institutes of Health, looked at how to standardize procedures for neuroscience technology. *See* Laurence R. Tancredi & Jonathan D. Brodie, *The Brain and Behavior: Limitations*

One important concern in this area that is not addressed in-depth by this Note is the competency and consciousness of the patient in question. In law, competency is not a new concept but it has never been applied to CVS witnesses. However, because TBI patients have served as witnesses in criminal trials, how competency is treated in regards to patients who have suffered a TBI may be illuminating, since the vegetative-state condition relates to brain injury.⁶² Concerns regarding the testimony of TBI patients include recall accuracy, how much weight the judge or jury can place on the testimony, and whether the witness can testify at all (e.g., the witness may lack the necessary speech abilities due to the TBI).⁶³ For any witness, not just ones with a TBI, federal and state evidentiary rules start with a presumption that the witness is competent to testify, but require witnesses “to possess the mental ability to perceive, recollect, narrate, and understand what it means to tell the truth.”⁶⁴

Of course, to determine if a CVS witness is truly competent and conscious, it will be important to ensure that the witness is responding during the brain scans with true intentional responses. Such information could be gleaned by having the witness undergo brain scans multiple times on various days to try to ascertain the extent of her conscious awareness. Multiple scans may be useful in that many patients may experience consciousness only intermittently, so one scan may not capture a patient’s true communication ability. Additionally, competency may be assessed by asking the patient a number of questions with verifiable answers, such as questions about personal history or basic common knowledge. Doing this could provide a baseline for determining whether the patient is able to give truthful answers. Assuming the patient succeeds past this important step, there are a variety of other obstacles that stand in the way of admitting this kind of evidence.

B. Hearsay

One considerable obstacle to admitting a CVS witness’s fMRI scans will be that courts will likely consider “statements” of a CVS

in the *Legal Use of Functional Magnetic Resonance Imaging*, 33 AM. J.L. & MED. 271, 281–82 (2007).

62. See Robert I. Simon & Alan A. Abrams, *Clinical Legal Issues*, in TEXTBOOK OF TRAUMATIC BRAIN INJURY 533, 537–38 (Jonathan M. Silver et al. eds., 2d ed. 2011).

63. See *id.*

64. *Id.*

witness to be hearsay.⁶⁵ Hearsay is defined as “a statement, other than one made by the declarant while testifying at the trial or hearing, offered in evidence to prove the truth of the matter asserted.”⁶⁶ Parties attempting to introduce a CVS witness’s testimony via fMRI scans will face two distinct hearsay challenges.

First, given that fMRI machines must be in a special room due to the powerful magnetic properties of the machine, a CVS witness’s “testimony” would not be given live and *in court*, technically making it an out-of-court statement.⁶⁷ Notably, a similar obstacle to the hearsay rule has been circumvented before through the use of live video testimony. In *Maryland v. Craig*, which was a child sexual abuse case, the Supreme Court permitted the child victim to testify via video conferencing technology due to concern that the child would suffer severe emotional distress if in the same room as the defendant.⁶⁸ The Supreme Court went so far as to note that it had “never insisted on an actual face-to-face encounter at trial in *every* instance in which testimony is admitted against a defendant.”⁶⁹ Given this precedential authority and the potential that in some cases the need for the CVS witness’s testimony will overcome the face-to-face preference, the actual questioning could be done via video conferencing technology to sidestep the in-court aspect of the hearsay issue.

Second, the true value of the testimony would likely not come from the questioning of the CVS patient herself but rather from the doctor or researcher who interprets the brain scans. This presents another difficulty in relation to hearsay, as the out-of-court statement would not be offered by the declarant herself; instead it would be offered by an interpreter of sorts—the doctor or researcher. Additionally, in most instances, the interpretations of the brain scans (i.e., whether the witness was answering “yes” or “no”) would be offered for the truth of the matter asserted; so, the “testimony” would likely be hearsay.

Importantly, if the hearsay falls under an exception in the Federal Rules of Evidence it may still be admitted.⁷⁰ The above scenario

65. But note that hearsay is generally only an issue in jury trials, not bench trials. See *Advanced Magnetic Closures, Inc. v. Rome Fastener Corp.*, 607 F.3d 817, 831 (Fed. Cir. 2010) (“[I]n the Second Circuit, as in other federal courts of appeals, the Federal Rules of Evidence do not generally apply when the judge is acting as a fact-finder because a judge can presumably exclude improper inferences.”).

66. *Hearsay*, BLACK’S LAW DICTIONARY (9th ed. 2009); see also FED. R. EVID. 801.

67. As noted above though, advancements in EEG technology may technically make it possible for a patient to undergo a brain scan in the courtroom, which may affect the legal analysis of the admissibility of this technology. See *supra* Section I.B.

68. 497 U.S. 836, 841, 857 (1990).

69. *Id.* at 847.

70. See FED. R. EVID. 803, 804, 807.

may fall under Rule 804, which involves hearsay exceptions when the declarant is unavailable as a witness. This Rule has two parts: 804(a) describes the criteria the declarant must meet in order to be considered “unavailable,” while 804(b) describes what kinds of testimony may be admitted, regardless of its status as hearsay, when the declarant is unavailable as a witness. First, it is possible that Rule 804(a)(4) applies. That section reads: “A declarant is considered to be unavailable as a witness if the declarant . . . cannot be present or testify at the trial or hearing because of death or a then-existing infirmity, physical illness, or mental illness[.]”⁷¹ It is plausible that the vegetative state could qualify as an “infirmity” or “physical illness.”⁷²

However, for the “testimony” to be admitted, it still has to pass muster under Rule 804(b) by falling under one of its enumerated exceptions. Rule 804(b)(6) offers a potentially applicable exception for our hypothetical scenario, admitting “statement[s] offered against a party that wrongfully caused—or acquiesced in wrongfully causing—the declarant’s unavailability as a witness, and did so intending that result.” Case law indicates that causation on the part of the party who wrongfully caused the declarant’s unavailability can include a spectrum of actions as broad as threatening the witness about showing up to testify to murdering the witness to prevent her from testifying.⁷³

Thus, examining the scenario presented at the beginning of Part II, it seems highly likely that if a defendant (or his agent) assaulted a witness violently enough to put her in a vegetative state with the intent to prevent that witness’s availability at trial, Rule 804(b)(6) would apply. Of course, the scenario only circumvents the rule against hearsay when the defendant (or his agent) is the one who acted to put the witness in a vegetative state. If, say, a healthy witness was going to

71. FED. R. EVID. 804(a)(4); *see, e.g.*, *People v. Duncan*, 835 N.W.2d 399, 407 (Mich. 2013) (four-year-old’s existing mental infirmity rendered her unavailable under FRE 804(a)(4)); *State v. Whisler*, 810 P.2d 540, 544 (Wash. Ct. App. 1991) (ninety-four-year-old’s health issues rendered him unavailable under FRE 804(a)(4)).

72. *See United States v. McGowan*, 590 F.3d 446, 453–54 (7th Cir. 2009) (district court did not abuse its discretion in determining that government witness was unavailable to testify due to a “then existing physical or mental illness or infirmity” (internal quotation marks omitted)); *Hoselton v. Metz Baking Co.*, 48 F.3d 1056, 1062 (8th Cir. 1995) (trial court did not commit plain error by allowing admission of deposition testimony of accountant since there was evidence he was ill and of advanced age); *United States v. Keithan*, 751 F.2d 9, 12 (1st Cir. 1984) (district court properly allowed the use of two government witnesses’ videotaped depositions at trial as there was evidence that one suffered from a condition that prevented him from walking and the other suffered from a heart condition that confined her to her home).

73. *See United States v. Johnson*, 767 F.3d 815, 823 (9th Cir. 2014) (district court properly found that the defendant had intentionally prevented the witness from testifying by directing others to threaten the witness on his behalf); *United States v. Stewart*, 485 F.3d 666, 671–72 (2d Cir. 2007) (finding that the defendant forfeited any right to exclude evidence of a witness’s out-of-court statements due to his involvement in the murder of the witness).

testify against the defendant, but then was violently assaulted and rendered vegetative by a completely separate third party (i.e., one not acting on the direction of the defendant or his agent), then this exception would not apply to the CVS witness's "testimony." The same would be true if the witness had an independent medical episode that caused the vegetative state. As such, even though it may be possible to bypass the rule against hearsay via Rule 804(b)(6), this exception will only apply in a very specific, limited number of instances.

For a hearsay exception that may apply more broadly, we can look to Rule 807, the "Residual Exception."⁷⁴ Essentially, Rule 807 provides that if the testimony is reliable and legitimately necessary for the party presenting it, then the court may allow admissibility of the evidence through the Residual Exception. Whether the scenario presented above would be admissible under the Residual Exception would depend on the specific circumstances of the situation, but this hearsay exception may envelop more variations than Rule 804(b)(6). A party may have a number of ways to demonstrate a legitimate need for the evidence under the Residual Exception, especially in situations where the evidence is critical to the case.

Overall, the hearsay obstacles to admitting a CVS witness's testimony are likely to be great barriers, since the exceptions—even the Residual Exception—apply in only a limited number of situations.⁷⁵ However, since this use of neuroscience technology and communication with CVS patients is new to the court, judicial decisionmakers may find that the need for an avenue for CVS patient participation in the courtroom meets the high bar the Residual Exception was intended to set.⁷⁶

C. The Confrontation Clause

The Constitution presents another issue comparable to the hearsay problem: the Sixth Amendment's "Confrontation Clause," which provides that "in all criminal prosecutions, the accused shall enjoy the right . . . to be confronted with the witnesses against him."⁷⁷ This means that the Confrontation Clause centers around the issue of

74. FED. R. EVID. 807.

75. See *United States v. Ingram*, 501 F.3d 963, 967 (8th Cir. 2007) (suggesting that use of the Residual Exception is limited to "rare[]" and "exceptional circumstances" (quoting *United States v. Peneaux*, 432 F.3d 882, 893 (8th Cir. 2005))), *vacated on other grounds*, 555 U.S. 1132 (2009).

76. See *Peneaux*, 432 F.3d at 893 ("Congress added Rule 803(24), the predecessor to Rule 807, because it could not foresee every possible evidentiary scenario.").

77. U.S. CONST. amend. VI.

cross-examination (i.e., “confrontation”).⁷⁸ It only applies in criminal cases, not civil proceedings, and only when the witness is brought against the defendant. So, if the defendant wanted to bring in CVS witness testimony on his behalf, the Confrontation Clause would not be a hurdle.

For the hypothetical scenario presented at the start of Part II, one might envision opposing attorneys cross-examining the CVS witness in the same way the direct examination was completed—by asking yes-or-no questions while the patient is in the fMRI machine. But would this satisfy the Confrontation Clause? Arguably, since the CVS witness could not be brought into court during trial, the defendant would not have the opportunity “to be confronted with the witnesses against him.” This might be remedied by allowing the defendant and his attorneys to attend the direct examination of the CVS witness when it takes place, thus allowing the potential for the defense to make objections in real time. The judge could also attend both the direct examination and cross-examination to rule on any objections or make decisions if a dispute arises between the parties.

Notably though, only “testimonial” statements cause a declarant to fall within the confines of the Confrontation Clause.⁷⁹ The Supreme Court has declared that statements are testimonial when made under circumstances which indicate that the primary purpose of the conversation (or interrogation/questioning) “is to establish or prove past events potentially relevant to later criminal prosecution.”⁸⁰ If the primary purpose is to assist police in an “ongoing emergency,” then statements made in that conversation are not testimonial.⁸¹ Whether a CVS witness’s statement is “testimonial” would differ on a case-by-case basis, and the judge would need to evaluate the statement to determine if any part of it was “testimonial” and thus barred by the Confrontation Clause.⁸² Overall, it is likely that most of the time a CVS witness’s statement will be testimonial, since questioning a CVS witness for a

78. See *Crawford v. Washington*, 541 U.S. 36, 53–59 (2004) (describing case law holding that the Confrontation Clause bars a witness’s out-of-court testimonial statements unless the witness is unavailable and the defendant had a prior opportunity to cross-examine the witness).

79. *Davis v. Washington*, 547 U.S. 813, 821 (2006).

80. *Id.* at 822.

81. *Id.*

82. A thought-provoking adjustment to the scenario presented in Part II would be if the court had a CVS witness who only demonstrated responses to direct-examination questions, but none to cross-examination questions. Since the technology cannot determine why a CVS witness is not responding (e.g., the reason could fall anywhere on a spectrum between a loss of consciousness to an unwillingness to respond), is it fair to rely on a witness who may have an easy out for questions she does not want to answer? Would a judge have enough basis for holding a CVS witness in contempt of court if she did not show any responses to cross-examination questions?

trial does not have the primary purpose of assisting police in an ongoing emergency but rather is relevant to criminal prosecution. However, even if something is barred by the text of the Confrontation Clause, there are certain exceptions to the bar against admission.

One such exception is the “forfeiture exception,” which applies when the defendant is responsible for the witness being unavailable, so long as the defendant has the *specific intent* of preventing the witness from participating in the legal proceedings at the time the defendant rendered her unavailable.⁸³ The forfeiture exception, which is textually similar to Rule 804(b)(6), states: “A defendant may forfeit confrontation rights and render hearsay rules inapplicable if the defendant is responsible for the witness’s unavailability.”⁸⁴ This textual similarity leads to overlap in what actions constitute responsibility for a witness’s unavailability. Since the actions falling under the forfeiture exception are similar to the actions mentioned in the Rule 804(b)(6) analysis, it seems likely that if the defendant (or his agent) assaults the witness so violently as to leave her in a vegetative state, this would qualify as the defendant being responsible for the unavailability of the witness. If this is the case, the testimony may bypass the Confrontation Clause via the forfeiture exception. However, the forfeiture exception applies in only a limited number of instances, and, as mentioned above, since questioning a CVS witness for trial will likely only produce testimonial statements, it may be difficult to circumvent the Confrontation Clause.

D. Interpreter Versus Expert

As discussed briefly above, it would always be necessary for a person experienced in interpreting fMRI scans to present fMRI evidence in a trial because “no fMRI image speaks for itself.”⁸⁵ That is, laypersons cannot look at a brain scan image and determine whether a CVS witness was answering “yes” or “no”; instead, someone with education and experience in this field must do the interpreting. There are at least two ways that the legal system could treat the person explaining the brain scans: either as an expert witness or an interpreter. How this role is defined will affect how a court assesses the admissibility of the person’s testimony.

The Federal Rules of Evidence have one rule specifically regarding interpreters—Rule 604—which states: “An interpreter must

83. *Giles v. California*, 554 U.S. 353, 368 (2008); *Davis*, 547 U.S. at 832–33.

84. *United States v. Johnson*, 767 F.3d 815, 820 (9th Cir. 2014) (citing *Giles*, 554 U.S. at 367).

85. N.J. Schweitzer & Michael J. Saks, *Neuroimage Evidence and the Insanity Defense*, 29 BEHAV. SCI. & L. 592, 593 (2011).

be qualified and must give an oath or affirmation to make a true translation.” Thus, a person who could demonstrate an educational or occupational background in neuroscience and reading brain scans, and who also gave an oath of affirmation in court, could act as an interpreter. Most of the conversation around neuroimages in the courtroom centers around diagnostic inferences made by examining brain scans, which require an “inferential leap” of using an image of the brain to explain behavior (e.g., when a researcher claims a defendant demonstrates a potential for future violent behavior because there is no activity in a certain part of the defendant’s brain when shown a violent image).⁸⁶ But, when using brain scans to say something akin to “this brain scan indicates that at this moment the patient was imagining playing tennis,” no inferential leap is made.

Thus, the use of this technology for communicating with CVS patients is most analogous to language itself in that CVS patients “speak” a language that is foreign to others in a courtroom. Just as courtroom interpreters translate for individuals who speak foreign languages, researchers or doctors “translate” the “foreign language” of neural imagery to the judge or jury. Although other uses of neuroimaging evidence in the courtroom lead to a diagnostic inference (and, thus, an inferential leap), using the evidence in this context would not. Arguably then this is not scientific evidence at all; it is “normal” evidence that is simply enabled by a specific technology. Where science typically illuminates facts (e.g., chemical X caused the plaintiff’s cancer), that is not what the technology is doing here—indeed, it is more like a voice synthesizer for the CVS patient.

Therefore, this Note posits that the most logical course would be to treat the person explaining the brain scans as an interpreter who is just “translating” the “language” of the brain. However, judges are probably more likely to treat the person as an expert witness given that judges have treated individuals testifying about brain scans as experts in other contexts.⁸⁷ This means that whoever testifies regarding brain

86. See Jennifer Kulynych, *Brain, Mind, and Criminal Behavior: Neuroimages as Scientific Evidence*, 36 JURIMETRICS J. 235, 240 (1996) (“Although neuroimages contain information only about the physical or functional state of brain tissue, expert witnesses make inferential leaps by using brain images to explain criminal behavior, lack of judgment or insight, or the potential for future violence.”).

87. See e.g., *Hose v. Chi. Nw. Transp. Co.*, 70 F.3d 968, 973 (8th Cir. 1995) (district court did not abuse its discretion in admitting a physician’s *expert testimony* about brain scans in a case about employer’s liability for employee’s injury); *In re Tylenol (Acetaminophen) Mktg., Sales Practices, & Prods. Liab. Litig.*, MDL No. 2436, 2016 WL 4056026, at *4 (E.D. Pa. July 27, 2016) (denying plaintiff’s motion to exclude a doctor’s *expert testimony* about brain scans in multidistrict litigation regarding claims of medication causing liver damage); *Blotcher v. Stewart*, 45 F. Supp. 3d 1274, 1283 (D. Colo. 2014) (holding that a doctor could give *expert testimony* regarding brain scans in an automobile accident case); *State v. Hales*, 152 P.3d 321, 340–41, 343–44 (Utah 2007)

scans would likely be attempting to serve as an “expert,” and thus would have to pass muster under Federal Rule of Evidence 702, which covers testimony by expert witnesses.⁸⁸ The question then becomes whether the *technology itself* is admissible—which is answered by evaluating whether judges will treat the technology as scientific evidence. Because the research with CVS patients is still in its early stages, judges will likely be hesitant to permit the use of the technology without running it through a scientific evidence admissibility analysis first. Further, the nature of neuroimaging and brain scans seems to fall readily into the scientific evidence category—indeed, it is evidence that involves science. Therefore, judges are likely to treat CVS patients’ brain scans as scientific evidence, making it important to evaluate how the technology will fare under that analysis.

E. Scientific Evidence

For a long time, the general acceptance standard was the majority rule for admitting scientific evidence.⁸⁹ As articulated in *Frye v. United States*, under this standard, an expert opinion based on a technique is admissible only if the technique is generally accepted in the relevant scientific community.⁹⁰ *Frye* involved an attempt to admit the results of a deception test, similar to a polygraph.⁹¹ The U.S. Court of Appeals for the D.C. Circuit held that the deception test did not meet the “general acceptance” standard, since it had not gained much recognition in the scientific community.⁹² The Supreme Court eventually adopted a new standard for assessing the admissibility of scientific evidence in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*⁹³ There, the Court held that trial judges should be the ones to make determinations regarding the admission of scientific evidence based on whether the evidence is both “reliable” and “relevant to the task at hand”—if it is, then the evidence is admissible.⁹⁴

(holding that defendant was prejudiced by his counsel’s failure to obtain *expert testimony* regarding victim’s brain scans).

88. FED. R. EVID. 702.

89. Cassin, *supra* note 15, at 948.

90. 293 F. 1013, 1014 (D.C. Cir. 1923).

91. *Id.*

92. *Id.*

93. 509 U.S. 579, 587–89, 597 (1993); see Cassin, *supra* note 15, at 948. Note that some states continue to use the *Frye* standard, although the majority follow *Daubert*. For a state-by-state breakdown on this issue, see Michael Morgenstern, *Daubert v. Frye – A State-by-State Comparison*, EXPERT INST. (Apr. 3, 2017), <https://www.theexpertinstitute.com/daubert-v-frye-a-state-by-state-comparison/> [https://perma.cc/4RCN-6MNN].

94. *Daubert*, 509 U.S. at 597.

To assist judges in making these determinations, the *Daubert* Court announced several factors judges can use to determine reliability: (1) “whether the technique has been tested,” (2) “whether it has been subjected to peer review and publication,” (3) “the potential error rate in using the technique,” (4) “the existence and maintenance of standards controlling its operation,” and (5) “whether it has been generally accepted in the scientific community.”⁹⁵ While these factors are persuasive, the Court was careful to note that the overall assessment is a flexible one and the factors are not a “definitive checklist or test.”⁹⁶ In this way, the Court provided judges with a decisionmaking framework, but allowed judges the necessary flexibility to adapt their decisions to factually different situations.⁹⁷ In other words, the *Daubert* factors are simply meant to assist judges in making a decision—meeting all of the factors does not necessarily mean the evidence will get admitted, just as *not* meeting all of the factors does not automatically keep the evidence out.⁹⁸ Thus, fMRI scanning on CVS patients would not necessarily have to meet all of the *Daubert* factors in order to be admissible, although judges are likely to assess each individual factor when making the admissibility determination.

The *Daubert* Court also addressed concerns that abandoning the *Frye* “general acceptance” standard would result in the admission of pseudoscientific evidence that would confuse juries, specifically stating that “[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence.”⁹⁹ Essentially, this means that a judge need only determine that the scientific evidence is *relevant* for it to be admissible, because after that the judicial “process,” (e.g., cross-examination of the expert witness, the presentation of contrary evidence, and instructions on the burden of proof) is all that is necessary to address concerns about the evidence.¹⁰⁰ Thus, the relevancy standard entails a “liberal perspective” in terms of

95. 509 U.S. at 593–94; Cassin, *supra* note 15, at 948. After *Daubert*, Rule 702 was amended in order to reflect the Court’s decision. Cassin, *supra* note 15, at 948.

96. *Daubert*, 509 U.S. at 593–94; Michael J. Saks & David L. Faigman, *Expert Evidence After Daubert*, 1 ANN. REV. L. & SOC. SCI. 105, 109 (2005) (“*Daubert* finally places the obligation to evaluate the evidence where one might have expected it to be all along: on the judges themselves.”).

97. See Teitcher, *supra* note 47, at 370.

98. See *id.*

99. 509 U.S. at 596; Teitcher, *supra* note 47, at 370–71.

100. See Green, *supra* note 58, at 31–32; see also Mark Pettit, Jr., *fMRI and BF Meet FRE: Brain Imaging and the Federal Rules of Evidence*, 33 AM. J.L. & MED. 319, 325 (2007). The Supreme Court supported its assertion in *Daubert* that the test proposed there was more liberal and flexible than that in *Frye* by claiming in another case that “the *Daubert* standard admits a broader range of testimony than the general acceptance test.” Cassin, *supra* note 15, at 949 (citing *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 142 (1997)).

application.¹⁰¹ Indeed, it seems that if a testifying expert for neuroimaging technology can proffer “sufficient supporting data and explain how the hypotheses were tested while accounting for conflicting opinions in true scientific fashion,” then this overcomes the *Daubert* hurdle and can be admitted.¹⁰²

Importantly though, the concern presented by the scenario at the beginning of Part II is not just a debate about whether fMRI is an accepted technology, but whether fMRI can be accepted in court *for this specific use*. If the proffered use (in our case, allowing a CVS witness to testify) is far enough removed from the typical use of the technology, then the court may be persuaded to exclude the evidence. For instance, in *United States v. Semrau*, the U.S. Court of Appeals for the Sixth Circuit considered the use of fMRI as a lie detector to be far enough removed from the typical use of fMRI (e.g., medical use for patients) to exclude the proffered evidence.¹⁰³ The use of fMRI to communicate with CVS patients, though, is more closely related to the typical use of fMRI, since it can involve medical assistance for patients (e.g., by asking patients questions about their healthcare experiences and preferences). Furthermore, using fMRI with CVS patients only necessitates objective evaluations of whether a patient answered “yes” or “no” (as opposed to lie detection via fMRI, which requires a more subjective evaluation¹⁰⁴).

One reason courts are so concerned with “typical uses” involves the idea that if something is used for its typical purpose it better protects against reliability concerns. When it comes to neuroscience technology, legal actors are especially concerned about reliability due to a fear that juries may be abnormally swayed by this type of evidence.¹⁰⁵ The concern is that pictures of brain scans and the testimony about them may “provide an air of infallibility and strongly prejudice or mislead a jury.”¹⁰⁶ Some scholars have called this problem the

101. Green, *supra* note 58, at 32.

102. Teitcher, *supra* note 47, at 392 (citing Erica Beecher-Monas & Edgar Garcia Rill, *The Law and the Brain: Judging Scientific Evidence of Intent*, 1 J. APP. PRAC. & PROCESS 243, 256, 262, 275–76 (1999)).

103. 693 F.3d 510, 521–23 (6th Cir. 2012).

104. See Zachary E. Shapiro, *Truth, Deceit, and Neuroimaging: Can Functional Magnetic Resonance Imaging Serve as a Technology-Based Method of Lie Detection?*, 29 HARV. J.L. & TECH. 527, 533 (2016) (“Crucially, there was no single region of the brain that was always active when different subjects lied, indicating the variability and unknowns that remain.”).

105. J. Ken Thompson, *A Review of the Admissibility of Novel Scientific Evidence*, 17 AM. J. TRIAL ADVOC. 741, 742–43 (1994).

106. Teitcher, *supra* note 47, at 372–73.

“seductive allure” of neuroscience.¹⁰⁷ However, there is conflicting evidence on whether neuroscience in fact has such a power over people.

For instance, one study indicated that participants who saw a brain scan image were more likely to grant a verdict of not guilty by reason of insanity.¹⁰⁸ In this experiment, participants read a summary of a criminal trial where the defendant put forth an insanity defense.¹⁰⁹ Participants were divided into six groups, each receiving a different version of the evidence presented at trial.¹¹⁰ One group received a brain scan image, one received a clinical psychologist’s testimony, and one received no expert evidence (acting as the control group).¹¹¹ After reading the evidence, participants determined a verdict. Those who saw the brain scan image were more likely to grant a verdict of not guilty by reason of insanity than those participants in the control group.¹¹² However, there was very little difference in verdict results between the brain scan image group and the group that received testimony by a clinical psychologist.¹¹³ Therefore, “[t]his suggests that neuroscience would not be significantly more prejudicial than psychologist testimony, which is already routinely permitted in trials.”¹¹⁴ Since this study indicates the potential that some of the jury’s overreliance on neuroscience evidence stems from viewing the actual image of the brain (rather than just hearing or reading testimony from an expert, like a clinical psychologist), a judge might consider admitting the expert testimony of a neuroscientist to discuss the brain scans but not permitting the party to introduce any actual brain scan images into evidence.¹¹⁵

Thus, it appears that under the current legal framework neuroimaging evidence—even when used for purposes besides diagnostic inferences—faces hurdles before it can enter the courtroom. Interestingly, many of these hurdles seem to be based on the way people view neuroimaging technology, rather than on the black letter law. As discussed above, there is good reason *not* to treat the use of this technology as scientific evidence when it is used to communicate with

107. See Cassin, *supra* note 15, at 951 (“Many believe jurors will be prone to give neuroscientific evidence a disproportionate amount of weight.”).

108. Schweitzer & Saks, *supra* note 85, at 596–98.

109. *Id.* at 597.

110. *Id.* at 598–99.

111. *Id.*

112. *Id.* at 602.

113. *Id.*

114. Cassin, *supra* note 15, at 951–52 (citing *United States v. Shay*, 57 F.3d 126, 133–34 (1st Cir. 1995), which determined that the lower court’s exclusion of expert psychological testimony was in error; and *State v. Buechler*, 572 N.W.2d 65, 74 (Neb. 1998), which found the same).

115. See Cassin, *supra* note 15, at 952.

CVS patients, but likely courts will indeed treat it as such simply because of the fact that an fMRI and brain scans are involved. Additionally, the fear surrounding the “seductive allure” of neuroscience, even if unwarranted, may make judges hesitant to permit this technology in their courtrooms.

Therefore, a party looking to admit fMRI scans into evidence for the purposes discussed in this Note must consider and overcome all of the obstacles. The party would do best to find a well-qualified person to testify regarding the brain scans, such as one who has been interpreting brain scans for a long time or has a high accuracy rate in interpreting verifiable brain scans, like those involving healthy volunteers. The party also ought to make persuasive arguments about the necessity of this evidence in the case at hand and offer to take steps to protect against the risk of the jury being too strongly persuaded by the scientific nature of the evidence (perhaps by agreeing not to admit the actual brain scan images). Taking this approach gives the party the best opportunity of having the evidence admitted under the current legal framework. However, if the evidence ultimately cannot make it past a judge or convince a jury, the following Parts demonstrates that there are still areas of the legal system where we might be able to employ this neuroscience technology.

III. NEURON-WITNESS IDENTIFICATION AND POSSIBLE INVESTIGATIVE USES

Imagine you are a police officer trying to solve a murder. There was one witness to the crime, but before questioning she was involved in a car accident that left her in a vegetative state. However, a brain scan shows evidence that she retains consciousness. Is there a way for you to ask her questions to help you identify the murderer? Could information gleaned from her be the basis for probable cause in obtaining an arrest warrant? More broadly, is it possible to use this technology in a criminal *investigation*, rather than a trial? Here, the CVS witness’s “statements” would not be proof, but rather would act as an investigative tool—the threshold for which is lower under the existing legal framework—making this technology more likely to be accepted for use in investigations than as evidence in criminal trials.

A. Investigative Tactics

Witness competency and accuracy, discussed in Part II, remain important considerations in this context. After all, in most situations involving the questioning of witnesses, police can assess various factors

to determine witness credibility. For instance, police might evaluate how nervous a witness seems, how much detail she is able to provide, and how emotional (or unemotional) she is when providing answers. Much of this would be difficult or impossible to evaluate with a CVS witness—since she cannot move or speak, or even explain her yes-or-no answers, all the police are left with is the simple response of yes or no.

There are a few possible ways to combat this concern. For one, police could start by asking the CVS witness questions with verifiable answers, such as questions about personal history or basic common knowledge. The police could also ask the CVS witness questions about the crime that the officers already know the answer to in order to test for accuracy.¹¹⁶ For example:

Police Know Correct Answer Is “Yes”	Police Know Correct Answer Is “No”
Did the crime occur on January 21 st , 2018?	Did the crime occur on January 1 st , 2018?
Was the weapon used during the commission of the crime a gun ?	Was the weapon used during the commission of the crime a knife ?

Recall that the questions have to be phrased in a yes-or-no (or at least a binary) way. For instance, examiners could instruct the CVS witness to think about playing tennis if the weapon used was a gun or think about walking through a house if the weapon used was a knife, rather than asking a series of these two questions in yes-or-no format. By asking verifiable questions, the police would be able to get some sense as to whether the CVS witness was providing any factually correct information.

In addition to using fMRI technology to ask the CVS witness binary questions about the crime, it would also be possible to carry out a sequential photo lineup where the witness views photographs of the potential suspect(s) and “filler” photos (such as stock photographs) that may resemble the suspect(s)—assuming the CVS witness has retained visual capabilities (i.e., the traumatic event did not leave her blind). On the other hand, a simultaneous photo lineup (where all of the photos are shown at once) might be more difficult to carry out in the scenario presented at the beginning of Part III. With the sequential method, the

116. It is important to note here that we cannot ascribe a certain “motive” or reason to a CVS patient if they answer a verifiable question incorrectly, since the only thing we know is whether they thought about playing tennis or walking through a house. It may be that the patient did not properly hear the question, could not comprehend the question, mistakenly thought about the incorrect mental imagery, or attempted to intentionally deceive the questioner. *Cf. supra* note 82 (questioning whether it is fair to rely on a witness who may have an easy out for questions she does not want to answer).

witness can answer yes or no to each photograph, as the images are shown one at a time; with the simultaneous method, the photos would be shown all at once. Thus, for the simultaneous method a researcher would have to give an instruction such as, "Think about playing tennis when I have indicated the photo you believe to be the perpetrator. Is the perpetrator pictured in the top left? Is the perpetrator pictured in the top center? Is the perpetrator pictured in the top right?" (and so on). Although a simultaneous lineup might be a bit more difficult to carry out, it is still theoretically possible, and police could use either method when questioning a CVS witness.¹¹⁷

While these techniques could be useful to police in investigations, the real question is whether the possible investigative uses of the brain-computer interface technology can serve as the basis for probable cause. The Fourth Amendment of the U.S. Constitution requires probable cause before a court can issue a warrant for police to make an arrest or carry out a search.¹¹⁸ Notably, hearsay can be used to form the basis of probable cause, meaning police officers can rely on any witness statements available to them during an investigation.¹¹⁹ Essentially, the legal question then is whether police officers can use a technology that is still in its early, and perhaps speculative, stages to generate probable cause. To analyze this question, it is helpful to examine somewhat analogous pieces of evidence that are able to serve as the basis for probable cause.

B. Analogous Technology

Analogous technology in this context includes some kind of mechanism or evidence that defies cross-examination. Of course, the CVS witness could theoretically be cross-examined, and the person testifying about the meaning of the brain scans could certainly be cross-examined, but this Section will focus on analogous *technologies*, not the people involved with the technology. Take police use of drug-sniffing

117. For more information on the differences between sequential and simultaneous photo lineups, and a discussion of the pros and cons of each method, see Nate Kornell, *Should Police Lineups Be Sequential or Simultaneous?*, PSYCHOL. TODAY (June 25, 2014), <https://www.psychologytoday.com/blog/everybody-is-stupid-except-you/201406/should-police-lineups-be-sequential-or-simultaneous> [<https://perma.cc/8KVH-756C>].

118. U.S. CONST. amend. IV; *Probable Cause*, CORNELL L. SCH. LEGAL INFO. INST., https://www.law.cornell.edu/wex/probable_cause (last visited May 8, 2018) [<https://perma.cc/MF98-KA4D>]. Note though that if there are "exigent circumstances" then a warrantless search or seizure may be justified. *Missouri v. McNeely*, 569 U.S. 141, 148–50 (2013) (discussing what may qualify as an exigent circumstance and the test for whether an officer faced a situation that justified a warrantless search or seizure).

119. In trials, by contrast, prosecutors have to point to solid evidence, rather than rely on hearsay (unless, of course, a hearsay exception is applicable). See *supra* Section II.B.

dogs, for instance. Plainly, it is impossible to ask the dog questions about why she did or did not alert (i.e., react) to the odor or presence of drugs in a certain situation. Yet, police routinely use drug-sniffing dog alerts as the basis for probable cause. Indeed, in 2013 the Supreme Court held that drug-sniffing dogs' alerts to the odor of drugs can form the basis of probable cause.¹²⁰ The Court noted that training records established the dog's reliability and that probable cause is a "flexible, common-sense standard."¹²¹ Arguably, the neuroscience technology laid out in the scenario in Part III may be analyzed in the same way—as long as there is some sort of record establishing the reliability of the testing mechanism, or perhaps a record establishing the reliability of this specific CVS witness's answers, the investigative method can serve as the basis of probable cause.

Another analogous piece of evidence involves the use of machines to form the basis of probable cause. For example, courtroom actors clearly cannot cross-examine a radar gun, but radar guns can undergo reliability testing.¹²² As one scholar notes about a U.S. Court of Appeals for the Ninth Circuit opinion, "[i]n the court's view, machine assertions—although raising reliability concerns—are simply the products of mechanical processes and, therefore, akin to physical evidence."¹²³ Of course, the "machine assertion" in the hypothetical scenario presented at the beginning of Part III is not simply the machine, it involves human input at multiple levels, including the person in the scanner, the researcher interpreting the brain scans that the machine puts out, and the developer of the machine itself. Certainly though, some of this is true of all machines in the sense that they are all created by humans. Despite this possible setback in reliability, courts have often relied on "machine testimony" in various forms and thus ought to be open to doing so in the case of neuroscience technology as a communication device for CVS witnesses.¹²⁴

Even if courts consider this technology to be insufficient as a basis for probable cause, its potential uses may still be effective in helping police identify suspects and learn more about crimes they are investigating. If this is the case, one can think about this technology as a license to interrogate, rather than as a basis for probable cause. For

120. *Florida v. Harris*, 568 U.S. 237, 249 (2013).

121. *Id.* at 240 (citing *Illinois v. Gates*, 462 U.S. 213, 239 (1983)).

122. *Accuracy of Radar Guns to Play Out in Court*, NASHVILLE PUB. RADIO (Nov. 1, 2007, 6:00 AM), <http://www.npr.org/templates/story/story.php?storyId=15835078> [<https://perma.cc/V534-7TSY>].

123. Andrea L. Roth, *Machine Testimony*, 126 YALE L.J. 1972, 1975 (2017) (citing *United States v. Lizarraga-Tirado*, 789 F.3d 1107, 1108 (9th Cir. 2015)).

124. *See id.* at 1975–76.

example, instead of arresting a person that a CVS witness indicates committed the crime, police could simply interrogate the identified person, which does not require probable cause.¹²⁵ Interrogation of that person may then lead to more evidence, such as a confession, which could then provide the basis for probable cause to make an arrest. Thus, even if this technology cannot be used as the sole basis for probable cause, it still has applicable uses within criminal investigations.

Undoubtedly though, the cases where a witness is a CVS patient likely are not high in number. Of course, just because it may not affect a great number of people or cases does not mean that it lessens the importance for those it does affect.¹²⁶ But where might society most commonly see a need for this technology in the legal system? The answer is when court proceedings are required for a CVS patient's end-of-life care issues or healthcare decisionmaking. The subsequent Part explores brain-computer interface technology within that legal context.

IV. NEURONAL WISHES AND POSSIBLE HEALTHCARE DECISIONS IN COURT

Imagine that you have ended up in a vegetative state but have retained consciousness. You do not have a legal document explaining your wishes in this situation. Some members of your family believe you would want life-sustaining measures, other family members believe you would want to cease such treatment. Is there a way for your loved ones to know your *current* wishes? Regardless of anything you said (or did not say) before you ended up in this condition, can you share your intent on whether you want to continue life-sustaining treatment with family members and, if necessary, a court?

Under this scenario, neuroscience technology could be useful in court when end-of-life issues or other healthcare decisions are disputed among family members and caregivers.¹²⁷ In fact, this is the actual scenario that the technology is being developed for—to give CVS patients a voice in their own decisionmaking.¹²⁸ Neuroimaging thus has a role to play in end-of-life intent, “and it seems likely that such tests will soon be offered as evidence in court proceedings.”¹²⁹

125. Such interrogation is of course subject to proper criminal investigation procedures, such as Miranda warnings.

126. The need for the technology and the significance in understanding its potential uses in criminal trials and investigations is still substantial for those CVS witnesses who can use it.

127. Fisher & Appelbaum, *supra* note 23, at 377.

128. See Ledford, *supra* note 24.

129. Fisher & Appelbaum, *supra* note 23, at 377.

Here, the Confrontation Clause would not be a problem since court proceedings regarding healthcare decisions take place in the civil, not criminal, context. Additionally, hearsay may be less of an issue because the Residual Exception becomes extraordinarily valid here—if the patient is indeed conscious, this is the only way for her to communicate her current wishes. Thus, admissibility becomes a balancing question under Federal Rule of Evidence 403, which says a court must exclude evidence if its “probative value is substantially outweighed” by its potential for prejudice, confusion, and the like.¹³⁰ Since the probative value here is extremely high (i.e., understanding the patient’s intent, at the most extreme level being whether they want to live or die) and the unfair prejudice appears nonexistent (i.e., this is not a criminal trial where a person’s liberty is on the line), the evidence ought to be admissible. The relevancy of patient intent is further explored in the following Section.

A. Patient Intent

Part of the consideration for the scenario presented in Part IV is a desire to respect patient autonomy, including the right to refuse medical care and the right to privacy.¹³¹ In fact, the Supreme Court in *Cruzan ex rel. Cruzan v. Director, Missouri Department of Health* established refusal of care as a liberty interest under the Due Process Clause of the Fourteenth Amendment of the U.S. Constitution, though the Court noted that this should be balanced against the state’s interest in preserving life.¹³² However, the Court in *Cruzan* seemed concerned about the state’s interest being given too little weight when the refusal of care decision was being made for an incompetent person *by someone else*, stating:

The differences between the choice made *by* a competent person to refuse medical treatment, and the choice made *for* an incompetent person by someone else to refuse medical treatment, are so obviously different that the State is warranted in establishing rigorous procedures for the latter class of cases which do not apply to the former class.¹³³

130. FED. R. EVID. 403.

131. See Darren P. Mareiniss, *A Comparison of Cruzan and Schiavo: The Burden of Proof, Due Process, and Autonomy in the Persistently Vegetative Patient*, 26 J. LEGAL MED. 233, 233 (2005) (exploring how autonomy, as reflected in the right to refuse care and the right to privacy, has become an overriding issue for courts); see also Peterson et al., *supra* note 17, at 4 (“Preservation of patient autonomy is a hallmark of ethical medical care . . .”).

132. 497 U.S. 261, 278–79 (1990).

133. *Id.* at 287 n.12; see also Kathy L. Cerminara, *Law, Perception, and Cultural Cognition Near the End of Life*, 55 WASHBURN L.J. 597, 616 (2016):

The ability to refuse life-sustaining medical treatment on behalf of another human being is an awesome power. Because of the importance of being able to make a decision

If neuroscience technology can establish that a vegetative-state patient is conscious and competent, then this changes the equation—no longer must someone else be making healthcare decisions on the patient's behalf, but rather the patient could make such decisions on her own. Indeed, if a patient is able to make decisions herself, then her liberty interest ought to outweigh the state interest in preserving life (if the patient's wishes conflict with that state interest). This affects the legal analysis because, as noted above, the stringency of the procedure for refusing medical care depends on *who* is making the healthcare decision (the person herself or someone else on her behalf).

Further, encompassed within federal and state constitutional rights to privacy is the right to control one's medical course, including the right to be free of unwanted treatment.¹³⁴ Additionally, case law indicates "that the right to refuse treatment is not lost merely because the noncognitive and vegetative condition of the patient prevents a conscious exercise of the choice to refuse further extraordinary treatment."¹³⁵ Thus, this protection for *unconscious* patients in a vegetative state indicates that the right to refuse "further extraordinary treatment" logically must also extend to *conscious* patients in a vegetative state.

Despite the developments in neuroscience, these rights may still be left unprotected since some jurisdictions have laws which, due to their narrow wording, do not currently permit fMRI communication as a method by which a patient can legally change her advance directive.¹³⁶ For instance, Colorado's statutory law permits revocation of a declaration only if the revocation is done orally, in writing, or by

that will end someone else's life, the state has more ability to regulate that decisionmaking process than it has to regulate a patient's own decisionmaking for himself or herself.

Of course, if a patient has an advance directive or other legal document permitting someone else to make healthcare decisions on her behalf, then procedures for permitting the designated person to make such decisions may not need to be *too* rigorous.

134. See, e.g., *Gray ex rel. Gray v. Romeo*, 697 F. Supp. 580, 585–86 (D.R.I. 1988) (holding that an individual has a right "to control fundamental medical decisions" regarding his or her own body); *Conservatorship of Drabick v. Drabick*, 245 Cal. Rptr. 840, 853 (Ct. App. 1988) (noting that state law "gives persons a right to determine the scope of their own medical treatment" and that "this right survives incompetence in the sense that incompetent patients retain the right to have appropriate decisions made on their behalf"); *McConnell v. Beverly Enters.-Conn., Inc.*, 553 A.2d 596, 600–02 (Conn. 1984) (discussing prior case law and the historical importance of the right to refuse medical treatment); *In re Colyer*, 660 P.2d 738, 741–43 (Wash. 1983) (explaining the importance of the right to privacy and the right to be free from bodily invasion); Shapiro, *supra* note 2, at 443 (citing these and other similar cases).

135. Shapiro, *supra* note 2, at 443 (citations omitted) (quoting another source) (internal quotation marks omitted).

136. See Harman, *supra* note 41, at 201 (citing COLO. REV. STAT. § 15-18-109 (2010); MD. CODE. ANN., HEALTH-GEN. § 5-604 (LexisNexis 2010); TENN. CODE ANN. § 32-11-106 (2010)).

physically destroying the declaration (e.g., burning the document).¹³⁷ Thus, a patient's communication via an fMRI scanner would not qualify under the text of the statute, meaning that a patient could not revoke a declaration in this way.

The text of Maryland's and Tennessee's statutory laws are similar, and if these statutes are not amended, a CVS patient in these jurisdictions may not be able to effect changes to her legal documents—even if she wanted to revoke a directive ordering removal of life support.¹³⁸ Indeed, the advancements in neuroscience technology “bring[] to light a class of people who can and should be making important healthcare decisions, but are now hindered only by the law.”¹³⁹ Thus, the law ought to develop to meet the needs of this population by permitting patients who can communicate via brain-computer interface technology the ability to adjust their legal documents using this method.

B. Concerns

Notwithstanding that there should be an obligation to communicate with these patients regarding their medical care, there are obstacles to facilitating this communication. The first concern is something that seems simple but is in fact considerably complicated: defining the vegetative state. Although there are broad parameters that outline what the vegetative state is, it can actually be very difficult for practitioners to differentiate from the minimally conscious state (“a condition in which a patient may inconsistently respond to commands, but cannot communicate interactively”¹⁴⁰) and locked-in syndrome (“a mental state in which a patient is awake and aware of his surroundings, but due to total or near-total paralysis is unable to move or speak”¹⁴¹). Since every patient—and brain injury—is unique, this further complicates the task of defining the vegetative state and makes formulating a general medical definition extremely difficult.¹⁴²

137. COLO. REV. STAT. § 15-18-109.

138. See Harman, *supra* note 41, at 215 (noting that because certain patients lack communication skills, the statutes as written deny these individuals the opportunity to change their medical directives).

139. *Id.* at 216.

140. Ledford, *supra* note 24.

141. Harman, *supra* note 41, at 195.

142. See Michael Hopkin, *Thoughts of Woman in 'Waking Coma' Revealed*, NATURE (Sept. 7, 2006), <http://www.nature.com/news/2006/060904/full/news060904-11.html> [<https://perma.cc/4WVJ-K4NW>] (debating whether a comatose patient who fulfills all the diagnostic criteria for a vegetative state but demonstrates conscious awareness should be defined as existing in a vegetative state).

For the purposes of assessing patient intent in end-of-life care and healthcare decisionmaking, which medical category the patient falls into should not be pertinent so long as she is able to use fMRI technology for communication purposes. However, the patient's diagnosis is relevant to the law because most states limit the decision to withhold or withdraw life-sustaining measures, such as artificial nutrition, to situations where the patient is in a permanently unconscious or vegetative state.¹⁴³ Thus, the medical definitions can have legal ramifications that affect whether practitioners are able to carry out patients' wishes regarding end-of-life care.

Furthermore, current statutory law also places certain parameters on end-of-life care.¹⁴⁴ These statutes often contain underdeveloped definitions of the "vegetative state," which are made further incomprehensible by the fact that these definitions often do not conform to the medical definitions or understanding of these diagnoses.¹⁴⁵ Additionally vexing is that, given divergent state-law definitions and the need for courts to analyze these matters on a case-by-case basis, case law does not elucidate the question of how to define or diagnose the vegetative state.¹⁴⁶

Another concern involves decisionmaking capacity. If a patient appears to make a decision to end life-sustaining care, are we willing to accept the possibility that the patient is not necessarily capable of such consequential judgment and perhaps did not actually want to die? Incapacity is defined as "an individual's functional inability to understand or to form an intention with regard to some act, as determined by a healthcare provider."¹⁴⁷ In determining decisionmaking capacity, simply discovering residual cognitive function in a vegetative-state patient by finding that she retains an ability to answer general yes-or-no questions is not sufficient.¹⁴⁸ Instead, the assessment involves whether the person has specific knowledge as it relates to the task at hand, as well as the ability to coordinate the information necessary to complete the task.¹⁴⁹ The brain injury

143. Fisher & Appelbaum, *supra* note 23, at 375.

144. *See id.* at 377 ("Many states have enacted statutes to address end-of-life surrogate decision-making, advance directives, or both.").

145. *Id.*

146. *Id.* at 377-78.

147. Simon & Abrams, *supra* note 62, at 535.

148. *Id.*; *see also* Hampshire et al., *supra* note 41, at 174 ("[I]f a physically non-communicative patient were ever to be asked to make decisions regarding the course of their long-term maintenance or whether potentially aversive treatments should be administered, it would first be necessary to demonstrate that they were able to make logical inferences in response to complex questions.").

149. Simon & Abrams, *supra* note 62, at 535.

inherent in the vegetative state complicates this, as “behaviorally nonresponsive patients with covert awareness are presumed to be decisionally impaired.”¹⁵⁰

Because of concerns related to decisionmaking capacity, some scholars have been hesitant to support asking patients in a vegetative state significant decisionmaking questions, such as end-of-life preferences, claiming that there may be underlying psychiatric ailments (e.g., depression) besides the brain injury which could influence patient answers.¹⁵¹ The concern stems from research studies that demonstrated a correlation between brain injury and various psychiatric conditions.¹⁵² The theory follows that if brain injury diminishes mental or psychiatric health, it is reasonable to assume that there is diminished decisionmaking capacity as well, regardless of whether consciousness remains.¹⁵³

The counterargument is that this concern simply necessitates the development of a way to test for psychiatric ailments, such as depression, in this patient population in order to determine whether the patient has diminished decisionmaking capacity.¹⁵⁴ Validated measures that currently test for these ailments, such as the Beck Depression Inventory,¹⁵⁵ could be adapted to ask only yes-or-no (or binary) questions, so that researchers could assess patients who communicate via fMRI technology using these scales before permitting the patients to make important healthcare decisions.¹⁵⁶ There is also literature on the quality of life experienced by patients with locked-in syndrome, which is similar to the vegetative state.¹⁵⁷ In a study involving locked-in syndrome patients, participants self-assessed their “global subjective well-being.”¹⁵⁸ Forty-seven of the sixty-five patients reported “overall happiness.”¹⁵⁹ Notably, the longer a patient had spent in the locked-in state, the more likely she was to report greater happiness.¹⁶⁰ This study suggests that having a brain injury does not

150. Peterson et al., *supra* note 17, at 4.

151. *See id.* at 10–11 (discussing the ethics of asking “behaviorally nonresponsive patients with residual covert awareness” questions with “high-stakes outcomes”).

152. *Id.*

153. *Id.*

154. *Id.* at 11.

155. The Beck Depression Inventory is intended to assess the intensity of depression. *See* Aaron T. Beck, Robert A. Steer & Margery G. Garbin, *Psychometric Properties of the Beck Depression Inventory: Twenty-Five Years of Evaluation*, 8 CLINICAL PSYCHOL. REV. 77, 79 (1988).

156. Peterson et al., *supra* note 17, at 11.

157. *See id.* (citation omitted).

158. *Id.*

159. *Id.*

160. *Id.*

necessarily mean that a patient will also be suffering from “diminished psychiatric well-being.”¹⁶¹

Importantly, decisionmaking is not an “all-or-nothing concept”; rather, it exists on a continuum, where the threshold for the capacity to make decisions depends (at least to some extent) on the gravity of the decision.¹⁶² For example, we may not necessarily question the capacity of someone to make a decision for themselves about whether to refuse a flu vaccination, even if the person lacks some of the conditions deemed necessary for coherent decisionmaking abilities.¹⁶³ However, we would probably be hesitant to let the same person refuse life-saving and safe treatment for a fatal disease.¹⁶⁴ This is because our calculus of the importance of the decisions—and the consequences of those decisions—is markedly different.¹⁶⁵ The first is a basic health choice with the most likely worst-case-scenario being that the person catches the influenza virus and is sick for a few days. The second is a life-altering choice where the consequence of death is a certainty. This is essentially what makes the end-of-life debate difficult—the consequences of the decision to end life-sustaining treatment are as far as the continuum can reach.

Therefore, society may be hesitant to permit someone in a vegetative state, who has sustained some level of brain injury, to make such a consequential decision. This value society places on capable decisionmaking may thus be in tension with the value of respecting patient autonomy. Ultimately, the legal system may have to decide—either across the board or on a case-by-case basis—which value it weighs more heavily. In situations where patients are able to demonstrate conscious thought though, it seems counterintuitive to entirely disregard their wishes. Thus, the legal system must address these countervailing concerns.

First, the legal system could maintain that patients in this condition who demonstrate conscious thought must undergo more rigorous testing than the “typical” person when the court is determining their level of competency. This could be similar to tests used with TBI patients or those with mental disabilities, though such tests would of course need to be adapted for use with fMRI technology (e.g., phrasing answers to test questions in a binary way). Second, the legal system could formulate a “partial competency” framework, whereby a patient’s

161. *Id.* (“Surely, there will be cases of psychiatric illness secondary to severe brain injury, which will undermine decision-making capacity. However, the foregoing study suggests that in the case of patient groups with severe neurological insult, the prevalence of depression may be small.”).

162. *Id.* at 10.

163. *Id.*

164. *Id.*

165. *Id.*

wishes are considered, but perhaps consent from a legal guardian would also be required if the patient is asking to end life-sustaining treatment. If the patient's wishes conflict with those of the legal guardian, a court could step in and make factual determinations based on evidence such as the patient's previous statements about healthcare treatment preferences, the current condition the patient is in, and so forth. Regardless of how the legal system chooses to address this question, it is imperative that it be addressed, since patients' autonomy—and their lives—hang in the balance.

CONCLUSION

How we can use technology that allows us to communicate with CVS patients within our legal system is not a simple question. It depends on the particular patient, the type of court proceeding, the nature of the questions asked and answers given, the purpose for which the communication is offered, and the conclusions asserted.¹⁶⁶ Although there are overlapping concerns with the attempted use of this technology in different facets of the legal system, each area of the law has unique considerations.¹⁶⁷ Notably though, as both the technology and the law develop, the calculus of admissibility will change. As it currently stands, the evidence garnered from this neuroscience technology is unlikely to be admissible for the purpose of CVS witness testimony in criminal trials. On the other hand, the use of this technology in police investigations and for making legal decisions regarding healthcare has broader applicability and fits more comfortably within the current framework.

Despite the present difficulties in implementing neuroimaging technology within the legal system, the imminent advances in neuroscience are likely to assuage some of the hesitations the law has about the technology. Indeed, the logical advancement in neuroscience involves using this technology to allow patients to communicate beyond yes-or-no answers.¹⁶⁸ For example, a researcher could say "imagine playing tennis when I say the letter you want," thus permitting a patient to create entire sentences in this way—although it would be

166. See Cassin, *supra* note 15, at 950–51 (noting that admissibility of neuroscience evidence necessarily will involve a case-by-case analysis).

167. For instance, it is important to consider that this technology can only be used in a binary, yes-or-no format (for now) and these types of questions can be leading. While asking leading questions during a cross-examination may be fine—since cross-examinations generally are leading—we may want to avoid leading questions in direct examinations, in questioning a witness during an investigation, and in asking about healthcare preferences.

168. See Taylor, *supra* note 11, at 1473 (positing a potential nonbinary method that CVS patients could use to communicate).

time consuming.¹⁶⁹ Even with that drawback, this type of method has been used with a locked-in syndrome patient who was able to communicate via eye-blink movements.¹⁷⁰ In that instance, the patient would blink when the letter he wanted was read off by a researcher or family member, eventually forming full sentences—in fact, he even authored an entire book using this method.¹⁷¹

The future of this area—both the science and the law—is unknown, but “[e]very useful new development must have its first day in court.”¹⁷² The technology will improve, and each of these scenarios will have its courtroom debut—perhaps sooner rather than later. When that day comes, the legal system should be prepared with where to begin its analysis. This Note offers a starting point from which to commence.

*Jessica Lauren Haushalter**

169. *See id.* (discussing the possible drawbacks of letter-by-letter communication).

170. *See* JEAN-DOMINIQUE BAUBY, *THE DIVING BELL AND THE BUTTERFLY: A MEMOIR OF LIFE IN DEATH* (Jeremy Leggatt trans., First Vintage International ed. 1998) (detailing the author's experience with locked-in syndrome, which reduced his ability to communicate to blinking his left eye).

171. *See id.* (poignantly, when Bauby first learned to communicate using this method, he was asked what he wanted and the first thing he spelled out with his eye blinks was “death”).

172. *United States v. Stifel*, 433 F.2d 431, 438 (6th Cir. 1970).

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Faye Johnson
Program Coordinator
Vanderbilt Law Review
Vanderbilt Law School
131 21st Ave South
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e-mail: faye.johnson@vanderbilt.edu

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