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PANEL 4: TRANSLATIONAL EXPECTATIONS AND ISSUES: MAKING IT WORK IN PRACTICE

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SPEAKERS: DR. MARTHA FARAH, PHD,* JUDGE NANCY GERTNER,** AND STACEY TOVINO***

I. INTRODUCTION

The final panel of the conference focused on translational expectations and issues, and turned to questions relating to whether and how the neuroimaging of pain may be useful in legal settings. The panel represented a range of expertise, including a neuroscientist who works on translational issues in law and science, a former federal judge, and a professor of law whose scholarship emphasizes the history of medicine.[1] Dr. Martha J. Farah, PhD spoke first, focusing on the dual promise and challenge of using neuroimaging as medical and legal evidence of pain.[2] She described the

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1. Dr. Martha Farah, PhD, Judge Nancy Gertner, & Prof. Stacey Tovino, Imaging the Brain, Changing Minds: Chronic Pain Neuroimaging and the Law Symposium, Panel 4: Translational Expectations and Issues: Making it Work in Practice (Apr. 25, 2014) [hereinafter Panel 4] (transcript on file with the editors).

2. *Id.* at 1; *see also id.* at 1–3 (explaining that neuroimaging will not be adequate evidence of pain until there is a standard way of describing the subjective psychological nature of pain); *see also, e.g.*, Adam J. Kolber, *Pain Detection and the Privacy of Subjective Experience*, 33 AM. J.L. & MED. 433, 433–34 (2007) [hereinafter *Pain Detection*] (noting that researchers have been able to use neuroimaging to identify precise brain regions that enable individuals to experience pain and the amount of pain a person is experiencing); Adam J. Kolber, *The Experiential Future of the Law*, 60 EMORY L.J. 585, 599 (2011) [hereinafter *The Experiential Future*] (acknowledging that

ways in which neuroimaging technologies (functional MRIs ("fMRI") in particular) are already useful in the field of psychiatry, changing basic research, challenging long standing disease definitions and descriptions, and suggesting new avenues for treatment.[3] She analogized between the utility of fMRIs in psychiatric illnesses and chronic pain disorders because both involve the search for the physiology of disorders that are otherwise phenomenological and subjective.[4] She expressed the hope that neuroimaging may produce a diagnostic marker for different kinds of chronic pain conditions, but cautioned that more research may show that pain is more various and complex than we currently imagine.[5] Indeed, we may not find a biomarker or neural signature for many different kinds of pain experience.[6] She expressed great optimism that fMRIs and other neuroimaging techniques may produce legally relevant results.[7] While acknowledging the group-to-individual inference problem and the reverse inference problem (discussed below),[8] she suggested that these are

although neuroimaging is being used in pretrial litigation, there are still numerous obstacles to overcome before neuroimaging can be used in clinics or courtrooms).

3. Panel 4, *supra* note 1, at 1; *see generally* Paul M. Matthews et al., *Applications of fMRI in Translational Medicine and Clinical Practice*, 7 NATURE REVIEWS NEUROSCIENCE 732, 735–37, 741 (2006) (reviewing the many applications of fMRI, including its use in selecting optimal treatment for patients with psychiatric diseases, establishing brain patterns associated with schizophrenia, and gaining better understanding of genetic factors).

4. Panel 4, *supra* note 1, at 1–2; *see also* Oguz Demirci & Vince D Calhoun, *Functional Magnetic Resonance Imaging – Implications for Detection of Schizophrenia*, 4 EUROPEAN NEUROLOGICAL REVIEW [EUR. NEUR. REV.], no 2, 2009, at 103, 103 (U.K.) (explaining that due to the subjective nature of schizophrenia, there is no objective method of diagnosing it, but using fMRI may be valuable in investigating the physiological disturbances that lead to the manifestation of the disease); *Pain Detection*, *supra* note 2, at 434, 441–42 (explaining that pain has many phenomenological components and it is hard to properly evaluate an individual's level of pain).

5. *See* Panel 4, *supra* note 1, at 2–3 (describing the need for an accurate method of describing chronic pain in order to be able to rely on neuroimaging as evidence of pain because, for example, chronic pain of someone with phantom limb might be different from the chronic pain of a bad back); *see also The Experiential Future*, *supra* note 2, at 597 (explaining that the new technologies available will improve methods of assessing pain in the future, but these new technologies may never be able to make intersubjective assessments of pain).

6. *See* Panel 4, *supra* note 1, at 2 (explaining that the ability to accurately map the different types of pain onto information from brain imaging will not be possible until there is a method of assessing the subjective nature of pain); *see also The Experiential Future*, *supra* note 2, at 589 (explaining that even though scientists have made tremendous progress in assessing pain with more precision, the technology may never be perfect).

7. Panel 4, *supra* note 1, at 3; *see also The Experiential Future*, *supra* note 2, at 610 (explaining that accurate assessment of pain using the fMRI may help juries properly assess pain awards).

8. *See infra* text accompanying notes 84–88 (discussing Dr. Farah's view on the reverse inference problem); *see generally*, Russell A. Poldrack, *Inferring Mental States From Neuroimaging Data: From Reverse Inference to Large-Scale Decoding*, 72 NEURON, 692, 692 (2011) (describing the many critiques of reverse inference in analyzing mental processes).

problems of experimental design, not principle problems that would prevent the development of a medically and legally useful tool.[9]

The Honorable Nancy Gertner (ret.) emphasized the challenges of using pain neuroimaging in the legal system.[10] She lauded Professor Farah's optimism and agreed that neuroimaging protocols relating to chronic pain may achieve sufficient accuracy and reliability to pass the standards of admissibility in court.[11] However, she sounded several important notes of caution. First, she emphasized a basic non-commensurability between scientific measurements of pain and the legal category of "pain and suffering."[12] "Suffering," she noted, is a normative concept.[13] It relates to value judgments about how a claimant experienced his or her injury or disability, and how much legal decision makers believe he or she should be compensated for that distress.[14] She suggested, accordingly, that even a "100 percent" perfect pain-o-meter could not fully substitute for the kinds of judgments that the law asks judges and juries to make."[15] She further emphasized several institutional considerations that should lead to caution relative to the use of neuroimaging.[16] She discussed the variability in judges' decisions regarding the admissibility of expert and scientific evidence, the appellate courts' limited review of trial courts'

9. Panel 4, *supra* note 1, at 5; *see generally* Poldrack, *supra* note 8, at 692, 694, 696 (acknowledging some of the limitations of reverse inference, but explaining the frameworks for getting around some of the experimental limitations).

10. Panel 4, *supra* note 1, at 6; *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, 303–04 (2012) (describing the incompatibility between science's focus on methodology and law's focus on normative judgments, and how this makes it difficult to translate scientific knowledge to legal certainty in the courtroom).

11. Panel 4, *supra* note 1, at 5; *see* Shaun Cassin, Comment, *Eggshell Minds and Invisible Injuries: Can Neuroscience Challenge Longstanding Treatment of Tort Injuries?*, 50 HOUS. L. REV. 929, 949 (2013) (citing an example of how a New York state court allowing a PET scan as evidence of brain trauma may, by extension, mean that other uses of neurosciences will pass the general acceptance standard applied to evidence in the courtroom).

12. Panel 4, *supra* note 1, at 6; *see also Pain Detection*, *supra* note 2, at 441 (explaining that the phrase "pain and suffering" is broadly construed in the legal context as to permit recovery for not only physical pain, but for fright, nervousness, grief, anxiety, worry, mortification, shock, humiliation, and indignity). *Cf.* Cassin, *supra* note 11, at 960 (explaining neuroscience's inability to predict psychological states such as emotional distress).

13. Panel 4, *supra* note 1, at 6; *see also Pain Detection*, *supra* note 2, at 441, 446 (explaining that the issue of attaching monetary value to the quality and quantity of pain that a plaintiff has experienced is a normative one).

14. Panel 4, *supra* note 1, at 6; *see also Pain Detection*, *supra* note 2, at 446 (explaining that the process of pain valuation involves attaching an appropriate monetary value to the quality and quantity of pain suffered by the plaintiff).

15. Panel 4, *supra* note 1, at 6; *see also Pain Detection*, *supra* note 2, at 446 (quoting Restatement (Second) of Torts on how difficult it is to value pain and suffering in the court).

16. Panel 4, *supra* note 1, at 6–7, 14–15.

evidentiary determinations, the distorting role played by differences in parties' resources, and the possible "Christmas tree effect"—the effect of being dazzled by lights and colors—that neuroimaging might have on jurors.[17] She expressed the hope that judges, neuroscientists, and legal scholars can work together to produce clear standards that can be applied in every courtroom to uniformly guide judges and juries.[18] She concluded on the optimistic note that if pain neuroimaging develops further and if uniform admissibility standards are generated, the law may no longer view claimants who have subjective complaints (like emotional pain and invisible but chronic physical pain conditions) with skepticism.[19]

Professor Stacey Tovino, a legal scholar and historian of medicine, offered both constructive and critical remarks about the ways in which legal institutions use and respond to medical evidence.[20] She described several concrete cases for pain neuroimaging in law, discussing health insurance reimbursement law, the Americans with Disabilities Act, and Social Security Law.[21] Turning to her more cautionary remarks, she briefly described the history of visualization technologies in the courtroom, and discussed historical and contemporary norms relating to the verification and treatment of pain.[22] In particular, she informed the conference about the history of underestimating the pain of underprivileged classes of people and the ways that that this history continues to influence medical treatment and legal decisions today.[23]

17. *Id.*; *see also* Jennifer Kulynych, *Psychiatric Neuroimaging Evidence: A High-Tech Crystal Ball?*, 49 STAN. L. REV. 1249, 1261 (explaining that state courts rely on the Frye test to evaluate admissibility of scientific evidence while federal courts rely on a more comprehensive validity analysis set forth by the Supreme Court in Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993)); Cassin, *supra* note 11, at 944, 951 (commenting on how cost can be a general deterrent to the use of neuroimaging in tort cases, and noting the "seductive allure" that neuroscience has on the jury).

18. Panel 4, *supra* note 1, at 8; *see also* Eggen & Laury, *supra* note 10, at 284–85 (providing a model that can guide judges and attorneys when confronted with functional neuroimaging evidence in tort cases).

19. Panel 4, *supra* note 1, at 16; *see also* Eggen & Laury, *supra* note 10, at 284, 289 (suggesting that the model proposed by the author can help substantiate claims of emotional distress).

20. *See* Panel 4, *supra* note 1, at 11–12 (giving examples of how hospitals and hospices could avoid being liable for neglecting to provide effective pain management control if the patient or their family could not provide evidence of pain).

21. *Id.* at 10–12.

22. *See id.* at 9–10, 14 (giving examples of the use of x-rays to show pain in the courtroom and how historically, pain has been treated differently in minority populations or less privileged individuals).

23. *Id.* at 9; *see* Dania Palanker, Note, *Enslaved By Pain: How the U.S. Public Health System Adds to Disparities in Pain Treatment for African Americans*, 15 GEO. J. ON POVERTY L. &

II. REMARKS OF PROFESSOR FARAH: HOW TO CREATE LEGALLY USEFUL TOOLS WITH FMRI

Professor Farah opened the panel by describing the ways in which fMRI of the brain has already been useful in understanding subjective, emotional states other than pain.[24] She described the ways in which neuroimaging (fMRIs in particular) "has already proven useful in psychiatry for research in revealing the pathophysiology of different symptoms and disorders . . . ."[25] Further, neuroimaging has proven useful "in identifying [endophenotypes] . . . , for [different psychiatric illnesses], for genetic research, [and] for drug development."[26]

Neuroimaging allows researchers who study psychiatric illnesses to proceed in more systematic ways than in the past, Professor Farah explained.[27] Previous research generally has been limited to testing "whether a certain molecule actually cures somebody or prevents somebody at high risks for schizophrenia from getting it."[28] Instead, using a fMRI, researchers can identify patterns in the brains of people with psychiatric illness, how these patterns differ from those in the brains of healthy control subjects, and then determine whether a particular drug "shifts that pattern [or] diminishes activation in the areas of concern."[29] For example, in the

POL'Y 847, 858 (2008) (discussing the interrelationship between race and socioeconomic status, and the disparities in pain treatment).

24. Panel 4, *supra* note 1, at 1; *see generally* Matthews et al., *supra* note 3, at 732, 735–37 (explaining the application of the fMRI to the treatment of emotional disorders, such as depression and schizophrenia).

25. Panel 4, *supra* note 1, at 1; *see also* Matthews et al., *supra* note 3, at 732, 736–37 (explaining how neuroimaging has been helpful in translational medicine and clinical practice in understanding complex diseases).

26. Panel 4, *supra* note 1, at 1; *see also* Matthews et al., *supra* note 3, at 732, 736–37 (explaining that the fMRI has been used for the characterization of certain neurophysiologically based phenotypes that are associated with genetic disorders and for selecting optimal treatment for patients with psychiatric diseases).

27. Panel 4, *supra* note 1, at 1; s*ee also* Abhisek C. Khandai & Howard J. Aizenstein, Recent Advances in Neuroimaging Biomarkers in Geriatric Psychiatry 2, 4 (June 1, 2014) (previously published in 15 CURR PSYCHIATRY REP. 360 (2013)) (on file with NIH), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3667151/pdf/nihms-474933.pdf.

28. Panel 4, *supra* note 1, at 1; *see also* S Miyamoto et al., *Treatments for Schizophrenia: A Critical Review of Pharmacology and Mechanisms of Action of Antipsychotic drugs*, 10 MOLECULAR PSYCHIATRY 79, 79–85 (2005) (providing a review of the evolution of the treatment of schizophrenia in the context of antipsychotic drug development).

29. Panel 4, *supra* note 1, at 1; *see also* Lisa J. Burklund & Matthew D. Lieberman, *Advances in Functional Neuroimaging of Psychopathology*, 18 PHIL., PSYCHIATRY, & PSYCHOL. 333, 334 (2011) (noting that the fMRI can elucidate neural regions and processes that may have abnormal functions in certain patients compared to healthy persons, providing useful information to optimize treatment).

case of depression, neuroimaging has allowed researchers to see that people suffering from depression show higher levels of activity in particular regions of the amygdala than do non-depressed people;[30] neuroimaging permits researchers to test which drugs reduce excess amygdalar activity.[31] These "research uses [of neuroimaging] matter" already have "been valuable."[32] In the clinical setting, neuroimaging could be useful in the future for "diagnosis, maybe treatment response prediction, [and] prognosis;"[33] however, its utility is less clear.[34] Using neuroimaging for these purposes currently is "not the standard of care."[35]

Debates about the uses of neuroimaging in the psychiatric research community could be useful in understanding the role of neuroimaging for the diagnosis, prognosis, and treatment of chronic pain, Professor Farah opined.[36] The appropriate uses of neuroimaging became a major issue in drafting the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders ("DSM").[37] Published by the American Psychiatric Association, the DSM embodies a consensus of the psychiatric community (or at least of the drafting committee that authors the DSM) discussing the recognized

30. Panel 4, *supra* note 1, at 1; *see also* J. Paul Hamilton et al., *Functional Neuroimaging of Major Depressive Disorder: A Meta-Analysis and New Integration of Baseline Activation and Neural Response Data*, 169 AM J PSYCHIATRY 693, 693 (2012) (stating that neural response studies using negative stimuli showed greater amygdalar response in patients with major depressive disorders compared to healthy individuals).

31. Panel 4, *supra* note 1, at 1; *see also* Callie L. McGrath et al., *Toward a Neuroimaging Treatment Selection Biomarker for Major Depressive Disorder*, 70 JAMA PSYCHIATRY 821, 824–25 (2013), *available at* http://archpsyc.jamanetwork.com/article.aspx?articleid=1696349 (showing that the left amygdala is one of the brain regions that demonstrates significant treatment outcome interaction using escitalopram and cognitive behavior therapy).

32. Panel 4, *supra* note 1, at 1; *supra* text accompanying notes 29–31.

33. Panel 4, *supra* note 1, at 1; *see also* Glenda M. MacQueen, *Will There Be a Role for Neuroimaging in Clinical Psychiatry?*, 35 J. PSYCHIATRY NEUROSCIENCE 291, 291 (2010) (stating that neuroimaging methods are being used not only for accurate diagnosis of psychiatric symptoms, but also for monitoring treatment responses and clinical outcomes).

34. Panel 4, *supra* note 1, at 1; *see also* MacQueen, *supra* note 33, at 292 (discussing the need to investigate the feasibility and barriers of incorporating neuroimaging modalities in routine clinical practice).

35. Panel 4, *supra* note 1, at 1; *see also* MICHAEL FIRST ET AL., AM. PSYCHIATRIC ASS'N, CONSENSUS REPORT OF THE APA WORK GROUP ON NEUROIMAGING MARKERS OF PSYCHIATRIC DISORDERS 5–6 (2012) (explaining that peer reviewed scientific literature does not yet provide studies that support the use of a diagnostic imaging biomarker with high reliability or neuroimaging measures with high sensitivity or specificity in detecting psychiatric disorders).

36. Panel 4, *supra* note 1, at 1.

37. *Id.*; *see generally* AM. PSYCHIATRIC ASS'N, THE DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS [hereinafter DSM] (5th ed. 2013); *see also* Seth J. Gillihan & Eric Parens, *Should We Expect "Neural Signatures" for DSM Diagnoses?*, 72 J. CLINICAL PSYCHIATRY 1383, 1388 (2011) (concluding that neuroimaging modalities are less accurate and more expensive than behavioral methods in diagnosing psychiatric disorders, and are thus unlikely to become a useful tool for DSM based diagnoses).

psychiatric illnesses and their diagnostic criteria.[38] The DSM has long been criticized as failing to define psychiatric illnesses in ways that map onto specific and unique pathophysiology—that is, psychiatric and emotional disorders that have physiological correlates and causes.[39] Yet, it remains unclear whether the same pathophysiology underlies all cases of what the DSM would identify as the same disorder, nor is it clear whether the same pathophysiology may give rise to sufficiently different presentations across patients, and whether the patients would receive different diagnoses.[40]

Accordingly, the National Institute of Mental Health ("NIMH") is directing its funding of psychiatric research toward studies that use neuroimaging to identify whether there are unique neurological correlates of different psychiatric diagnoses, and to attempt to identify the ways in which the brains of people with distressing psychiatric symptoms function differently than the brains of matched controls.[41] This direction on the part of NIMH led to conflict with the drafters of the DSM because "NIMH thinks it's all a bad way of classifying patients and so we're only going to fund people who use [neuroimaging]. It is quite a mess."[42]

This "mess," Professor Farah discussed, "is instructive for the problem we're talking about" because pain scientists are looking for neural markers of pain in the same way that psychiatric researchers are looking for neural markers of psychiatric diseases:[43]

38. DSM, *supra* note 37; *see also* DSM, AM. PSYCHIATRIC ASS'N, http://www.psychiatry.org/practice/dsm (last visited Mar. 18, 2015).

39. *See, e.g.*, Sally L. Satel, *Why the Fuss over D.S.M.-5?*, *Sunday Review*, N.Y. TIMES (May 11, 2013), *available at* http://www.nytimes.com/2013/05/12/opinion/sunday/why-the-fuss-over-the-dsm-5.html?_r=0 (stating that the DSM is an "imperfect guide to predicting" treatments because psychiatric diagnoses are based on clinical signs that tend to cluster—not on the mechanism of the illness, like with bacterial pneumonia).

40. *See* AM. PSYCHIATRIC ASS'N., A RESEARCH AGENDA FOR DSM-V 33–34 (David J. Kupfer et al. eds., 2002) (stating that the current classification in psychiatry resembles medicine of 50 to 100 years ago, when the pathophysiology of many diseases was not yet known).

41. *Strategic Research Priorities*, *Strategy 1.3: Identify and Integrate Biological Markers (Biomarkers) and Behavioral Indicators Associated with Mental Disorders*, NAT'L INST. MENTAL HEALTH, http://www.nimh.nih.gov/research-priorities/strategic-objectives/strategy-13.shtml (last visited Feb. 8, 2015).

42. Panel 4, *supra* note 1, at 1; *see also* Press Release, Thomas R. Insel, Dir., Nat'l Inst. of Mental Health, & Jeffrey A. Lieberman, President-elect, Am. Psychological Ass'n, DSM-5 and RDoC: Shared Interests (May 13, 2013) (on file with NIMH), *available at* http://www.nimh.nih.gov/news/science-news/2013/dsm-5-and-rdoc-shared-interests.shtml (noting that NIMH's Research Domain Criteria ("RDoC") project hopes to create new ways of classifying mental disorders that directly reflects modern brain science).

43. Panel 4, *supra* note 1, at 1.

> A neural signature of pain would be a diagnostic marker. What you're aiming to do is map a psychological entity—schizophrenia, depression, pain, whatever—onto a physiological entity [as indicated by] a certain pattern of BOLD[44] response or functional conductivity.[45]
>
> . . .
>
> [Though it is] not trivial to get these things right, there's good reason for optimism that imaging will be useful here.[46]

Professor Farah noted that the challenges of identifying the physiological correlates and causes of pain, or of other psychologically mediated phenomena like depression, requires careful conceptual work as well as intensive "bench" or investigational work.[47] To find the physiological correlates, "we [first] need to get the psychological description right."[48] Professor Farah referred to this process of identifying and categorizing the subjective phenomena into natural kinds as "carving the bird at the joints."[49] This, she noted, has not yet occurred in psychiatry, and "even [the DSM's] strongest defenders would say it probably isn't really carving the bird of psychopathology at the joints. It's a sort of good enough system that has high reliability, and so much of our knowledge is encoded relative to it that we can't afford to throw it out."[50]

Instead of a physiologically robust description of psychiatric illnesses, "we have certain psychological concepts of ability and disability and so forth, but we really don't have a good parse of mental problems into natural

44. Blood-oxygen level-determination ("BOLD") technique is a widely used fMRI method that measures brain activity by measuring cerebral blood flow. *See* Nikos K. Logothetis, *The Neural Basis of the Blood-Oxygen-Level-Dependent Functional Magnetic Resonance Imaging Signal*, 357 PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON B: BIOLOGICAL SCIENCES [PHIL. TRANS. R. SOC. LOND. B] 1003, 1010 (2002) (U.K.)

45. Panel 4, *supra* note 1, at 1–2; *see also* Logothetis, *supra* note 44, at 1008, 1010 (describing the BOLD technique in depth).

46. Panel 4, *supra* note 1, at 2.

47. *Id.* at 1–2; *see also Division of Neuroscience and Basic Behavioral Science (DNBBS)*, NAT'L INST. MENTAL HEALTH, http://www.nimh.nih.gov/about/organization/dnbbs/index.shtml (last visited Mar. 18, 2015) (listing, as a high research priority, the development of new physiological models to understand biological functions in normal and abnormal mental functions).

48. Panel 4, *supra* note 1, at 2; *see also Division of Neuroscience and Basic Behavioral Science (DNBBS)*, *supra* note 47.

49. Panel 4, *supra* note 1, at 2.

50. *Id.* at 2; *see also* Press Release, DSM-5 and RDoC: Shared Interests, *supra* note 42 (stating that the DSM is still the "contemporary consensus standard" for the diagnosis and treatment of mental disorders).

kinds."[51] Similarly, she noted, "we don't have a very good parse of pain into the natural kinds of pain."[52] We have clinical and legal categories, such as "real pain, malingered pain, chronic pain, subacute [pain], whatever," but these general, descriptive labels may not map onto what happens in the brain.[53] She suggested that it will be necessary to achieve "an intertheoretical reduction," in which researchers work to harmonize the ways they describe and categorize pain with the ways that pain and pain disorders are represented in the brain.[54] Some of our descriptive labels may not map onto the neurophysiological differences of how different kinds of pain are experienced and how various pain disorders disturb normal pain processing in the brain.[55]

This comes back to the idea that "you need to carve the pain bird and the brain bird [at its joints]," or achieve a clear understanding of the relationship between the phenomenology and the physiology.[56] Professor Farah noted that there is some relationship between acute and chronic pain, but they are sufficiently different in that the "articulation" between them might constitute a "joint."[57] Further, there is "evidence that different kinds of chronic pain are different physiologically. So, the chronic pain of somebody with phantom limb might be different than the chronic pain of a bad back or a burn victim . . . ."[58] Thus, "carving the bird at the joints" may

51. Panel 4, *supra* note 1, at 2; *see also* Thomas A. Widiger & Douglas B. Samuel, *Diagnostic Categories or Dimensions? A Question for the* Diagnostic Statistical Manual of Mental Disorders—Fifth Edition, 114 J. ABNORMAL PSYCHOL. 494, 494 (2005) (discussing the problems with the idea of absolute boundaries in categorical divisions of mental disorders and the limitations of this model).

52. Panel 4, *supra* note 1, at 2.

53. *Id.* at 2. *Cf.* C. Maestu Unturbe et al., *Pneumatic Device for Somatosensorial and Pain Stimulation Compatible with Magnetic Functional Resonance (fMRI) and Magnetoencefalography (MEG) DISNESO- 02*, XXVI CONGRESO ANUAL DE LA SOCIEDAD ESPAÑOLA DE INGENIERIA BIOMÉDICA [CASEIB] 372, 374 (2008) (concluding that there is less variability in descriptions of central pain responses because of imaging technology).

54. Panel 4, *supra* note 1, at 2.

55. *Id*. *Cf*. *The Experiential Future*, *supra* note 2, at 597–99 (explaining the various ways researchers have analyzed different pain stimuli that activate different parts of the brain).

56. Panel 4, *supra* note 1, at 2; *see also* A.Vania Apkarian et. al., *Pain and the brain: Specificity and Plasticity of the Brain in Clinical Chronic Pain*, 152 J. PAIN S49, S50 (2011) (explaining that the connection between consciousness and biological processes of pain are tentative).

57. Panel 4, *supra* note 1, at 2; *see also Acute vs. Chronic Pain*, CLEVELAND CLINIC, http://my.clevelandclinic.org/services/anesthesiology/pain-management/diseases-conditions/hic-acute-vs-chronic-pain (last visited Mar. 18, 2015) (describing the differences between acute pain, which is shorter in length and often has an identifiable cause, and chronic pain, which is persistent over time and is often incurable and poorly understood).

58. Panel 4, *supra* note 1, at 2; *see also* Apkarian et al., *supra* note 56, at S55 (discussing how distinct pain involves "unique brain regions"); A D (Bud) Craig, *Mapping Pain in the Brain*,

not be as straightforward as finding the distinctions among acute pain, chronic pain, emotional pain, and malingered pain. There may be many important phenomenological and physiological distinctions that we are only beginning to see and understand in the brain. "Again," she emphasized, "we need to sort out these distinctions before we can confidently say I have a chronic 'pain-o-meter.'"[59]

Professor Farah then emphasized the importance of the phenomenological and neurological differences between different kinds of pain.[60] She praised the work of Tor Wager, Karen Davis, and others in inducing acute pain in the lab and identifying its neurological correlates.[61] She stressed, however, that "we have good clinical, phenomenological and some biological reasons to think that chronic and acute pain are pretty distinct beasts."[62] If one of these researchers were to "come[] back to us in a couple of years and say[] I've got this pattern classifier that works 99 percent of the time [that] say[s] who's in acute pain and who isn't . . . . You would be thrilled to have that, but you would not want to use it to decide whether somebody who's applied for disability benefits is in chronic pain."[63] She then emphasized again that "[y]ou really wouldn't want to do that."[64]

Professor Farah argued that "people go to extremes in evaluating [the merits of] functional neuroimaging."[65] Commenters either view the fMRI

WELLCOME TRUST, http://www.wellcome.ac.uk/en/pain/microsite/science2.html (last visited Mar. 18, 2015) (explaining how different feelings of pain have their own pathways to the brain).

59. Panel 4, *supra* note 1, at 3; *see also The Experiential Future*, *supra* note 2, at 599 (noting, despite the developments in the imaging of pain, that the research is still in its early stages and requires "further elaboration and replication").

60. Panel 4, *supra* note 1, at 3.

61. *Id.* at 2; *see generally* Karen D. Davis et al., *Functional MRI of Pain- and Attention-Related Activations in the Human Cingulate Cortex*, 77 J. NEUROPHYSIOLOGY 3370 (1997) (utilizing fMRIs to determine if regions of the brain were reacting the way they were anticipated to react); Tor D. Wager et al., *An fMRI-Based Neurologic Signature of Physical Pain*, 368 NEW ENG. J. MED. 1388 (2013) (using fMRI to assess pain in particular subjects); Jamil Zaki et al., *Different Circuits for Different Pain: Patterns of Functional Connectivity Reveal Distinct Networks for Processing Pain in Self and Others*, 2 SOC. NEUROSCIENCE 276 (2007) (exploring the overlapping and distinct experiences of pain for self and others).

62. Panel 4, *supra* note 1, at 2; *see also Acute vs. Chronic Pain*, *supra* note 57 (explaining the differences between acute and chronic pain).

63. Panel 4, *supra* note 1, at 2.

64. *Id.*

65. *Id.* at 3; *see also, e.g.*, R. Todd Constable, *Challenges in fMRI and Its Limitations*, *in* FUNCTIONAL MRI: BASIC PRINCIPLES AND CLINICAL APPLICATIONS 75 (Scott H. Faro & Feroze B. Mohamed eds., 2006) (addressing the challenges of fMRIs in function); Humera Ahsan et al., *Application and Advantage of Functional Magnetic Resonance Imaging and Blood Oxygen Level Dependent (BOLD) Imaging Modality*, 59 JOURNAL OF PAKISTAN MEDICAL ASSOCIATION [J PAK

"as this great panacea that's going to make psychology obsolete, because why do you need all this mind stuff when you can just look at the brain," or they go to the other extreme of dismissing the fMRI as meaningless because "they make these beautiful pictures out of these funky [BOLD] signals that [vary] depending on what plane you got off of" or other trivial factors that can distort the BOLD signal.[66] Accordingly, Professor Farah took some time "to address some of the technical issues with imaging and with identifying these natural kinds at the brain level."[67]

First, she addressed the question of variability in the BOLD signal.[68] She noted that other speakers had given "reasons to be cautious when interpreting the results of [BOLD] MRI," yet she "disagree[d] with . . . the implication that this is a fundamental limitation of [BOLD] MRI that will keep it from delivering informative results to people . . . who want to . . . figure out if somebody is in chronic pain or not."[69] Understanding the obstacles that can interfere with the reliability of the BOLD signal does not make the BOLD signal useless.[70]

These problems show, in Professor Farah's view, that at least two factors need to be addressed to ensure that the research using the fMRI is useful.[71] The first is that "if you're going to develop [neuroimaging] methods for real world use, [including legal and clinical use, researchers] need to standardize them on the relevant populations."[72] This, she said, "is totally doable."[73] She acknowledged that "these [experiments] are not easy to do or cheap to do, but they are perfectly doable empirical research."[74]

Additionally, she emphasized the use of correct control conditions when scanning an individual for research or clinical purposes. If an

MED ASSOC] 794 (2009) (exploring the benefits of using these techniques in diagnosing certain types of conditions).

66. Panel 4, *supra* note 1, at 3; *see also* REBECCA A. CLAY, AM. PSYCHOLOGICAL ASS'N, FUNCTIONAL MAGNETIC RESONANCE IMAGING: A NEW RESEARCH TOOL 2 (2007) ("A brain scanning technology called functional magnetic resonance imaging (fMRI) isn't quite a mind reader, but it comes close."); *see generally* Logothetis, *supra* note 44, at 1008 (noting that the BOLD contrast is the mainstay of fMRIs because of "its reasonably high sensitivity and wide accessibility").

67. Panel 4, *supra* note 1, at 3.

68. *Id.*

69. *Id.*

70. *Id*. *But see also* Craig M. Bennett & Michael B. Miller, *fMRI reliability: Influences of Task and Experimental Design*, COGNITIVE, AFFECTIVE, & BEHAV. NEUROSCIENCE (Aug. 10, 2013) https://labs.psych.ucsb.edu/miller/michael/PDF/Bennett-CABN-2013.pdf (finding that many factors impact the reliability of fMRI data).

71. Panel 4, *supra* note 1, at 3.

72. *Id*. at 3–4.

73. *Id*. at 3.

74. *Id.*

individual who claims to have pain does not produce a BOLD signal consistent with the kind of pain he or she claims to have, then it would become important to determine if the subject's brain produces anomalous results in response to other forms of stimuli (the control conditions).[75] So, she opined, "if you don't get the normal networks showing up in resting [BOLD] or for chronic pain . . . and you also don't get normal responses and networks for word reading, color perception, et cetera, then of course you're going to conclude that there's something misleading about the [BOLD] response in this person—not that this person doesn't have pain."[76]

Professor Farah then turned to two other, common objections to the use of fMRI or other forms of neuroimaging for diagnostic or other individual uses: the group-to-individual inference problem, and the inverse inference problem.[77] She acknowledged the concerns about "group-to-individual [inferences] and worries [that] inverse inferences" are "worthwhile rules of thumb."[78] She then continued that she wants to "be somewhat provocative in saying an individual is just a group of one. There is not . . . [a] categorical difference between inferences to individuals and inferences to groups.[79] It's all about the variance and about having the appropriate standard sample to relate the individual to."[80]

Professor Farah then discussed the concept of reverse inference as it applies to the use of neuroimaging as proof of pain. In this context, she noted, reverse inference becomes problematic when the interpreter of an fMRI concludes that a particular area of the brain became activated because the person was in pain, when in fact any number of other conditions could have caused the observed activation.[81] Professor Farah provided a helpful

75. *Id.*; *see also* Bennett & Miller, *supra* note 70 (stating that reliability for controls is higher than reliability in clinical disorders).

76. Panel 4, *supra* note 1, at 3.

77. *Id.*; *see also* Benjamin Bumann, *The Future of Neuroimaging in Witness Testimony*, 12 AM. MED. ASS'N J. ETHICS 873, 874–75 (2012) (discussing the various issues of making a reverse inference from groups to individuals in BOLD fMRI responses); *Brain Decoding and Inverse Inference in fMRI: A Brief Introduction*, PARIETAL, https://team.inria.fr/parietal/research/fmri_decoding/introduction/ (last visited Mar. 18, 2015) (noting problems that researchers see with the inverse inference approach).

78. Panel 4, *supra* note 1, at 3.

79. *Id.* at 4; *see also* Martha J. Farah et al., *Functional MRI-Based Lie Detection: Scientific and Societal Challenges*, 15 NATURE REVIEWS NEUROSCIENCE 123, 126 (2014) (explaining that determining the accuracy of fMRI based lie detection on an individual includes assessing the same "sensitivity and specificity" of a group of individuals in the general population).

80. Panel 4, *supra* note 1, at 4–5 (discussing this problem in the example of United States v. Semrau, 693 F.3d 510, 522 (2012)).

81. *Id.* at 5; *see also* Martha J. Farah, *Brain Images, Babies, and Bathwater: Critiquing Critiques of Functional Neuroimaging*, 44 HASTINGS CENTER REP., Mar.–Apr. 2014, at S19, S24 (2014) [hereinafter *Brain Images, Babies, and Bathwater*] (noting that a problem with reverse

example: "if pain activates the anterior cingulate cortex ("ACC"), but so does cognitive conflict, and so does attention to internal physiological state, then just when you see the ACC light up, you can't know that it was from pain when it could have been from other things."[82] In this particular scenario, any reverse inference that ACC activation was exclusively due to pain would be misleading or mistaken.[83]

While Professor Farah acknowledged that reverse inferences like this one can be a problem in interpreting neuroimages, she went on to argue that "not all reverse inference is pernicious and misleading."[84] Instead, with "due diligence" and proper studies that take into account "all the different psychological states that somebody could be in," it becomes possible to determine "what the probability is that [the research subject is] in any one of the possible states that could have caused [activation]" during the fMRI scanning session.[85] Accordingly, if the research shows that pain is likely to cause a "particular pattern of activation" more so than anything else, then one can say (to some degree of certainty) that the individual is in pain.[86] Professor Farah concedes that while "you definitely can't say 100 percent for sure," it could be possible to "say it's this likely that the person is in pain."[87] The issue then, of course, is the degree of accuracy. The scientific and legal communities accept high percentage probabilities as valid in other areas of study, as in genetic testing and identification, but Professor Farah believes the same can hold true in using neuroimaging as evidence of the likelihood of pain.[88]

inference was discovered in a study of the anterior cingulate cortex ("ACC"), which shows that there are multiple psychological states that can cause activation).

82. Panel 4, *supra* note 1, at 5; *see also Brain Images, Babies, and Bathwater*, *supra* note 81 ("Activity in this area has been elicited by processes as diverse as attention to one's own heartbeat and emotional regulation.").

83. Panel 4, *supra* note 1, at 5; *see also Brain Images, Babies, and Bathwater*, *supra* note 81 (noting that the "wanton use of reverse inference" can lead to flaws in the data that is received from the fMRI).

84. Panel 4, *supra* note 1, at 5; *see also Brain Images, Babies, and Bathwater*, *supra* note 81 (stating that reverse inference is not inherently invalid if the interpreters of these studies recognize that there is a "range of psychological processes that can activate a region under a given set of circumstances").

85. Panel 4, *supra* note 1, at 5; *see also Brain Images, Babies, and Bathwater*, *supra* note 81 (noting that although reverse inferences are prone to criticism, it is possible that they can be valid if framed correctly).

86. Panel 4, *supra* note 1, at 5; *see also Brain Images, Babies, and Bathwater*, *supra* note 81 (explaining that a valid reverse inference can be gleaned from the knowledge of a "full range of psychological processes" that could produce pain).

87. Panel 4, *supra* note 1, at 5; *see also Brain Images, Babies, and Bathwater*, *supra* note 81 (hypothesizing that there is a 75 percent chance of high probability with the right evidence).

88. *See* Martha J. Farah, *Neuroethics: The Ethical, Legal, and Societal Impact of Neuroscience*, 63 ANN. REV. PSYCHOLOGY 571, 588 (2012) [hereinafter *Impact of Neuroscience*]

Accepting Professor Farah's assertion that reverse inference as to pain and neuroimaging may be a problem in the design of any particular experiment or study is not a problem *per se*, the question then becomes: how far are we from being able to use these images in a meaningful way? Professor Farah predicts that this potential use of brain imaging is not very far away, commenting that she would be surprised if the research had not reached this point within ten years.[89] While recognizing these studies will require no small amount of work, Professor Farah remains optimistic that "if what you want is a method that for in certain predetermined populations [there can be something that] can give you substantially increased confidence that they are in pain or chronic pain . . . it just seems extremely obtainable."[90]

Professor Greely built on Professor Farah's comments by proposing a research agenda for how to develop functional neuroimaging to the point where it could be admissible in court as evidence of pain. He suggested that researchers gather a large cohort of subjects in a particular age range who suffer from a common form of chronic pain, "like the most common form of chronic lower back pain."[91] These subjects should be control matched with a large pain free cohort.[92] Scanning and comparing these large populations should help researchers to "see if we can come up with . . . markers that have . . . substantial positive predictive and negative predictive value."[93] For these studies to be rigorous and replicable, Professor Greely emphasized the importance of standardized procedures and instructions.[94]

(comparing genetics and neuroscience as means of predicting probabilities of human behavior); *see also* BRENT GARLAND, NEUROSCIENCE AND THE LAW: BRAIN, MIND AND THE SCALES OF JUSTICE 5–6 (2004) (explaining that neuroscience has a strong predictive ability that will be useful in the courtroom).

89. Panel 4, *supra* note 1, at 5; *see also* Martha J. Farah, *Emerging Ethical Issues in Neuroscience*, 5 NATURE NEUROSCIENCE 1123, 1128 (2002) ("One need not project very far into the future to see the increasing role of neuroscience in our lives . . . .").

90. Panel 4, *supra* note 1, at 5; *see also* Owen D. Jones et al., *Law and Neuroscience*, 33 J. NEUROSCIENCE 17624, 17629 (2013) (noting that neuroscience makes it possible for a person's mental state to be determined, which can ultimately be valuable to the legal system).

91. Panel 4, *supra* note 1, at 17.

92. *Id.* at 17; *see also Pain Detection*, *supra* note 2, at 444 (referring to a German research study in which MRIs were used to compare a group of individuals with chronic low back pain to a group of healthy control subjects in order to determine the differences in brain images).

93. Panel 4, *supra* note 1, at 17; *see also Impact of Neuroscience*, *supra* note 88, at 576 ("For example, if the best prediction from a person's brain activity is to a very high or low value of a psychological trait, one could conclude that the person is in fact unlikely to be low or high, respectively, on that trait.").

94. Panel 4, *supra* note 1, at 17; *see also* 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, 1154, 1190 (2010) (noting that there is risk of distortion of brain images without these standardized procedures).

Laboratories that do such research could be independently certified, as with laboratories that process DNA.[95]

In regards to Professor Greely's proposal, it might be important to test a range of subjects (e.g., not all white college students) under a range of conditions.[96] Professor Haythornthwaite noted that chronic pain varies considerably over time, and suggested that assays of chronic pain would need to be repeated multiple times with the same patient since a single scan could provide a misleading "snapshot."[97] With these caveats, and with large sample sizes, standardization, and certification, Professor Greely stated that "there's a good chance we will get there and should get there."[98]

III. REMARKS OF JUDGE NANCY GERTNER: THE LAW'S NORMATIVE AND INSTITUTIONAL CONCERNS CANNOT BE "SOLVED" BY SCIENCE

Judge Gertner expressed serious concerns regarding the use of neuroimaging as proof of pain in the courtroom. She worried that the scientific value of the images may get lost in translation, and doubted the courts' ability to "rationally embod[y] the science in a way that everyone can understand."[99] The concerns, she said, are twofold: first, Judge Gertner questioned judges' ability "to be gatekeepers of this science" in light of the lax standards for the admissibility of scientific evidence; second, she worried that the "potential for distortion" is particularly high when lay jurors are asked to interpret complex scientific images.[100]

95. Panel 4, *supra* note 1, at 17; *see also* STEVE OLSON ET AL., INST. OF MED., INTEGRATING LARGE-SCALE GENOMIC INFORMATION INTO CLINICAL PRACTICE: WORKSHOP SUMMARY 48 (2012) (noting that the certification process should include "quality control systems," procedures "for repeating unclear or unexpected results," and ensuring that "positive results are not false positives").

96. *See* SALLY SATEL & SCOTT O. LILIENFELD, BRAINWASHED: THE SEDUCTIVE APPEAL OF MINDLESS NEUROSCIENCE 195 n.33 (noting that a range of test subjects can differ by "social behavior, moral behavior, fairness, performance on IQ tests, and analytical abilities").

97. Panel 4, *supra* note 1, at 21; *see also* CHRONIC PAIN: ASSESSMENT, DIAGNOSIS, AND MANAGEMENT 62 (Michael S. Margoles & Richard Weiner eds., 1999) (indicating that chronic pain may change from day to day).

98. Panel 4, *supra* note 1, at 17; *see also* Brown & Murphy, *supra* note 94, at 1154, 1207 (stating that standardization reduces distortion, and large sample sizes are sufficient to show normal variance of subjects); OLSON ET AL., *supra* note 95 (stating that certification of laboratories is important for validity in testing).

99. Panel 4, *supra* note 1, at 8; *see also* Judge Nancy Gertner, *Commentary on the Need for a Research Culture in the Forensic Sciences*, 58 UCLA L. REV. 789–90 (2011) [hereinafter *Research Culture in the Forensic Sciences*] (noting that prosecutors and courts benefit the most from forensic evidence because other parties may face the disincentive to challenge that the judge abused their discretion by allowing this evidence during a trial).

100. Panel 4, *supra* note 1, at 5–6; *see also* Adam Teitcher, Comment, *Weaving Functional Brain Imaging into the Tapestry of Evidence: A Case for Functional Neuroimaging in Federal*

Judges' discretionary role in deciding what expert and scientific evidence may be admitted could present particular difficulties relative to neuroimaging.[101] As an initial matter, Judge Gertner noted that the threshold for admitting evidence is not very high.[102] Under the Federal Rule of Evidence 401, a party need only show that the evidence is relevant, or that it "makes a fact more likely" in order for that evidence to be admitted.[103] This low bar to admissibility gives individual judges a great deal of discretion as to what will be allowed into the courtroom.[104] The very same piece of evidence, Judge Gertner suggested, could "come into court A and not come into court B," which is a troubling possibility.[105] Judges' decisions about what evidence to admit or exclude is "subject to all the distortions" that impair decision makers generally, including institutional pressures, the decision makers' own varying knowledge and perspectives, and the effects of parties' resources.[106] What "we typically see," Judge Gertner related, is that parties with greater resources are more successful in getting their evidence before a judge and getting a favorable ruling on the admissibility of that evidence.[107] This is not because judges favor better resourced parties, but rather because such parties can afford to generate more and better quality expert evidence and then present the evidence to the court with highly skilled advocates and experts.[108]

Criminal Courts, 80 FORDHAM L. REV. 355, 384, 389 (2011) (explaining Judge Gertner's frustration with the admission of scientific evidence because of the question of its reliability).

101. Panel 4, *supra* note 1, at 7; *see also Research Culture in the Forensic Sciences*, *supra* note 99, at 790 (listing several issues relating to deficiencies in scientific evidence).

102. Panel 4, *supra* note 1, at 6; *see also* Teitcher, *supra* note 100, at 358 n.12 (explaining that evidence is relevant when a fact becomes "more or less probable than it would be without the evidence").

103. Panel 4, *supra* note 1, at 6; *see also* FED. R. EVID. 401 ("Evidence is relevant if: (a) it has any tendency to make a fact more or less probable than it would be without the evidence; and (b) the fact is of consequence in determining the action.").

104. Panel 4, *supra* note 1, at 7; *see also* Teitcher, *supra* note 100, at 371 (noting that trial judges hear a lot of the facts of the case, giving them a significant amount of discretion in admitting evidence).

105. Panel 4, *supra* note 1, at 7; *see also* Teitcher, *supra* note 100, at 369–70 (explaining that the evidential inquiry of judges is mostly subjective when determining relevance and reliability).

106. Panel 4, *supra* note 1, at 6; *see also* Craig M. Cooley & Gabriel S. Oberfield, *Increasing Forensic Evidence's Reliability and Minimizing Wrongful Convictions: Applying* Daubert *Isn't the Only Problem*, 43 TULSA L. REV. 285, 286, 291–92, 379 (2007) (noting that there are many reasons for distortions in evidence, which can detrimentally impact the legal system).

107. Panel 4, *supra* note 1, at 6; *see also* Nancy Gertner, *National Academy of Sciences Report: A Challenge to the Courts*, 27 CRIM. JUST. 8, 11 (2012) ("[U]nequal and limited resources make it particularly difficult to raise forensic challenges.").

108. Panel 4, *supra* note 1, at 15; *see also* REFERENCE MANUAL ON FORENSIC EVIDENCE 19 (Fed. Judicial Ctr. et al. eds., 3d ed. 2011) (stating that plaintiffs are more likely to choose to pay for expensive experts).

The process of appellate review does not provide much of a safeguard against the inconsistent admission of evidence, as the standard for reversal is increasingly difficult to meet.[109] Judge Gertner notes that evidentiary decisions are reviewed by appellate courts in a way that is "enormously deferential[] to the trial judge[s]."[110] To get a ruling reversed, a party must show that a judge has abused his or her discretion, which requires "show[ing] that no conscientious judge acting intelligently could honestly have taken the view expressed by the judge."[111] Put more plainly, she said, this standard requires the complaining party to demonstrate that the judge "act[ed] like a moron" or was "dishonest" in order to win an appellate reversal of a trial court's evidentiary ruling pursuant to the abuse of discretion standard.[112] When viewed in conjunction with the high degree of discretion involved in admitting or denying evidence in the first place, the lack of any meaningful review of these rulings is particularly disconcerting.

Judge Gertner went on to voice another concern that the complex science behind neuroimaging can be easily distorted and misinterpreted when presented to a lay jury.[113] Specifically, Judge Gertner worried about the group-to-individual problem introduced by Professor Farah.[114] She noted that the sophistication of Professor Farah's numerical explanation is "not matched in the courtroom."[115] Instead, juries are often presented with simplified, colored brain images that advocates easily can distort.[116] Judge Gertner explained that "[i]f a bunch of numbers went on a screen, it would be easier to understand and say oh it's just numbers" and data about a

109. Panel 4, *supra* note 1, at 7; *see also* Amanda Peters, *The Meaning, Measure, and Misuse of Standards of Review*, 13 LEWIS & CLARK L. REV. 233, 244–46 (2009) (discussing the standards for reversal used by the court, and the difficulties associated with meeting these standards).

110. Panel 4, *supra* note 1, at 7; *see also* Jennifer L. Katz, Kelly v. State*: Limiting Trial Courts' Broad Discretion to Make Evidentiary Decisions and Managing Trials*, 66 MD. L. REV. 1162, 1170 (2007) (discussing the trial court's broad discretion pursuant to the rules of evidence, limited only by the requirement that decisions are not arbitrary and capricious, or beyond reason).

111. Panel 4, *supra* note 1, at 7; *see also* Peters, *supra* note 109, at 244–45 (discussing the wide meaning of abuse of discretion).

112. Panel 4, *supra* note 1, at 7. *Cf.* Peters, *supra* note 109, at 245 (discussing the various standards applied by courts under "abuse of discretion," which is not defined by law).

113. Panel 4, *supra* note 1, at 7 (arguing that since the courts' function as a gatekeeper is limited, there is a risk that juries can distort the evidence presented to them).

114. *Id*. at 6; *see also id.* at 3 (reporting that Prof. Farah highlighted the importance of considering group-to-individual problems and the issues concerning inverse inferences).

115. *Id.* at 6; *see also id.* at 4–5 (discussing issues concerning the use of fMRI data and statistical inferences).

116. *Id.* at 6; *see also* David M. Eagleman, *Neuroscience and the Law*, 45 HOUS. LAW., Mar./Apr. 2008, at 36, 38 (2008), *available at* http://www.thehoustonlawyer.com/aa_mar08/indice.htm (noting that jurors could be convinced that the pictures are more important than they really are).

phenomenon.[117] "[B]ut what goes onto the screen is something that looks like a brain and [that] is colored," and so instead of looking like the statistical data that it is, it looks like an actual thing—like a photograph or an x-ray of the brain, which it is not.[118] She noted that even she, with an interest in scientific evidence, was initially "astonished to learn that the little colors on the [fMRI images] didn't represent my brain" or any particular brain, but instead are statistical re-creations of numerical data generated from the averages of many scans of many brains, and that any one brain might respond quite differently.[119] Her own experience raises the question of "[c]an you adequately communicate that to jurors?"[120] Accordingly, this evidence runs the great risk of "being tremendously prejudicial precisely because it looks like a brain and has the aura of science."[121]

While Judge Gertner finds this science "tremendously interesting," her concerns cause her to want to "press the pause button" on introducing evidence consisting of pain neuroimaging in the courtroom.[122] In our current world, she recommends developing stricter standards that judges must adhere to in admitting evidence, in addition to training sessions for judges on the relevant science.[123] Hoping to avoid inconsistent rulings, Judge Gertner urged the legal community to establish "some controls

117. Panel 4, *supra* note 1, at 6; *see also* E. Spencer Compton, Note, *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, 345–46 (2010) (discussing how jurors have trouble fully grasping neuroimaging data even when provided with expert testimony). *But see* Joe S. Cecil et al., *Citizen Comprehension of Difficult Issues: Lessons from Civil Jury* Trials, 40 AM. U. L. REV. 727, 757–58 (1991) (discussing how juries struggle to comprehend statistical information).

118. Panel 4, *supra* note 1, at 6; *see also* Compton, *supra* note 117 (noting how jurors have trouble fully grasping neuroimaging data even when provided with expert testimony regarding its statistical information). *But see* So Yeon Choe, Comment, *Misdiagnosing the Impact of Neuroimages in the Courtroom*, 61 UCLA L. REV. 1502, 1522 (2014) (discussing a study that found that laypeople consider neuroimages as credible because they are viewed as photographs of the brain).

119. Panel 4, *supra* note 1, at 14; *see also* Stacey A. Tovino, *Functional Neuroimaging Information: A Case for Neuro Exceptionalism?*, 34 FLA. ST. U. L. REV. 415, 422 (2007) (describing how fMRI images are developed and used).

120. Panel 4, *supra* note 1, at 14.

121. *Id.* at 6; *see also* Laurence R. Tancredi & Jonathan D. Brodie, *The Brain and Behavior: Limitations in the Legal Use of Functional Magnetic Resonance Imaging*, 33 AM. J.L. & MED. 271, 289 (2007) (discussing concerns regarding how people view fMRI images as concrete images and as truth); Choe, *supra* note 118.

122. Panel 4, *supra* note 1, at 8.

123. *Id.*; *see also* Choe, *supra* note 118, at 1542–44 (discussing the need for training for judges and a new standard by which judges should review fMRI evidence).

earlier . . . before we start fighting it out in court," encouraging further discourse between judges, legal scholars, clinicians, and neuroscientists.[124]

Judge Gertner then raised several issues relating to the normative and institutional aspects of legal proceedings. These normative and institutional issues prevent neuroimaging and other forms of scientific evidence from mapping directly onto legal questions and processes.[125] She turned first to the normative role of the jury in matters involving the valuation of damages for pain and suffering. Jurors considering neuroimaging evidence of pain (if admitted) generally would not be making determinations such as "yes or no," but rather questions of how "to quantify pain [and suffering]."[126] The category of "pain and suffering . . . may sound redundant to the scientists in the room," but, she emphasized, it is not.[127] The term "suffering," she explained, is "really a measure of how bad we feel about you [the victim or plaintiff], [and] it's really a lay measure [or] a normative judgment" about relative merit.[128] Because of the normative aspect of what "suffering" means and its value, suffering "does not map onto the science [about pain] that we're talking about."[129] This absence of an identity between what pain imaging could show or what pain quantification could measure, and what the law means by "suffering" and the values that juries ascribe to "pain and suffering" is at the root of "why we're getting closer but [we] will never [get] there . . . ."[130]

Judge Gertner then noted that Michael Pardo and Amanda Pustilnik had spoken about "social framework evidence," and that perhaps neuroimaging evidence of pain and other subjective states could "come in like social framework evidence."[131] With social framework evidence, "you

124. Panel 4, *supra* note 1, at 15.

125. *Id.* at 14.

126. *Id.* at 6.

127. *Id.*; *see also infra* text accompanying note 128–29.

128. Panel 4, *supra* note 1, at 6; *see also* Mark A. Geistfield, *Due Process and The Determination of Pain and Suffering Tort Damages*, 55 DEPAUL L. REV. 331, 346 (2006) (discussing concerns that pain and suffering are a normative judgment for juries).

129. Panel 4, *supra* note 1, at 6; *see also* Margaret C. Rodgers, Comment, *Subjective Pain Testimony in Disability Determination Proceedings: Can Pain Alone be Disabling?*, 28 CAL. W. L. REV. 173 (1991) (discussing that even though everyone experiences pain, not all suffer the same degree of pain).

130. Panel 4, *supra* note 1, at 6; *see also* Geistfield, *supra* note 128, at 339 (discussing the various factors that cause juries to have difficulty identifying and quantifying pain and suffering).

131. Panel 4, *supra* note 1, at 14; *see also* Joel Greenspan, Adam Kolber, & Michael Pardo, Imaging the Brain, Changing Minds: Chronic Pain Neuroimaging and the Law Symposium, Panel 2: "Excess Pain," Hyperalgisia, and the Variability of Subjective Experience 13 (Apr. 25, 2014) [hereinafter Panel 2] (transcript on file with the editors) (discussing the potential of using neuroimaging evidence in social science contexts, similar to the use of eyewitness identification evidence).

make it clear [to the jury that this doesn't describe any individual, but that the evidence represents] averages in the same way that social psychology about eyewitness identification comes in."[132] When experts offer evidence about the average reliability of eyewitness identification, "[t]hey're not saying, 'oh, this person's identification was unreliable,'" but they're saying that issues arise when witnesses make eyewitness identifications.[133] Judge Gertner expressed the view that "neuroscientific framework" evidence could be the best and most plausible use for fMRI or other neuroimaging of pain and subjective states, but suggested that jurors still might remain confused and unable to distinguish group averages from individual data, particularly when faced with colorful pictures that look like real brains.[134]

Judge Gertner concluded with some observations about the relationship between the skepticism toward pain and the development of law in areas related to pain.[135] She explained that "one of the reasons why [areas of law such as tort] did not pay attention to mental health [complaints and] to subjective complaints of pain [is] because of the problem of dissembling."[136] In the absence of objective proof in contexts where parties stand to gain, the law must be concerned about "the notion that people would lie about it."[137] The development of the law, which makes a distinction between physical and emotional injuries, "actually followed that concern" about fraud relating to claims of conditions that are not

132. Panel 4, *supra* note 1, at 6, 14; *see also* Panel 2, *supra* note 131 (discussing how through a social framework, a shift can occur regarding how neuroimaging evidence can be used); *see also* Mark S. Boudin, *Behavioral Science Evidence in the Age of* Daubert*: Reflections of a Skeptic*, 73 U. CIN. L. REV. 867, 911 (2005) (noting court findings that eyewitness evidence is similar to the knowledge of behavioral scientists, such as psychologists).

133. Panel 4, *supra* note 1, at 14; *see also* Boudin, *supra* note 132 (stating that experts provide testimony regarding the average eyewitness's reliability).

134. Panel 4, *supra* note 1, at 6; *see also* Teitcher, *supra* note 100, at 373 (explaining the "Christmas Tree Effect"). Professor Adam Kolber commented on Judge Gertner's concerns, remarking that over a decade ago, judges and scholars initially raised the same concerns relative to the admission of CAT and structural MRI scans in cases involving closed head trauma. Panel 4, *supra* note 1, at 13. The concern at that time was that the lights and colors would confuse and dazzle the jurors, a phenomenon commonly called "the Christmas Tree Effect." *Id.* Yet, it is now common to admit CT and structural MRIs in closed head trauma cases; it seems, Professor Kolber remarked, that the Christmas Tree Effect has not prevented jurors from intelligently considering such evidence in other kinds of brain related cases. *Id.* at 13–14.

135. Panel 4, *supra* note 1, at 16. Judge Gertner offered these comments during the question and answer period of the panel.

136. *Id.*

137. *Id.*; *see also* Steven I. Friedland, *Law, Science and Malingering*, 30 ARIZ. ST. L.J. 337, 339 (1998) (discussing the concerns the court faces regarding malingering).

objectively verifiable.[138] She suggested that the law might begin to break down the distinction between physical and mental, and objective and subjective.[139] She re emphasized her earlier point, however, that clinical and research measures of brain states and other physiological states will "never map 100 percent onto [legal concepts of] pain and suffering and the quantitative measures of [the value of] pain."[140]

IV. REMARKS OF PROFESSOR STACEY TOVINO: NEUROIMAGING OF PAIN HAS CONCRETE LEGAL POTENTIAL BUT COULD REINSCRIBE EXISTING INEQUALITIES

Professor Tovino discussed three areas of law that she believes could be affected by advances in the neuroscientific understanding of pain, and by pain imaging in particular.[141] She discussed the Social Security Disability Insurance ("SSDI") regime, the Americans with Disabilities Act ("ADA"), and various state law regimes relating to the abuse of children, the elderly, and other vulnerable populations.[142] She concluded by sounding a note of caution drawn from her years in practice about the over zealous adoption of new sciences by the plaintiffs' bar, particularly in areas relating to neuroscience and neuroimaging.[143]

SSDI is one area of the law that Professor Tovino believes will be greatly affected if neuroimaging can be introduced as proof of pain.[144] SSDI statutes, she noted, practically "beg for images" because "both the SSDI statute and regulations say that an individual statement as to pain 'shall not alone be conclusive evidence of disability.'"[145] Instead, the

138. Panel 4, *supra* note 1, at 16; *see also* Erica Goldberg, *Emotional Duties*, 47 CONN. L. REV. 809, 818 (2015) (describing tort law's distinction between physical and emotional harm for "fear of fraudulent claims due to the subjective and unprovable nature of emotional injury").

139. Panel 4, *supra* note 1, at 16.

140. *Id*. (responding to a question as to whether the fMRI can provide an objective measure of pain when considering race and gender discrimination); *see also The Experiential Future*, *supra* note 2, at 600–04 (outlining five major obstacles to neuroimaging pain assessment techniques including: generalizing pain degrees across groups, inability to measure individual variations, the unknown effects of chronic pain, the sensory versus cognitive components of pain, and the inability to measure malingered pain).

141. Panel 4, *supra* note 1, at 8–12.

142. *Id.*

143. *Id*. at 12 (describing her personal experiences of defending hospice workers who did not know their patients were in pain).

144. *Id.*

145. *Id.* at 10; *see also* 42 U.S.C. § 423(d)(5)(A) (2012); How We Evaluate Symptoms, Including Pain, 20 C.F.R. § 404.1529 (2014). Interestingly, other professional organizations, like the American Pain Society, do not require additional proof of pain, stating "that the patient's self report of pain is the single most reliable indicator of pain." *See* AM. PAIN SOC'Y, PAIN: CURRENT UNDERSTANDING OF ASSESSMENT, MANAGEMENT, AND TREATMENTS 4 (2012).

statutes and regulations call for claimants to "prove that there is physical or mental impairment resulting from an anatomical, physiological, or psychological abnormality that can be shown by medically acceptable clinical and laboratory diagnostic techniques."[146] Claimants and adjudicators emphasize the word "shown" in the regulations, creating a bias in favor of image based forms of medical evidence, like an x-ray or an fMRI.[147] She went on to explain that it is "because of [the] language that we have in our federal statutes and regulations that I know individuals will almost be compelled to try to introduce neuroimaging evidence of their pain" if it is available.[148]

The SSDI regulations further state that pain "shall not alone be conclusive evidence of [a] disability."[149] What is "so interesting" about this is that the requirements of the regulation are "almost exactly the opposite" of the definitions of pain and proof of pain that are embraced by medical organizations.[150] For example, she noted that "the American Pain Society states that the patient's self report of pain is the single most reliable indicator of pain."[151]

Health insurance is another realm that would potentially be affected by the neuroimaging of pain.[152] As an expert in mental health parity law,[153] Professor Tovino was particularly concerned with the coverage (or lack thereof) of mental health issues under government insurance plans.[154] As health insurance laws currently stand, there is no "federal definition of mental health and substance use disorder benefits that would be given equal

146. Panel 4, *supra* note 1, at 10; 42 U.S.C. § 423(d)(5)(A); 20 C.F.R. § 404.1529.

147. *See* Mickles v. Shalala, 29 F.3d 918, 928–29 (4th Cir. 1994) (sustaining an ALJ denial of benefits because after four doctors and extensive testing—including a CAT scan, ultrasound examinations, an electromyogram, a nerve conduction study, upper gastrointestinal studies, serological tests, and bone tests—they could not find the alleged pain).

148. Panel 4, *supra* note 1, at 10.

149. *Id*.; 20 C.F.R. § 404.1529.

150. Panel 4, *supra* note 1, at 10; *see also* AM. PAIN SOC'Y, *supra* note 145 (defining pain as a purely subjective analysis with no objective measures).

151. Panel 4, *supra* note 1, at 10; AM. PAIN SOC'Y, *supra* note 145.

152. Panel 4, *supra* note 1, at 10; *see generally* Tovino, *supra* note 119, at 469–78 (analyzing the effects of neuroimaging examinations on health insurance coverage and payouts).

153. *Tovino*, *supra* note 119.

154. Panel 4, *supra* note 1, at 10. According to Professor Tovino, mental health parity law "essentially tries to get rid of the distinctions [between] physical health conditions and mental health conditions in the context of health insurance." *Id.* at 12; s*ee also* Stacey A. Tovino, *Reforming State Mental Health Parity Law*, HOUS. J. HEALTH L. & POL'Y 455, 456 (2011) (analyzing divergent state parity laws and justifying expanding state parity laws by eliminating "biologically-based" and "severe mental illness" artificial distinctions, and proposing a model uniform mental health parity law).

protection."[155] Instead, each state must "designate or pick something called an 'essential health benefits benchmark plan.'"[156] Until at least 2015, states must offer benefits for any mental health issue covered under their plan, but are not required to do so for any mental health issue not listed in the plan.[157] This, she noted, has far reaching effects for American citizens with mental health issues, and Professor Tovino explained how this has played out in the health care system:[158]

> some states' benchmark plans still contain exclusion for pain management services to the extent they're not offered through hospice, which means that we still have, even post Mental Health Parity Act of 1996, post the Paul Wellstone and Pete Domenici Mental Health Parity and Addition Equity Act of 2008, and post Affordable Care Act of 2010, we still have discrimination against individuals with mental health conditions, especially chronic and acute pain in the context of health insurance.[159]

If patients were able to provide neuroimaging as proof of their chronic or acute pain, then the discrimination that exists in relation to health insurance coverage of mental health conditions could potentially be reduced or eliminated.[160] More generally, Professor Tovino's observation about the lack of parity coverage for pain management of conditions that fall under

155. Panel 4, *supra* note 1, at 10; *see also* Stacey A. Tovino, *All Illnesses Are (Not) Created Equal: Reforming Federal Mental Health Insurance Law*, 48 HARV. J. ON LEGIS. 1, 7–9 (2012) (describing how most public health care beneficiaries and some individuals with private insurance do not have a federal legal right to equal physical and mental health insurance benefits); *cf.* B. Jessie Hill, *What is the Meaning of Health? Constitutional Implications of Defining "Medical Necessity" and "Essential Health Benefits" Under the Affordable Care Act*, 38 AM. J.L. & MED. 445, 449–50 (2012) (analyzing the "circularity" in defining the terms "medical necessity" and "essential health benefits" due to statutes leaving other entities, such as states or insurers, to create the definitions).

156. Panel 4, *supra* note 1, at 10; *see* Hill, *supra* note 155, at 446 (describing how the Affordable Care Act grants states the authority to define the term "essential health benefits" and to choose a package of essential benefits to be provided).

157. Panel 4, *supra* note 1, at 10; Tovino, *supra* note 155, at 42–44.

158. Tovino, *supra* note 155, at 12; *see infra* text accompanying notes 159–60.

159. Panel 4, *supra* note 1, at 12; *see also* Tovino, *supra* note 155, at 43–44 (distinguishing between grandfathered and non-grandfathered insurance plans and detailing how many health plans are exempt from providing mental health and substance use disorder benefits).

160. Stacey A. Tovino, *Neuroscience and Health Law: An Integrative Approach?*, 42 AKRON L. REV. 469, 495–97 (2009) (concluding that neuroimaging can improve the passage and non-discriminatory application of mental health parity laws, and can be used as evidence to demonstrate that mental health disorders are biological in nature, which means that the distinction between physical and mental illness is artificial).

the rubric of mental health diagnoses shows just how the classification (whether legal, medical, or administrative) of chronic pain conditions as "psychiatric" rather than the straightforward "medical" classification leads to discriminatory limitations on denials of care.[161] This points to the crucial issue of clarifying, for legal and medical actors, the relationship between pain and negative emotion and establishing that the presence of negative emotion in the pain experience should not be an excluding condition for the provision of pain management services.[162]

The neuroimaging of pain could also possibly impact abuse and neglect laws.[163] Professor Tovino noted that various branches of law "have always struggled" with questions related to the kinds of pain inflicted by child abuse and elder abuse (or the abuse of other vulnerable populations, like persons living in care facilities).[164] She noted that many forms of abuse do not involve direct physical battery like being "kicked or punched, but what has happened to them causes them a lot of physical pain and suffering [and] also emotional pain and suffering."[165] Most of the pertinent statutes and regulations "do define physical abuse to include physical pain, and then they also define emotional abuse to include emotional pain"; but plaintiffs have typically been unable to definitively prove any long lasting physical or emotional pain experienced as a result of abuse or neglect.[166] The neuroimaging of pain, she suggested, could shed light on the long lasting

161. Panel 4, *supra* note 1, at 12 (describing how neuroimaging studies led to the reclassification of gambling from an impulse disorder to something more akin to a substance abuse disorder, which qualified gambling addicts for mental health services under the Affordable Care Act); *see generally* Tovino, *supra* note 155 (analyzing the effects of distinguishing between physical and mental illness, and the resulting discrimination against mental health coverage).

162. Panel 4, *supra* note 1, at 12; *see also* Goldberg, *supra* note 138, at 826 (discussing the difficulties of measuring "emotional harm" and "psychic injuries," and recent advances in identifying changes in neural pathways of patients suffering from PTSD).

163. Panel 4, *supra* note 1, at 11.

164. *Id.* at 12; *see also The Experiential Future*, *supra* note 2, at 624–26 (describing how neuroimaging can supplement evidence in physical or sexual abuse cases if the victim is either unable to communicate or may be considered unreliable).

165. Panel 4, *supra* note 1, at 12; *see generally* Debra Niehoff, *Invisible Scars: The Neurobiological Consequences of Child Abuse*, 56 DEPAUL L. REV. 847, 861 (2007) (detailing, through the use of neuroimaging, the extensive, long term trauma associated with child maltreatment, abuse, and neglect).

166. Panel 4, *supra* note 1, at 12; *see also* 42 U.S.C. § 5119c (2012) ([C]hild abuse crime [is] . . . a crime committed under any law of a State that involves the physical or mental injury, sexual abuse or exploitation, negligent treatment, or maltreatment of a child by any person . . . ."); 45 C.F.R. § 1340.2 (2014) (defining "child abuse and neglect" as "the physical or mental injury, sexual abuse or exploitation, negligent treatment, or maltreatment of a child . . . ."); *The Experiential Future*, *supra* note 2, at 624 (describing how of the three million cases referred to child protective services, child sexual abuse can rarely be diagnosed because physical findings are often absent).

effects of indirect physical and emotional pain, and, in particular, on the formative effects of early life physical and emotional pain.[167] The use of neuroimaging in this capacity could have far reaching effects on this area of the law.[168]

Professor Tovino noted that new understandings of chronic pain diseases may be informing anti-discrimination laws under the ADA.[169] Until 2008, a person who suffered from a chronic pain condition could not be considered disabled under the Act if the person's pain responded to treatment—that is, if the person could take medication that reduced his daily pain to a tolerable level, then he would not qualify as disabled for ADA purposes.[170]

This created a distinction under the ADA regime between pain conditions and other medical conditions whose impairments can be mitigated.[171] If a person is deaf, for example, but can hear using a prosthetic device like a cochlear implant, he continues to be a deaf individual with a qualifying disability, entitling him to protection under the ADA.[172] The use of a prosthetic that reduces the impairment caused by the disability still means that the person is qualified as "disabled" for purposes of the Act.[173] In 2008, the ADA Amendments Act removed this distinction, acknowledging that even if treatment improves the degree of impairment

167. Panel 4, *supra* note 1, at 11; *see also* Ruth Eckstein Grunau, *Neonatal Pain in Very Preterm Infants: Long-Term Effects on Brain, Neurodevelopment and Pain Reactivity*, 4 RAMBAM MAIMONIDES MEDICAL JOURNAL [RAMBAM MAIMONIDES MED J] 1, 3 (2013) (Isr.) (explaining the use of MRIs to track brain development following neonatal pain).

168. Panel 4*, supra* note 1*,* at 11; *see also* Stacey A. Tovino, *Functional Neuroimaging and the Law*: *Trends and Directions for Future Scholarship*, 7 AM. J. BIOETHICS 44, 46, 52 (2007) [hereinafter *Functional Neuroimaging and the Law*] (explaining the potential implications for understanding pain in the context of tort and criminal law).

169. Panel 4, *supra* note 1, at 11; *see also Functional Neuroimaging and the Law*, *supra* note 168, at 48 (noting the potential of neuroimaging to identify a disability, and enabling employers to screen individuals based on the information).

170. Tovino, *supra* note 155, at 11; *see also* 42 U.S.C. §12102(2) (1990) (defining "disability" as a physical or mental impairment that substantially limits one or more of the major life activities of an individual, a record of such impairment, or being regarded as having such an impairment); *see also* 42 U.S.C. §12102(4)(E) (2009) ("[T]he determination of whether an impairment substantially limits a major life activity shall be made without regard to the ameliorative effects of mitigating measures.").

171. Tovino, *supra* note 155, at 11; *compare* 42 U.S.C. §12102(2) (1990) (making no mention of potential pain mitigation) with 42 U.S.C. §12102(4)(E) (2009) (stating that making a determination as to whether an impairment limits a life activity or not will be done without looking to any mitigating circumstances or measures).

172. *See* 42 U.S.C. § 12102(4)(E)(i)(I) (2009) (listing hearing aids and cochlear implants as examples of mitigating measures that are not regarded in the determination of impairment). *But see* 42 U.S.C. § 12102(4)(E)(ii) (2009) ("[T]he mitigating measures of ordinary eyeglasses or contact lenses shall be considered . . . .").

173. 42 U.S.C. § 12102(4)(E)(i)(I) (2009).

imposed by a chronic pain condition, the individual continues to suffer from an ongoing medical condition that may be disabling.[174] This formal parity may implicitly recognize a medical advance that the scientists in this conference have described: pain is both a symptom and a disease in itself—the presence or absence of the symptom of pain on a given day does not indicate whether the person suffers from an ongoing chronic pain disorder.[175] Thus, a person with a chronic pain condition may have a symptom free day without being cured of the disease with its complex and multi faceted etiology.[176]

Professor Tovino then offered with some words of caution, grounded in her role as a civil and regulatory attorney. She described seeing how quickly new technology involving brain imaging can pervade areas of law.[177] She voiced particular concern with overeager plaintiffs adopting developing science, warning:

> whenever we have an advance in the neuroscientific understanding of a particular health condition or an advance in neuroimaging, you just have literally no idea how quickly plaintiffs, patients, individuals, claimants, whatever you want to call them, will jump on that bandwagon and try to use it to achieve whatever goal they may have.[178]

Professor Tovino voiced some concerns regarding the use of neuroimaging as proof of pain.[179] Drawing on her work as a medical historian, she grounded her cautions with important lessons from history.[180] She discussed the historically inequitable treatment of pain across various social strata, "including class, race, age, gender, occupation, and other

174. *See* 42 U.S.C. § 12102(4)(D) (2009) ("An impairment that is episodic or in remission is a disability if it would substantially limit a major life activity when active.").

175. *See The Experiential Future*, *supra* note 2, at 597 (noting the problems inherent in intersubjective evaluations of pain, and explaining how scientific advances can help alleviate them).

176. *See id.* at 600 (listing pain's complex nature as one of five obstacles facing new pain evaluating technology).

177. Panel 4, *supra* note 1, at 10; *see also* Jay D. Aronson, *The Law's Use of Brain Evidence*, 6 ANN. REV. L. & SOC. SCI. 93, 94 (2010) (noting the potential dangers of applying new technology to the law).

178. Panel 4, *supra* note 1, at 10.

179. *Id.* at 8.

180. *Id.*

indicia of social status and hierarchy."[181] She then urged the members of the conference to be mindful of persistent inequities in the practice of medicine and the provision of adequate pain relief to women and minorities in particular.[182]

One particularly troubling example in the history of medicine involves the administration of anesthesia, which historically was governed by a "complex moral calculus."[183] Physicians historically were less likely to dispense pain medication to "individuals of lower class, including racial and ethnic minorities."[184] Similarly, in a legal forum, the pain complaints of blue collar citizens were often rejected.[185] After railway accidents in both the United States and Great Britain, "many physicians rejected injured laborers and railway and other common carrier passengers' complaints of pain."[186] Put simply, Professor Tovino opined, the pain of the privileged mattered while the pain of the poor did not.[187]

In discussing the long history of inequitable pain treatment, Professor Tovino went on to note the "very poor history of experimenting on racial and ethnic minorities, and inflicting pain on them in human subjects research."[188] Invasive studies typically were not conducted on subjects from "racial and ethnic majorities, including Caucasian Americans."[189] Professor Tovino discussed the disturbing case of Dr. J. Marion Sims, a physician who "conducted experimental surgical interventions for vesicovaginal fistulas on populations of African American slave women,

181. *Id.*; *see generally* Dania Palanker, Note, *Enslaved by Pain: How the U.S. Public Health System Adds to Disparities in Pain Treatment for African Americans*, 15 GEO. J. ON POVERTY L. & POL'Y 847 (2008) (tracing the disparate pain treatment of African Americans in the United States from slavery to the present).

182. Panel 4, *supra* note 1, at 8.

183. *Id.*; *see also* Daniel Goldberg, *Pain Without Lesion: Debate Among American Neurologists, 1850–1900*, 15 INTERDISCIPLINARY STUDIES IN THE LONG NINETEENTH CENTURY [19] 1, 11 (2012) (U.K.).

184. Panel 4, *supra* note 1, at 8; *see also* Palanker, *supra* note 181, at 856 (describing the painful experiments performed on slaves without pain medication or sedation).

185. Panel 4, *supra* note 1, at 8; *see also* Goldberg, *supra* note 183 (explaining how pain treatment in the nineteenth century was distributed according to social strata).

186. Panel 4, *supra* note 1, at 8; *see also* Goldberg, *supra* note 183 ("In both Great Britain and the USA, many physicians and neurologists rejected injured workers and railway passengers' complaints of injury following railway accidents.").

187. Panel 4, *supra* note 1, at 9.

188. *Id.*; *see also* Palanker, *supra* note 181, at 855–56 (explaining the Tuskegee Syphilis Experiment and the resulting mistrust of the American healthcare system by African Americans).

189. Panel 4, *supra* note 1, at 9.

but not Caucasian women, due to his belief that slaves had much lower sensitivity to pain than his white patients."[190]

These examples remain relevant as concerns relating to the "inequitable under-treatment" of pain along class and racial lines continue to pervade health care today.[191] In 2011, Professor Tovino noted, the Institute of Medicine declared that the "inequitable treatment of pain is so significant that it is a public health problem."[192] This problem is particularly prevalent in emergency rooms since there are few, if any, objective tests to determine if someone is in pain.[193] The administration of pain medicine or other pain management techniques is a highly subjective action left to doctors' discretion.[194] These discretionary determinations may incorporate the biases prevalent in the culture where the physician lives and practices; thus, "multiple current studies show that physicians have unconscious racial and ethnic biases when deciding whether or not" to prescribe pain medicine.[195] To prevent history from repeating itself as the science of pain imaging progresses, Professor Tovino emphasized that it is important to acknowledge and learn from these examples of the inequitable treatment of pain.[196]

190. *Id.*; *see also* Goldberg, *supra* note 183, at 23 n.40 ("[P]art of the reason J. Marion Sims conducted his experiments regarding a surgical intervention for vesicovaginal fistula on African American slave women was due to his belief that the slaves had much lower sensitivity to pain than his white patients.").

191. Panel 4, *supra* note 1, at 9; *see also* Palanker, *supra* note 181, at 856 (noting that although the most blatant segregation ended with the Civil Rights Act and the creation of Medicare, remnants continue today).

192. Panel 4, *supra* note 1, at 9; INST. OF MED. OF THE NAT'L ACADS., REPORT BRIEF: RELIEVING PAIN IN AMERICA: A BLUEPRINT FROM TRANSFORMING PREVENTION, CARE, EDUCATION, AND RESEARCH 1 (2011), *available at* http://www.iom.edu/~/media/Files/Report%20Files/2011/Relieving-Pain-in-America-A-Blueprint-for-Transforming-Prevention-Care-Education-Research/Pain%20Research%202011%20Report%20Brief.pdf.

193. Panel 4, *supra* note 1, at 9; *see also* Palanker, *supra* note 181, at 851–52 (describing a 1996 study of emergency room prescribing practices, finding that African Americans received fewer analgesics).

194. Panel 4, *supra* note 1, at 9; *see also* Palanker, *supra* note 181, at 866–67 (noting that physician bias can affect treatment decisions and communication with a patient).

195. Panel 4, *supra* note 1, at 9; *see also* Palanker, *supra* note 181, at 866–67 (citing an American Medical Association report finding that physicians harbor racial stereotypes that affect treatment decisions).

196. *See* Panel 4, *supra* note 1, at 8.