# A Mindful Military: Linking Brain and Behavior Through Neuroscience at Court-Martial

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*Neuroscience is beginning to touch on questions that were once only in the domain of philosophers and psychologists, questions about how people make decisions and the degree to which those decisions are truly "free." These are not idle questions. Ultimately, they will shape the future of legal theory and create a more biologically informed jurisprudence.*[1]

## I. Introduction

Sergeant Andrew Jones, a 21B Combat Engineer, served three tours in Iraq and Afghanistan between 2004 and 2010. He drove combat engineer vehicles (CEV), supervised crews, and cleared routes vital for military operations and economic growth. His weekly routine often included more than ten route-clearing missions. Luckily, he experienced few encounters with improvised explosive devices (IEDs) during his three tours.

His service, however, left it almost impossible to evade contact completely. Once, the ripple from IED contact on his convoy's lead vehicle shook his head inside his trailing vehicle, forcing its collision with the vehicle's interior. His worst experience: a direct hit incident causing his vehicle to tip. Despite careful reliance on his military equipment—combat helmet, improved outer tactical vest, and vigilant use of the vehicle's safety restraints—Sergeant Jones slammed into the vehicle's ceiling as it toppled. The impact left him unconscious. He rejoined his unit after several weeks of rehabilitation under doctor's caution about the effects of post-traumatic stress disorder (PTSD) and traumatic brain injury (TBI).

Redeployment with the head injury was unfriendly to Sergeant Jones. Increased frequency in the duration and intensity of headaches left him feeling changed. He became aggressive and volatile. His friends and family noticed drastic differences in his demeanor. The pain erupted five-months after his third deployment. Upset with a noisy neighbor, he grabbed a baseball bat from the front closet and stormed his neighbor's apartment. Quickly he found the source of the noise—loud music from the middle-school kid next door—and started swinging. Sergeant Jones struck repeatedly until his neighbor could barely move.

While Sergeant Jones's case is hypothetical, there are numerous civilian examples of criminals whose actions are triggered by brain abnormality or injury.[2] Neuroimaging research has increasingly intersected with criminal law trial practice in an effort to explain how cognitive brain functions influence criminal behavior.[3] As the popularity of neuroscience grows, military counsel must increase their understanding of neuroimaging and its potential at court-martial. Neuroscience should immediately impact sentencing considerations and the way military counsel view inquiries under Rule for Court-Martial (RCM) 706. Although the reliability of neuroimaging fails to meet current evidentiary standards,[4] the military may provide a solution to several common concerns with the legal relevance of neuroscience research.

Neuroscience research suggests that the military is at a heightened risk for creating examples like Sergeant Jones.[5] Neuroimaging-based studies have linked TBI to violent crime and deviant behavior.[6] Between 2000 and 2010, the Defense and Veterans Brain Injury Center reported 178,876 cases of TBI.[7] Despite current hurdles to the admissibility of neuroimaging evidence, it has potential to inform capacity

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[1] David Eagleman, *The Brain on Trial*, THEATLANTIC.COM, http://www.theatlantic.com/magazine/archive/2011/07/the-brain-on-trial/308520/2/?single_page=true (last visited Feb. 1, 2013).

[2] *See, e.g.*, Theodore Y. Blumoff & Emily Paavola, *Foreword: The Brain Sciences and Criminal Law Norms*, 62 MERCER L. REV. 705, 755 (2010) (mentioning the story of Phineas Gage). Gage is one of the first reported cases of modern neurology. *The Incredible Case of Phineas Gage*, NEUROPHILOSOPHY.COM, http://neurophilosophy.wordpress.com/2006/12/04/the-incredible-case-of-phineas-gage/ (last visited Feb. 1, 2013). Gage received severe injury to his brain during a railroad accident that lodged a tamping iron through his skull. *Id*. The incident and brain damage resulted in severe personality changes. *Id*. *See also* Adam Teitcher, Note, *Weaving Functional Brain Imaging into the Tapestry of Evidence: A Case for Functional Neuroimaging in Federal Criminal Courts*, 80 FORDHAM L. REV. 355, 361–62 (2011) (telling the story of Ron's case). Ron, an ordinary forty-year-old school teacher, suffered from uncontrollable urges and pedophilia due to a large tumor in his right frontal lobe. *Id*. Once Ron had the tumor removed, his urges dissipated. *Id*. Unfortunately, the tumor slowly returned. *Id*. As it grew so did Ron's urges. *Id*.

[3] Blumoff & Paavola, *supra* note 2, at 755. The article mentions Professor Adrian Raine as among the leading neuroscience researchers focused on understanding criminal behavior. *Id*. Professor Raine and similar researchers have shown that poor brain functions correspond with "impulsivity, loss of self control, and an inability to inhibit behavior—all conditions which conduce to criminal behavior." *Id*.

[4] *See, e.g.*, Zink v. Missouri, 278 S.W.3d 170, 178 (Mo. 2009); United States v. Mezvinsky, 206 F. Supp. 2d 661, 674 (E.D. Pa. 2002).

[5] *See* HANNAH FISCHER, CONG. RESEARCH SERV., RS22452, U.S. MILITARY CASUALTY STATISTICS: OPERATION NEW DAWN, OPERATION IRAQI FREEDOM, AND OPERATION ENDURING FREEDOM 2–3 (2010); Major Timothy P. Hayes, Jr., *Post-Traumatic Stress Disorder on Trial*, 190 MIL. L. REV. 67, 75–79 (2007); *see also* Kmarquize, *Study: Traumatic Brain Injury and Criminal Behavior*, HUBPAGES®, http://kmarquize.hubpages.com/hub/brain_injury_and_ criminal_behavior (last visited Feb. 1, 2013).

[6] Kmarquize, *supra* note 5.

[7] *See* FISCHER, *supra* note 5, at 3.

determinations, assist with determining mental responsibility, and suggest whether an accused possessed an appropriate level of criminal mens rea.[8] At a minimum, neuroimaging evidence may be introduced during sentencing to prove extenuation, mitigation, or aggravation.[9]

Looking to the future, the military holds a unique ability to support the development of neuroscience in the courtroom. The military's expansive population, medical entrance examination requirement, and focus on TBI provide the tools to combat several of the obstacles preventing the reliable legal application of neuroscience.

This article will first discuss some basic information about neuroimaging and its potential at court-martial. It will outline the technology supporting functional and structural neuroimaging and then detail neuroscience's likely impact on different areas of court-martial proceedings. It will walk through the foundational military statutes regulating capacity, mental responsibility, mens rea, and sentencing and explain their natural connection with neuroscience. Second, it will discuss current neuroimaging case law and address why counsel must be aware of the emerging field of neuroscience. Third, the article will highlight several of the influential drawbacks that prevent the admissibility of neuroscience evidence. Finally, it will speculate about the future of neuroimaging and recommend that the current military population base and focus on TBI could assist in the advancement of neuroscience.

## II. Neuroimaging Basics and Court-Martial Potential

Neuroscience creates hope in a greater understanding of the connection between the physical makeup of the brain and the thoughts generated by one's mind.[10] The vast potential surrounding neuroscience and its legal influence have stirred extensive academic debate and research.[11] Arguments range from calling for a complete overhaul of the way the law views intent-based crimes and their associated punishment to real world attempts to use functional imaging as a lie detection tool at trial.[12] More prominently, neuroscience has crept into trial practice as an aid to determine mens rea and mental capacity.[13] Discussions include neuroscience's useful place during the sentencing phase of trial as well.[14]

Military counsel must understand the basics of neuroimaging, realize its growing influence on the law, and prepare for its application at court-martial. Part A of this section will briefly discuss the common methods of neuroimaging and highlight the distinction between functional and structural images. Part B will then analyze the areas of court-martial practice neuroscience will likely influence, pinpoint the legal concepts of capacity, mental responsibility, and mens rea as neuroscience focus areas during the merits phase of trial. Part B concludes with a discussion of the use of neuroimaging during sentencing.

### A. Neuroscience Basics

Neuroimaging is a clinical specialty focused on producing non-invasive computer-generated images of the brain.[15] Often seen as a "window to the human brain,"[16] it attempts to develop a better understanding of the correlation between brain structure and human behavior.[17] Neuroimaging testing technology includes a wide range of technical tools using different methods aimed at obtaining functional and structural information about the brain.[18] The distinction between functional and structural neuroscience and the related imaging technology can impact trial strategy and admissibility.[19] Therefore, counsel must understand the

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[8] *See generally* Teneille Brown & Emily Murphy, *Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States*, 62 STAN. L. REV. 1119 (2010); Spencer Compton, *Not Guilty by Reason of Neuroimaging: The Need for Cautionary Jury Instructions for Neuroscience Evidence in Criminal Trials*, 12 VAND. J. ENT. & TECH. L. 333, 341–42 (2010); Nita A. Farahany, *Behavioral Genetics in Criminal Cases: Past, Present, and Future*, 2 GENOMICS, SOC'Y, AND POL'Y 72, 76 (2006).

[9] *See Zink*, 278 S.W.3d at 181 (recognizing evidence of organic brain abnormality as a mitigating factor during the penalty phase of trial); United States v. Kelley, 22 C.M.R. 723, 729 (C.G.B.R. 1956) (holding the accused's mental ability to adhere to the right as important sentencing evidence); *see also* Farahany, *supra* note 8, at 76.

[10] *See generally* Eagleman, *supra* note 1.

[11] *See, e.g.*, *The MacArthur Foundation Research Network on Law and Neuroscience*, LAWNEURO.ORG, http://www.lawneuro.org/ (last visited Feb. 1, 2013).

[12] *See* Eagleman, *supra* note 1 (discussing the need to reform sentencing procedures and punishment tools in order to accept rehabilitation measures associated with neuroscience); Henry T. Greely, *Neuroscience and Criminal Justice: Not Responsibility but Treatment*, 56 U. KAN. L. REV. 1103, 1103–06 (2008); Report and Recommendation, United States v. Semrau, No. 07-10074 M1/P, at 38–39 (W.D. Tenn. E. Div. 2010) [hereinafter Report and Recommendation] (recommending the exclusion of expert testimony based on functional magnetic resonance imaging (fMRI) testing as a tool for lie detection).

[13] Farahany, *supra* note 8, at 76.

[14] *Id*.

[15] Compton, *supra* note 8, at 339.

[16] *Id*.

[17] *Id*. at 334–35; *see also* Micahael S. Gazzaniga, *What Is Cognitive Neuroscience?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONSICE INTRODUCTION 2–4 (U. Cal. Santa Barbara 2010) (defining neuroscience as the field of scientific endeavor that is trying to understand how the brain enables the mind).

[18] *See* Scott N. MacMillan & Michael Vaughn, *Weighing Evidence of Brain Trauma or Disorder in Courts*, 46 CRIM. LAW BULL. NO. 3, art. 5, at 1 (2010).

[19] *See* Compton, *supra* note 8, at 339; Owen Jones et al., *Brain Imaging for Legal Thinkers: A Guide for the Perplexed*, 2009 STAN. TECH. L. REV. 5, ¶ 2, http://stlr.stanford.edu/pdf/jones-brain-imaging.pdf (last visited Feb. 1, 2013); *see also* Teitcher, *supra* note 2, at 363. "While structural imaging captures a snapshot of the brain at one point in time, functional imaging tracks patterns of metabolic activity in the brain over a period of time.

differences and the accompanying scientific complications.[20]

*1. Structural Imaging*

Similar to an x-ray, structural neuroimaging is used to show structural abnormalities in the brain itself.[21] Generally, computed tomography (CT) and magnetic resonance imaging (MRI) scanning are used to develop pictures of the brain's physical characteristics.[22] Physical characteristic differences can be used to detect trauma results, depict brain lesions, and advance the discovery and treatment of neurological diseases.[23] Depending on the extent to which the brain abnormality influences behavior, structural neuroimaging evidence could find its way into court-martial proceedings.[24]

Computed tomography scanning techniques push radiation through the body to develop a structural picture.[25] The pushed radiation encounters varying levels of density as it passes through different tissues in the body.[26] Researchers capture the variance on special film and create a picture of the body's internal structure.[27] The process is repeated from multiple angles around the body and compiled by computers to develop information about physical structure.[28] The images produced depict "damage, atrophy, intrusion, and developmental anomalies."[29]

Magnetic resonance brain-imaging uses a different scientific procedure to capture physical characteristics.[30] The patient is surrounded by electromagnetic coils and the components of a transceiver that create a strong magnetic field around the patient.[31] Additionally, the MRI creates several smaller magnetic fields that send and receive radio waves.[32] Within the atoms of the body, protons spin on an axis of the nuclei carrying a positive charge, and "[a]s they spin, these electric charges form what can be thought of as tiny magnets."[33] This normal occurrence is altered when a patient enters the MRI chamber.[34] The magnetic field forces the body's protons to align themselves.[35] Once aligned, the protons are hit with short, precise radio frequency pulses causing them to flip around temporarily altering their axes of spin.[36] The protons return to their original position after the pulses stop and give off a new energy picked up by the MRI coils.[37] The MRI is able to produce images from the energy information.[38]

*2. Functional Imaging*

Functional imaging captures an entirely different aspect of the brain than structural imaging: the function or activity in the brain.[39] "[I]t is critically important to understand that functional brain imaging . . . is not like taking a picture with your iPhone;"[40] rather, it captures an indirect understanding of brain activity by tracking patterns of blood flow and oxygen consumption in different areas of the brain.[41] Functional neuroimaging studies will generally attempt to pair a certain human behavior with increased activity in particular brain areas.[42] The industry is not standardized, however, and numerous methods for capturing functional brain images exist.[43]

Positron emission tomography (PET) and its associated single proton emission computed tomography (SPECT) measure brain functioning by injecting organic radioactive tracers into a patient's blood stream.[44] The tracers are

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Functional brain imaging is thus categorically different than structural brain imaging." *Id.*

[20] *See* Compton, *supra* note 8, at 339.

[21] Jones et al., *supra* note 19, ¶ 4.

[22] *Id*.

[23] Teitcher, *supra* note 2, at 361.

[24] *See supra* Part II.B (discussing neuroimaging within the context of the court-martial process); *see also* Compton, *supra* note 8, at 341. Attempts to introduce structural neuroimaging evidence in a criminal context include use during competency determinations, guilt, and sentencing. *Id*.; *see, e.g.*, Teitcher, *supra* note 2, at 357–62 (discussing two examples that suggest appropriate legal use for structural brain scans).

[25] Jones et al., *supra* note 19, ¶ 4.

[26] *Id*.

[27] *Id*.

[28] *Id*.

[29] *Id*.

[30] *Id*.

[31] *See* Marcus Raichle, *What Is an fMRI?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 5–7 (U. Cal. Santa Barbara 2010).

[32] Jones et al., *supra* note 19, ¶¶ 4–5.

[33] *Id*.; *see also* Raichle, *supra* note 31, at 5–7.

[34] *See* Jones et al., *supra* note 19, ¶¶ 4–5; *see also* Mathew Kalapurayil, *What Is MRI? How Does MRI Work?*, MEDICAL NEWS TODAY (Apr. 16, 2009, 4:00 PDT), http://www.medicalnewstoday.com/articles/146309.php.

[35] *See* Jones et al., *supra* note 19, ¶¶ 4–5; *see also* Kalapurayil, *supra* note 34.

[36] *See* Jones et al., *supra* note 19, ¶¶ 4–5.

[37] *Id*.

[38] *Id*.

[39] *See* Blumoff & Paavola, *supra* note 2, at 748–52.

[40] Raichle, *supra* note 31, at 6.

[41] *See* Jones et al., *supra* note 19, ¶¶ 4–5; Teitcher, *supra* note 2, at 363–64.

[42] *See* Jones et al., *supra* note 19, ¶¶ 4–5.

[43] *See id*.; *see aslo* Teitcher, *supra* note 2, at 362–69.

[44] *See* Jones et al., *supra* note 19, ¶¶ 4–5. Although similar to positron emission tomography (PET), single proton emission tomography (SPECT) uses single photon emission computed technology. *Id*. In SPECT the radioactive isotopes can be traced for longer periods and require fewer injections, but do not map the brain activity as accurately. Teitcher, *supra* note 2, at 364–65.

measured repeatedly over a short period of time as they flow through the patient's bloodstream and accumulate in different areas of the brain based on the brain's metabolic needs.[45] The adjustments are paired with different segments of the brain indicating brain functioning.[46]

Electroencephalography (EEG), magnetoencephalography (MEG), and quantitative electroencephalography (qEEG), apply another method to map brain functioning.[47] Non-invasive sensors are attached to a patient's scalp that measure electrical activity occurring near the patient's scalp.[48] The activity is monitored against different stimuli to gain inferences about brain processes.[49]

Despite the alternatives, functional magnetic resonance imaging (fMRI) is the most discussed method of functional neuroimaging within the legal community.[50] Functional magnetic resonance imaging detects blood movement in the brain using the same technology as MRI structural imaging discussed above.[51] Relying on the widely recognized principal that changes in oxygen demand are indicative of neural activity, fMRI traces neural activity by recording the movement of oxygen-carrying blood.[52] Since neurons require oxygen-carrying blood immediately after firing to replace spent energy, blood levels suggest fluctuating brain activity.[53]

Neuroimaging technology is able to trace the different magnetic properties in oxygenated blood and deoxygenated blood and monitor blood flow activity in small cubic volumes known as voxels.[54] The measurements indirectly capture adjustments in neuron activity.[55] Neuroscience studies attempt to measure and match increased neural activity in different areas of the brain as patients perform controlled behaviors.[56]

Patients undergoing fMRI examinations will enter the examination with the instruction to lie completely still.[57] The researcher will then enter a variable to elicit a change in neural activity.[58] The variable might be a specific physical behavior, answering questions, or visualizing some unknown.[59] Hundreds of recordings are made of each voxel during this process.[60] The activity within each voxel is measured over time and averaged.[61] The results are then overlapped with an anatomical image of the brain.[62] The final image "is a composite of an anatomical image, of the researcher's choosing, and a statistical representation of the brain activity in that image, also of the researcher's choosing."[63]

Every method of structural and functional imaging provides new insight into the physical brain and its relation to cognition.[64] The fascination with the inner workings of the brain and the opportunity for answers to the unknown immediately raise questions about the application of neuroscience in the law.

B. Additional Evidence of Capacity, Responsibility, and Thought

Criminal law and court-martial proceedings are not immune to this fascination. Already, criminal courts have considered neuroimaging evidence at different stages of trial.[65] Trial attorneys have litigated to include neuroimaging for mitigation, as an indicator of mental responsibility demonstrating the lack of capacity.[66] Military counsel would be remiss not to consider the potential of neuroscience as it relates to sentencing procedures at court-martial, mental responsibility inquiries, and the elements of criminal offenses. Thus, the following sections will address neuroimaging in relation to an accused's capacity to stand trial, mental responsibility, mens rea, and its use as

[45] *See* Jones et al., *supra* note 19, ¶¶ 4–5; Teitcher, *supra* note 2, at 362–69.

[46] *See* Jones et al., *supra* note 19, ¶¶ 4–5; Teitcher, *supra* note 2, at 362–69.

[47] *See* Jones et al., *supra* note 19, ¶¶ 4–5; Teitcher, *supra* note 2, at 362–69.

[48] *See* Jones et al., *supra* note 19, ¶¶ 4–5; Teitcher, *supra* note 2, at 362–69.

[49] *See* Jones et al., *supra* note 19, ¶¶ 4–5.

[50] *See* Brown & Murphy, *supra* note 8, at 1138 (stating that fMRI will "dominate older methods as courtroom evidence"); *see also* Compton, *supra* note 8, at 339–40 (describing fMRI as the most notable form of neuroimaging technology); Raichel, *supra* note 31, at 5 (noting PET and magnetic resonance imaging (MRI) as the two techniques at the forefront of neuroimaging research in humans); Teitcher, *supra* note 2, at 366 (describing fMRI as the "most prevalent method of functional brain imaging").

[51] *See* Jones et al., *supra* note 19, ¶¶ 4–5.

[52] *See id*.; Blumoff & Paavola, *supra* note 2, at 748–49.

[53] Brown & Murphy, *supra* note 8, at 1138 (explaining the principle commonly referred to as hemodynamic response).

[54] *Id*. This process is known as Blood Oxygen Level Dependent (BOLD) response. *Id*.

[55] *See* Jones et al., *supra* note 19, ¶¶ 4–5.

[56] *See id*.; Brown & Murphy, *supra* note 8, at 1139.

[57] *See* Brown & Murphy, *supra* note 8, at 1139.

[58] *Id*.

[59] *See id*.; Jones et al., *supra* note 19, ¶¶ 4–5.

[60] *See* Jones et al., *supra* note 19, ¶¶ 4–5.

[61] *Id*.

[62] *Id*.

[63] *Id*.

[64] *Id*.

[65] *See, e.g.*, McMurtey v. Ryan, 539 F.3d 1112 (9th Cir. 2008); People v. Weinstein, 591 N.Y.S.2d 715 (N.Y. Sup. Ct. 1992); Oregon v. Kinkel, 56 P.3d 463 (Or. Ct. App. 2002); United States v. Kasim, No. 2:07CR56, 2008 U.S. Dist. Lexis 89137 (N.D. Ind. 2008).

[66] *See, e.g.*, People v. Jones, 210 A.D.2d 904 (N.Y. App. Div. 1994); Zink v. Missouri, 278 S.W.3d 170 (Mo. 2009).

mitigation or aggravation evidence at sentencing.

*1. Capacity to Stand Trial*

Neuroscience likely will find that one of its quickest avenues into court-martial practice relates to an accused's capacity to stand trial. It will be most insightful in assessing the accused's current mental state at the time of trial. Furthermore, experts can easily integrate neuroimaging into mental capacity inquiries in conjunction with other relevant mental health indicators.[67] Under RCM 706, neuroscience can assist in determining whether an accused has the requisite mental ability to participate in a trial by providing the state of the accused's physical brain function and its link to his ability to stand trial.[68]

The rule of law in the United States places great value on an accused's ability to participate in criminal proceedings against him.[69] The Due Process Clause of the Fourteenth Amendment prohibits prosecution of an accused who does not have "sufficient present ability to consult with his lawyer with a reasonable degree of rational understanding and has 'a rational as well as factual understanding of the proceedings against him.'"[70] The Manual for Courts-Martial (MCM) echoes this critical right by requiring the accused's ability to cooperate intelligently in his defense before being brought to trial by court-martial.[71]

In furtherance of this important right, the MCM outlines a specific procedure for an inquiry into the mental capacity of the accused.[72] Rule for Court-Martial 706 requires any investigating officer, trial counsel, defense counsel, or military judge with reason to believe that the accused lacks the mental competence to stand trial to request an inquiry into the accused's mental condition.[73] In part, the inquiry must answer whether the accused is "presently suffering from a mental disease or defect rendering the accused unable to understand the nature of the proceedings against the accused or to conduct or cooperate intelligently in the defense."[74] An expert must make this determination.[75] Typically, a board consists of at least one psychiatrist or clinical psychologist, but at a minimum the board must consist of physicians or clinical psychologists.[76] The accused's ability to raise the issue of capacity does not fade. Evidence at trial may trigger an inquiry under RCM 706 and, if successful, delay proceedings until the accused develops the capacity to stand trial.[77]

Neuroscience fits cleanly into the process for determining the accused's current mental state. It can provide physical and functional brain variables that aid in the board's determination.[78] For instance, neuroimaging might uncover physical deficiencies such as tumors and areas of trauma.[79] Likewise, functional neuroimaging might discover abnormal blood flow patterns that suggest reduced functioning and capacity problems.[80] Logically, when capacity is an issue, the law requires a current assessment of brain function before the accused may face trial.[81] This natural connection places capacity determinations at the forefront of discussions relating to the use of neuroscience in the law.

*2. Mental Responsibility*

Lack of mental responsibility is an affirmative defense under the MCM.[82] The defense applies to any severe mental disease or defect that prevents an accused from appreciating the "nature and quality or the wrongfulness of his or her acts" at the time of the crime.[83] Naturally, this affirmative defense associates strongly with the potential application of neuroscience within criminal law.

Neuroscience attempts to relate the physical makeup or functioning of the brain to behaviors associated with decision-based activity. The law assumes that an accused is mentally responsible for his actions at the time of the crime, but will not hold someone accountable for involuntary acts.[84]

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[67] MANUAL FOR COURTS-MARTIAL, UNITED STATES, R.C.M. 909 (2012) [hereinafter MCM].

[68] *Id.* R.C.M. 706.

[69] *See* Missouri v. Anderson, 79 S.W.3d 420, 432 (Mo. 2002).

[70] State v. Johns, 34 S.W.3d 93, 104 (Mo. 2000) (citing and quoting Godinez v. Moran, 509 U.S. 389, 396 (1993)).

[71] MCM, *supra* note 67, R.C.M. 909(a). "No person may be brought to trial by court-martial if that person is presently suffering from a mental disease or defect rendering him or her mentally incompetent to the extent that her or she is unable to understand the nature of the proceedings against them or to conduct or cooperate intelligently in the defense of the case." *Id*.

[72] *Id.* R.C.M. 706.

[73] *Id*.

[74] *Id*.

[75] *Id.*

[76] *Id.*

[77] *Id*.; United States v. Estes, 62 M.J. 544, 548–49 (A. Ct. Crim. App. 2005). If a capacity issue is raised at trial, the accused must demonstrate, by a preponderance of the evidence, that he suffers from a mental disease or defect that renders him unable to appreciate and participate in the proceedings. MCM, *supra* note 67, R.C.M. 706.

[78] *See* Helen Mayberg, *Does Neuroscience Give Us New Insights into Criminal Responsibility*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 37–39 (U. of Cal. Santa Barbara 2010). For example, traumatic brain injury (TBI) has been liked to violent behavior. Kmarquize, *supra* note 5.

[79] *See* Mayberg, *supra* note 78, at 38–39.

[80] *See id*. at 38.

[81] MCM, *supra* note 67, R.C.M. 909(a).

[82] *Id.* R.C.M. 916(k)(1).

[83] *Id*.

[84] *Id.* R.C.M. 916(k)(3)(A).

If science could provide legally reliable evidence relating the involuntary nature of certain actions to physical evidence, it could reduce the potential for error associated with current methods of interpreting mental responsibility.[85]

Currently, courts-martial must maintain a presumption of mental responsibility until the accused establishes that he was not mentally responsible at the time of the offense.[86] Once raised, the proper authority should refer the issue of mental responsibility to an inquiry conducted under RCM 706.[87] Like an inquiry into capacity, a board of physicians and clinical psychologists interview the accused and consider his background, actions, and mental history to determine whether he was mentally responsible at the time of the alleged offense.[88] The unbiased physical insight accompanying neuroscience could provide information beyond the inconclusive answers to questions posed by experts and the accused's mental history.

Most likely, structural neuroimaging could aid the diagnosis of trauma injuries like TBI.[89] The physical abnormalities might trigger additional testing or suggest reduced responsibility.[90] For example, PTSD has been associated with reduced size and function in the hippocampus, an area of the brain associated with memory recall.[91] This association with reduced memory can also impact an individual's fear response under certain circumstances.[92] It is not unreasonable to suggest that neuroimaging research could develop relationships between particular brain activity and violent behavior, deception, or the ability to process information that would assist mental responsibility determinations.[93]

*3. Mens Rea*

Defendants are more commonly seeking to offer neuroscience evidence as a means to negate the mens rea element of an alleged crime.[94] A criminal conviction often requires elements of behavior (actus reus) and thought (mens rea).[95] While a person's physical actions are easily observable and articulated at trial, determining the level of intent associated with the actions provides a more ambiguous challenge. Neuroscience increases the hope of inserting a definitive explanation into the process of "coupling a particular state of mind (or level of deliberation) with the criminal act."[96]

The use of neuroscience evidence as a potential means to negate a mens rea element is a fact-specific, crime-specific analysis.[97] Referred to as partial mental responsibility in the RCM, evidence showing that an accused had a mental condition affecting but not negating his ability to have a specific state of mind to commit a specific offense is not an affirmative defense.[98] It has potential, however, during the guilt or innocence phase of trial, to create reasonable doubt.[99] An accused unable to meet the requisite intent should not be convicted because he has not met an essential element of the crime.[100] For example, in *United States v. Mezvinsky*,[101] the defendant attempted to introduce a PET scan to show his inability to knowingly make false statements as required by the elements within fraud charges against him.[102] Although the court recognized the possibility of connecting diminished brain function to the elements of fraud, it excluded the evidence because Mezvinsky's experts could not connect his current mental ability to his level of knowledge at the time of the offenses.[103]

The current model instruction in the Military Judges' Benchbook on circumstantial evidence links mens rea directly to the imprecision of indirect, circumstantial evidence: "Direct evidence of intent is often unavailable.

[85] *See* Frederick Schauer, *Can Bad Science Be Good Evidence? Neuroscience, Lie Detection, and Beyond*, 95 CORNELL L. REV. 1191, 1207, 1215, 1218–19 (2010). Reliability standards in science and law may be drastically different because each has different goals. *Id*. at 1214. Courts must maintain an error rate standard sufficient for the trier of fact, not for scientific validity. *Id*. at 1207, 1214–15.

[86] MCM, *supra* note 67, R.C.M. 916(k)(3)(A). The accused must establish the he was not mentally responsible at the time of the alleged offense by clear and convincing evidence. *Id*.; *see also* United States v. Estes, 62 M.J. 544, 548–49 (A. Ct. Crim. App. 2005).

[87] MCM, *supra* note 67, R.C.M. 916(k)(3)(B).

[88] *Id*. R.C.M. 706; *see* Major Jeff Bovarnik, *Trying to Remain Sane Trying an Insanity Case:* United States v. Thomas S. Payne, ARMY LAW., June 2002, at 13.

[89] Interview with Colonel Rick Malone, U.S. Army, Dir., Ctr. for Forensic Behavioral Sci. Forensic Psychiatry, in Washington, D.C. (Mar. 1, 2012) [hereinafter Malone Interview].

[90] *Id*.

[91] *Id*.; *see also* Matthew Tull, *The Effect of PTSD on the Brain*, ABOUT.COM, http://ptsd.about.com/od/symptomsanddiagnosis/a/hippo-campus.htm (last viewed Feb. 1, 2013).

[92] Malone Interview, *supra* note 89; *see also* Tull, *supra* note 91.

[93] *See* Mayberg, *supra* note 78, at 37; *see also* AnthonyWagner, *Can Neuroscience Identify Lies?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 13 (U. of Cal. Santa Barbara 2010).

[94] *See* Jones et al., *supra* note 19, ¶ 2.

[95] *See* Brown & Murphy, *supra* note 8, at 1128–29.

[96] *Id*.

[97] *See* Jones et al., *supra* note 19, ¶¶ 5–6.

[98] MCM, *supra* note 67, R.C.M. 916(k)(2). The discussion states, "evidence of a mental condition not amounting to a lack of mental responsibility may be admissible as to whether the accused entertained a state of mind necessary to be proven as an element of the offense." *Id*. R.C.M. 916(k)(2) discussion.

[99] *See* Farahany, *supra* note 8, at 72–73.

[100] *See id*.

[101] 206 F. Supp. 2d 661, 67 (E.D. Pa. 2002). *See also* People v. Weinstein, 591 N.Y.S.2d 715 (N.Y. Sup. Ct. 1992) (finding brain defect evidence in support of an argument that the accused was not responsible for strangling his wife and throwing her from a twelfth floor window admissible).

[102] *See Mezvinsky*, 206 F. Supp. 2d at 662–63.

[103] *See id*. at 665, 677.

The accused's intent, however, may be proved by circumstantial evidence. In deciding this issue, [the panel] must consider all relevant facts and circumstances."[104] Since one cannot x-ray a person's mind to determine what he was thinking at the time of the crime, fact-finders must infer intent through acts and words.[105] Advances in neuroscience may provide an opportunity to eliminate the guessing game fact-finders play while evaluating mens rea elements by linking behavior to identifiable brain functions at the time of the offense without inference.

*4. Sentencing Phase*

The military considers rehabilitation of the accused, general deterrence, specific deterrence of misconduct, and social retribution as the generally accepted sentencing philosophies.[106] Trial counsel may present matters in aggravation "directly relating to or resulting from offenses which the accused has been found guilty."[107] Defense may present matters in extenuation—explaining the circumstances surrounding the offense—and mitigation to support a recommendation of clemency in sentencing.[108] Furthermore, the military judge may relax the rules of evidence during sentencing upon defense request.[109]

Neuroscience evidence is useful in many areas of military sentencing. Trial counsel may argue that brain images demonstrate a propensity for violence and suggest that there is minimal potential for rehabilitation given the accused's brain condition. Or, he may attempt to argue that the accused has a diminished ability to understand the wrongfulness of his actions and recommend prolonged confinement to promote the protection of society. Hypothetically, a shrinking hippocampus associated with diminished brain functioning and memory failure suggests reduced behavioral control. If true, everyday activity could trigger uncontrolled violence, limiting accused's rehabilitative potential and the legal system's ability to deter his specific behavior.

Several significant hurdles exist, however, preventing the admission of neuroimaging evidence by the government.[110] Rule for Courts-Martial 1001(b)(4) places restrictions on evidence in aggravation: the government aggravation evidence must demonstrate a direct adverse impact "immediately resulting from the accused's offense."[111] Without a connection to the offense, the government may not introduce neuroimaging evidence.[112] Additionally, government counsel may attempt to introduce evidence of rehabilitative potential.[113] This evidence is substantially limited as well.[114] Witnesses may give a brief "yes" or "no" answer as to whether the accused possesses rehabilitative potential and succinctly address the "magnitude or quality" of that potential.[115] Rule for Courts-Martial 1001(b)(5) ensures the accused receives an individualized sentencing proceeding.[116] If the government introduces rehabilitative potential evidence, it must relate to the accused's "character, performance, and potential."[117] Testimony on rehabilitative potential must be accompanied by sufficient foundation to demonstrate knowledge of the accused's character and potential.[118] This threshold presents several problems for the government. First, the accused has control over his brain. Just as an accused may limit the government's access to rehabilitative potential information by "simply not talking to anyone about his case," he could simply deny access to brain imaging. Second, neuroimaging may not qualify as information about the accused's "character, moral fiber, and determination to be rehabilitated."[119] A neuroimaging expert would explain test results, which might fail to assess the deeper understanding of the accused's personality contemplated by R.C.M. 1001(b)(5).

Conversely, defense may attempt to show extenuation arguing that under the circumstances the accused could not understand or control his actions; perhaps the accused requires treatment and not punishment.[120] Neuroscience may support counsel's argument that enhanced punishment would not assist in any general or specific deterrence under the circumstances.

As early as 1956, military courts recognized neurological evidence as a mitigating factor during

[104] U.S. DEP'T OF ARMY, PAM. 27-9, MILITARY JUDGES' BENCHBOOK para. 7-3 (1 Jan. 2010).

[105] Brown & Murphy, *supra* note 8, at 1122 (quoting HOWARD LEVENTHAL, CHARGES TO THE JURY AND REQUESTS TO CHARGE IN A CRIMINAL CASE IN NEW YORK § 4:18 (2009)).

[106] MCM, *supra* note 67, R.C.M. 1001(g).

[107] *Id.* R.C.M. 1001(b)(4).

[108] *Id.* R.C.M. 1001(c)(1)(A) & (B).

[109] *Id.* R.C.M. 1001(c)(3).

[110] *See infra* Part III.B.

[111] MCM, *supra* note 67, R.C.M. 1001(b)(4).

[112] *Id.*

[113] *Id.* R.C.M. 1001(b)(5).

[114] *Id.*

[115] *Id. See also* Edward J. O'Brien, *Rehabilitative Potential Evidence: Theory and Practice*, ARMY LAW., Aug. 2011, at 5. Rule for Court-Martial 1001(b)(5) contemplates one question and a concise answer as to whether the accused has "good, no, some, little, great, zero, much . . . potential for rehabilitation." *Id.* at 7.

[116] *Id.* at 8.

[117] *Id.*

[118] *Id.*

[119] *Id.*

[120] MCM, *supra* note 67, R.C.M. 1001(c).

sentencing. In *United States v. Kelley*,[121] the U.S. Coast Guard Board of Review found the accused sane after a detailed neuropsychiatric evaluation.[122] But, the court acknowledged the accused's diminished ability to adhere to the right conduct and reduced his sentence.[123] The theory is present in civilian courts as well.[124] In *Crook v. State*,[125] the Florida Supreme Court vacated a death sentence because the lower court did not properly consider the effect of the accused's organic brain damage in sentencing.[126] Arguably less culpable, Crook's brain damage "predisposed him to fits of violence."[127]

The relaxation of the rules of evidence during sentencing may encourage admission and allow counsel to avoid admissibility hurdles often associated with neuroimaging.[128] Although enticing to quickly apply neuroscience at trial as a "terrific, new, wiz-bang technology—which can reveal inner structures and workings of the brain,"[129] counsel must cautiously consider the particular relevance and reliability of brain-images as they relate to particular facts and circumstances.[130] Neuroscience may act as a double-edged sword ready to operate in favor of either side.

## III. Neuroimaging—Current Criminal Law Admissibility

Historically, some courts have admitted brain imaging evidence introduced in support of successful mental responsibility defenses.[131] Athletes, after years of compounding head impact injury, have relied on the possibility of brain trauma evidence to explain violent and criminal behavior.[132] The future promises detailed insight into links between physical brain function and control over one's action.[133] Indeed, the law requires access to examinations that assist in the evaluation, preparation, and presentation of a defense "when a defendant demonstrates to the trial judge that his sanity at the time of the offense is to be a significant factor at trial."[134] The future of neuroscience must balance this right against its own relevance and reliability at trial. Despite the hope associated with neuroimaging, steep hurdles exist that may prevent the admissibility and effective use of neuroscience in court.[135]

Persuasive use of neuroimaging involves decisions regarding the appropriate forum in which to introduce evidence supporting brain injury and functioning. This section will outline current standards of admissibility required for expert testimony centered on neuroimaging. It will then map out the shortcomings of neuroscience as a predictor of intentional criminal behavior. Finally, it will suggest that the best fit for neuroscience during courts-martial is as an aid to RCM 706 inquiries and during the sentencing phase of trial.

### A. Are Counsel Obligated to Look into the Brain?

The increased emphasis on neuroimaging begs the question whether counsel are obligated to affirmatively seek neuroimaging evidence. The genesis of this possibility stems from the U.S. Supreme Court decision in *Ake v. Oklahoma*.[136] Certainly, when mental impairment is an issue, courts impose additional requirements on counsel.[137] The expectation for counsel to consider neuroimaging evidence will rise as its popularity and use increase. Under the right circumstances, a failure to request brain scans will amount to ineffective assistance of counsel (IAC).

In *Ake*, the U.S. Supreme Court addressed whether the "Constitution requires that an indigent defendant have access

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[121] 22 C.M.R. 723 (C.G.B.R. 1956).

[122] *See id.* .at 729.

[123] *Id*. Additionally, defense counsel regularly present post-traumatic stress disorder (PTSD) diagnoses as extenuation evidence during sentencing. *See* Hayes, *supra* note 5, at 102–04. Being careful not to raise an affirmative defense, counsel may suggest leniency because of the impact PTSD has on an accused's judgment and behavior. *Id*.

[124] *See, e.g.*, Robinson v. Johnson, 151 F.3d 256 (5th Cir. 1998); People v. Sapp, 73 P.3d 433 (Cal. 2003).

[125] 908 So.2d 350 (Fla. 2005).

[126] *Id*. at 358–59.

[127] Farahany, *supra* note 8, at 73.

[128] *See infra* Part III.B; MCM, *supra* note 67, R.C.M. 1001(c)(3).

[129] Jones et al., *supra* note 19, ¶ 5.

[130] *See id*.

[131] *See* Teitcher, *supra* note 2, at 401. In defense of John Hinckley's attempted assassination of Ronald Reagan, the judge allowed expert testimony and computer axial tomography (CAT) scan images of Hinckley's brain suggesting abnormal atrophy and organic brain disease. *Id*. The jury found Hinckley not guilty by reason of insanity. *Id*.

[132] Mary Kate Malone, *Ex-Notre Dame Coach Brown Offers Mental Disease Defense*, SOUTH BEND TRIBUTE.COM (November 30, 2011), http://articles.southbendtribute.com/2011-11-30/news/30461383_1_insanity-defense-mental-state-corwin-brown (last visited Feb. 1, 2013). Corwin Brown, a former college and NFL defensive back, faces charges of confinement and domestic battery in Granger, Indiana. *Id.* Corwin plans to use an insanity defense and will receive psychological testing to help determine whether his actions were related to head trauma linked to college football and his eight-year National Football League career. *Id*.

[133] *See* Greely, *supra* note 12, at 1103–04 (representing the belief that neuroscience will dramatically change the criminal justice system); *but see* Stephen J. Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO ST. J. CRIM. L. 397 (2006).

[134] Ake v. Oklahoma, 470 U.S. 68 (1985); *see also* United States v. Mustafa, 22 M.J. 165, 169 (1986) (adopting the *Ake* standard for military courts).

[135] *See* Read Montague, *How Is Neuroscience Likely to Impact Law in the Near Future?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 60 (Univ. Cal. Santa Barbara 2010).

[136] 470 U.S. 68 (1985).

[137] *See, e.g.*, Porter v. McCollum, 130 S. Ct. 447 (2009) (requiring counsel to seek expert assistance because the accused had questionable mental health); *see also* United States v. Kreutzer, 61 M.J. 293 (C.A.A.F. 2005).

to the psychiatric examination and assistance necessary to prepare an effective defense based on his mental condition, when his sanity at the time of the offense is seriously in question."[138] The Court's conclusion that our system of justice entitled Ake to psychiatric assistance in forming his defense relied heavily on "the pivotal role that psychiatry has come to play in criminal proceedings."[139] Specifically, the Court embraced the value of expert testimony in its finding that fundamental fairness entitles defendants to an "opportunity to present their claims fairly within the adversary system."[140]

In 1999, the Tenth Circuit applied *Ake* to neurological testing.[141] That court believed that a history of severe physical and sexual abuse combined with lengthy periods of hospitalization and diagnosed schizophrenia were sufficient to trigger the application of *Ake*.[142] Accordingly, the state should have provided CT scans to rule out brain abnormalities.[143] Furthermore, the court alluded to expansion of the right to introduce psychiatric testimony into competency determinations and sentencing.[144]

*Ake's* holding is expanding to include neurological expert assistance as well. In *People v. Jones*,[145] the New York Supreme Court, Appellate Division, found abuse of discretion in the denial of neurological testing for a defendant who sustained traumatic head injury as a child and produced evidence of a thirty-year history of alcoholism.[146] The court enforced Willie Jones's right to introduce expert opinion relating his reduced cognitive ability to the element of intent.[147] More recently, the Ninth Circuit determined that "without medical expert opinion testimony" discussing the impact of the accused's retardation and brain tumor on predisposition, the defense could not properly address its entrapment defense.[148]

Neuroimaging has also been tied to high profile cases like *United States v. Hinckley*.[149] The jury found John Hinckley not guilty by reason of insanity after considering CAT scan evidence that suggested organic brain disease.[150] Additional cases demonstrate the use of neuroscience in decisions finding accused incompetent to stand trial and as a tool to inspire leniency.[151] An expectation for counsel to consider neuroimaging evidence should follow its increased popularity and use.

Court-martial practice should experience an expansion in the reliance on neuroimaging evidence much like that exhibited in civilian courts. In 1986, the U.S. Court of Military Appeals (CMA) adopted the holding in *Ake*.[152] The CMA stated that there "can be no question that a military accused is entitled to have equal opportunity with the Government to obtain witnesses to assist him in his defense" and reiterated the *Ake* standard.[153]

In cases with sanity at issue, military courts have carefully protected the accused's right to due process under the Sixth Amendment.[154] In *United States v. Kreutzer*,[155] the Court of Appeals for the Armed Forces (CAAF) demonstrated this protection by finding that the trial judge erroneously denied Sergeant William Kreutzer a capital mitigation specialist.[156] In its decision, the CAAF suggested that the importance of the mental health mitigation specialist went beyond exploration of diminished capacity.[157] The court reasoned that "[p]roperly prepared and presented

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[138] *Ake*, 470 U.S. at 70.

[139] *Id*. at 78–82 (quoting Ross v. Moffitt, 417 U.S. 600, 612 (1974)).

[140] *Id*. The Court seemed heavily influenced by the factual background supporting Ake's mental instability claims. *Id*. His bizarre behavior at arraignment prompted a competency determination, and a state psychiatrist found Ake incompetent to stand trial. *Id*. Once Ake was found competent, he was heavily sedated. *Id*. These facts, combined with the importance of the insanity defense to Ake's case, led the Court to decide that Ake had been denied due process because he was not provided psychiatric assistance. *Id*.

[141] Walker v. Attorney Gen. for the State of Okla., 167 F.3d 1339, 1348 (10th Cir. 1999); *but see* Bates v. Florida, 750 So. 2d 6, 17 (Fla. 1999) (holding that the court did not violate *Ake* by not appointing organic brain experts to conduct a MRI and CAT scan).

[142] *See Walker*, 167 F.3d at 1341–42, 1348.

[143] *Id*. at 1348.

[144] *Id*.; *see also* Compton, *supra* note 8, at 342.

[145] 210 A.D.2d 904 (N.Y. App. Div. 1994).

[146] *Id*. at 904.

[147] *Id*.

[148] United States v. Sandoval-Mendoza, 472 F.3d 645, 655–56 (9th Cir. 2006).

[149] 525 F. Supp. 1342, 1348 (D.D.C. 1981).

[150] *See id.* at 1348.

[151] *See* United States v. Kelley, 22 C.M.R. 723, 724 (C.G.B.R. 1956) (considering neuropsychiatric evaluation as early as 1956 to reduce the accused's sentence); United States v. Kasim, No. 2:07CR56, 2008 WL 4822291, at *10–11, 20 (N.D. Ind. 2008) (relying in part on SPECT scans showing reduced blood flow to the temporal lobes to find the defendant incompetent to stand trial).

[152] United States v. Mustafa, 22 M.J. 165, 168–69 (C.M.A. 1986).

[153] *Id*. The court quoted the *Ake* standard that due process requires "that when a defendant demonstrates to the judge that his sanity at the time of the offense is to be a significant factor at trial," the accused is entitled to "access to a competent psychiatrist that will conduct an appropriate examination and assist in evaluation, preparation, and presentation of the defense." Ake v. Oklahoma, 470 U.S. 68, 74 (1985).

[154] United States v. Kreutzer, 61 M.J. 293, 295 (C.A.A.F. 2005). "Compulsory process, equal access to evidence and witnesses, and the right to necessary expert assistance in presenting a defense are guaranteed to military accuseds." *Id*.

[155] 61 M.J. 293 (C.A.A.F. 2005).

[156] *Id.* at 295. Sergeant Kreutzer requested a mental health specialist to address specific personality disorders. *Id*. at 301.

[157] *Id*.

testimony . . . could go beyond demonstrating diminished capacity and be a substantial part of a defense against the premeditation element" of premeditated murder.[158]

As neuroscience expands and its use at trial becomes more popular, counsel must acknowledge its utility. As the courts have already experienced, neuroimaging case law regularly focuses on IAC issues questioning counsel's failure to consider neuroimaging evidence as a trial tool.[159] Since counsel do not regularly consider neuroimaging evidence, issues arise on appeal questioning the absence of neuroscience at trial.[160] For instance, counsel could see consequences like those displayed in *Porter v. McCollum*.[161] The U.S. Supreme Court found Porter's counsel deficient for their failure to investigate and present evidence of Porter's mental health, family background, and military service.[162]

Although neuroscience is currently viewed as a discretionary trial tool that might assist in complex cases, it is a growing science. As neuroimaging refines itself, the legal gap between choosing neuroscience and mandating its use will likely shrink quickly. The transition of neuroimaging evidence should parallel legal changes requiring mental health evidence. At some point, neuroimaging and mental health will become so intertwined that the Court's decision in *Ake* will extend neuroimaging as well.[163] Ultimately, the law and neuroimaging will collide by mirroring *Porter* and result in IAC for counsel's failure to examine the brain.[164]

B. Theory, Purpose, and Use

The accused's right to seek psychiatric evaluation to assist in the defense does not ensure admissibility, however. Admission of expert testimony, like that associated with neuroimaging, must undergo careful judicial scrutiny before admission.[165] Since appellate courts review the military judge's decision to allow expert testimony for abuse of discretion,[166] she will act as the primary gatekeeper in determining whether to admit neuroimaging testimony.[167] This section will address the standards for admission of neuroscience-based expert testimony that are intended to safeguard fact-finders from unreliable or irrelevant expert testimony.

During court-martial, the military judge may admit expert testimony if: (1) the expert possesses appropriate qualifications; (2) the expert will testify regarding subject matter appropriate for expert testimony; (3) the court finds there is a basis for the expert testimony; (4) the testimony is relevant; (5) the evidence is reliable; and (6) the evidence's probative value outweighs other considerations.[168] In *Daubert v. Merrell Dow Pharmaceuticals Inc.*,[169] the U.S. Supreme Court outlined five additional factors that should be considered before determining whether scientific testimony is reliable.[170] The technique should be (1) testable, (2) have a definable error rate, (3) be subject to peer review, and (4) have a standardized technique.[171] Fifth, judges may also consider the technology and methodology's general acceptance in the scientific community.[172]

Commentator Edward Imwinkelried has paired these requirements into three gate-keeping questions for the trial judge.[173] First, the trial judge must determine "the specific theory or technique that the expert proposes to rely on as the basis for his or her opinion."[174] Next, the judge must define the particular purpose for the specific technique proposed.[175]

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[158] *See id*.

[159] *See, e.g*., Zink v. State, 278 S.W.3d 170 (Mo. 2009); United States v. Gray, 51 M.J. 1 (C.A.A.F. 1999); *see generally* MacMillan & Vaughn, *supra* note 18 (summarizing a number of neuroimaging-based cases appealed for ineffective assistance of counsel).

[160] *See generally* MacMillan & Vaughn, *supra* note 18 (summarizing a number of neuroimaging based cases appealed for ineffective assistance of counsel).

[161] 130 S. Ct. 447 (2009).

[162] *Id*. at 453. Porter suffered from brain abnormality and cognitive defects. *Id*. He also grew up in an abusive family and experienced harsh combat in the Korean War. *Id*. at 448–49.

[163] *See* Ake v. Oklahoma, 470 U.S. 68, 70 (1985) (requiring access to psychiatric examination and assistance).

[164] *See Porter*, 130 S. Ct. 477 (finding ineffective assistance of counsel for failure to examine the accused's mental health).

[165] *See* Brown & Murphy, *supra* note 8, at 1174–76 (introducing the evidentiary cycle neuroimaging evidence must circle prior to admission). The deciding judge must consider case law standards, Federal Rules of Evidence (FRE) 702, and 403. *Id*.

[166] United States v. Sandoval-Mendoz, 472 F.3d 645, 652 (9th Cir. 2006); United States v. Griffin, 50 M.J. 278, 283–84 (C.A.A.F. 1999).

[167] *Sandoval-Mendoz*, 472 F.3d at 652; *Griffin*, 50 M.J. at 283–84.

[168] *See* MCM, *supra* note 67, MIL. R. EVID. 401, 402, 403, 702, 703; *see also* United States v. Houser, 36 M.J. 392, 397 (C.M.A. 1993) (outlining the six factors a military judge should consider before admitting expert testimony); United States v. Gipson, 24 M.J. 246 (C.M.A. 1987) (addressing the reliability of expert testimony).

[169] 509 U.S. 579 (1993).

[170] *Id*. at 593; *see also* Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999) (extending the test established in *Daubert* to non-scientific experts).

[171] *Daubert*, 509 U.S. at 593.

[172] *Id*.

[173] Edward J. Imwinkelried, *Serendipitous Timing: The Coincidental Emergence of the New Brain Science and the Advent of an Epistemological Approach to Determining the Admissibility of Expert Testimony*, 62 MERCER L. REV. 959, 975–78 (2011). Imwinkelried compares the timing of the Supreme Court's decision to move away from the general acceptance approach as a proxy for the reliability test established in *Frye* and toward the current approach. *See id*. He suggests that the test in *Frye* was unsuited to deal with brain imaging evidence; therefore, the Court moved to a test that would more carefully scrutinize expert reliability. *Id*.

[174] *Id*. at 975.

[175] *See id*. at 977.

Finally, the trial judge must consider "whether the expert presented enough methodologically sound empirical reasoning to validate that particular use of the specific theory."[176]

This approach is helpful because courts often intertwine reliability, relevance, and probative value when evaluating the admissibility of expert testimony and neuroimaging evidence. Relying on *Daubert* and the Federal Rules of Evidence (FRE) or the Military Rule of Evidence (MRE) 702, courts generally begin by testing reliability.[177] The reliability analysis includes consideration of portions of the *Daubert* factors as they apply to the case's factual background.[178] "The test of reliability is 'flexible,' and *Daubert's* list of specific factors neither necessarily nor exclusively applies to all experts or in every case,"[179] but must be tailored to the facts of the particular case.[180] Reliability must also focus on the scientific principles used in generating tests and methodology, not the conclusions drawn by the expert.[181] Although this focus makes the scientific testing particularly important, it also requires a close nexus between reliability and relevance to the testimony sought in the specific case. The testimony must "fit" the issue before the court.[182]

The "fit" test allows reliability to quickly bleed into a concurrently applied relevance test.[183] The reliability of scientific evidence like neuroimaging must be "valid for the purposes for which it is being offered."[184] There must be a "logical nexus between the data and the ultimate conclusions."[185] The reliability of the scientific method must "fit" the purpose for which it is being offered, and the data must be valid for that purpose.[186] This link between testing, testimony, and purpose blends the analysis of relevance and reliability.[187] As a result, it allows courts to determine that there "is simply too great an analytical gap between the data and the opinion proffered."[188]

For example, researchers may develop neuroimaging tests to evaluate functioning under stressful conditions. The test may insert stressors like violent images or complicated tasks on a calm patient to analyze their impact on functioning. Although the results may be fascinating in the research setting, they are not reliable in predicting specific behavior or relevant to the accused's criminal conduct. Instead, the test should recreate a behavioral trigger to meet the "fit" test.[189] If a patient suffers from PTSD associated with loud noises or a specific object, a better nexus might include testing in relation to those specific triggers.[190]

Finally, courts balance relevance standards under FRE 401 and FRE 403. Although the *Daubert* factors are "not intended to be exhaustive or unduly restrictive," courts are able to evaluate the potential of neuroimaging evidence to mislead fact-finders.[191] Courts have come to different conclusions under FRE 403, depending on the particular phase of trial and attempted use of neuroimaging evidence.[192]

In 2009, a Hawaii court allowed neuroimaging-based expert testimony.[193] After its FRE 403 balance, the court permitted the experts to discuss a defendant's ability to reason, learn from experience, and interact independently in a social setting.[194] However, the court prohibited the experts from testifying to the ultimate conclusion: whether the defendant possessed the requisite mens rea.[195] Its opinion explained that expert testimony would be "significantly

[176] *Id*. at 978.

[177] *See* FED. R. EVID. 702; MCM, *supra* note 67, MIL. R. EVID. 702; *see also* Saldana v. Kmart Corp., 260 F.3d 228, 232 (3d Cir. 2001); United States v. Mezvinsky, 206, F. Supp. 2d 661, 666 (E.D. Pa. 2002); United States v. Griffin, 50 M.J. 278, 284 (C.A.A.F. 1999); United States v. Houser, 36 M.J. 392, 398 (C.M.A. 1993).

[178] *See Houser*, 36 M.J. at 398.

[179] Kumho Tire Co. v. Carmichael, 526 U.S. 137, 141–42 (1999). "*Daubert* makes clear that the factors it mentions do not constitute a 'definitive checklist or test.'" *Id*. at 150 (quoting Daubert v. Merrell Dow Pharm. Inc., 509 U.S. 579, 593 (1993)).

[180] *See* Report and Recommendation, *supra* note 12, at 23.

[181] *See* Clausen v. M/V New Carissa, 339 F.3d 1049, 1056 (9th Cir. 2003); United States v. Williams, No. CR 06-00079 DAE-KSC, 2009 WL 424583 (D. Haw. 2009).

[182] *See Daubert*, 509 U.S. at 591; *see also* United States v. Mezvinsky, 206 F. Supp. 2d 661, 666 (E.D. Pa. 2002).

[183] *See Daubert*, 509 U.S. at 591(describing the "fit" requirement as primarily a relevance determination); *see also* United States v. Green, 405 F. Supp. 2d 104, 119 (D. Mass. 2005) (relating the "fit" test to reliability).

[184] *Green*, 405 F. Supp. 2d at 119.

[185] Brown & Murphy, *supra* note 8, at 1178.

[186] *See Green*, 405 F. Supp. 2d at 119; Brown & Murphy, *supra* note 8, at 1178.

[187] United States v. Williams, No. CR 06-00079 DAE-KSC, 2009 WL 424583, at *4 (D. Haw. 2009) (stating, "testimony which does not relate to any issue in the case is not relevant, and ergo, non-helpful" in its discussion of the "fit" test).

[188] Gen. Elec. Corp. v. Joiner, 522 U.S. 136, 146 (1997).

[189] *See* Daubert v. Merrell Dow Pharm. Inc., 509 U.S. 579, 591 (1993).

[190] *See* Imwinkelried, *supra* note 173, at 983–86.

[191] *See* Clark v. Arizona, 548 U.S. 735, 775 (2006) (contrasting mental disease evidence used for capacity determinations with its ability to inform jurors about mens rea without being unfairly prejudicial); *see also* Sullivan v. U.S. Dep't of the Navy, 365 F.3d 827, 834 (9th Cir. 2004).

[192] *See, e.g.*, *Williams*, 2009 WL 424583 at *4; Report and Recommendation, *supra* note 12, at 33–38.

[193] *Williams*, 2009 WL 424583 at *19. Williams, charged with murdering his five-year-old daughter, sought to introduce evidence of his borderline intellectual functioning to demonstrate his inability to form the required intent. *See generally id*.

[194] *See id*. at *19.

[195] *See id.* at *17.

probative on the issue of whether Defendant could have formed the requisite mens rea,"[196] but FRE 704(b) prevents testimony that "compels the ultimate conclusion of whether a defendant had the mens rea at the time of the offense."[197] Likewise, in 2006, the Ninth Circuit reversed a case to ensure that the defendant was able to present MRI evidence of a brain tumor.[198] The evidence addressed his predisposition as it related to his entrapment defense.[199] The court believed the jury could not evaluate the merits of the defendant's claim without the expert testimony.[200]

Others considered the appeal of neuroimaging evidence dangerous, like a shiny new toy captivating the attention of jurors and preventing them from focusing on the limitations of neuroscience studies.[201] This belief that the colorful brain images produced through neuroimaging will impress jurors to a degree that they will not adequately evaluate the testimonial explanation of the images is often referred to as the "Christmas tree phenomenon."[202] The suggested phenomenon creates an even greater problem if jurors believe the images provide explanation beyond the science's capabilities. If flashy photographs overpower questionable expert testimony, panels might rely solely on neuroimaging to draw conclusions on ultimate issues that such evidence should not ordinarily support.[203] An overreliance on neuroscience could spark concerns under MRE 704, which prevents testimony answering the ultimate issue before the fact-finder.[204]

Judges must balance the reliability and relevance of the testing,[205] counsel's ability to critically cross-examine experts in the neuroscience arena,[206] and the illusion of exactness brain testing provides when testing the "Christmas tree phenomenon."[207] As all the pieces of admissibility intertwine, Imwinkelried's three-step analysis for evaluating neuroimaging evidence provides a simple framework for this legally complex, factually intense area by focusing the *Daubert* analysis.[208] In relation to neuroscience, it requires acknowledgment of the particular brain imaging technique, understanding of the techniques application, and scrutiny of the scientific reasoning linking expert opinion evidence to specific research.[209]

C. Hurdles to Neuroscience Admissibility

As discussed above, before developments in neuroimaging are considered in court, they must satisfy the expert testimony factors established in *Daubert*[210] and adhere to applicable rules of evidence.[211] Once admitted, the evidence must then persuade the fact-finder.[212] Presently, neuroscience is not ready to meet this heavy burden.[213] This section discusses several pitfalls that should currently prevent the admissibility of neuroscience evidence: (1) the inherent risk in the group-individual study dynamic, (2) the dilemmas neuroscience faces in its attempt to explain brain function at the time of the crime with information captured months or years after the fact, (3) the array of neuroimaging testing techniques and lack of standardization, and (4) the effects outside influences might have on individual brain testing.

*1. Comparing the "Normal Brain" Against Individuals*

Neuroscience researchers advance their theories through sample population testing designed to establish an example

[196] *Id*. at *19.

[197] *Id*. at *18. Likewise, Military Rule of Evidence (MRE) 704 prevents testimony that "embraces an ultimate issue to be decided by the trier of fact." MCM, *supra* note 67, MIL. R. EVID. 704.

[198] *See generally* United States v. Sandoval-Mendoza, 472 F.3d 645 (9th Cir. 2006).

[199] *Id*.

[200] *See id*. at 656.

[201] *See* Compton, *supra* note 8, at 344–46.

[202] *See* Brown & Murphy, *supra* note 8, at 1191. The Christmas tree phenomenon refers to the belief that jurors will be dazzled by the lights and imagery of neuroscience to such an extent they will be unable to evaluate the testimony explaining the pictures. *Id*. Like young children looking at a beautifully lit Christmas tree, jurors could be easily distracted. *Id*.

[203] *Id*.

[204] MCM, *supra* note 67, MIL. R. EVID. 704.

[205] *See* Imwinkelried, *supra* note 173, at 981–86.

[206] *See* Compton, *supra* note 8, at 338–39.

[207] *See id*. at 345–46; *see also* Schauer, *supra* note 85, at 1210–12; *see also supra* note 206 and accompanying text (discussing the Christmas tree phenomenon).

[208] *See generally* Imwinkelried, *supra* note 173.

[209] *See id.* at 981–86. For example, a military judge might use this test in evaluating the use of fMRI testing linking brain functioning and the violent behavior displayed by Sergeant (SGT) Jones in this article's introductory hypothetical. *See supra* Part I. The military judge must first understand the blood-oxygen measurements taken by fMRI. *See supra* Part II.A.2. The measurements might show increased brain functioning in a certain area of the brain during violent behavior with a degree of statistical certainty. The military judge must then determine the proposed purpose or "fit" for the research. *See* Imwinkelried, *supra* note 173, at 977–78, 983–85. Perhaps the expert will present information that SGT Jones's brain displayed increased functioning in that area during a variety of behaviors. The military judge must evaluate its fit to an assertion that SGT Jones could not control his behavior during the assault or that SGT Jones's brain acted more impulsively than normal. *Id*. Finally, the military judge must evaluate whether "there is enough or adequate support for the claim." *Id*. at 979. This would likely require analysis of the frequency and reliability of the research. *See id*. at 979, 983–85.

[210] 509 U.S. 579 (1999).

[211] *See, e.g*., MCM, *supra* note 67, MIL. R. EVID. 403, 702.

[212] *See* N.J. Schweitzer et al., *Neuroimages as Evidence in Mens Rea Defense: No Impact*, 17 PSYCHOL. PUB. POL'Y & L. 357, 390 (2011) (concluding that the impact of neuroimages on juries "are not the irresistible force that some feared").

[213] *See generally* Morse, *supra* note 133; *see also* Schweitzer et al., *supra* note 212, at 388–89.

brain structure and function that represents the vast majority of society—to define the "normal" brain.[214] Unfortunately, the limited sample population and the complexity of the brain make it extremely difficult to establish a baseline "normal brain."[215] Experts compound the issue as they attempt to relate population-based experiments to a particular individual.[216] An individual brain may look or function differently from the "normal" brain developed in the sample population, but function normally for that individual.[217] The clouded link between statistical probability and the individual can make neuroimaging unreliable and irrelevant evidence.

Another problem is that statistical error is inherent in current neuroscience. Neuroimaging has shown that not every brain functions in exactly the same manner.[218] Since each member of the sample population may have individual nuances in brain functioning, the "group brain" is not truly accurate.[219] It is an averaging of the population.[220] Unique distinctions between individual brains in the control group create statistical error, and the error increases as the researcher compares the control group "normal" brain to an external test subject.[221] The extreme number of variables in brain functioning reduces the ability of expert analysis to make reliable predictions.[222] Neuroscience, then, can only compare an individual's brain function or structure to that of a standardized "group brain" defined as the "normal" brain.[223] Ultimately, differences merely indicate differences and, therefore, have no real legal diagnostic or evidentiary value, even with expert testimony.[224] An individual brain could display a unique way of functioning and still be "normal" in its own way.

Neuroimaging's scientific error could reduce in-court reliability and prevent admissibility under *Daubert*.[225] Compare neuroscience's scientific error, which is driven by the researcher's margin of accepted error in a particular experiment, to standardized levels in urinalysis testing.[226] Even with specific widely accepted cutoff levels, drug testing has encountered problems under the *Daubert* standard.[227] In *United States v. Campbell*,[228] CAAF held that the military trial judge erred by admitting lysergic acid diethylamide (LSD) tests without hearing evidence on the "frequency of error and the margin of error in the testing process."[229] In particular, novel sciences must face "careful inquiry."[230] Accordingly, neuroscience, a new novel science, must prove statistical reliability before admission.

Neuroscience grows strength in its ability to predict behavior when a large sample group shares a similar brain function and when differences coincide with similar behavioral problems, however. For example, repeated studies have demonstrated that increased activity in a particular area of the brain may be shared commonly among subjects who display enhanced aggression.[231] Examples like this, when repeated over large sample populations with similar results, bring enhanced credibility to neuroscience.

Despite some findings of similarities across broader sample populations, a rapid increase in reliability is unlikely. The current science is expensive and control groups are sparse.[232] These practical factors limit neuroscience's ability to develop a completely reliable "normal" brain model to compare individual tests against.[233] More importantly, they limit neuroscience's ability to generate accurate analyses of

[214] *See* Raichle, *supra* note 31, at 9–11.

[215] *See* Montague, *supra* note 131, at 61 (describing the limitations of neuroscience because it is in its infancy). *See also* Wagner, *supra* note 93, at 13–23 (discussing the limited sample populations used in functional imaging based attempts to ascertain information about how the brain functions during false testimony).

[216] *See* Teitcher, *supra* note 2, at 386–88.

[217] *See* Mayberg, *supra* note 78, at 38–40.

[218] *See* Morse, *supra* note 133, at 403–04.

[219] *See* Raichle, *supra* note 31, at 7–12.

[220] *Id*.

[221] *See* Teitcher, *supra* note 2, at 387.

[222] *Id*.

[223] *See* Mayberg, *supra* note 78, at 37–40; Morse, *supra* note 133, at 403–04.

[224] *See* Mayberg, *supra* note 78, at 37–40.

[225] *See* Raichle, *supra* note 31, at 9 (stating, "[i]t must, however, always be kept in mind that the validity of findings in any function image data is critically dependent upon the statistical analysis strategy employed").

[226] *See* Major Walter Hudson & Major Patricia Ham, United States v. Campbell*: A Major Change for Urinalysis Prosecution?*, ARMY LAW., May 2000, at 38, 38–40. Military urinalysis cutoffs are set at 200 ng/ml for THC and 1000 ng/ml for BE, the metabolites for marijuana and cocaine, respectively. *See* Unites States v. Barnes, 53 M.J. 624, 629 (N-M. Ct. Crim. App. 2000).

[227] *See generally* United States v. Campbell, 50 M.J. 154 (C.A.A.F. 1999); *see also* Hudson & Ham, *supra* note 227, at 38–40; *but see* United States v. Green, 55 M.J. 76, 81 (C.A.A.F. 2001).

[228] 50 M.J. 154 (C.A.A.F. 1999).

[229] United States v. Campbell, 52 M.J. 386, 388 (C.A.A.F. 2000). If this is a different citation to Campbell, please provide a full citation.

[230] *See* United States v. Green, 55 M.J. 76, 79–80 (C.A.A.F. 2001).

[231] *See* Blumoff & Paavola, *supra* note 2, at 755. Blumoff discusses Professor Adrian Raine's research indicating that deficits in the pre-frontal cortex signify a propensity to commit crime. *Id.* Symptoms such as impulsivity, loss of self-control and an inability to inhibit behavior are closely tied to criminal aggression. *Id*. *See also* ADRIAN RAINE, THE PSYCHOPATHOLOGY OF CRIME: CRIMINAL BEHAVIOR AS A CLINICAL DISORDER (1993); *Study: Traumatic Brain Injury and Criminal Behavior*, *supra* note 5 (correlating prefrontal cortex deficits associate with TBI to a predisposition for violent behavior).

[232] Morse, *supra* note 133, at 403–04. "Imaging is at present very expensive and requires carefully chosen and cooperative subjects. Consequently, the number of experimental subjects and control in any study tends to be small and precise replications are infrequent." *Id*.

[233] *Id*.

common defects among experimental groups.[234] Thus, the ability to predict behavior is relatively limited.

The limits of neuroscience are particularly important in the courtroom. Generally, expert testimony incorporating neuroimaging seeks explanation of individual criminal responsibility.[235] While the potential for science to make this determination is intriguing, it is not yet ready.[236] The gap between the control group's "normal" brain and an individual's mens rea is too great for the current science to reliably predict.[237] Although neuroimaging could describe physical and functioning differences as compared against some degree of normalcy, currently it cannot make the leap required to explain individual intent.[238]

*2. Time Gap*

Neuroscience's inability to determine mental responsibility relates closely to the time gap problems associated with the introduction of neuroimagry into evidence. Typically, counsel develop neuroimaging strategy well after a crime has been committed.[239] Psychological examination and brain imaging usually occur around the time of trial. This practice equips the neuroscience expert with the ability to testify about an accused's brain structure and function at the time of trial.[240] Most often, this testimony is not relevant, however, because the fact-finder's concern lies with the accused's mental state at the time of the crime.[241] At best, expert testimony could identify abnormalities in an accused's brain function and structure at the time of testing[242] but cannot provide "actual proof that the defendant is unable to appreciate the nature and quality or the wrongfulness of his acts" at the time of the crime.[243]

Since the brain is a dynamic, complex organ, it is nearly impossible to draw a direct correlation between brain function and human behavior that meets the required legal standard, let alone sufficiently relate current images to past behaviors or thoughts that may be months or even years attenuated.[244] The potential for inconsistency is too strong to allow admissibility.[245] Replicating a brain's functioning as it occurred during the criminal event would be nearly impossible.[246] Since the event already occurred, the mind may trigger new areas of the brain during attempts to reenact or reconstruct the scenario for analysis. The testing environment may create new brain functions different and perhaps indistinguishable from the criminal event.[247] The mind may simply act differently over time.[248] The variables are simply too extensive to allow testimony without reliable variance prediction.

Moreover, experts rarely have a baseline test from the accused to compare against an accused's current functional brain structure.[249] This lack of baseline data generates questions regarding the extent of a brain abnormality at the commission of the crime.[250] Tumor growth, brain deterioration, or subsequent head trauma could change images over time.[251] Neuroscience does not have an accurate way to hypothesize about past behavior using current images.[252] And without a baseline comparison of the accused's brain, allowing such evidence could confuse the fact-finder about the evidence's inherent unreliability.[253]

*3. Human Error*

The accuracy of neuroscience relies on clinical procedure selection, precise technical decisions, and human

[234] *Id*.

[235] *See* Farahany, *supra* note 8, at 72–73.

[236] United States v. Mezvinsky, 206 F. Supp. 2d 661, 667–69 (E.D. Pa. 2002) (excluding PET scans as unreliable and irrelevant to the legal question at issue); United States v. Puerto, No. 07-14097, 2010 WL 3191765 (11th Cir. 2010) (excluding neuroscience evidence because experts were unable to testify "with any medical certainty" that the defendant lacked intent at the time of the offense).

[237] *See* Mayberg, *supra* note 78, at 41.

[238] *See* John H. Blume, *Life, Death, and Neuroimaging: The Advantages and Disadvantages of the Defense's Use of Neuroimages in Capital Cases-Lessons from the Front*, 62 MERCER L. REV. 909, 911–14, 927–30 (2011); *see also* Teitcher, *supra* note 2, at 389–92.

[239] *See* United States v. Gray, 51 M.J. 1, 14–15 (C.A.A.F. 1999) (raising the defense of mental responsibility during post-proceedings); Malone, *supra* note 128 (introducing a request for psychological brain testing after the government's initiation of charges).

[240] *See* Jones et al., *supra* note 19, ¶ 10.

[241] *See id*.

[242] *See* Mayberg, *supra* note 78, at 37–38.

[243] June Campbell Moriarty, *Flickering Admissibility: Neuroimaging Evidence in the US Courts*, 26 BEHAV. SCI. & L. 29, 42 (2008); *see also* MCM, *supra* note 67, R.C.M. 916(k).

[244] *See* Teitcher, *supra* note 2, at 387–89.

[245] *See* Compton, *supra* note 8, at 344. "The brain is incredibly complex—there is not one single area that controls a person's thoughts or actions; rather, there is an interconnectedness between different parts of the brain that cannot always be captured by scans or images." *Id*.

[246] *See* Montague, *supra* note 135, at 60–62.

[247] *See* Schauer, *supra* note 85, at 1201. A critical flaw in neuroimaging lie detection research is determining whether the study measures what it sets out to measure. *See id*. (pointing out the problem in instructing patients to lie rather than viewing brain activity as part of a uninfluenced behavior).

[248] *See* Brown & Murphy, *supra* note 8, at 1188 (highlighting changes in mental state).

[249] *See id*. at 1187.

[250] *Id*.

[251] Jones et al., *supra* note 19, at 10. Jones lists concepts to consider that place brain imaging within its broader context. *Id*. His tenth point, "Today's brain is not yesterday's brain," encourages consideration of brain changes over time, which might include the development of "atypical anatomical or functional conditions." *Id.*

[252] *See* Mayberg, *supra* note 78, at 37.

[253] *See, e.g.*, Trapp v. Spencer, 479 F.3d 53 (1st Cir. 2007); United States v. Dock, 35 M.J. 627 (A.C.M.R. 1992).

interpretation.[254] A minor variance in these factors could have substantial impact in the courtroom.[255] Inside the decision to use a particular procedure lies the potential for human error.

The images produced by neuroimaging are the result of an expansive variety of tools both functional and structural.[256] The lack of a standardized measurement tool creates extensive variability in neuroscience and its potential courtroom influence. Each clinical procedure brings particular nuances and technical requirements that could sway scientific results. For example, the American Academy of Neurology and American Clinical Neurophysiology Society determined that the validity of qEEG methods was insufficient for diagnosis of post-concussion syndrome, mild or moderate head injury, and attention disorders.[257]

Simple decisions could have major reliability impacts. The sophistication of neuroscience requires complex statistical maps describing brain function during testing.[258] Small decisions regarding how to analyze the data or where to set the statistical significance threshold can have a large impact on the discovery of brain abnormalities.[259] Even when the technical threshold is met, the resulting accuracy is still limited by the expert's ability to interpret the data.[260] "As the studies get more complex, so does the data, which in turn increases the subjectivity and disparity in interpreting results."[261] Further, there may be limited correlation between the results from one scan to the next and from one researcher to the next.[262] This reality creates a reliability gap between the creation of neuroimages and its subjective supporting expert testimony.[263]

*4. Outside Influence*

Other outside factors can present unknown impacts on neuroimaging testing as well. "[U]se of psychoactive medications like sleep, anti-epileptic, antidepressant, and anti-anxiety medications, as well as the patient's behavioral state, mood and motivation at the time of scanning (anxious, sad, sleepy, distracted, uncooperative), must also be considered as potential contributors to any observed deviant scan pattern."[264] Furthermore, neuro-testing is generally performed under strict controls that allow the researcher to focus on a simple specific action or task.[265] The complexity of the subject's everyday thought processing would likely change the scientific results.[266] Likewise, the use of illegal drugs, anxiety associated with criminal actions, and the intensity of life outside the lab could change the brain's functional behavior.[267] After all, "the brain is incredibly complex—there is not one single area that controls a person's thoughts or actions; rather, there is an interconnectedness between different parts of the brain that cannot always be captured by scans or images."[268]

The researcher must also consider whether the "behavioral state under investigation is static (developmental anomaly, old head injury), episodic (bipolar manic depressive versus euthymic state), or progressive (Alzheimer's disease, frontotemporal dementia)."[269] If measurable over time, the condition could help explain past and future brain conditions.[270] Unfortunately, this adds another layer to the already problematic analysis by increasing the number of required tests and ultimately the number of influential variables.

If admissible, the fact-finder should have a clear understanding of the limitations surrounding neuroscience evidence.[271] This includes background information regarding all factors that might alter testing reliability. One approach is crafting appropriate instructions. Spencer Compton suggests a sample jury instruction that includes the following:

> (1) instructing the jury not to assume the testifying witness is a scientific expert, but rather a witness qualified as an expert for the purposes of trial, (2) describing some limitations of neuroscience, (3) instructing jurors that they may accept or reject neuroscience evidence on the whole, and (4) reminding jurors of their role as fact-finders.[272]

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[254] *See* Jones et al., *supra* note 19, ¶¶ 6–10.

[255] *Id*.

[256] *See generally*, MacMillan & Vaughn, *supra* note 18. The article addresses court decisions surrounding Organic Brain Disorder, CAT scan evidence, PET scan evidence, MRI, and fMRI evidence. *Id*.

[257] *See* Scott T. Grafton, *Has Neuroscience Already Appeared in the Courtroom?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 56 (Univ. of Cal. Santa Barbara 2010).

[258] *See* Brown & Murphy, *supra* note 8, at 1144–52.

[259] *Id*.

[260] *See* Blume, *supra* note 239, at 925–27 (using a radiologist's failure to discover a brain tumor as an example of human error in neuroscience).

[261] Teitcher, *supra* note 2, at 386.

[262] *Id*.

[263] *See* Compton, *supra* note 8, at 344.

[264] Mayberg, *supra* note 78, at 39.

[265] *See* Compton, *supra* note 8, at 344.

[266] *Id*.

[267] *See* Mayberg, *supra* note 78, at 39–40.

[268] *Id*.

[269] *Id*. at 40.

[270] *See id*.

[271] *See* Compton, *supra* note 8, at 351–52.

[272] *Id*.

Despite the admissibility hurdles, the use of neuroscience in the law is expanding.[273] Between 2007 and 2008, the number of cases in which counsel introduced neurological or behavioral genetics evidence jumped from 112 to 199.[274] In 2009, the number hovered around 200.[275].

## IV. Future Military Application

The application of neuroimaging is an unavoidable concern for counsel. Current practices in the U.S. military may provide solutions for a number of the hurdles associated with the introduction of neuroimaging evidence. For example, the military could provide a large sample population filled with cooperative subjects that can create a reliable comparative baseline. Furthermore, the military has begun extensive research into TBI that already includes the use of emerging neuroimaging techniques.[276]

This section will address the possible uses of neuroimaging within the military. It will discuss the steps the military has already taken in support of neuroscience and recommend the military as a sample population for future neuroscience research. Military-based research could provide a solution to many of the neuroimaging pitfalls associated with admissibility. Next, the section will address RCM 706 inquiries as an immediate possibility for the use of neuroimaging evidence and suggest how that information could influence other areas of the court-martial, such as sentencing proceedings. It will also discuss the current case law targeting the use of neuroimaging as a tool to negate mens rea.

### A. A Military Sample Population

The brain, mind, and mental responsibility weigh heavy in the thoughts of servicemembers.[277] The long wars in Iraq and Afghanistan have led to a steady increase in PTSD and TBI diagnoses among military ranks.[278] Post Traumatic Stress Disorder rates have increased from 1,614 cases in 2000 to over 9000 in 2010.[279] The ten-year total hits almost 90,000.[280] Traumatic Brain Injury cases have seen similar annual increases from under 11,000 in 2000 to nearly 30,000 in 2009, totaling 178,876 between 2000 and the first quarter of 2010.[281]

The stark changes in military brain-related trauma create further concern in an environment already focused on cognitive brain testing.[282] Additionally, the costs of neuroimaging decrease as the science grows. Within a military context, those costs might reduce further. The government has an incentive to increase neuroscience funding for the diagnosis and treatment of TBI and PTSD. Consequently, the military will continue to lead advances in neuroscience and the treatment of brain-related injury. Most likely, neuroimaging research tools and centers in the military will reduce the costs associated with requesting brain scans for legal purposes. This may accelerate the possible use of such science in military courtrooms beyond that exhibited currently in civilian courts.

In 2008, Congress responded to the military's TBI problem by directing pre- and post-deployment cognitive testing for servicemembers.[283] Servicemembers are required to take a set of computerized tests that provide an individual cognitive assessment baseline.[284] The testing allows a comparison base for servicemembers combating TBI.[285] Although a step in the right direction, the required testing is limited.[286] The tools used may not have the appropriate sensitivity to identify cognitive problems associated with mild TBI.[287]

Neuroscience could provide the necessary solution. Already, groups are working in connection with the military to use neuroimaging to diagnose PTSD and TBI.[288] The U.S. Army has also partnered with Columbia University to develop pre- and post-deployment fMRI technology that

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[273] BRAIN WAVES MODULE 4: NEUROSCIENCE AND THE LAW 4 (The Royal Society 2011), *available at* http://royalsociety.org/policy/publications/.

[274] *Id*.

[275] *Id*.

[276] Peggy Eastman, *New National Treatment Center for Soldiers with TBI and PTSD Opens*, NEUROLOGYNOW (June 29, 2010), http://journals.lww.com/neurologynow/blog/breakingnews/pages/post.aspx?PostID=8.

[277] *See Military & TBI*, BRAIN TRAUMA FOUNDATION, www.braintrauma.org/tbi-faqs/military-tbi/ (last visited Jan. 9, 2013).

[278] *See* FISCHER, *supra* note 5, at 2–3. In 2000, the 1614 cases of PTSD are labeled "not deployed" meaning the PTSD was diagnosed before deployment. *Id*. at 2. In 2010, the PTSD cases are labeled 1423 "not deployed" and 7739 "deployed." *Id*. Deployed cases are those that were diagnosed sometime after the individual deployed. *Id*. at 1.

[279] *Id*. at 2.

[280] *Id*.

[281] *Id*. at 2–3.

[282] *See* Christian Elliott, *Military Uses for Cognitive Testing*, MYBRAINTEST (Aug. 17, 2010), http://www.mybraintest.org/2010/08/military-uses-for-cognitive-testing/; John Ohab, *Neuroimaging Study Investigates Blast-Induced Traumatic Brain Injury*, ARMED WITH SCIENCE (Feb. 2, 2010, 2:00PM), http://science.dodlive.mil/2010/02/02/neuro-imaging-study-investigates-blast-induced-traumatic-brain-injury/.

[283] Elliott, *supra* note 282.

[284] *Id*.

[285] *Id*.

[286] *Id*.

[287] *Id*.

[288] *See* Harvard Med. Sch. Psychiatry Neuroimaging Lab., *Traumatic Brain Injury*, PSYCHIATRY NEUROIMAGING LABORATORY, http://pnl.bwh.harvard.edu/tbi.html [hereinafter Harvard Med. Sch. Psychiatry Neuroimaging Lab.] (last updated on Feb. 1, 2013). A group started research in 2008 working with redeploying Soldiers to find markers within the brain that would indicate PTSD and TBI symptoms. *Id.*

focuses on identifying and treating TBI.[289] Furthermore, the military opened a $65 million technologically cutting-edge center focused on TBI treatment through neuroimaging in 2010.[290] The National Intrepid Center of Excellence (NICoE) is located in Bethesda, Maryland, and includes an advanced area equipped for scanning with the most up-to-date PET, MRI, and CT technology.[291] The center can use multiple brain images to capture brain functioning and develop TBI treatment.[292] For trial practitioners, these centers introduce a viable option for brain scan requests. Instead of requesting expensive civilian expert assistance, counsel can request use of the facility to evaluate clients. Additionally, NICoE's research may lead to treatment possibilities that could enhance extenuation evidence by reducing TBI symptoms associated with violence and criminal behavior.[293]

The military has begun to implement several programs to combat TBI and the hurdles associated with neuroimaging.[294] As technology increases and its associated cost decreases, the military should expand its testing beyond pre- and post-deployment.[295] Currently, servicemebers are required to undergo a physical examination prior to entering service.[296] The military could create a huge sample population by outfitting medical entrance processing stations with brain imaging technology. Doing so would create a universal baseline brain function recording. This process would expand the sample population used in neuroscience research from a generally small group to a diverse cross-section of the population. It would also take advantage of a compliant population with an incentive to cooperate because of their profession's increased risks of TBI and PTSD.

As an unintended consequence, the intersection of law and neuroscience could benefit from the implementation of military neuroimaging research. Studies have linked TBI to violent behavior often associated with crime.[297] Such progressive research could provide a better understanding of TBI's influences over behavior as they relate to criminal elements and sentencing factors. Furthermore, the testing would help reduce the common time gap problem associated with neuroscience. Experts would have a baseline record to compare against images taken after the commission of a criminal offense.

These advantages associated with military-based neuroimaging and the current focus on TBI identification and treatment should substantiate increased brain testing research among servicemembers. Future growth ought to encompass a means to capture a functional image of every servicemember's brain prior to service and at periodic steps throughout their career.

B. Rule for Court-Martial 706

Rule for Court-Martial 706 already includes an effective avenue to utilize neuroimaging evidence.[298] As discussed earlier, RCM 706 requires a board of physicians or clinical psychologists to inquire into an accused's mental capacity and mental responsibility.[299] This determination requires the board to answer four distinct questions: (1) "at the time of the alleged criminal conduct, did the accused have a severe mental disease or defect," (2) "what is the clinical psychiatric diagnosis," (3) "was the accused, at the time of the alleged criminal conduct and as a result of such severe mental disease or defect, unable to appreciate the nature and quality or wrongfulness of his or her conduct," and (4) "is the accused presently suffering from a mental disease or defect rendering the accused unable to understand the nature of the proceeding against the accused or to conduct or cooperate intelligently in the defense."[300] In addition, other appropriate questions and answers may be included in the report.[301] Because of its close connection to psychiatry, neuroimaging bolsters the psychiatric diagnosis. The addition of neuroimaging to RCM 706 inquiries would provide a valuable tool to doctors on the board and counsel involved in the court-martial.

Criminal behavioral differences are a result "of the interplay between specific gene variants, environmental stressors, and violence."[302] Compelling testimony about an accused's mental responsibility should include a description of his brain function and structure, as well as his personal history, environmental influences, and behavior.[303] A mental responsibility inquiry that could demonstrate these elements, including a neuroimaging element, would be more useful to the court and counsel. Combining traditional methods of psycho analysis with scientifically based examinations of

[289] *See* Ohab, *supra* note 282.

[290] *See* Eastman, *supra* note 276.

[291] *Id*.

[292] *Id*.

[293] *See* Kmraquize, *supra* note 5.

[294] *See* Eastman, *supra* note 276; Harvard Med. Sch. Psychiatry Neuroimaging Lab., *supra* note 288.

[295] *See The Brain Sciences in the Courtroom, A Symposium of the Mercer Law Review October 22, 2010*, 62 MERCER L. REV. 769, 833–34 (2011). Panel member, Emily Paavola, outlined the costs associated with MRI and PET scans. *Id.* Typical scans cost between $7000 and $8000 with an additional cost of $15,000 for the quantitative analysis. *Id.*

[296] U.S. DEP'T OF ARMY, REG. 40-501, STANDARDS OF MEDICAL FITNESS para. 2-1 (4 Aug. 2011).

[297] *See* Kmraquize, *supra* note 5.

[298] MCM, *supra* note 67, R.C.M. 706.

[299] *Id*.; *see supra* Part II.B.

[300] MCM, *supra* note 67, R.C.M. 706.

[301] *Id*.

[302] Farahany, *supra* note 8, at 74.

[303] *See id*. at 75.

brain functioning and structure should provide a clearer picture of the influences guiding an accused's behavior.

This combination of factors has already influenced several civilian courts. In *Walker v. Oklahoma*,[304] the Tenth Circuit acknowledged that the appellant's mental illness had an organic component, but did not find error because the expert at trial was able to form an opinion without additional neurological tests.[305] In *United States v. Kasim*,[306] the U.S. magistrate judge considered the defendant's demeanor, his inability to concentrate, his inability to understand the charges, and SPECT results supporting the symptoms before finding Kasim incompetent to stand trial.[307] In *United States* v. *Williams*,[308] the court and experts on both sides agreed that a variety of tests are useful for examining intelligence, cognitive functioning, and neuropsychological functioning.[309] The court found that failure to conduct fMRI scans and qEEG analysis could impact the weight of expert testimony.[310]

Military courts should face similar neuroimaging-based inquiry requirements in cases that require RCM 706 examination. Servicemembers have complex backgrounds that include the emotional impact of armed conflict, often receive treatment from various medical professionals, and undergo multiple treatment programs. Counsel might consider utilizing neuroimaging testing to increase the weight of expert testimony derive from RCM 706 results.

The CAAF has recognized that psychiatry is not an exact science.[311] Often, psychiatrists come to varying conclusions.[312] Neuroimaging information could provide psychiatrists with an evaluation factor that requires limited personal interpretation. For example, consider the impact of a timely neuroimaging testing request in a case like *United States v. Gray*.[313]

In early 1988, a mixed officer and enlisted panel convicted Specialist Ronald Gray of numerous offenses including premeditated murderer and three specifications of rape.[314] The panel sentenced Gray to death, a dishonorable discharge, total forfeitures, and reduction to Private E-1.[315] Gray's appeal included three legal issues centered on neuroimaging.[316] The CAAF reviewed whether Gray should have received a "new trial based on newly discovered evidence of organic brain damage,"[317] whether the panel received an accurate understanding of Gray's mental health condition,[318] and whether he received adequate psychiatric assistance in the "evaluation, preparation, and presentation of his case."[319]

During the post-trial process, Gray claimed that newly discovered evidence would "produce a substantially more favorable result."[320] A physician specializing in neurology concluded that Gray "suffers from organic brain defects that probably impaired his capacity to distinguish right from wrong and conform his conduct to the law."[321] Gray also asserted a national standard of care for professional psychiatric evaluations that would require a MRI brain scan and a thorough analysis of Gray's head trauma history.[322] Although the court recognized *Ake's* requirement to competent psychiatric assistance and an appropriate mental health examination, its opinion demonstrated a clear concern for Gray's post-trial attack on the psychiatric assistance he received at trial.[323]

In its opinion on the neuroimaging issues, the CAAF highlighted the difference in the pre- and post-trial expert opinions and that the common occurrence of conflicting expert opinion does not alone require a rehearing.[324] The court also relied on the "substantial mitigating evidence" already presented by Gray's "trial psychiatric experts and his family."[325] Unwilling to enter a battle of experts on post-trial, the court found that counsel presented favorable evidence to demonstrate Gray's mental status and organic brain damage.[326]

Most counsel, however, will not find themselves in the middle of a post-trial mental responsibility battle. They will more likely find themselves at a point in the trial process

[304] 167 F.3d 1339 (10th Cir.).

[305] *Id*. at 1349.

[306] No. 2:07CR56, 2008 WL 4822291 (N.D. Ind. 2008).

[307] *Id*. at *17–18.

[308] No. CR06-00079, 2009 WL 424583 (D. Haw. 2009).

[309] *See id.* at *5.

[310] *Id*. at *6.

[311] United States v. Gray, 51 M.J. 1, 17 (C.A.A.F. 1999). The court noted, "divergence of opinion among psychiatrists is not novel and does not provide a legal basis for concluding that one or the other is performing inappropriate tests or examinations." *Id*.

[312] *See id*.

[313] 51 M.J. 1 (C.A.A.F. 1999).

[314] *Id*. at 9.

[315] *Id*.

[316] *Id*. at 5–8.

[317] *Id*. at 12.

[318] *Id*. at 14.

[319] *Id*. at 16.

[320] *Id*. at 12.

[321] *Id*. at 13.

[322] *Id*.

[323] *See id*. at 16–17.

[324] *See id*. at 14–17.

[325] *Id*. at 18.

[326] *See id*. at 15–18.

ripe for a RCM 706 request. During trial preparation, without the benefit of hindsight, a complete assessment should include consideration of organic brain damage testing. Although the court in *Gray* did not reverse the case based on the experts' failure to conduct MRI scans, it recognized a variety of factors that indicated brain damage to the fact-finder.[327] Prior head injury from parachuting, a history of development problems, and abnormal EEG results indicated similar diagnosis as the expected brain scan results.[328]

Unfortunately, these facts are not unique for military counsel. Many military accused suffer from deployment-related head injury and PTSD, immerse themselves in a drinking culture, and have lengthy stories that can reveal an abusive history. *Gray* demonstrates that military counsel have access to neuroimaging evidence. Additionally, it outlines factual circumstances that should trigger brain scan requests. If an accused's history includes head trauma, mental health issues, or alcohol abuse, neuroimaging evidence can provide significant insight into an accused's behavior. As neuroscience advances and interconnects with the law, counsel's discretion to request neuroimaging evidence will narrow.

Military counsel preparing for trial should avoid the post-trial problems associated with *Gray* and elicit neuroimaging tests as part of their traditional RCM 706 request. This approach allows neuroimaging to influence the board's mental responsibility determination without facing the evidentiary obstacles of in-court admissibility. Furthermore, counsel will gain insight into the accused's brain structure and function. Since RCM 706 allows for the inclusion of "other appropriate questions" and for defense to receive the full report, counsel can use the inquiry to pinpoint areas of mental emphasis or concern necessary for trial preparation.[329] This information will be "critical not only to the question of his mental responsibility at the time of offense but as extenuation and mitigation evidence."[330]

C. Indication of Innocence

The RCM 706 inquiry results might also produce evidence indicating a lack of mens rea. Although courts should exclude neuroscience evidence because of the many hurdles discussed above,[331] they are already addressing mens rea issues relating to neuroimaging evidence. Despite the limited military case law centered on neuroimaging, military counsel will likely encounter legal issues centered on neuroscience's ability to indicate whether an accused's brain function capability allowed him to form a specific intent during the commission of an offense. Increased cases of PTSD and TBI in the military only exacerbate this likelihood.[332] The growing number of servicemembers suffering from PTSD and TBI amplifies the possibility that military accused suffer from brain disease and mental health problems. Consequently, courts-martial should experience more litigation surrounding the accused's mental ability to form intent.

Without military precedent, civilian case law will drive the initial use of neuroimaging evidence to negate mens rea. For example, a New York court found an abuse of discretion in not authorizing neurological testing that could aid the fact-finder in assessing the defendant's ability to form intent and perceive risk.[333] The defendant should have been allowed to explore his organic brain damage in support of his self-defense argument.[334] The fact that the victim was larger than the defendant and held a three-foot piece of lumber while breaking into the defendant's home influenced the court's 1994 decision.[335] More recently, the Ninth Circuit found an abuse of discretion in the exclusion of MRI-based testimony connecting a brain tumor to the element of predisposition in an entrapment defense.[336] Although the lower court found the imaging evidence unreliable, the case was reversed under the assertion that uncertain medical knowledge should not be precluded when medical expert opinion testimony "permits the assertion of a reasonable opinion."[337]

Conversely, cases have acknowledged the "considerable debate" that "exists within the literature as to the reliability of functional MRI and QEEG scans."[338] A Pennsylvania federal district court applied *Daubert* to PET scans relating to the "knowingly and willfully" element in a fraud case.[339] The court strictly applied the "fit" test in its conclusion that the evidence's "hopelessly elusive nature simply would not be helpful to the trier of fact."[340] In line with the hurdles to admissibility discussed earlier, the court pointed out that the science did not support a connection between specific areas

[327] *See id*. at 17 (recognizing the expert opinion of Doctor Merikangas, a civilian psychiatrist).

[328] *Id*.

[329] MCM, *supra* note 67, R.C.M. 706(c).

[330] *Gray*, 51 M.J. at 20.

[331] *See supra* Part III.B.

[332] *See* Hayes, *supra* note 5, at 78; *see also* FISCHER, *supra* note 5, at 2–3.

[333] People v. Jones, 210 A.D.2d 904, 904 (N.Y. App. Div. 1994).

[334] *Id*.

[335] *Id*.

[336] United States v. Sandoval-Mendoza, 472 F.3d 645, 655–56 (9th Cir. 2006).

[337] *See id*. at 655 (quoting United States v. Finley, 301 F.3d 1000, 1007 (9th Cir. 2002)).

[338] United States v. Williams, No. CR06-00079, 2009 WL 424583, at *5 (D. Haw. 2009).

[339] *See* United States v. Mezvinsky, 206 F. Supp. 2d 661, 667 (E.D. Pa. 2002).

[340] *Id*. at 674.

of the brain and a specific disorder.[341] It also noted the inability of PET scans to explain twelve years of retrospective brain functioning.[342]

Missouri courts also focused on the link between neuroscience and testimony in a 2009 determination that PET scan evidence would have been inadmissible at trial.[343] Although the defendant's mental state was an issue in whether he lacked the appropriate culpable mental state to commit first degree murder, the expert could not link the scientific method used to the defendant's mental problems.[344] In 2010, a federal district court in Tennessee excluded fMRI tests focused on lie detection.[345] The defense sought admission to disprove elements associated with fraud, but the court found the tests unreliable under *Daubert* and unfairly prejudicial under FRE 403.[346]

Courts-martial are not exempt from similar issues surrounding the introduction of neuroimaging evidence. Many crimes under the Uniform Code of Military Justice require proof of intent-based mens rea elements.[347] Furthermore, military courts allow evidence that negates specific intent.[348] In *Ellis v. Jacob*,[349] the CMA ensured Ellis could present evidence of extreme sleep deprivation in order to negate the element of specific intent necessary to convict him of murdering his son.[350] In *United States v. Berri*,[351] the trial judge erred by failing to instruct the panel to consider expert testimony that negated the element of specific intent.[352]

Military nuances may also impact the admissibility of neuroscience as a mens rea identifier. For example, military panels are generally made up of a cross-sample that includes a high level of education, deployment experience, and most likely some connection to mental defects through PTSD and TBI.[353] These attributes may make military panels less susceptible to the "Christmas tree" effect and more equipped to evaluate the appropriate weight expert testimony and neuroscience research deserve.[354] At the same time, the military's relation to PTSD and TBI might reduce the effectiveness of neuroimaging evidence. Servicemembers familiar with successfully combating mental disease may be less influenced by evidence that suggests an accused could not possess a certain mens rea.

Additionally, neuroscience-based litigation has found its way into military practice. In *United States v. Dock*,[355] a military panel considered contrasting expert opinion discussing whether the accused's crimes were caused by organic brain damage.[356] Ultimately, the panel convicted Private First Class Todd Dock of premeditated murder.[357] On appeal, the U.S. Army Court of Military Review found that the evidence supported the panel's finding that Dock understood the nature of his action and could have conformed to the law.[358]

Just as civilian courts have been forced to balance the questionable reliability of neuroscience against the accused's right to present a case on an increasing scale, courts-martial will likely confront the same issue. Although neuroimaging should initially find more success as a sentencing tool, military counsel must not discount attempts to introduce neuroscience on the merits. According to Colonel Rick Malone, Director for U.S. Army Center for Forensic Behavioral Sciences Forensic Psychiatry, neuroimaging performs best as a means to discover organic brain damage and as a tool in making diagnoses.[359] Although skeptical of neuroimaging's admissibility on the merits, Colonel Malone agreed that under the right fact pattern neuroimaging could be used as a part of an expert's analysis as to whether an accused could meet a specific intent element.[360] In his scenario, neuroimaging played a fraction of the expert's consideration.[361] Neuroimaging, most likely structural

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[341] *See id.* at 675.

[342] *Id*.

[343] *See* Zink v. Missouri, 278 S.W.3d 170, 178–79 (Mo. 2009).

[344] *Id*.

[345] *See* Report and Recommendation, *supra* note 12, at 39.

[346] *Id*.

[347] *See generally* MCM, *supra* note 67, pt. IV, ¶¶ 9, 43, 46. Article 85—Desertion, with an element that requires intent to remain away permanently, Article 121—Larceny, has varying levels of intent, and Article 118—Murder, which has layers of mens rea elements ranging from knowledge to premeditation. *Id*.

[348] *See supra* Part II.B.3; *see also* MCM, *supra* note 67, R.C.M. 916.

[349] 26 M.J. 90 (C.M.A. 1988).

[350] *Id.* at 93–94.

[351] 33 M.J. 337 (C.M.A. 1991).

[352] *Id.* at 344.

[353] *See* UCMJ art. 25 (2012). Court-martial panels members must be best qualified based on "age, education, training, experience, length of service, and judicial temperament." *Id*.

[354] *See supra* Part III.B.

[355] 35 M.J. 627 (A.C.M.R. 1992).

[356] *Id.* at 636. The defense experts concluded that Dock's ventricular system was abnormally large due to illness or trauma. *Id.* at 633. They suggested that the pressure in Dock's brain combined with alcohol abuse and clinical depression could cause rage and aggression leading to irresistible impulses. *Id*. Government experts disagreed and expressed the unreliability of neurological testing in their conclusion that Dock's "neurological defect did not affect his ability to reason or control his behavior." *Id*. at 635.

[357] *Id.* at 629.

[358] *Id*. at 636.

[359] Malone Interview, *supra* note 89.

[360] *Id*.

[361] *Id*.

imaging, would aid in the diagnosis of a brain abnormality such as TBI.[362] Then, the expert would consider it among an array of neurological tests, patient history, and behavioral motivators before addressing the accused's ability to form a specific intent of an offense.[363]

Military courts have also recognized the inexact nature of forensic psychology.[364] In *United States v. Gray*,[365] CAAF refused to align itself with a particular side in a battle of expert testimony. It did "not welcome descent into the 'psycho-legal' quagmire of battling psychiatrists and psychiatric opinions."[366] In *United States v. Griffin*,[367] CAAF upheld a decision to prohibit coerced confession testimony.[368] In *Griffin*, the trial judge found the expert testimony of little value to the trier of fact and unable to meet the MRE 702 and *Daubert* standards and CAAF held that he properly performed his "gate keeping" function.[369] Perhaps neuroimaging will meet a similar fate. Or, the trial judge may let the panel weigh the issue under specific instructions.[370] After all, the trier of fact is the appropriate evaluator of conflicting expert testimony.[371]

Although neuroscience faces a steep challenge before admissibility as a means to indicate innocence in the military, a particular factual background and relevant purpose may push neuroimaging into evidence.

## V. Conclusion

In a case like that of Sergeant Jones—a war-torn Soldier suffering from the effects of head trauma and PTSD—neuroimaging evidence provides a window of insight into the connection between his injury and behavior. The fast-paced development of neuroscience and its ever-increasing intersection with criminal law challenges counsel to study and understand its changing relevance. Court-martial practice enhances this reality because the nature of military service often presents military accused who suffer from mental health concerns and brain trauma.

Neuroscience's present novelty will quickly evaporate as researchers standardize neuroimaging testing and expand insight into the connection between the brain and behavior. As the reliability of and access to neuroscience increase, courts will solidify the expectation that counsel must consider, if not affirmatively pursue and introduce, neuroimaging evidence. To the extent they do so, courts should proceed incrementally, first requiring neuroimaging evidence on sentencing and as a required addition to inquiries under RCM 706; only later should they condone it as a means of assessing mens rea.

Neuroscience, however, is not a panacea with respect to mental health issues at trial, and counsel's understanding of its limitations is imperative. Counsel must understand the distinction between functional and structural neuroimaging and the value each may have in court. Furthermore, neuroscience research has specific evidentiary reliability problems it must overcome before courts accept its introduction. Time gaps between offense and brain testing, inexact error rates, outside influences on the brain, and its inherent group to individual brain comparison greatly reduce the legal reliability of neuroimaging evidence. Counsel must consider these variables along with the accused's history, additional neurological tests, and mental health analysis in determining the appropriate use of neuroimaging evidence.

Finally, the military's concern for advancing the treatment and diagnosis of PTSD and TBI, current research tools, and vast testing population provide tremendous opportunities and a ripe environment capable of reducing many neuroimaging research and admissibility concerns. As military neuroimaging research progresses, it will influence courts-martial practice and the expectation of counsel to consider neuroimaging evidence. Perhaps more than any other trial practitioner, the military advocate must understand the considerable future potential of neuroimaging.

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[362] *Id*.

[363] *Id*.

[364] United States v. Ake, 470 U.S. 68, 81 (1985); *see also* United States v. Gray, 51 M.J. 1, 17 (C.A.A.F. 1999) (addressing the potential disagreement in psychiatric diagnosis).

[365] 51 M.J. 1 (C.A.A.F. 1999).

[366] *Id.* at 17.

[367] 50 M.J. 278 (C.A.A.F. 1999).

[368] *Id.* at 285.

[369] *Id*.

[370] *See* United States v. Dock, 35 M.J. 627, 635 (A.C.M.R. 1992).

[371] *See id.* at 634–36. The trier of fact must evaluate conflicting expert testimony in "context of the totality of the evidence and after proper instructions by the military judge." *Id.*