NEUROSCIENCE AND MENTAL COMPETENCY: CURRENT USES AND FUTURE POTENTIAL

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INTRODUCTION

One major conundrum in the field of law and neuroscience is that the mental states that are most relevant to legal determinations are often mental states that occurred in the *past*, and can longer be assessed. Could the defendant, at the time he committed the crime, have had the cognitive capacity to satisfy the required *mens rea* for the crime charged? Was an individual's tortious conduct intentional or inadvertent? Even if the field of neuroscience eventually gains the ability to provide data relevant to understanding of immediate mental states, those data will be unavailable to legal actors by the time someone is actually interested in gathering them.[1]

The issue of mental competency in criminal cases is an exception to this general problem.[2] Unlike most other relevant mental states in the law, competency deals with a criminal defendant's *current* mental state, during the litigation itself.[3] Does the defendant understand the nature of the charges and the proceedings? Does he have the ability to communicate with and assist his lawyer? If neuroscience has the potential to shed light on these questions, it can be very useful, because the defendant is readily available and

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[1] *See* Stephen J. Morse, *Avoiding Irrational Neurolaw Exuberance: A Plea for Neuromodesty*, 62 MERCER L. REV. 837, 849 (2011) ("Assessing criminal responsibility involves a retrospective evaluation of the defendant's mental states at the time of the crime. No criminal wears a portable scanner or other neurodetection device that provides a measurement at the time of the crime, at least not yet.").

[2] *See id.* at 850 ("Questions concerning competence or predictions of future behavior are based on a subject's present condition. Thus, the problems besetting the retrospective responsibility analysis do not apply to such questions. The criteria for competence are functional. They ask whether the subject can perform some task, such as understanding the nature of a criminal proceeding or understanding a treatment option that is offered, at a level the law considers normatively acceptable to warrant respecting the subject's choice and autonomy.").

[3] *See id.*

neuroscience data could potentially be gathered as soon as the issue is raised.

Scholarship in the law and neuroscience arena has exploded in the past ten years.[4] Surprisingly, however, relatively little scholarship has been written addressing the potential for neuroscience to aid in competency evaluations. We do not have clear data as to how often neuroscience is used in competency evaluations by experts or in hearings conducted by courts. There is virtually no literature discussing how neuroscience data, at our current level of understanding, might be able to aid in determining competency. This article aims to begin to fill that gap. The article proceeds in three Parts. In Part I, I outline the U.S. law governing competency in criminal cases and describe the most common way that experts providing opinions to the court on that subject carry out competency evaluations. In Part II, I review recent empirical studies examining the use of neuroscience in courts of various jurisdictions, and focus particularly on those studies' descriptions of the use of neuroscience in competency proceedings. I also conduct an anecdotal survey of recent cases involving neuroscience in competency decisions. In Part III, I examine several areas in which neuroscience has the potential to make a greater contribution to competency determinations. A brief conclusion follows.

I. MENTAL COMPETENCY IN THE U.S. LEGAL SYSTEM

A. Legal Standards

One of the fundamental requirements of due process in the American criminal justice system is that a criminal defendant must be considered competent before he can be tried for his alleged crimes.[5] Indeed, this concept was established in legal systems before the United States was even formed. In his Commentaries on the Laws of England, William Blackstone provided the foundational reasoning for why an incompetent defendant lacks the ability to make a plea or go to trial within the bounds of due process:

> If a man in his sound memory commits a capital offence, and before arraignment for it, he becomes mad, he ought not to be arraigned for it; because he is not able to plead to it with that advice and caution that he ought. And if, after he has pleaded,

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[4] *See, e.g.*, Owen D. Jones & Francis X. Shen, *Law & Neuroscience in the United States*, *in* INTERNATIONAL NEUROLAW 349, 351 (T.M. Spranger ed., 2012).

[5] *See* 40 AM. JUR. 2D *Proof of Facts* § 1 (1984) [hereinafter *Proof of Facts*].

> the prisoner becomes mad, he shall not be tried; for how can he make his defence?[6]

Essentially, the concept goes, though a mentally incompetent defendant is *physically* present in the courtroom, he is not *mentally* present at a level sufficient to defend himself, and so a trial against him would amount to a trial in abstentia—a historically disfavored violation of due process.[7]

The U.S. Supreme Court has articulated this basic requirement on several occasions. The most prominent is *Dusky v. United States*.[8] In that case, the defendant was charged with kidnapping a young girl and taking her across state lines.[9] At his arraignment, the defendant's lawyer suggested "that there was a question of the defendant's mental competency to stand trial," and the district court accordingly ordered an evaluation "to determine, insofar as possible, whether . . . the defendant was possessed of sufficient mental and moral faculties as to be capable of distinguishing between right and wrong and to be conscious of the nature of the acts which he was then doing or committing."[10] The examiners determined that the defendant was schizophrenic, and that he would be unable to understand the nature of the proceedings against him and aid in his defense.[11] Despite this, the district court found the defendant competent to stand trial, and he was convicted.[12] After the Eighth Circuit affirmed, the Supreme Court reversed, and delivered the now-familiar two-part test as to whether a defendant is competent to make a plea or stand trial: the district court must determine (1)

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[6] WILLIAM BLACKSTONE, COMMENTARIES ON THE LAWS OF ENGLAND 24 (Univ. of Chi. Press 1979); *see* Drope v. Missouri, 420 U.S. 162, 171 (1975) (citations omitted); *Proof of Facts*, *supra* note 5, § 1, 2. With reference to Blackstone's use of the word "mad," it is worth noting that one common theme in this area, both in Blackstone's time and more recently, is that is a lack of clear delineation between competency between other legally relevant mental conditions, such as insanity. Generally, competency is understood to be "the [defendant's] capacity to understand the nature and object of the proceedings against him, to consult with counsel, and to assist in preparing his defense." *Proof of Facts*, *supra* note 5, § 2. Accordingly, "capacity to know the difference between right and wrong"—a common measure of legal insanity—"while relevant in determining a defendant's criminal liability, is totally irrelevant to the issue of his competency to stand trial." *Id.* § 2.

[7] *See Drope*, 420 U.S. at 171 (citations omitted). The connection between proper procedures in determining competency and the defendant's *due process* rights specifically comes from *Pate v. Robinson*, 383 U.S. 375, 386 (1966).

[8] Dusky v. United States, 271 F.2d 385 (8th Cir. 1959), *rev'd*, 362 U.S. 402 (1960).

[9] *Dusky*, 271 F.2d at 386–87.

[10] *See id.* at 387. This order is another early example of confusion between competency evaluations, which concern the defendant's capacity to exercise his due process rights, and sanity evaluations, which concern the defendant's capacity to be culpable for criminal acts.

[11] *See id.* at 389.

[12] *See id.* at 389, 401.

"whether [the defendant] has sufficient present ability to consult with his lawyer with a reasonable degree of rational understanding" and (2) "whether he has a rational as well as factual understanding of the proceedings against him."[13]

Later cases applied and elaborated on the underlying principle announced in *Dusky*. For example, in *Drope v. Missouri*, the Court explained that an explicit competency determination need not be made in every case, but rather, is necessary only when a court has reason to doubt the defendant's competency.[14] In that case, the trial court had ignored substantial indicia of the defendant's lack of competence to stand trial, including medical evaluation, the defendant's wife's testimony as to his erratic behavior, and his own attempted suicide.[15]

Congress has also codified rules regarding competency determinations, based largely on the standard laid out in *Dusky*. As part of the Insanity Defense Reform Act of 1984, Congress enacted 18 U.S.C. § 4241, which provides rules for "[d]etermination of mental competency to stand trial or to undergo postrelease proceedings."[16] Section 4241 provides that either the prosecutor or defense may file a motion for a hearing to determine the defendant's competency.[17] The court is then required to hold a hearing "if there is reasonable cause to believe that the defendant may presently be suffering from a mental disease or defect rendering him mentally incompetent to the extent that he is unable to understand the nature and consequences of the proceedings against him or to assist properly in his defense."[18] After the court holds a hearing, it must then determine, by a preponderance of the evidence, whether the defendant is actually suffering from such a mental disease or defect so as to be rendered incompetent.[19] If that is the case, the court must then "commit the defendant to the custody of the Attorney General," who must house the defendant under further conditions of the Act.[20]

The end result of the case law and statutory scheme is a robust constitutional right. The competency of a defendant to stand trial, plead guilty, or be sentenced is a jurisdictional legal issue, and

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[13] *See* Dusky v. United States, 362 U.S. 402, 402–03 (1960).
[14] *See* Drope v. Missouri, 420 U.S. 162, 180 (1975).
[15] *See id.* at 163–64, 166, 169 (citations omitted).
[16] *See* 18 U.S.C. § 4241 (2006).
[17] *Id.*
[18] *Id.* § 4241(a).
[19] *Id.* § 4241(d).
[20] *Id.*

accordingly it cannot be waived.[21] And whether a defendant is competent is a *status* of the defendant, not a defense that a defendant raises; unlike an insanity defense, a defendant does not concede his guilt of the crime by claiming that he is incompetent.[22]

B. How Does the Court Evaluate Competency?

The Supreme Court has not articulated specific factors for courts to assess in determining whether the *Dusky* standard has been satisfied, and so individual jurisdictions have articulated their own sets of considerations, though they often overlap. For example, the Sixth Circuit has explained:

> In making [the competency] determination, the district court must consider several factors, including the defendant's demeanor, any prior medical opinion regarding competency, and evidence of irrational behavior. An attorney's opinion about his client's competency is likewise a relevant factor. Moreover, although a defendant may show signs of paranoia or other mental illness, "such an illness would not necessarily render the defendant incompetent to stand trial." In short, "there are . . . no fixed or immutable signs which invariably indicate the need for further inquiry to determine fitness to proceed; the question is often a difficult one in which a wide range of manifestations and subtle nuances are implicated."[23]

While no single consideration is considered to be more important than any other one, the court itself is extremely restricted in the context in which it is able to observe and evaluate the defendant. Typically, the court has only seen the defendant at a few hearings (such as an initial appearance, arraignment, or detention hearing)

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[21] Pate v. Robinson, 383 U.S. 375, 384 (1966) (citing Taylor v. United States, 282 F.2d 16, 23 (8th Cir. 1960)) ("[I]t is contradictory to argue that a defendant may be incompetent, and yet knowingly or intelligently 'waive' his right to have the court determine his capacity to stand trial.").

[22] *See* Michael L. Perlin, *"God Said to Abraham/Kill Me a Son": Why the Insanity Defense and the Incompetency Status Are Compatible with and Required by the Convention on the Rights of Persons with Disabilities and Basic Principles of Therapeutic Jurisprudence*, 54 AM. CRIM. L. REV. 477, 489 (2017).

[23] United States v. Willis, 362 Fed. App'x 531, 534 (6th Cir. 2010) (citations omitted); *see also* United States v. Abernathy, No. 08–20103, 2009 U.S. Dist. LEXIS 31168, *7 (E.D. Mich., Apr. 13, 2009) (citations omitted) ("The determination of whether a defendant is mentally competent to stand trial is a question left to the sound discretion of the district court, with the advice of psychiatrists [or other mental health professionals]. The medical opinion of experts as to the competency of a defendant to stand trial is not binding on the court, since the law imposes the duty and responsibility for making the ultimate decision of such a legal question on the court and not upon medical experts.").

before the defendant either pleads or goes to trial. Further, the defendant is not required to speak extensively at any of these hearings.[24] Accordingly, courts often exercise their discretion under 18 U.S.C. § 4241(b) to "order that a psychiatric or psychological examination of the defendant be conducted, and that a psychiatric or psychological report be filed with the court."[25] Because of the court's relative lack of familiarity with the defendant, as well as the court's lack of expertise in determining mental capacity, competency determinations often turn on the result of the psychiatric or psychological evaluation (or evaluations).[26]

As with the court, evaluating psychiatrists and psychologists are not subject to many specific requirements in making their competency evaluations.[27] Among the broad considerations frequently considered are "to what extent, if any, [the defendant] is mentally [disabled], disoriented, suffers impairment of recent or remote memory, has impaired thought processes, experiences hallucinations or delusions, and whether his behavior is agitated, bizarre, incoherent, inappropriate, irrelevant, or tangential."[28]

Typically, psychologists and psychiatrists employ a mix of interviews and behavioral tests in conducting competency evaluations.[29] During the interview, the examiner is able to gather global information about the defendant's mental and physical health history, upbringing, and understanding of the legal system.[30] The interview process also allows the examiner to conduct an assessment of the defendant's speaking abilities, affect, and general intelligence.[31]

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[24] Arthur Harris Rosenberg, *Competency for Trial: A Problem in Interdisciplinary Communication*, 53 JUDICATURE 316, 318 (1970).

[25] 18 U.S.C. § 4241(b) (2016).

[26] Of course, it is worth emphasizing that the ultimate decision rests with the court. *See, e.g.*, Rosenberg, *supra* note 24, at 321 ("Competency, in the final analysis, is a legal issue which must be determined by the court with the assistance of the medical expert. It is an abdication by the courts of their prerogatives to blindly follow psychiatric pronouncements which may be based on a partial or total lack of understanding of the issues involved in a determination of legal, not medical, competence for trial.").

[27] *See id.* at 319.

[28] *Proof of Facts*, *supra* note 5, § 5.

[29] *See, e.g.*, United States v. Arterberry, No. 05-CR-81165, 2015 U.S. Dist. LEXIS 26706, at *4–8 (E.D. Mich. Mar. 5, 2015).

[30] *See, e.g.*, *id.* at *7–8 (citations omitted) (discussing findings of an examiner's interview).

[31] *See* Gianni Pirelli et al., *A Meta-Analytic Review of Competency to Stand Trial Research*, 17 PSYCHOL. PUB. POL'Y & L. 1, 4 (2011) ("Data from competency instruments represent only one piece of a comprehensive competency assessment and must be integrated with information obtained from clinical interviews, other relevant test data, and observations/reports from collateral sources"); *see, e.g.*, United States v. Johnson, No. 7: 15-05(01)-DCR, 2015 WL 6472252, at *2–3 (E.D. Ky. Oct. 27, 2015); United States v. Smith, No. 6:12-CR-07-GFVT-HAI,

Examiners perform a variety of different behavioral assessments, generally targeted at obtaining a score of the defendant's intelligence and understanding of the legal system. One common general-intelligence test that examiners often use in competency evaluations is the Wechsler Adult Intelligence Scale ("WAIS").[32] That test, often considered the "gold standard in intelligence testing, provides an 'approximation of an individual's overall cognitive functioning' and includes various subsections to test different cognitive abilities."[33] As one scholar described, "the test measures total IQ across multiple dimensions including vocabulary, short-term memory, comprehension, sequential reasoning, symbol manipulation, abstract reasoning, general information, perceptual organization, spatial perception and overall level of intellectual function. For the WAIS-III, an average IQ is one hundred with a standard deviation of fifteen points."[34]

Essentially, use of the WAIS allows competency examiners to get an objective score of the defendant's IQ, with the goal that it aids in determining whether the defendant has sufficient intelligence to understand the proceedings and communicate intelligently with his lawyer.[35]

Examiners also often use standardized questions that seek to measure the defendant's understanding of the criminal justice system specifically, rather than his general intelligence level. One regularly-used such set of questions is the Evaluation of Competency to Stand Trial-Revised Instrument ("ECST-R"), which "is a checklist of questions designed to measure a defendant's ability to understand the nature and consequences of the proceedings against him, as well as his ability to assist his lawyers in his own defense."[36] As described

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2012 WL 12871184, at *4 (E.D. Ky. June 27, 2012), *adopted*, No. CR 12-07-GFVT, 2012 WL 12871808 (E.D. Ky. Oct. 2, 2012); United States v. Cunningham, No. 09-20926-CR, 2010 WL 2670871, at *4–5 (S.D. Fla. July 2, 2010).

[32] *See, e.g.*, Pirelli et al., *supra* note 31, at 4 ("[The WAIS test is one of the t]hree traditional measures most commonly researched in the competency arena"); Johnson, 2015 WL 6472252, at *2–3 (citations omitted); United States v. Chapple, 1995 U.S. App. LEXIS 516, at *2–3 (6th Cir. Jan. 6, 1995) (citation omitted); United States v. Moruzin, No. CR. 05-306 (JBS), 2006 WL 3000182, at *9–10 (D.N.J. Oct. 19, 2006) (citation omitted); 93 AM. JUR. *Trials* 1 § 16 (2004) ("The Wechsler Adult Intelligence Test . . . is the premier standardized intelligence test in current use.").

[33] *Arterberry*, 2015 WL 1004725, at *5–6 (quoting United States v. Montgomery, No. 2:11-CR-20044-JPM-1, 2014 WL 1516147, at *80 (W.D. Tenn. Jan. 28, 2014)).

[34] Bruce Ebert, *Competency to Be Executed: A Proposed Instrument to Evaluate an Inmate's Level of Competency in Light of the Eighth Amendment Prohibition Against the Execution of the Presently Insane*, 25 L. & PSYCHOL. REV. 29, 38–39 (2001).

[35] *See id.* at 39–40.

[36] United States v. Merriweather, 921 F. Supp. 2d 1265, 1277 n.15 (N.D. Ala. 2013) (citation

by one court:

> The ECST–R primarily contains 28 items consisting of multiple questions which produce scores on four scales which assess competency to stand trial. There are four dimensions of evaluation: Consult with Counsel (CWC), Factual Understanding of the Courtroom Proceedings (FAC), Rational Understanding of the Courtroom Proceedings (RAC), and Atypical Presentation Scale.[37]

Examples of questions used on the test include whether the defendant understands the respective roles of his attorney, the judge, and the jury; whether he understands the differences between a guilty and not guilty verdict and what is necessary to show them; whether he understands the possible consequences of a guilty verdict; and whether he understands the nature of criminal charges and the trial process.[38]

When considering the standardized tests in conjunction with the interview, the examiner is then able to provide an opinion as to the competency of the defendant to plead or stand trial. Indication of low intelligence on the WAIS or a similar intelligence test, indication of a poor understanding of the legal system on the ECST-R, and indications of mental health issues or other problems during interviews may collectively indicate a lack of competency.

All three of those measures, however, suffer from a potential problem: all of the measures involve voluntary—and thus manipulable—responses on the part of the defendant. A defendant who would like to avoid trial on the charges against him could attempt to exaggerate his mental health problems or lack of understanding of legal issues, and intentionally score poorly on intelligence tests.[39] Such misleading during a competency evaluation is termed "malingering," which is defined by the DSM–IV as "the

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omitted); *see, e.g.*, United States v. Battle, 613 F.3d 258, 260 (D.C. Cir. 2010); United States v. Lohan, No. 13-CR-152A, 2013 U.S. Dist. LEXIS 132992, at *7 (W.D.N.Y. Sept. 17, 2013); *Cunningham*, 2010 U.S. Dist. LEXIS 76464, at *6; United States v. Abreu, No. 1:06-CR-329, 2007 WL 2780555, at *2 (N.D. Ohio Sept. 24, 2007).

[37] *Arterberry*, No. 05-CR-81165, 2015 WL 1004725, at *6–7 (citation omitted).

[38] *See id.* at *7–8 (citations omitted); United States v. Miranda-Martinez, No. 1:13-CR-251-TWT, 2015 WL 630397, at *2 (N.D. Ga. Feb. 12, 2015) (citations omitted); Khalil v. United States, No. 1:13cv675, 2013 U.S. Dist. LEXIS 165850, at *12–13 (N.D. Ohio Nov. 21, 2013) (citations omitted).

[39] *See* Rachel E. Springman & Brian R. Vandenberg, *The Effects of Test-Strategy Coaching on Measures of Competency to Stand Trial*, 9 J. FORENSIC PSYCHOL. PRAC. 179, 180 (2009) ("The effectiveness of psychological tests depends upon the naiveté of the examinee to the instruments and how they work and coaching poses substantial problems for conducting effective competency evaluations.").

intentional production of false or grossly exaggerated physical or psychological symptoms, motivated by external incentives such as avoiding military duty, avoiding work, obtaining financial compensation, evading criminal prosecution, or obtaining drugs."[40] Malingering could potentially be exacerbated by defendants' attorneys informing them how competency evaluations work, potentially providing examinees with insight as to how to be classified as not competent.[41]

To combat malingering, some of the standardized tests frequently given include validity scales embedded within them—metrics that measure the examinee's responses to determine "whether the individual taking the test is exaggerating their problems, minimizing them, is responding inconsistently, doesn't understand the test questions or procedure, or is answering at random."[42] Likewise, a validity measure can be used later on to assess the pattern of responding of an individual on a measure like the WAIS test. Both types of measures in part attempt to determine whether a pattern of incorrect responses was legitimate, excessively poor beyond what even a disabled respondent would be expected to produce, or simply random.[43]

When feigned disability is suspected, examiners can also administer standardized tests that are specifically designed to detect malingering.[44] For example, one such test is the Validity Indicator Profile ("VIP"). The test

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[40] AM. PSYCHIATRIC ASSOC., DIAGNOSTIC & STATISTICAL MANUAL OF MENTAL DISORDERS 683 (1994); *see, e.g.*, United States v. Battle, 235 F. Supp. 2d 1301, 1306 (N.D. Ga. 2001) (citation omitted).

[41] *See* Martha W. Wetter & Susan K. Corrigan, *Providing Information to Clients About Psychological Tests: A Survey of Attorneys' and Law Students' Attitudes*, 26 PROF. PSYCHOL. RES. & PRAC. 474, 477 (1995).

[42] Discepolo v. Gorgone, 399 F. Supp. 2d 123, 125 (D. Conn. 2005) (citation omitted) (describing validity scales in the context of the Personality Assessment Inventory test). The ECST-R contains such a scale. United States v. Gutierrez, No. 6: 14-020-DCR, 2014 U.S. Dist. LEXIS 178494, at *6 (E.D. Ky. Dec. 30, 2014) ("The report indicates that Gutierrez responded incorrectly to easier items while answering harder items correctly."); United States v. Sonnenberg, No. 1:06 CR 078, 2007 U.S. Dist. LEXIS 28203, at *3 (D.N.D. Apr. 17, 2007) ("The instrument also includes validity scales to address the potential for the examinee's performance being an under-representation of his true ability.").

[43] *See* United States v. Arterberry, No. 05-CR-81165, 2015 U.S. Dist. LEXIS 26706, at *15 (E.D. Mich. Mar. 5, 2015) (citation omitted) ("[Defendant] obtained [a] . . . score far below what he should have been able to achieve simply by guessing. His below-chance score on the ILK demonstrated he intentionally provided incorrect responses to questions about . . . the legal process in an effort to portray deficiencies in his understanding of the legal process.").

[44] *See, e.g.*, *id.* at *11 (citation omitted) ("[The examiner] administered the Validity Indicator Profile ("VIP") test, which according to her report, is 'a measure designed to identify valid and invalid response styles on cognitive tests,' such as the WAIS–IV test.").

> is a two-alternative forced choice procedure intended to identify when the results of cognitive and neuropsychological testing may be invalid because of malingering or other problematic response styles. The test consists of 100 problems that assess nonverbal abstraction capacity and 78 word-definition problems. The VIP attempts to establish whether an individual's performance in an assessment battery should be considered representative of his or her true overall capacities (valid or invalid).[45]

The test primarily measures "*consistency*, that is, whether an individual performs comparably on questions of comparable difficulty, or whether the pattern of correct and incorrect responses is random, which would indicate malingering."[46]

Other common tests are even more straightforward. For example, the Test of Memory Malingering ("TOMM") "'is a 50-item visual recognition test' that 'consists of two learning trials and an optional retention trial, and provides two cutoff scores': (1) performance that is below chance, and (2) performance that is below established norms of scores attained by head injured and cognitively impaired patients."[47] The test functions by measuring the extent to which the examinee is able to remember whether particular visual items had been presented to him during specific learning trials.[48] If the examinee's scores are below chance or below typical scores of impaired patients, malingering is inferred.[49] One other test—the Inventory of Legal Knowledge ("ILK")—uses a similar method with questions targeted toward legal information, like the ECST-R.[50] The test functions the same as the TOMM: if an examinee scores

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[45] *Id.* at *11 n.2 (quoting Richard I. Frederick & Ross D. Crosby, *Development and Validation of the Validity Indicator Profile*, 24 L. & HUM. BEHAV. 59, 59 (2000)).

[46] *Arterberry*, 2015 U.S. Dist. LEXIS 26706, at *11 n.2 (citation omitted).

[47] *Id.* (citation omitted); *see* Tom N. Tombaugh; *Test of Memory Malingering (TOMM)*, PEARSON CLINICAL, http://www.pearsonclinical.com/psychology/products/100000191/test-of-memory-malingering-tomm.html#tab-details (last visited Mar. 2, 2018).

[48] *See* United States v. Shenghur, 734 F. Supp. 2d 552, 554 (S.D.N.Y. 2010) (citations omitted), *aff'd*, 466 F. App'x 61 (2d Cir. 2012).

[49] *See, e.g.*, *Shenghur*, 734 F. Supp. 2d at 554.

[50] *See Arterberry*, 2015 U.S. Dist. LEXIS 26706, at *14 (citation omitted) ("[The ILK test is] a test containing 61 true-false items related to the legal process."); *see, e.g.*, United States v. Gray, No. H-15-060-1, 2017 U.S. Dist. LEXIS 31949, at *7 (S.D. Tex. Mar. 7, 2017); United States v. Brown, No. 14-CR-00218(02), 2017 U.S. Dist. LEXIS 33255, at *7 (W.D. La. Feb. 13, 2017), *adopted*, No. 14-CR-00218(02), 2017 U.S. Dist. LEXIS 32404 (W.D. La. Mar. 7, 2017); United States v. Rodriguez, No. 14-20877-CR, 2015 U.S. Dist. LEXIS 152323, at *18 (S.D. Fla. Nov. 10, 2015); United States v. Forrest, No. 07-CR-60054, 2010 U.S. Dist. LEXIS 118229, at *13 (W.D. La. Oct. 7, 2010), *adopted*, No. 07-60054, 2010 U.S. Dist. LEXIS 118226, at *1 (W.D. La. Nov. 5, 2010).

significantly below chance, or below the scores normally achieved by impaired individuals, the examiner infers malingering.[51]

Of course, malingering detection methods are only useful if they can accurately detect malingerers. All of the tests described above are *behavioral* measures—that is, they measure nothing more than the voluntary responses of the examinee.[52] In theory, a savvy participant could fashion responses that would indicate reduced competency while not being so outlandish that malingering is inferred. There is some literature on the accuracy of these measures, though there does not appear to be a consensus. One study found roughly 80 percent sensitivity (the ability to correctly diagnose a malingering examinee as malingering) and 70–80 percent specificity (the ability to correctly diagnose a non-malingering examinee as truthful) of the TOMM.[53] Other measures appear to have fewer data collected regarding accuracy. One scholar reviewed the ILK and found a sensitivity of 76 percent and specificity of 79 percent, leading the author to conclude that the test's standard cutoff score may lead to too many false positive results.[54] Importantly, these studies did not involve any sort of training in how to most effectively evade detection on the tests. Though at least one study has found that such intervention was not particularly effective,[55] the literature is relatively sparse, and there may be effective ways to avoid classification as a malingerer.

II. NEUROSCIENCE'S CURRENT IMPACT ON COMPETENCY EVALUATIONS

As discussed in the introduction, determining whether a defendant is competent to stand trial or enter a plea is an issue of current mental capacity. And as discussed in Part I.B, it is common to attempt to indirectly measure that capacity via psychological

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[51] *See* EMILY D. GOTTFRIED, IMPROVING THE DETECTION OF FEIGNED FACTUAL KNOWLEDGE DEFICITS IN DEFENDANTS ADJUDICATED INCOMPETENT TO PROCEED 3 (2014).

[52] *See, e.g.*, *ILK: Inventory of Legal Knowledge, Details*, PAR, https://www.parinc.com/Products/Pkey/204 (last visited Apr. 8, 2018).

[53] *See* Lili O. Graue et al., *Identification of Feigned Mental Retardation Using the New Generation of Malingering Detection Instruments: Preliminary Findings*, 21 CLINICAL NEUROPSYCHOLOGIST 929, 938 tbl. 2, 939 (2007); *see also* Kolleen E. Hurley & William Paul Deal, *Assessment Instruments Measuring Malingering Used with Individuals Who Have Mental Retardation: Potential Problems and Issues*, 44 MENTAL RETARDATION 112, 112 (2006) (discussing increasing specificity).

[54] Steve Rubenzer, *Review of the Inventory of Legal Knowledge*, 3 OPEN ACCESS J. FORENSIC PSYCHOL. 70, 73–75 (2011).

[55] *See* Springman & Vandenberg, *supra* note 39, at 196.

assessment, observation of behavior, and standardized testing.[56] Because the mental capacity at issue derives from brain activity, it is natural to think that recent advances in our understanding of neuroscience would mean that neuroscience plays a greater role in evaluating competency. Does it? This Part explores recent literature and case law on the issue.

Before proceeding, it is important to define exactly what we mean when we say "neuroscience evidence." In a way, all of the testing described *supra* Part II.B involves the brain; indeed, it is a way of measuring mental capacity, which derives from the brain, without directly measuring brain activity.[57] For the purposes of this article, I do not consider this type of data when used in a competency proceeding as "neuroscience evidence." Instead, I consider data that directly measures biological indicators of brain activity as "neuroscience evidence," such as MRI and fMRI (measuring hydrogen density in the case of a structural MRI[58] and blood flow to a particular region of the brain in the case of fMRI),[59] and EEG, which measures electrical activity at the scalp as a result of brain activity.[60]

A. Accounts in the Prior Literature

Law and neuroscience is still a relatively nascent field, and scholars are just beginning to catalogue the ways in which

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[56] *See supra* Part I.B.

[57] *See* Jean Macchiaroli Eggen & Eric J. Laury, *Toward a Neuroscience Model of Tort Law: How Functional Neuroimaging Will Transform Tort Doctrine*, 13 COLUM. SCI. & TECH. L. REV. 235, 238 (2012).

[58] *See What Is fMRI?*, UC SAN DIEGO SCH. MED., http://fmri.ucsd.edu/Research/whatisfmri.html (last visited Apr. 10, 2018).

[59] *See id.*

[60] *See Electroencephalogram (EEG)*, JOHNS HOPKINS MED. HEALTH LIBR., https://www.hopkinsmedicine.org/healthlibrary/test_procedures/neurological/electroencephalogram_eeg_92,P07655 (last visited Apr. 10, 2018). I note that my definition is similar to that used by others examining the use of neuroscience in court. *See, e.g.*, Jennifer A. Chandler, *The Use of Neuroscientific Evidence in Canadian Criminal Proceedings*, 2 J.L. BIOSCIENCES 550, 551, 552 (2015) (explaining the use of inclusion and exclusion criteria in determining whether evidence is neuroscientific); Nita A. Farahany, *Neuroscience and Behavioral Genetics in U.S. Criminal Law: An Empirical Analysis*, 2 J.L. BIOSCIENCES 485, 486 n.3 (2016) (defining neurobiological evidence). However, it is not without flaws; as others have pointed out, it lacks to ability to determine the level of sophistication of the supposed neuroscience evidence being introduced. *See* Matthew Ginther, *Neuroscience or Neurospeculation? Peer Commentary on Four Articles Examining the Prevalence of Neuroscience in Criminal Cases Around the World*, 3 J.L. BIOSCIENCES 324, 325 (2016). From my perspective, it is a useful functional definition for sifting through numerous cases potentially involving the presentation of neuroscience evidence, but does lack the granularity necessary to get a full understanding of how the evidence was presented or used. In my view, this tradeoff is a reasonable one in introductory, exploratory studies like this one and those cites in this Part.

neuroscience has been used in courtrooms. Accordingly, little published literature speaks to the extent to which neuroscience is already used in the competency domain. There are, however, a few studies that have provided some foundation.

In 2016, the Journal of Law and the Biosciences published a quartet of papers that provided an empirical accounting of the use of neuroscience evidence in criminal proceedings in four jurisdictions: the United States,[61] England and Wales,[62] Canada,[63] and the Netherlands.[64] Like the United States, Canada, England, and the Netherlands all have standards for competency to stand trial.[65] Each of the four papers found at least some cases in which neuroscience was used in a competency context. Nita Farahany, examining U.S. cases, found the most extensive use of neuroscience in evaluating competency: Of all 1,585 total cases between 2005 and 2012 in which neuroscience evidence was raised under Farahany's analysis, 15 percent involved competency.[66] Of that 15 percent, 77 percent involved competency to stand trial, and 23 percent involved other competency issues, such as competency to make a plea.[67] Farahany noted the implication of this finding in terms of the lack of scholarly discussion of neuroscience in competency decisions:

> [W]hile many scholars have discussed the implications of using neurobiological evidence for mitigation of criminal punishment, virtually no author has discussed the implications of using it to assess the competency of a criminal defendant. And yet the empirical analysis herein illustrates

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[61] *See* Farahany, *supra* note 60, at 485.

[62] *See* Paul Catley & Lisa Claydon, *The Use of Neuroscientific Evidence in the Courtroom by Those Accused of Criminal Offenses in England and Wales*, 2 J.L. BIOSCIENCES 510, 510 (2015).

[63] *See* Chandler, *supra* note 60, at 550.

[64] *See* C.H. de Kogel & E.J.M.C. Westgeest, *Neuroscientific and Behavioral Genetic Information in Criminal Cases in the Netherlands*, 2 J.L. BIOSCIENCES 580, 580 (2015). For further commentary on these four papers, *see* John B. Meixner Jr., *The Use of Neuroscience Evidence in Criminal Proceedings*, 3 J.L. BIOSCIENCES 330, 331 (2016).

[65] England's standard is termed "fitness to plead." J.W. Looney, *The Arkansas Approach to Competency to Stand Trial: "Nailing Jelly to A Tree"*, 62 ARK. L. REV. 683, 687 (2009). In Canada, the standard is codified, and termed "fitness to stand trial." Canada Criminal Code, R.S.C. 1991, c. C-43. The Netherlands' standard is less frequently applied, but provides for a suspension of prosecution. *See* Michael van der Wolf et al, *Understanding and Evaluating Contrasting Unfitness to Stand Trial Practices: A Comparison between Canada and the Netherlands*, 9 INT. J. FORENSIC MENTAL HEALTH 245, 246 (2010) ("If a defendant suffers from such defective development or diseased disturbance of his mental faculties that he is not capable of understanding the intention of the criminal proceedings against him, the prosecution will be adjourned. As soon as the defendant has recovered, the suspension of the prosecution will be lifted.").

[66] Farahany, *supra* note 60, at 486, 496.

[67] *Id.* at 497 graph 7.

> that the second most common use of biological neurobiological evidence in criminal cases is to challenge competency.[68]

While Farahany does not provide detail about the type of neuroscience evidence offered in those cases, she does provide some anecdotal discussion of three cases involving the use of neuroscience in competency claims.[69] In all three examples, experts discussed neurological disorders or brain damage that could impact a finding of competency.[70]

The Canadian study, authored by Jennifer Chandler, had a similar finding. Of the 133 total cases in their sample involving neuroscience, ten involved evidence that impacted the determination of "fitness to stand trial," Canada's competency standard.[71] Chandler does not, however, go into detail as to how neuroscience evidence was used in those determinations.[72]

The England and Wales study likewise describes cases in which neuroscience was used in relation to fitness to stand trial or plead,[73] though the paper does not provide a quantitative summary of how many cases in the sample related to fitness. Instead, it provides anecdotal samples of cases relating to fitness.[74] Similar to the Farahany study, it appears that most of those cases involved imaging evidence relating to brain injury that could affect fitness to stand trial or plead.[75]

The Netherlands study stands in contrast with the others. In the total sample of 231 cases, authors C.H. de Kogel and E.J.M.C. Westgeest found that only four cases related to competency to stand trial.[76] They describe that all of those cases involved evidence of brain injury or other clear impairments:

> We found only a few cases in which neuroscientific information was introduced in relation to fitness to stand trial, and all of these concern accused persons who were mentally severely handicapped. In these cases, the neuroscientific information appears to support and further strengthen or buttress the evidence about impairments

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[68] *Id.* at 491.
[69] *Id.* at 497–99.
[70] *Id.*
[71] Chandler, *supra* note 60, at 564, 565 tbl. 5.
[72] *See id.* at 564.
[73] Catley & Claydon, *supra* note 62, at 512.
[74] *Id.* at 523–24.
[75] *See, e.g.*, *id.* at 525–26.
[76] Kogel & Westgeest, *supra* note 64, at 584, 587 tbl. 4.

already overly apparent from the person's behavior.[77]

The low number of neuroscience cases in that sample relating to competency is also not surprising because findings relating to competency in general appear to be much more circumscribed in the Netherlands than in the other three jurisdictions.[78] Thus, the number likely relates more to the sample of cases than to the usefulness of neuroscience in competency cases in the Netherlands.[79]

B. A Brief Survey of Recent Cases

Overall, the relatively scant empirical literature to date indicates that neuroscience is largely used as part of the competency evaluation process in one way: to provide imaging and/or other neurological support for a diagnosis (or nondiagnosis) of brain injury or disorder that is relevant to mental capacity.[80] While that is one major possible use of neuroscience in the competency evaluation process, as discussed *infra* Part III, it is not the only one.

Because the literature has provided only a basic accounting of how neuroscience is used in competency proceedings, I conducted an informal survey of U.S. cases within the last year involving neuroscience in competency proceedings. I conducted a search on Westlaw of all federal and state cases between December 2016 and December 2017[81] based on search terms similar to those used by Farahany.[82] The search yielded a total of 319 cases. Because this

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[77] *Id.* at 590.

[78] *See* van der Wolf et. al, *supra* note 65, at 245 ("In Canada, a substantial number of defendants are found unfit annually, while in the Netherlands the practice has been limited to just a few cases in the past two centuries.").

[79] Other recent articles have surveyed cases involving the presentation of neuroscience evidence, but, to my knowledge, none have presented information relating to the use of neuroscience in competency determinations. For example, in 2015, Deborah W. Denno published an expansive study of 800 criminal cases involving the use of neuroscience evidence, but there was no discussion of the relationship between that evidence and competency proceedings. *See* Deborah W. Denno, *The Myth of the Double-Edged Sword: An Empirical Study of Neuroscience Evidence in Criminal Cases*, 56 B.C.L. REV. 493, 498, 499 (2015).

[80] *See supra* Part II.A.

[81] The studies discussed *supra* Part II.A examined cases prior to this period, so this sample is a unique one. It is important to note, however, that many cases in the sample involved lengthy procedural histories, especially those cases involving defendants seeking post-conviction relief. Thus, the neuroscience evidence discussed was not always based on recent neuroscience; cases regularly discussed scans that had occurred years prior to the instant opinion. *See, e.g.*, Hugueley v. Westbrooks, No. 09-1181-JDB-egb, 2017 WL 3325008, at *8–11 (W.D. Tenn. Aug. 3, 2017) (citations omitted).

[82] The actual search term was: compet! /p (neuro! or frontal or "head injury" or "pet scan" or eeg or fmri or "ct scan" or "brain disorder" or "cognitive impairment" or meg or "brain scan" or brain). The term was based on Farahany's study. *See* Farahany, *supra* note 60, at 490. The search was conducted on December 10, 2017.

essay is not designed to be a full empirical review of the use of neuroscience in competency evaluations, I do not here present complete data, but rather an anecdotal sense of those cases.

The majority of cases captured in the search did not involve the presentation of neuroscience evidence in competency hearings, but rather were captured for other reasons. For example, many cases referenced the behavioral tests described *supra* Part I.B as "neurological testing" or described the examining individual as a "neuropsychologist" or "neurologist" and were thus captured by the search.[83] This finding is not surprising; the vast majority of the cases captured in the Farahany study likewise did not involve the presentation of neuroscience evidence and were ultimately discarded from the sample. In my sample, those cases that did involve presentation of neuroscience exclusively involved discussion of the use of neuroimaging in confirming neurological injury potentially related to the competency determination. For example, in *United States v. Dalasta*,[84] a defendant who was indicted for possession of a firearm had previously had a temporal lobectomy as treatment for a seizure disorder.[85] At a hearing to determine his competency, an evaluating doctor testified about the consequences of such surgery, opining that his damaged brain made it impossible for him to be competent, ultimately resulting in the both the trial and appellate courts' determinations that the defendant was not competent to stand trial[86]:

> In July 2012, Dr. Taylor reported to the state court: "Mr. Dalasta is Not Competent to stand trial, and most-likely never will be." Dr. Barlow reported in August 2012: "I am providing Mr. Dalasta with . . . biological treatment for his PTSD and depression/anxiety . . . . It is impossible for Mr. Dalasta to be restored to competency, as his cognitive problems . . . are the result of the removal of the [left temporal lobe] of his brain. These are not reversible changes." Dr. Robert Jones opined in March 2013 that Dalasta would never regain competency to

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[83] *See, e.g.*, United States v. Jones, No. 10-03090-01-CR-S-DGK, 2017 WL 4054157, at *2 (W.D. Mo. Aug. 23, 2017), *adopted*, No. 6:10-CR-03090-DGK, 2017 WL 4052166 (W.D. Mo. Sept. 11, 2017). The search also captured a number of civil cases that were discarded, often discussing the "competency" of an expert or attorney, using that term for its standard, rather than legal, meaning. *See, e.g.*, Sul-Lowe v. Hunter, 48 N.Y.S.3d 844, 846 (App. Div. 2017) (citation omitted).

[84] United States v. Dalasta, 856 F.3d 549 (8th Cir. 2017).

[85] *See id.* at 551.

[86] *See id.* (citations omitted).

stand trial.[87]

Similarly, in *Hugueley v. State*,[88] a defendant who had been convicted of murder and sentenced to death alleged on habeas review that newly discovered evidence, in the form of an MRI conducted ten years after his trial, demonstrated that he was not competent at the time of trial.[89] As the court explained:

> Following the Petitioner's MRI in 2013, two new mental health experts concluded, based on the MRI results, and contrary to all other experts who previously examined him, that the Petitioner had been incompetent to stand trial in the capital case a decade earlier, as well as later when he filed and subsequently withdrew his petition for post-conviction relief. The Petitioner views the two opinions of incompetency as "newly discovered evidence," which invalidate his third first degree murder conviction, sentence of death, and later withdrawal of his petition for post-conviction relief as to that conviction and sentence.[90]

Those later experts opined that "Petitioner had a 'reduced h[i]ppocampal volume and increased size of the temporal horn,' findings which suggested that the temporal lobe regions of his brain deviated from typical size."[91] And, a subsequent expert who later examined the petitioner stated that

> functions of the frontal lobes are critical in "consulting with one's lawyer with a reasonable degree of rational understanding" as required by [*Dusky*.] [The Petitioner's] understanding is inherently irrational as he cannot properly process external and internal cues. That is to say, because of his brain malformation, [the Petitioner's] capacity to rationally understand the proceedings is compromised.[92]

Ultimately, the court rejected the evidence, explaining that the appeal "merely present[s] different opinions, long after the fact, that [the petitioner] was incompetent then and even at the time of his 2003 trial. . . . . [T]he Petitioner virtually ignores the previous detailed findings of mental health experts that he was competent."[93]

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[87] *Id.*

[88] Hugueley v. State, No. W2016-01428-CCA-R3-ECN, 2017 Tenn. Crim. App. LEXIS 554 (Tenn. Crim. App. June 28, 2017).

[89] *See id.* at *1–2.

[90] *Id.* at *5–6.

[91] *Id.* at *42.

[92] *Id.* at *43 (quoting Dusky v. United States, 362 U.S. 402, 403 (1960)).

[93] *Hugueley*, 2017 Tenn. Crim. App. LEXIS 554, at *45.

A number of other cases involved similar references to neuroscience evidence.[94] None of these cases, however, provided extensive discussion of the neuroscience evidence. This is not necessarily because the courts are treating neuroscience evidence with only surface-level analysis, but rather, typically, the opinions captured by the search are not first-instance decisions relating to competency.[95] Indeed, judicial decisions related to competency rarely elicit a written opinion but are rather often decided from the bench.[96] Many of the cases that did discuss neuroscience evidence discussed it in the context of discussion of a *prior* competency finding that is now being challenged, either on direct appeal or in the habeas context.[97] Unfortunately, there is no currently available method of searching orders that are not indexed on a major database, such as Westlaw, and so it is difficult to find these "first level" sources.

Other cases involved discussion that alluded to neuroscience evidence that may have been presented at some point, but was not made clear in the opinion.[98] And still other cases implied that neuroscience evidence presented at a competency hearing might have been useful, but was not presented.[99]

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[94] *See, e.g.*, United States v. Williams, 684 F. App'x 767, 772 (11th Cir. 2017) ("[During a competency proceeding,] a forensic psychologist from the Bureau of Prisons . . . examined an MRI of [the defendant's] brain"). The issue also arises when making a determination of whether a prisoner sentenced to death is competent to be executed, which flows from a different set of case law. *See, e.g.*, Madison v. Comm'r, Alabama Dep't of Corr., 851 F.3d 1173, 1181 (11th Cir. 2017), *judgment rev'd sub nom.* Dunn v. Madison, 138 S. Ct. 9 (2017) (citing evidence of mental capacity from medical reports in this context).

[95] *See Williams*, 684 F. App'x, at 767; *Madison*, 851 F.3d, at 1173.

[96] *See, e.g.*, Kenneth Williams, *The Antiterrorism and Effective Death Penalty Act: What's Wrong with it and How to Fix it*, 33 CONN. L. REV. 919, 932 (2001).

[97] *See, e.g.*, Commonwealth v. Holland, 73 N.E.3d 276, 286 (Mass. 2017) ("In December, 2000, the judge appointed the third attorney, who eventually tried the case. At counsel's urging, the judge ordered the defendant to undergo EEG testing and a CT scan. Neither test yielded abnormal results. Beyond these tests, trial counsel also took steps to have the defendant evaluated to determine whether he was competent to stand trial."); *Hugueley*, 2017 Tenn. Crim. App. LEXIS 554, at *2.

[98] *See, e.g.*, Black v. Carpenter, 866 F.3d 734, 747 (6th Cir. 2017) (citation omitted) ("Black presented expert witnesses' findings that Black had a brain disorder."); United States v. Salery, 681 F. App'x 854, 855 (11th Cir. 2017) ("Dr. Shaffer also conducted neurological testing that showed impairment of Salery's frontal lobes."); People v. Lafkas, No. A144859, 2017 Cal. App. Unpub. LEXIS 6111, at *17 (Cal. Ct. App. Aug. 31, 2017) ("Dr. Flinton added that he had performed a 'brief neurological screen that did not identify any impairment' but believed his presentation suggested he may have suffered 'some impairment (front lobe damage) from the repeated head injuries that he had incurred.'").

[99] *See, e.g.*, United States v. DeLeon, No. CR 15-4268 JB, 2017 U.S. Dist. LEXIS 66735, at *61 (D.N.M. May 1, 2017) (citation omitted) ("E. Martinez has not undergone any medical testing in connection with his competency evaluations, such as an MRI, to identify the brain injuries."); Cousins v. State, 2017 Md. App. LEXIS 1065, at *18 (Md. Ct. Spec. App. Oct. 23, 2017) ("Appellant's assertion that . . . [he] may have brain damage from in-vitro abuse suffered by the mother at the hands of the father is a bald assertion without corroboration and,

On the whole, the anecdotal cases I reviewed provided only a narrow window of how frequently neuroscience evidence is used in competency proceedings, but implied that the use of neuroscience is relatively infrequent and circumscribed—limited to data indicating the presence of brain injury, and often for the purpose of buttressing already-present behavioral data regarding competency.[100]

III. How Could Neuroscience Be Used in Future Competency Evaluations?

The previous two Parts provide a few lessons. First, competency evaluations often involve the collection of significant data to try to provide a relatively objective conclusion to support the more subjective inferences made by the court and by examiners. Second, neuroscience still appears to play a relatively limited role in this process, though it does appear occasionally. What role might it play in the future? This Part describes a few possibilities.

A. Neuroscience Data Regarding Brain Injury or Illness

As described *supra* Part II, the most likely area of future use for neuroscience in competency evaluations is neuroscience's ability to provide relatively objective, difficult-to-manipulate data regarding brain injury or illness that may inform an examiner about an individual's cognitive capacity. There are, however, important nuances in this area. Perhaps the most important is the distinction between what neuroscience data can tell us about brain *injury* as compared to what neuroscience data can tell us about *psychiatric or psychological conditions*.[101] Currently, the generally accepted neuroscientific perspective is that while "some physical injuries leave long-lasting and indisputable evidence of an injury, which can be observed in both brain and behavior," "there are no objective laboratory tests . . . for the vast majority of psychiatric and

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therefore, insufficient to support evidence of a history of mental health issues or brain damage that would have triggered a court to *sua sponte* re-evaluate Appellant's competency to stand trial.").

[100] There are other commonly cited cases in this arena that were not captured as part of my search because they were not within the past year. Those cases tend to follow the same principles of the cases captured in my sample. *See, e.g.*, United States v. Kasim, No. 2:07 CR 56, 2008 U.S. Dist. LEXIS 89137, at *17, *18, *19 (N.D. Ind. Nov. 3, 2008); United States v. Hammer, 404 F. Supp. 2d 676, 724 (M.D. Pa. 2005); United States v. Gigante, 982 F. Supp. 140, 147 (E.D.N.Y. 1997); State v. Marshall, 27 P.3d 192, 199 (Wash. 2001) (citation omitted).

[101] *See* Erin D. Bigler, et al., *Structural Neuroimaging in Forensic Settings*, 84 UKMC L. Rev. 301, 313, 326 (2015).

psychological conditions."[102] Thus, there is a disconnect—neuroscience data may be able to provide support for a diagnosis of a brain injury that may be probative as to a defendant's competency, but it can provide little help as to a diagnosis of psychological illness, which is largely diagnosed behaviorally.[103]

As seen in the cases, this type of neuroscience evidence manifests in competency proceedings along with behavioral evidence, as a form of buttressing the basic behavioral data. For example, if an examiner observed behavioral indicators of a frontal lobe injury that could be probative of a defendant's competency, subsequent neuroscience data could provide support for the conclusion that the behavior was the result of an injury: "[where an individual suffered] acute traumatic brain injury (TBI) from blunt force trauma incurred during an accident . . . [the injury] could be objectively shown by presenting [sic] neuroimaging findings . . . along with family member and work associate reports, and neuropsychological test findings."[104] Importantly, this ability to use neuroscience to support behavioral findings as to brain injury is very new.[105] Indeed, even an understanding that brain injuries and disorders are rooted in biological bases was not accepted prior to modern neuroimaging.[106] As Erin Bigler and her co-authors explain,

> Historically, neurology, psychiatry, and psychology had very little appreciation for the biological bases of behavior. For instance, the original "Organic Brain Syndrome" classification, as outlined in the first Diagnostic and Statistical Manual (DSM) of the American Psychiatric Association, was that objective neurological deficits had to be obviously expressed as some abnormal reflex, motor (hemiplegia), sensory (visual field defect), perceptual (hemi-field neglect), sensory-perceptual (graphomotor impairment), and/or language (aphasia) indicator.[107]

Bigler et al. continue with a discussion of "neurodevelopmental" disorders:

> Disorders such as schizophrenia are now recognized to be

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[102] *Id.* at 303.

[103] This distinction was borne out in the case sample I reviewed, where those cases in which neuroscience evidence was presented typically involved brain injury. Other accounts in the literature largely tell the same story. *See supra* Part II.B.

[104] Bigler et al., *supra* note 102, at 305.

[105] *See id.* at 306.

[106] *See id.* at 306–07.

[107] *Id.* at 306.

> neurodevelopmental, marked by premorbid neurocognitive deficits, a significant change from the "schizogenic mother" approach of previous decades. Recently, the National Institute of Mental Health has sought a diagnostic approach to mental illness which incorporates this view, establishing an approach which will identify diagnoses based on biomarkers and mechanisms, including structural, neurochemical and physiological brain correlates. Unmistakably, part of the so-called "holy grail" of psychiatric classification has been the potential biomarker role that brain imaging could play.[108]

Is it realistic to think that, eventually, neuroscience data will be used to support behavioral indicators of *psychological illness*, as it is to support indicators of brain injury? It is difficult to know, but in my view, there are reasons to be optimistic. It is clear, for example, that there are biological bases of psychological illness. As Bigler et al. write,

> In 2015, while this review is being written, the debate about whether abnormalities exist in the brain of individuals with schizophrenia is over. They do exist. The best and most compelling evidence comes from consortia of publicly funded research projects involving very large sample sizes and uniform automated neuroimaging analyses, like those discussed in this review. As shown by van Erp et al., based on 2,028 individuals diagnosed with schizophrenia who were compared to 2,540 healthy controls, those with schizophrenia had significantly smaller hippocampi, amygdalae, thalami, nucleus accumbens, and intracranial volume (a reflection of reduced brain size), and enlarged ventricular system (corroborating the original CT findings of Johnstone et al.). What remains to be explained, however, is how structural brain differences relate to the collection of behaviors we accept as schizophrenia: are they part of the developmental or degenerative processes? Which abnormal brain regions relate to which aspects of schizophrenia and aberrant cognition and behavior? Are they related to medication used to treat schizophrenia? Do unmedicated people with schizophrenia have the same neuropsychiatric trajectory as those who are medicated? Do these structural differences cause the behaviors and symptoms of schizophrenia, occur in parallel, or result from a lifetime of altered neurodevelopment? While

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[108] *Id.* at 307.

> imaging alone cannot answer these questions, it does provide a baseline of objective knowledge, which frames them and assists in designing intervention and treatment programs.[109]

Of course, knowing that there are biological bases of psychological illness is very different from being able to measure those biological bases through the use of neuroscience data. Critically, this area will likely run into the much-discussed "group to individual" inference problem: while, over a large sample, we may be able to detect differences in the brains of individuals with a psychological illness as compared to the brains of health control subjects, it is much more difficult to detect, in a single individual, whether a psychological illness is present. The large sample of studies like the one described above help to smooth out the noisy data; that signal is not going to be so apparent in a single-subject sample, as would be necessary when looking at one defendant in a competency hearing. This problem is pervasive in many applications of science to legal issues, where individual inferences are often necessary for the science to be relevant.

Still, with the extreme advances in neuroscience that we have seen over the past several decades, it is not unreasonable to expect that, eventually, we will have reliable biomarkers of psychological illness. If we do reach that point, I would expect that neuroscience evidence regarding psychological illness will be used in court, much like neuroscience evidence related to brain injury is used now. Importantly, neuroscience evidence is particularly useful because it provides a level of objectivity that behavioral testing does not:

> Traditional psychological and neuropsychological test findings require an assessment of effort and performance, introducing an element of subjectivity in the inferences drawn by experts based on clinical experience. In the forensic arena, this has opened up these types of assessment methods to all sorts of criticisms, where the arguments put forth in numerous textbooks may be used in the courtroom to dissect psychological and neuropsychological test findings into something attributed to nothing more than poor effort, malingering, invalid test administration, or incorrect interpretation.[110]

Of course, even if gains are made to the point where neuroscience data can be used to aid in competency determinations, that does not

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[109] *Id.* at 313–14.
[110] *Id.* at 310.

mean that neuroscience will be used regularly. One issue may be cost: neuroimaging is expensive, and if its only use is to buttress conclusions that can be arrived at through less expensive behavioral indicators, courts may not always think that the cost of neuroscience data is worth the expense.[111] As with other uses of neuroscience evidence in court, neuroscience data may be used primarily in the "biggest" cases, such as death penalty cases, or cases where the defendant has the financial resources to seek his own experts for a competency evaluation.

B. Neuroscience Data Regarding Malingering of Cognitive Deficit

As described *supra* Part I.B, a common problem with the behavioral tests that are administered during competency evaluations is malingering. While behavioral measures are often used to attempt to detect malingering, they are often coarse, and a skilled malingerer may be able to avoid detection.[112]

Neuroscience may be able to offer a separate type of malingering detection through the use of a memory-detection paradigm called the concealed information test ("CIT").[113] Though commonly associated with "lie detection" conducted using the polygraph, the CIT seeks not to detect whether an individual is lying, but rather whether she recognizes particular pieces of information that are relevant to the investigator's inquiry.[114] The key principle is that when an individual sees an item that has personal meaning among a list of other items of the same category that do not have personal meaning, the individual's physiological response to the meaningful item will differ from her response to the other items in a measurable way.[115]

The CIT is most frequently used to attempt to detect information related to a crime to determine whether an individual was involved in the crime:

> For example, if a murder was committed at 800 Church Avenue using a .38 caliber revolver, the CIT seeks to determine whether a suspect recognizes the address and type

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[111] *See* Jennifer S. Bard, *"Ah Yes, I Remember It Well" + : Why the Inherent Unreliability of Human Memory Makes Brain Imaging Technology a Poor Measure of Truth-Telling in the Courtroom*, 94 OR. L. REV. 295, 311–12 (2016).

[112] *See supra* Part I.B.

[113] *See* John B. Meixner Jr., Note & Comment, *Liar, Liar, Jury's the Trier? The Future of Neuroscience-Based Credibility Assessment in the Court*, 106 NW. UNIV. L. REV. 1451, 1455 (2012).

[114] *See id.*

[115] *See id.* at 1458.

> of weapon[.] The CIT presents subjects with various stimuli, one of which is a crime-related item (the probe, such as the gun used to commit a murder). Other stimuli consist of control items that are of the same class (irrelevants, such as other potentially deadly weapons: a knife, a bat, etc.) such that an innocent person would be unable to discriminate them from the crime-related item. If the subject's physiological response is greater for the probe item than for irrelevant items, then knowledge of the crime or other event is inferred.[116]

Initially, the CIT was conducted using the polygraph machine—when an individual saw the meaningful probe item, she would experience physiological responses like increased sweating of the fingertips and changes in heart rate.[117] More recently, however, the CIT has been adapted for use with neuroscience data as the primary response measure.[118]

The most commonly used method involves the use of electroencephalography ("EEG"), which allows an investigator to collect electrical activity at the scalp based on voltage generated from neuronal firing in the brain.[119] When a specific sensory stimulus, such as an image or word flashed on a screen, is presented to an individual whose brain activity is being collected via EEG, the EEG response to that stimulus is termed an "event-related potential" ("ERP").[120] In 1965, researchers discovered that when individuals were exposed to a single meaningful or unusual item among a list of other nonmeaningful items, the meaningful or unusual item generated a large positive ERP component about 300 milliseconds after the meaningful or unusual item was presented.[121] This component was thus termed the "P300" component.[122] The P300 component has been researched extensively, and has been used as the primary dependent measure in a number of CIT studies—the idea being that when an individual sees a meaningful item, such as the

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[116] *Id.* at 1458.

[117] *See* David T. Lykken, *The GSR in the Detection of Guilt*, 43 J. APPLIED PSYCHOL. 385, 385 (1959) (discussing using the polygraph to conduct the first published CIT); Meixner, *supra* note 113, at 1458.

[118] Meixner, *supra* note 113, at 1458–59.

[119] *See* STEVEN J. LUCK, AN INTRODUCTION TO THE EVENT-RELATED POTENTIAL TECHNIQUE 3 (2nd ed. 2014).

[120] *See id.* at 2, 4.

[121] *See* Samuel Sutton et al., *Evoked-Potential Correlates of Stimulus Uncertainty*, 150 SCI. 1187, 1187 (1965).

[122] *See id.*; *P300 (Neuroscience)*, SCIENCEDIRECT, https://www.sciencedirect.com/topics/neuroscience/p300-neuroscience (last visited Apr. 12, 2018).

weapon he used to commit a crime, a large P300 peak will be generated in response to that item.[123]

What does all of this have to do with detecting malingering of cognitive deficits relevant to competency to stand trial? In addition to determining whether an individual recognizes an item related to the commission of a crime, the P300 ERP component can be used to detect whether an individual is feigning memory loss.[124] In 1995, J. Peter Rosenfeld and his colleagues instructed a number of participants to feign amnesia resulting from a head injury, and pretend that they could not recognize information associated with them, such as their phone numbers, birthdates, or mothers' maiden names.[125] After the participants took a pencil-and-paper test in which they pretended not to recognize those items and intentionally made errors when asked to recognize them, they were given a P300-based CIT.[126] As expected, individuals who feigned amnesia still demonstrated substantially larger P300 components in response to their own phone numbers, birthdates, and mothers' maiden names, as would be expected from non-injured individuals who actually recognized those items, and in contrast to what would be expected from individuals legitimately experiencing amnesia.[127]

Several follow-up studies have replicated those findings and expanded on them. In 1996, Joel Ellwanger and colleagues conducted a study similar to Rosenfeld et al. 1995.[128] Participants were tested on their memory of three item types: their own birthdate, the name of the experimenter (whose name each participant learned prior to participating), and a number of words they had studied from a list at the start of the experiment.[129] As in Rosenfeld et al. 1995, some participants were instructed to pretend not to recognize those items while their brain waves were being recorded.[130] The authors once again found that, at the group level, participants' P300 peaks were significantly larger for meaningful words than for nonmeaningful words.[131] They also, however, conducted more sophisticated

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123 *See* Meixner, *supra* note 113, at 1458–59.

124 *See* J. Peter Rosenfeld et al., *Detecting Simulated Amnesia with Event-Related Brain Potentials*, 19 INT'L J. PSYCHOPHYSIOLOGY 1, 10 (1995); Meixner, *supra* note 113, at 1459.

125 Rosenfeld et al., *supra* note 124, at 2.

126 *See id.* at 2–3.

127 *See id.* at 7–10.

128 *See* Joel Ellwanger et al., *Detecting Simulated Amnesia for Autobiographical and Recently Learned Information Using the P300 Event-Related Potential*, 23 INT'L J. PSYCHOPHYSIOLOGY 9, 10–11 (1996).

129 *Id.* at 11–12.

130 *See id.* at 12.

131 *See id.* at 14–15.

statistical analyses to determine, at the individual subject level, whether each individual recognized the meaningful items as different from the nonmeaningful items presented.[132] The data were encouraging: for the birthdate and experimenter-name block, they were able to detect between 80 percent and 100 percent of the malingering participants, though the accuracy dipped toward 50 percent for the word-list block.[133] The study represented an important step: if a P300-based CIT is to be useful in detecting malingering during competency evaluations, it must be able to detect malingerers at the individual-subject level, as that is the only measure that is important when determining whether a single defendant is competent.[134]

Another 1996 study produced by the same research group provided a different contribution: rather than testing for recognition of personally relevant information such as a birthdate or a mother's maiden name, as was common in the studies discussed above, Rosenfeld and co-authors required participants to attempt to feign memory loss on a forced-choice procedure—a sort of true/false test in which, on each trial, participants were shown a three-digit number, followed by a second three-digit number, and asked to determine whether the first number matched the second.[135] EEG data were collected during these trials, with the expectation that participants would produce large P300 responses to the second number when it matched the first, regardless of whether they claimed to recognize the second number as a match.[136] Largely, this hypothesis was supported by the data—P300 amplitude was substantially larger for matching numbers, and individual diagnostic accuracy (in diagnosing each individual as malingering or not) was somewhere between 65 percent and 85 percent, though the procedures used for diagnosing were relatively preliminary.[137]

More recent data have demonstrated increased diagnostic accuracy. In 1999, the same research group instructed participants to complete a forced-choice identical to the one used in Rosenfeld et al. 1996 while also collecting EEG data, but then also administered a purely behavioral "category test" that required participants to learn

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[132] *See id.* at 17.

[133] *Id.* at 17 & tbl. 3.

[134] *See id.* at 20.

[135] *See* J. Peter Rosenfeld et al., *Detection of Simulated Malingering Using Forced Choice Recognition Enhanced with Event-Related Potential Recording*, 10 CLINICAL NEUROPSYCHOLOGIST 163, 165 (1996).

[136] *See id.* at 169.

[137] *See id.* at 172.

patterns of shapes.[138] For this latter test, the investigators assessed malingering simply via the participants' response choice, similar to the tests described *supra* Part II.B.[139] As with the previous studies, some participants were instructed to feign memory loss and avoid detection.[140] Critically, when combining the neuroscience-based and behavioral measures, the authors were able to correctly classify all of the malingering participants, without misclassifying any participants who were not malingering.[141]

The data in this domain remain limited, but they are encouraging for several reasons. First, the Ellwanger et al. 1999 data imply that neuroscience data may be independent of behavioral data with regard to detecting malingered cognitive deficits,[142] and the two may thus be combined to provide for greater detection accuracy. Though further studies are needed to fully support this conclusion, the early data show that neuroscience could provide a real benefit to the detection of malingering.[143] Second, while sophisticated malingerers may be able to answer behavioral questions in a way so as to avoid detection of their malingering, it may not be as easy for them to manipulate their EEG data to avoid detection.[144] Though there are countermeasures that individuals can do to reduce the accuracy of CIT-type tests,[145] it would require another level of sophistication for malingerers to use those (though data indicating whether countermeasures are effective in defeating CITs designed to detect malingering of cognitive deficit would be helpful). Third, the methods used in these studies largely overlap with methods already used by competency evaluators who suspect malingering of cognitive deficit, and may not be especially difficult to integrate.

There are, of course, serious limitations to these methods as well. The most important, in my view, is that the methods described above only aid in detecting malingered deficit with regard to memory, and many cognitive deficits affecting competency are not related to

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[138] Joel Ellwanger et al., *Identifying Simulators of Cognitive Deficit Through Combined Use of Neuropsychological Test Performance and Event-Related Potentials*, 21 J. CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY 866, 869–70 (1999).

[139] *See id.* at 870; *supra* Part II.B.

[140] *See* Ellwanger, *supra* note 138, at 867–68.

[141] *See id.* at 873. A second experiment yielded similar results. *See id.* at 874–75.

[142] *See id.* at 866.

[143] J. Peter Rosenfeld et al., *Simple, Effective Countermeasures to P300-Based Tests of Detection of Concealed Information*, 41 PSYCHOPHYSIOLOGY 205, 205 (2004).

[144] *See* Ellwanger, *supra* note 138, at 871.

[145] *See generally* Rosenfeld et al., *supra* note 143, at 205, 206, 217, 218 (describing countermeasure mechanisms).

memory.[146] This problem seriously limits the application of the P300-based CIT in this context—as a recognition detector, when recognition is not relevant, the test is not useful. There may be, however, other ways to make a CIT useful in the detection of malingering. For example, other tests that are used to determine the extent to which a defendant understands the legal process, such as the ECST-R,[147] could be adapted into a form in which EEG data are collected during administration with the expectation that when a participant recognized a correct answer to a particular question, a large P300 potential would be evoked. This might require some serious reorganization of the test, but it is worth further inquiry.

C. Neuroscience Data Informing Competency Decisions Among Group Classifications

While detecting individual brain injury and malingering are areas in which neuroscience might have an impact on competency proceedings in the near future, there are other areas of potential use that are less immediately certain. One such area that I will briefly discuss is the potential for neuroscience to provide data that might lend to the conclusion that certain classes of individuals are more prone to being incompetent than others.

The clearest potential example of such a group is juveniles. Though the Supreme Court has not directly addressed whether the competency framework it has laid out applies to juveniles, most states have done so, and some have applied differing standards to juveniles with the understanding that juveniles have not reached the same cognitive development as adults.[148] To my knowledge, none of those rules have been explicitly based on neuroscience data, though the Supreme Court has referenced neuroscience data in supporting some of its holdings regarding juvenile punishment. In *Graham v. Florida*,[149] the Court held that juvenile offenders cannot be sentenced to life imprisonment without parole for non-homicide offenses.[150] In reaching that holding, the court explained that

> developments in psychology and brain science continue to

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[146] Elizabeth L. Glisky, *Changes in Cognitive Function in Human Aging*, *in* BRAIN AGING: MODELS, METHODS, AND MECHANISMS 4, 16 (2007).

[147] *See supra* notes 36–38 and accompanying text.

[148] *See, e.g.*, Christopher A. Mallett, *Juvenile Competency Standards' Perfect Storm: Ineffective Punitive Policies; Undetected Incompetent Youth; and* Roper v. Simmons, 44 CRIM. L. BULL. 848, 849, 850, 851, 852 (2008).

[149] Graham v. Florida, 560 U.S. 48 (2010).

[150] *See id.* at 82.

> show fundamental differences between juvenile and adult minds. For example, parts of the brain involved in behavior control continue to mature through late adolescence. Juveniles are more capable of change than are adults, and their actions are less likely to be evidence of "irretrievably depraved character" than are the actions of adults.[151]

Then, in *Miller v. Alabama*,[152] the Court once again referenced the concept in holding that mandatory life sentences without the possibility of parole for juveniles are unconstitutional.[153]

Without delving into current neuroscience data that might imply whether juveniles are less likely to satisfy the *Dusky* standard than adults, it is easy to see the parallels between the *Graham* and *Miller* line of cases and potential future cases related to competency.[154] Even if neuroscience makes no contribution to the shaping of competency standards themselves and who they apply to, neuroscience data implying that certain groups are more vulnerable to falling below the competency threshold might inform examiners or courts making competency determinations about a single person. And these conclusions may not be limited to the juvenile context—neuroscience could provide data relevant to the potential competency of other groups, such as drug addicts or recovering drug addicts, individuals who have been victims of abuse, or a host of other characteristics.

To be clear, however, I think this area is one in which neuroscience's contribution will not come soon, if it does come at all. Courts tend to be reluctant to extrapolate group data to individual cases,[155] and so group data showing, for example, that recovering drug addicts have a biological predisposition toward incompetency would have to be very compelling to influence a single judge in a competency evaluation. I do not think we are currently close to such compelling group data.

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[151] *Id.* at 68 (internal citations omitted).

[152] Miller v. Alabama, 567 U.S. 460 (2012).

[153] *Id.* at 465.

[154] *See, e.g.*, Kathryn Monahan et al., *Juvenile Justice Policy and Practice: A Developmental Perspective*, 44 CRIME & JUST. 577, 579, 591, 598 (2015) (summarizing current neuroscience data regarding juvenile development).

[155] *See, e.g.*, David L. Faigman et al., *G2i Knowledge Brief: A Knowledge Brief of the MacArthur Foundation Research Network on Law and Neuroscience*, MACARTHUR FOUND. RES. NETWORK ON L. & NEUROSCIENCE, 2017, at 1, 2.

D. Caveats

Before concluding, it is worth discussing some general caveats as to the potential impact of the methods described in this Part. As Stephen Morse and others calling for "neuromodesty" have repeatedly (and wisely) explained, because behavior is what the law is interested in, behavior should always be the starting point (and often the ending point) in legal inquiry:

> The criteria for both responsibility and competence are behavioral; therefore, actions speak louder than images. This is a truism for all criminal responsibility and competence assessments. If the finding of any test or measurement of behavior is contradicted by actual behavioral evidence, then we must believe the behavioral evidence because it is more direct and probative of the law's behavioral criteria. For example, if the person behaves rationally in a wide variety of circumstances, the agent is rational even if the brain appears structurally or functionally abnormal. We confidently knew that some people were behaviorally abnormal, such as being psychotic, long before there were any psychological or neurological tests for such abnormalities. . . .
>
> If actions speak louder than images, however, what room is there for using neuroevidence? Let us begin with cases in which the behavioral evidence is clear and permits an equally clear inference about the defendant's mental state. For example, lay people may not know the technical term to apply to people who are manifestly out of touch with reality, but they will readily recognize this unfortunate condition. No further tests of any sort will be necessary to prove this. In such cases, neuroevidence will be at most convergent and increase our confidence in what we already had confidently concluded. Determining if it is worth collecting the neuroevidence will depend on whether the cost-benefit analysis justifies obtaining convergent evidence.[156]

As a general matter, I agree with Professor Morse. In most cases, behavioral evidence will be enough for courts to make conclusions about competency, and accordingly, neuroscience evidence will continue to be rare. To the extent that neuroscience evidence is used, it will often be in a supporting role, buttressing behavioral evidence

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[156] Morse, *supra* note 1, at 852, 853.

where it is cost-effective to do so.[157]

I do think, however, that the arena of competency is somewhat unique in that the motivation to malinger cognitive deficits is often high, and neuroscience provides potentially unique evidence that cannot easily be hidden through malingering. While an individual can pretend to be unable to communicate with her attorney or understand the proceedings surrounding her, and if she is savvy, she may be able to avoid detection through behavioral tests of malingering, it will be more difficult for her to fake brain damage that might be associated with the condition she claims she has, or avoid neural signatures of recognition that indicate that her capacity is greater than she is leading on. In short, I think the data to date indicate that neuroscience can play a twofold role in competency evaluations: (1) support for behavioral conclusions, and (2) verification of the validity of the behavioral indicators used.

CONCLUSION

I believe there are several key points to draw from this introductory examination of neuroscience in competency proceedings. First, competency proceedings are one of the few legal proceedings where an individual's current mental state is directly relevant, and thus, it is a proceeding where neuroscience evidence stands to be potentially very useful. Second, though we know neuroscience is occasionally used in competency proceedings right now and that it is primarily used as an aid to diagnosing brain injury that might be relevant to competency, we still have very little understanding of the full current extent of neuroscience use in competency proceedings. Third, there are several ways in which neuroscience could potentially be useful in competency proceedings in the future; primarily continued diagnosis of brain injury and illness, and detection of malingering of cognitive deficit.

Substantial future study is necessary to get a better understanding of these conclusions. Empirical examination of the use of neuroscience in legal contexts is still in its infancy, and a study more thoroughly examining the use of neuroscience in competency contexts over a broader period of time would be a major contribution. Perhaps even more critically, collaboration between neuroscientists and lawyers is necessary for lawyers to fully understand the potential for

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[157] *See* Owen D. Jones, *Seven Ways Neuroscience Aids Law*, *in* NEUROSCIENCES AND THE HUMAN PERSON: NEW PERSPECTIVES ON HUMAN ACTIVITIES 5–6 (2013).

the use of neuroscience in court, and for neuroscientists to understand what further data are necessary to make neuroscience more useful in competency contexts.

As the science progresses, I expect we will see a continued increase in the use of neuroscience in competency proceedings, perhaps to a greater extent than in other proceedings where current mental states are less immediately relevant. Though it is doubtful that we will ever have a perfect diagnostic tool to measure the questions that a competency evaluation seeks to answer, competency is a primary example of a legal proceeding where neuroscience can provide strong support for behavioral indicators.