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Panel 1: Legal and Neuroscientific Perspectives on Chronic Pain

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PANEL 1: LEGAL AND NEUROSCIENTIFIC PERSPECTIVES ON CHRONIC PAIN

DAVID SEMINOWICZ, AMANDA PUSTILNIK, AND STEPHEN RIGG

SPEAKERS: THE HON. ANDRE DAVIS,* KAREN D. DAVIS,** AND HANK
GREELY***

I. INTRODUCTION

In the first panel, the Honorable Andre Davis (“Judge Davis”), along with Professors Hank Greely and Karen Davis (“Professor Davis”), discussed various topics relating to chronic pain.¹ The focus of this panel concerned how chronic pain is medically interpreted and received, as well as how the legal system deals with the issues created by chronic pain.

The panel tackled several questions regarding chronic pain, one of which was whether the law is equipped to handle chronic pain related cases.² The panel began with the definitions of pain and chronic pain, descriptions of the types of pain that might be seen clinically and in a courtroom, and raised the issue of whether chronic pain should be conceptualized as a disease.³ The discussion then moved to how

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*** Professor Greely is a professor at Stanford University, and is the director of the Center of Law and Biosciences.

1. Hon. Andre Davis, Karen D. Davis, & Hank Greely, *Imaging the Brain, Changing Minds: Chronic Pain Neuroimaging and the Law Symposium, Panel 1: Legal and Neuroscientific Perspectives on Chronic Pain* (Apr. 25, 2014) [hereinafter Panel 1] (transcript on file with the editors).

2. *Id.* at 2.

3. *Id.* at 5–11.

neuroimaging studies have transformed our understanding of acute and chronic pain, noting our abilities to understand chronic pain mechanisms and describing the goal to eventually develop an objective measure of pain.⁴

Next, the panel discussed why chronic pain based claims are both important and challenging to the legal system, and how the legal system currently deals with such claims.⁵ The first issue raised was that incentives distort behavior.⁶ For example, the risks of exaggeration and fraud can arise when a party and his or her attorney have “skin in the game.” Legal decision makers’ fear of fraud can have a distorting effect too, leading to excess suspicion toward claimants with pain disorders. The panel also discussed various factors that affect pain related cases.⁷ In particular, chronic pain related claims arise most often in the administrative law setting, pursuant to Social Security Disability Insurance or workers’ compensation insurance regimes, but can also arise in tort, ERISA, and others.⁸

Then the panel discussed how the advances in neuroimaging science might (or might not) assist in adjudicating pain questions in various legal settings.⁹ The panel discussed whether science has come far enough to find correlations between certain brain activity and chronic pain, and the validity and reliability of such correlations and probative evidence.¹⁰ The panel highlighted the “reverse inference problem” in interpreting brain scans; that is, a particular scan pattern may correlate with a particular mental state, like the state of being in pain, but many different mental states could produce similar looking brain patterns.¹¹ This reverse inference problem is one facet

4. *Id.* at 11–13.

5. *Id.* at 13–15.

6. *See id.* at 16–17 (indicating that Davis, J. and Prof. Karen Davis discussed how the contingent fee arrangement could drive lawyers to push clients to seek more in damages, and how America’s healthcare system could induce more chronic pain sufferers to sue).

7. *See id.* at 17–18 (stating that Davis, J. and Prof. Hank Greely discussed how neuroscience, neuroimaging, and in some cases, even secret surveillance can be factors in determining chronic pain cases).

8. *See id.* at 6–8 (reporting that Prof. Hank Greely discussed the different kinds of chronic pain legal claims and the various laws giving rise to those claims); *see also, e.g., Report of the Commission on the Evaluation of Pain*, 50 SSA SOC. SECURITY BULL. 13, 14–15 (1987), available at <http://www.ssa.gov/policy/docs/ssb/v50n1/v50n1p13.pdf> (noting that since the early 1980s, an increasing number of SSA cases have challenged the Social Security Administration’s policy on the evaluation of pain).

9. Panel 1, *supra* note 1, at 18–19.

10. *Id.* at 21–22.

11. *Id.* at 22–24; *see also Reverse Inference: Neuroscience’s Greatest Fallacy?*, KNOWING NEURONS (Feb. 12, 2014), <http://knowingneurons.com/2014/02/12/reverse-inference-neurosciences-greatest-fallacy> (explaining reverse inference as an epidemic of backwards reasoning in which an observed brain activity is correlated to cognitive processes that are not

of the broader issue that brain scans are not self interpreting and have no self evident meaning, unlike, for example, an x-ray of a broken bone. The panel further discussed the similarities and differences between neuroimaging evidence and some types of scientific evidence and visual courtroom techniques that have become commonplace in the courtroom.¹²

Bringing the session to an end, the panelists and participants discussed the future of neuroimaging in the courtroom and the types of research that might be necessary to use neuroimaging as proof of pain.¹³ Overall, the panel ended on a cautiously optimistic note of taking pain neuroimaging evidence to the courtroom.

II. WHAT IS CHRONIC PAIN?

In order for scientists and legal actors to begin a meaningful dialogue on pain and the law, it is necessary to have a clear understanding of how each field views chronic pain.

A. Definitions

Pain, as defined by the International Association for the Study of Pain (“IASP”), is “[a]n unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”¹⁴ The IASP further declares that pain is always subjective and can be experienced in the absence of a physical stimulus.¹⁵

The generally accepted definition of chronic pain is pain that persists for an extended period of time (typically greater than three months), or persisting beyond the normal time of healing for a particular injury.¹⁶ There is no single definition of chronic pain, however, that captures all pain conditions, owing to the many possible sources and manifestations of these disorders. For example, in neuropathic pain (such as with carpal tunnel syndrome), pain arises as a direct consequence of “a lesion or disease

actually tested, but rather linked through research implicating a particular brain area with a particular cognitive process).

12. Panel 1, *supra* note 1, at 25–26.

13. *Id.* at 26–27.

14. *IASP Taxonomy*, INT’L ASS’N FOR STUDY OF PAIN (Oct. 6, 2014), <http://www.iasp-pain.org/Education/Content.aspx?ItemNumber=1698#Peripheralneuropathicpain>.

15. *Id.*

16. See *Chronic Pain: Symptoms, Diagnosis, & Treatment*, NAT’L INST. HEALTH MEDLINEPLUS, Spring 2011, at 5, 5–6, available at <http://www.nlm.nih.gov/medlineplus/magazine/issues/spring11/articles/spring11pg5-6.html> (defining chronic pain as pain that persists for longer than 12 weeks).

[affecting] the somatosensory nervous system,”¹⁷ whereas inflammatory pain (such as with rheumatoid arthritis) is a type of pain that arises from activation of nociceptors (neurons that are responsive to noxious stimuli).¹⁸ A third type of chronic pain disorder is sometimes referred to as functional pain disorders, which typically includes irritable bowel syndrome, chronic low back pain, and fibromyalgia, among others, and is characterized by pain in the absence of a clear physical cause and is often associated with anxiety and mood disturbance.¹⁹ Note that as the mechanisms of a pain disorder are uncovered through research, classification of the disorder might change.

B. Pain Classifications

Whether a chronic pain disorder falls into the neuropathic, inflammatory, or functional category, hypersensitivity (sometimes called allodynia or hyperalgesia)²⁰ via peripheral and central sensitization is usually present.²¹ At the brain level, the long-term consequences of either type of pain might affect sensory, cognitive, and emotional circuits.²² These brain changes can be detected with neuroimaging methods, and in

17. *IASP Taxonomy*, *supra* note 14.

18. See *Types of Pain*, DEP'T PAIN MED. & PALLIATIVE CARE, <http://www.stoppain.org/pcd/content/addiction/nociceptive.asp> (last visited Mar. 5, 2015) (stating that rheumatoid arthritis is a type of inflammatory pain caused by the activation of pain receptors on the surface level of the body).

19. See Fânia Cristina Santos et al., *Síndrome de amplificação dolorosa no idoso. Relato de caso e revisão da literatura* [Pain Amplification Syndrome in the Elderly. Case Report and Literature Review] 13 *Rev DOR. SÃO PAULO* 175, 177 (2012) (Spain), available at http://www.scielo.br/pdf/rdor/v13n2/en_15.pdf (stating that functional pain syndromes include chronic pain, where the symptoms may have no organic cause at all).

20. Joel Greenspan, Adam Kolber, & Michael Pardo, *Imaging the Brain, Changing Minds: Chronic Pain Neuroimaging and the Law Symposium*, Panel 2: “‘Excess’ Pain, Hyperalgesia, and the Variability of Subjective Experience” 8 (Apr. 25, 2014) [hereinafter Panel 2] (transcript on file with the editors) (explaining that “hyperalgesia” is pain that is produced by stimulation that is experienced at a higher pain level than would normally be associated with that stimulation).

21. See Jeffery Norris, *World of Chronic Pain Suddenly Looks Different to Researchers*, UNIV. CAL. S.F. (Nov. 16, 2009), <http://www.ucsf.edu/news/2009/11/8209/chronic-pain-hypersensitivity-nerve-pathways-use-vglut3-and-opioid-receptor> (stating that chronic pain due to hypersensitivity is common); see also Clifford J. Woolf, *Pain Hypersensitivity*, THE WELLCOME TRUST, <http://www.wellcome.ac.uk/en/pain/microsite/science4.html> (last visited March 5, 2015) (stating that two mechanisms involved with hypersensitivity are central sensitization and peripheral sensitization).

22. See Karen D. Davis & Massieh Moayedi, *Central Mechanisms of Pain Revealed Through Functional and Structural MRI*, 8 *J. NEUROIMMUNE PHARMACOLOGY* 518, 518 (2013), available at <http://www.pain.anes.pitt.edu/sites/default/files/central%20mechanisms%20of%20pain%20review.pdf> (stating that brain structure is not static and can adapt to prolonged nociceptive input and pain, and may often be the cause of chronic pain).

particular, the emphasis in this field has been on functional and structural MRIs.²³ The most consistent findings across chronic pain disorders conclude that patients have decreased gray matter volume and increased activation during evoked pain and cognitive and emotional tasks compared to the control group.²⁴ While to date, there have been no clear demonstrations that these brain changes could be used as objective biomarkers for chronic pain, the aggregate findings suggest that pain is a disease of the brain,²⁵ and that with recent advances in neuroimaging technology and analysis techniques, the possibility of using these scans as objective biomarkers is becoming a near reality.²⁶

C. *The Trouble With Pain in Legal Settings*

For scientific and medical communities, the rather open-ended definitions of pain generally work. Pain is the number one reason that a person will seek medical attention.²⁷ For the caregiver, except in a very small number of cases, there is no reason to question a patient's complaint, and the caregiver and the patient will work together toward the common goal of relieving pain. In the legal system, the opposing goals of the claimant and the defense pose problems for conditions that can only be subjectively validated. As Professor Greely commented about pain in the legal system, "we know that there are people who lie, [and] we know there

23. See Karen D. Davis & Massieh Moayedi, *Central Mechanisms of Pain Revealed Through Functional and Structural MRI*, 8 J. NEUROIMMUNE PHARMACOLOGY 518, 520 (2013), available at <http://www.pain.anes.pitt.edu/sites/default/files/central%20mechanisms%20of%20pain%20review.pdf> (stating that neuroimaging technologies, specifically functional and structural MRIs, can be used to detect brain responses, gray matter volume, functional connectivity, and neuronal activity in the brain).

24. See *id.* at 529 (stating that when comparing healthy controls versus patients with chronic pain, fMRIs of patients with chronic pain showed heightened emotional responses during periods of evoked pain when trying to balance pain and emotionally challenging tasks).

25. See David Borsook, *Neurological Diseases and Pain*, 135 BRAIN 320, 320 (2012), available at <http://brain.oxfordjournals.org/content/brain/135/2/320.full.pdf> ("More recently, clinicians and researchers have come to the conclusion that, in many cases, chronic pain is a direct result of the neurological disease, or may even be considered an integral part of the underlying disease.").

26. See Davis & Moayedi, *supra* note 23, at 530 ("[K]nowledge gained from fundamental neuroimaging studies of pain may provide insight into biomarkers of chronic pain and the optimal time to intervene with treatment and also can provide insight into potential side effects of treatment . . ."). Currently, this is limited to predicting acute pain in healthy subjects, but the field is advancing in the direction of using the scans of both healthy people and those with chronic pain. *Id.* at 518.

27. *Pain*, NAT'L CTR. FOR COMPLEMENTARY & INTEGRATIVE HEALTH, <https://nccih.nih.gov/health/pain> (last modified Jan. 27, 2015).

are people who exaggerate The legal system needs some kind of evidence to help it evaluate whether somebody is in pain, whether they're exaggerating the pain, [or] whether they're lying about it."²⁸ This problem is not peculiar to pain disorders: as Judge Davis observed, "the law has long struggled to satisfy itself that it can do a good job of separating the bogus, exaggerated claims from the legitimate claims."²⁹ But separating legitimate from bogus claims may be more difficult (or may be perceived by decision makers as more difficult) in cases involving pain because of pain's nature as invisible, subjective, and unquantifiable.

Thus, the dilemma that the panel faced was what—if anything—could the current and near future state of neuroimaging research provide the legal system in terms of evidence. In American tort law, the goal is to "quantify, identify, legitimize, and compensate people who are suffering from the negligence of others."³⁰ Thus, in most cases where pain and suffering are concerned, not only is there a requirement to demonstrate that the pain is real, but there is the requirement to show that it was the result of a particular incident.³¹ In most administrative law settings, as in the Social Security Disability Insurance ("SSDI") regime and in workers' compensation regimes, the problems of causation are absent; the individual claiming disability benefits (called "the insured") must demonstrate that his or her pain is real and disabling, regardless of its external causes or internal etiology.³² As Professor Davis notes, "nobody—and even people within the pain scientific and medical community—can agree whether or not [chronic pain is] a disease."³³

D. *Is Chronic Pain a Disease?*

28. Panel 1, *supra* note 1, at 10.

29. *Id.* at 6.

30. *Id.*; see also Stephen J. Shapiro, *Overcoming Under-Compensation and Under-Deterrence in International Tort Cases: Are Statutory Multiple Damages the Best Remedy?*, 62 MERCER L. REV. 449, 449 (2011) (stating that the widely recognized purpose of tort law is to compensate the parties that are injured by the wrongdoings of others).

31. See Joseph H. King, Jr., *Causation, Valuation, and Chance in Personal Injury Torts Involving Preexisting Conditions and Future Consequences*, 90 YALE L.J. 1353 (1981) (stating that causation, or the cause and effect relationship of incident to injury, must be established before liability can be imposed).

32. See *Complex Regional Pain Syndrome (CRPS) and Social Security Disability*, SOCIAL SECURITY DISABILITY HELP, <http://www.disability-benefits-help.org/disabling-conditions/complex-regional-pain-syndrome> (last visited Mar. 5, 2015) (stating that the claimant must establish a diagnosis of chronic pain and how chronic pain affects the claimant's daily living and work-related performance in order to receive social security benefits for a chronic pain injury).

33. Panel 1, *supra* note 1, at 11.

In a recent debate, scientists have questioned whether chronic pain is best described as a “disease” in its own right.³⁴ The topic is contentious in part because the definition of disease is somewhat ambiguous. Professor Davis was in favor of classifying chronic pain as a disease and believed that in doing so, it would only be beneficial for patients (as it has been for other diseases),³⁵ but stated that others in the field disagreed for various reasons.³⁶ A recent paper outlines the potential negative consequences of labeling chronic pain as a disease based on neuroimaging studies, which included: negative effects on (1) the therapeutic dialogue between clinicians and patients; (2) the social dialogue about reimbursement for pain treatments and disability due to pain; and (3) the chronic pain research agenda.³⁷ Professor Davis’s opinion on pain being classified as a disease in terms of the legal outcomes was that “if a judge is told by the medical community that this person has a disease, I think that [the lawyer’s] job must be easier”³⁸

Some have argued that neuroimaging evidence supports the idea that chronic pain is a disease of the brain.³⁹ If chronic pain leads to consistent alterations in brain structure and activity, then presumably this position would hold. Since chronic pain can have multiple causes and diverse comorbid clinical manifestations, it is yet unclear whether such a consistent pattern would be attainable.

While the definitions of pain and chronic pain are generally clear to the scientific and medical fields, they remain—intentionally—quite open to interpretation. The subjective nature of pain means that no two people will

34. See Mark D. Sullivan et al., *What Does it Mean to Call Chronic Pain a Brain Disease*, 14 J. PAIN 317, 318 (2013) (stating that classifying chronic pain as a disease may have negative effects on therapeutic and social dialogues, as well as chronic pain research); Karen D. Davis, *Is Chronic Pain a Disease? Evaluating Pain and Nociception Through Self-Report and Neuroimaging*, 14 J. PAIN 332, 332 (2013) (noting that political issues should not detract from the scientific and medical evidence that suggest chronic pain should be considered a disease).

35. Panel 1, *supra* note 1, at 11. See also Davis, *supra* note 34, at 332 (suggesting that classifying chronic pain as a disease will promote an open dialogue and “improve patient and physician attitudes, public understanding and caring, as well as research efforts and funding”). Judge Davis noted that labeling substance abuse and alcoholism diseases (in the DSM) was a good thing for the law and for society. Panel 1, *supra* note 1, at 14.

36. Panel 1, *supra* note 1, at 14. See also Davis, *supra* note 34, at 332 (stating that others argue that there is a need for “whole body pathology” and “first-person complaints”); Sullivan et al., *supra* note 34 (arguing that “chronic pain” may fail to attain disease status due to a negative effect on the doctor-patient therapeutic dialogue, the social dialogue regarding reimbursement for pain treatments, and the chronic pain research agenda).

37. Sullivan et al., *supra* note 34.

38. Panel 1, *supra* note 1, at 15.

39. See, e.g., David Borsook et al., *The Pain Imaging Revolution: Advancing Pain into the 21st Century*, 16 NEUROSCIENTIST 171, 173 (2010).

necessarily share identical pain experiences following a common injury.⁴⁰ Not only that, but the recovery from an injury in one person might be rapid and complete, with no residual pain, while in another person who suffered the same injury, despite having appeared to be healed, the pain would persist.⁴¹ The potential physiological, psychological, and genetic factors for such individual variability are numerous.⁴² This leaves the legal decision makers to evaluate the claimant's subjective account of pain along with various forms of conflicting or corroborating medical evidence, but without the possibility of objective proof of the degree of pain or pain related disability. How does neuroimaging inform our understanding of *why* chronic pain occurs?

E. *Neuroimaging of Chronic Pain*

One of the reasons that neuroimaging is useful in informing our understanding of chronic pain is the familiarity that the general public has with the field. Many people have seen the popular press descriptions of how activity in some brain region is associated with a certain behavior, or more recently, how your brain changes with learning, development, or in disease states.⁴³

Professor Davis noted that in general, pain researchers are using neuroimaging to discover how chronic pain alters brain function and structure.⁴⁴ Many studies have provided substantial evidence of consistent brain functional and structural changes in chronic pain disorders, including

40. See Tetsuo Koyama et al., *The Subjective Experience of Pain: Where Expectations Become Reality*, 102 PROC. NAT'L ACAD. SCI. U.S. 12950, 12950 (2005) (stating that sensory events are highly subjective and vary by the individual).

41. See Marieke Jepma et al., *The Dynamics of Pain: Evidence for Simultaneous Site-Specific Habituation and Site-Nonspecific Sensitization in Thermal Pain*, 15 J. PAIN 734, 742–44 (2014) (describing how variability in pain outcomes may be attributed to several factors). A good example of this is post-thoracotomy chronic pain, which about 50 percent of patients develop. Despite it being a common and fairly standardized procedure with little variability in surgical healing, there is considerable variability in the pain related outcomes of the surgery. Emine Ozgur Bayman & Timothy J. Brennan, *Incidence and Severity of Chronic Pain at 3 and 6 Months After Thoracotomy: Meta-Analysis*, 15 J. PAIN 887, 887 (2014).

42. See Luda Diatchenko et al., *Idiopathic Pain Disorders—Pathways of Vulnerability*, 123 J. PAIN 226, 229 (2006) (explaining factors that can be attributed to variation in pain outcomes).

43. See Alvaro Pascual-Leone & Margot J. Taylor, *A Developmental Framework of Brain and Cognition from Infancy to Old Age*, 24 BRAIN TOPOGRAPHY 183, 183 (2011) (explaining how the human brain remains malleable, changing throughout life even after childhood development).

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

functional pain disorders, fibromyalgia, irritable bowel disorder, and temporomandibular joint disorder.⁴⁵

Perhaps a bigger question is whether we will be able to predict someone's pain with neuroimaging techniques. This work can rely on functional magnetic resonance imaging ("fMRI"), but also upon other neuroimaging techniques, like Positron Emission Tomography ("PET") and MRI spectroscopy ("MRS"), which provide readouts of neurotransmitter binding and chemical systems in the brain and can provide a more "refined look at what might be wrong during chronic pain."⁴⁶

F. *Limitations of Pain Neuroimaging*

There are also important limitations to our understanding of chronic pain. Despite the wealth of recent knowledge gains, major questions about the mechanisms of chronic pain remain. Professor Davis described the non-compatibility of two existing theories, each of which have support from multiple lines of research: in one theory (the "specificity theory"), individual neuronal pathways are specifically tuned to a percept, such as pain; the other theory (the "pattern theory") takes an integrative view, which is that there is no single cell or pathway responsible for pain, but rather pain is an integration of inputs that lead to cognitive, emotional, and sensory responses.⁴⁷ The field generally accepts some middle ground.⁴⁸ Functional neuroimaging research on acute pain has determined that certain brain regions are reliably activated by painful stimuli.⁴⁹ Chronic pain research similarly finds differences in structure and function in predictable regions of the brain (although with considerably more variability than in

45. See, e.g., David A. Seminowicz et al., *Regional Gray Matter Density Changes in Brains of Patients with Irritable Bowel Syndrome*, 139 *GASTROENTEROLOGY* 48, 48–49 (2010) (giving examples of consistent structural and functional changes in the brain associated with chronic pain disorders).

46. Panel 1, *supra* note 1, at 11–12. See also CAROLYN ASBURY, THE DANA FOUND., *BRAIN IMAGING TECHNOLOGIES AND THEIR APPLICATIONS IN NEUROSCIENCE* 38–43 (2011), <https://www.legalbluebook.com/R-18-2-1> (describing neuroimaging techniques such as functional magnetic resonance imaging, Positron Emission Tomography, and MRI spectroscopy).

47. Panel 1, *supra* note 1, at 12. See also Ronald Melzack & Patrick D. Wall, *Pain Mechanisms: A New Theory*, 150 *SCIENCE* 971, 971 (1965) (explaining the definitions of "specificity theory" and "pattern theory").

48. See Massieh Moayedi & Karen D. Davis, *Theories of Pain: From Specificity to Gate Control*, 109 *J NEUROPHYSIOLOGY* 5, 10 (2013) (describing how components of several theories of the brain and pain are currently used, creating a multidimensional approach).

49. See R. Christopher deCharms et al., *Control over Brain Activation and Pain Learned by Using Real-Time Functional MRI*, 102 *PROC. NAT'L ACAD. SCI. U.S.* 18626, 18626 (2005) (reporting on studies regarding brain activity in response to pain).

studies of acute pain).⁵⁰ But in the absence of a coherent theory of the brain (specificity theory, pattern theory, or some as-yet-undeveloped theory), the full meaning of these findings remains unclear.

As a second example of how our understanding of brain circuits in chronic pain is limited, Professor Davis noted that in a fMRI, the smallest unit that one can examine is “comprised of tens of thousands of cells.”⁵¹ In other words, with non-invasive neuroimaging technology, our measurement units (or voxels) represent “a mixed response that integrates everything going on in that little chunk of the brain.”⁵² To date, no brain region, group of regions, or network has been found to be specific to pain. Pain is a complex experience, having sensory, emotional, and cognitive components, and any activation observed in response to pain could be a representation of one or a combination of these components.

The specificity theory vs. pattern theory and the problems with interpreting pain neuroimaging data are just two examples of where our understanding of brain circuitry involved in chronic pain is limited. There is still much active research in this area, and pain will not be understood completely in the foreseeable future. Nonetheless, significant progress has been made in our understanding of pain that could inform the legal system, at least imparting the knowledge that chronic pain changes the brain in a manner comparable to other recognized neurological and psychiatric disorders.⁵³

III. THE PRICE OF PAIN: WHAT ARE THE MOTIVES FOR CLAIMING PAIN?

One of the biggest differences that the panelists identified between the legal and medical systems that deal with pain and pain evidence is that participants in the legal system were much more likely to have “skin in the game.”⁵⁴ While it is possible for doctors to have a stake in their diagnoses,⁵⁵ it is much more common for a lawyer (in a contingent fee

50. See Ulrike Friebe et al., *Coordinate-Based Meta-Analysis of Experimentally Induced and Chronic Persistent Neuropathic Pain*, 58 *NEUROIMAGE* 1070, 1073–74 (2011) (explaining brain function in pain studies).

51. Panel 1, *supra* note 1, at 10 (stating that there is a lack of empirical data to show how pain is received at the second- and third-order neurons in the central nervous system).

52. *Id.* at 12.

53. See Pascual-Leone & Taylor, *supra* note 43 (explaining how the pain leads to brain changes).

54. See Panel 1, *supra* note 1, at 13 (referring to “skin in the game” as an investment in the outcome).

55. For example, a doctor who prescribes controlled painkillers to someone who was faking the need could possibly face professional discipline, lose her Drug Enforcement Administration

arrangement, for example) to have a stake in the outcome of a trial.⁵⁶ The panel concluded that while this could be a good thing, even at the best of times, the situation requires monitoring.⁵⁷ But the party with perhaps the most skin in the game is the party making a claim for having pain.⁵⁸

Features of legal regimes can themselves have a distorting effect, inducing claimants to present themselves as more impaired than they are and even, paradoxically, causing claimants to experience greater levels of actual disability.⁵⁹ Professor Davis described how certain legal regimes can have a physiologically disabling effect on their intended beneficiaries.⁶⁰ She recounted being told by arthritic patients that they were physically capable of being productive for a few of hours a day—but that they had to avoid being active because their insurers did not offer part time disability claims.⁶¹ She reported hearing: “If I go out and I try to be a good citizen, try to do some things, try to work a bit a couple hours a day, I see people taking pictures of me. But by noon, I’ve had it. So I’m sitting now, in my house, getting worse, not moving forward, because otherwise they don’t believe me.”⁶²

Judge Davis echoed a similar point, noting that if someone brought suit against certain large companies, they “can be pretty sure that, at various times over the next eighteen to thirty six months, there will be somebody near [them] with a camera, recording.”⁶³ These intrusions can force claimants to stagnate their recoveries while they try to move forward with their claims, leaving them unable to even try to improve for fear that the other side will catch them doing something active, even just once.⁶⁴ The

license, or even be on the hook criminally. See David W. Feeder, II, *When Your Doctor Says, "You Have Nothing to Worry About," Don't Be So Sure: The Effect of Fabio v. Bellomo on Medical Malpractice Actions in Minnesota*, 78 MINN. L. REV. 943, 945–46 (1994) (explaining that physicians may be held liable in tort for malpractice when their patients sustain injuries under their care in cases like physician failure or omission in diagnosis).

56. Panel 1, *supra* note 1, at 17.

57. *Id.*

58. See Ronen Avraham, *Putting a Price on Pain-and-Suffering Damages: A Critique of the Current Approaches and a Preliminary Proposal for Change*, 100 NW. U. L. REV. 87, 87 (2006) (stating that pain and suffering awards make up 50 percent of total awards).

59. See *id.* at 115 (explaining why plaintiffs may “behave strategically” by exaggerating pain to increase medical costs for a larger monetary award).

60. See Panel 1, *supra* note 1, at 19 (describing the negative consequences associated with plaintiff surveillance).

61. *Id.*

62. *Id.*

63. *Id.* at 18.

64. See William A. Chittenden III et al., *Recent Developments in Health Insurance, Life Insurance, and Disability Insurance Case Law*, 49 TORT TRIAL & INS. PRAC. L.J. 233, 243–44 (2013) (giving examples of video surveillance used in disability and injury claims).

fear is that a jury (or insurance company) will then assume that the claimant is out all the time, being much more active than claimed.⁶⁵

IV. WHAT KINDS OF LEGAL CLAIMS RELATING TO CHRONIC PAIN ARE MOST COMMON AND SIGNIFICANT?

Professor Greely, Judge Davis, and, from the audience, Judge Nancy Gertner, discussed the ways in which claims involving chronic pain come before the legal system. Professor Greely first presented a functional grouping of claims involving pain.⁶⁶ He described three general categories of pain related claims that may arise in a variety of legal contexts.⁶⁷ A spirited discussion amongst the legal participants ensued, concerning the difficulties that claims of each kind pose for legal decision makers.⁶⁸ Then Professor Greely, Judges Davis, and Judge Gertner described the specific legal regimes under which claims involving chronic pain arise, and certain evidentiary and institutional concerns particular to each setting.⁶⁹

A. *Three Kinds of Pain Claims and the Issues They Present*

The first category that Professor Greely defined involves claims for economic loss.⁷⁰ Such claims take the form of an assertion by the claimant who says something like “[because] [t]he pain is so bad . . . there are . . . economically rewarding things[] that I cannot do”⁷¹ These claims, Professor Greely noted, can be brought in various bodies of law.⁷² A claimant might seek compensation for the loss of ability to work from state or federal government disability insurance schemes, from a private insurer pursuant to ERISA,⁷³ or in tort if the pain and resulting economic losses

65. *See id.* (showing instances where courts allowed video surveillance as a consideration of whether or not the plaintiff was disabled); *see also* Panel 1, *supra* note 1, at 18 (noting that one controversial “gold standard” of determining a plaintiff’s disability is secret surveillance).

66. Panel 1, *supra* note 1, at 7–8.

67. *Id.*

68. *See id.* at 8–10 (starting a discussion about the problems of evidence issues and calculating the value that pain and suffering poses for the legal system).

69. *Id.* at 8–10, 25–26.

70. *Id.* at 7.

71. *Id.*

72. *Id.*

73. Employment Retirement Income Security Act of 1974 (“ERISA”), Pub. L. No. 93-406, 88 Stat. 829 (codified as amended at 29 U.S.C. §§ 1001–1461 (2012)).

result from alleged negligence.⁷⁴ He noted that claims for economic loss are the most common form used in claims relating to pain.⁷⁵

The second category of pain related claims that Professor Greely described involves claims for “particular medical services, or rehabilitative services, or other services” related to managing the claimant’s pain condition.⁷⁶ Such claims can arise after an insurer has denied coverage for such services because it has determined that the claimant does not really need these because the person is not “truly in pain,” or because these services that are not the sorts of things that are medically accepted as being useful based on the claimant’s diagnosis, or because an insurer interprets the services to fall outside of the scope of the insured’s coverages.⁷⁷ Professor Greely commented that cases like these probably “come up a lot,” but that it is hard to know; such cases fly “under the radar” because they are likely to settle.⁷⁸ Claims that take this form may arise in several legal contexts, including ERISA and civil suits in contracts against private insurers.⁷⁹

The third category, and, in Professor Greely’s view, perhaps the hardest to adjudicate, involves claims for the non-economic damages related to pain—that is, compensation for various forms of suffering.⁸⁰ Such compensation is for “the pain they suffer every day as a result of the injury” and its non-economic impact on their lives.⁸¹ Many losses related to chronic pain, particularly if the pain is severe, are real but hard to quantify: these losses relate to what it means to experience the self or to live a fully realized life.⁸² Chronic pain changes cognition and mood, meaning that a person in chronic pain inhabits a somewhat different self and mind than he or she did prior to the pain condition.⁸³ Pain limits life activities, curtailing

74. Panel 1, *supra* note 1, at 1, 7.

75. *Id.* at 7.

76. *Id.*

77. *Id.*

78. *Id.*

79. *See, e.g., id.* (explaining that in the United States, many people receive health coverage through their employees, and that relationship is governed by ERISA).

80. *Id.*

81. *Id.*

82. *See generally* Sandra H. Johnson, Knox Todd, & Benjamin W. Moulton, *Chronic Pain and Health Communities: Legal, Ethical, and Policy Issues in Improving the Public’s Health*, 31 J.L. MED. & ETHICS (SPECIAL SUPPLEMENT) 4, 70 (2007) (noting that the effects of chronic pain include work incapacity, increase in consumption of health care resources, the diminished chance of a healthy lifestyle due to the inability to do physical exercise, and the increased risk of depression).

83. Sigrid Fry-Revere & Elizabeth K. Do, *Chronic Problem: Pain Management of Non-Cancer Pain in America*, 16 J. HEALTH CARE L. & POL’Y 193 (2013) (explaining that pain creates

opportunities to engage in meaningful experiences.⁸⁴ Severe chronic pain (and its medication regime) could be incompatible with pregnancy and child rearing, excelling in one's career, travel, or with taking a walk on a beautiful day. Such damages for the claimant's suffering (sometimes also termed "hedonic" losses)⁸⁵ are "different from the fact that they're not going to be able to work So how do we evaluate that?"⁸⁶ This category of claims for damages arises only in tort, as disability insurance regimes do not provide additional compensation for such real but inchoate losses.⁸⁷

Judge Davis commented on the difficulty in evaluating this third category of pain related claims and losses, recalling a case he presided over when he was sitting on the state court in Baltimore.⁸⁸ The case involved a tort claim brought by an older man with early stage Parkinson's disease who fell and injured himself as a result of the defendant's negligence.⁸⁹ The Judge recalled that the plaintiff and his wife were "lovely" and sympathetic.⁹⁰ The jury issued a verdict in the plaintiff's favor along with a very large damages award, and the defendant moved to reduce the damages.⁹¹ Sufficient evidence supported the verdict but not the size of the damages award, so the Judge "had to reduce the award in this case."⁹² This is an example, he said, of where "the law does permit a judge, after the jury has made a decision to quantify pain and suffering, to reduce that award," via a "remittitur" of the amount of damages.⁹³

The problem, Judge Davis explained, is "[h]ow do I, as a judge, do the remittitur? If I'm absolutely convinced that the jury has been too generous and acted arbitrarily or on the basis of improper factors in making an award,

debilitating effects that erode an individual's quality of life with physical and emotional consequences).

84. Johnson, Todd, & Moulton, *supra* note 82.

85. See BLACK'S LAW DICTIONARY 417 (8th ed. 2007) ("Damages that attempt to compensate for the loss of the pleasure of being alive."); see also *Hedonic Damages Law & Legal Definition*, USLEGAL.COM, <http://definitions.uslegal.com/h/hedonic-damages/> (last visited Mar. 8, 2015) (noting that there is no objective measurement for the value of human life).

86. Panel 1, *supra* note 1, at 7.

87. See *id.* (noting that the Social Security Disability Act ("SSDA") did not permit claims based on pain until 1984, and that the SSDA still limits claims based on pain if and only if it is the symptom of some objective medical condition the claimant can point to).

88. *Id.* at 9.

89. *Id.*

90. *Id.*

91. *Id.*

92. *Id.*

93. *Id.* Remittitur is "[a]n order awarding a new trial, or a damages amount lower than that awarded by the jury, and requiring the plaintiff to choose between those alternatives[; or] . . . The process by which a court requires either that the case be retried, or that the damages awarded by the jury be reduced." BLACK'S LAW DICTIONARY, *supra* note 85, at 1321.

how am I, as a judge, [supposed] to recalibrate that? Because frankly, [I may be] no better than a jury in doing so.”⁹⁴ He suggested that the judges tend to ask themselves, “‘what’s fair?’ [W]hatever that means.” The second question a judge might ask him or herself is a more pragmatic one about how much can be awarded versus what is “[left] on the table . . . that ‘sweet spot’ [where] everybody is unhappy, but it’ll stand up on appeal.”⁹⁵

The pragmatic and institutional considerations that Judge Davis identifies here will no doubt remain regardless of future techniques for evaluating pain and suffering. He also noted, “the law may be a long way from getting the kind of help from science for these kinds of problems.”⁹⁶ But, he said, “hope springs eternal”⁹⁷ that improved understandings of the reality of chronic pain and of its specific effects on people suffering from such conditions will help jurors and judges to come to more informed and specific valuations of the appropriate damages in any particular case.⁹⁸ Better information could help judges and jurors move beyond factors like likeability (or lack thereof), as well as inform their gut sense of “what’s fair?”⁹⁹

Building on Judge Davis’ comments, Professor Greely noted an additional difficulty in valuing these kinds of cases: a jury (or, in some cases, a judge) must put a value on the claim at one point in time—the time of the verdict.¹⁰⁰ Yet the claimant may change greatly over time, for better or for worse, which can lead to the one time award being excessively high or low.¹⁰¹

94. Panel 1, *supra* note 1, at 9. Judge Morris Hoffman expressed a similar sentiment on Panel 2. See Panel 2, *supra* note 20, at 11 (“[Judges] suffer this problem of getting deadened to the process.”). This may reflect accurate self-assessment or judicial modesty. It would be interesting to gather data on how judges and jurors, respectively, evaluate pain and suffering damages based on the same evidence.

95. Panel 1, *supra* note 1, at 9.

96. *Id.*

97. *Id.*

98. *Id.*

99. Natalie Salmanowitz, *The Case for Pain Neuroimaging in the Courtroom: Lessons from Deception Detection*, 2 J.L. & BIOSCIENCES 139, 144–45 (2015), available at <http://jlb.oxfordjournals.org/content/2/1/139.full.pdf+html> (arguing for the use of fMRI to detect the validity of pain in tort cases).

100. See Panel 1, *supra* note 1, at 10 (noting the difficulty that courts have in determining whether the claimant is really feeling pain based on the claimant’s self report).

101. See *id.* (emphasizing that self assessments are dangerous because it is difficult to know if and how much a complainant may be exaggerating and changing their self assessments).

B. *The Legal Regimes or Contexts in Which These Kinds of Claims Arise*

Pain related claims that fall into the three categories mentioned above arise in various legal contexts. Professor Greely remarked that such claims “come up in tort suits at the state and federal level, . . . come up enormously in administrative procedures for disability payment—the Social Security Administration has literally hundreds of thousands of these—and they’ll come up in other occasional, strange contexts, like [when] seeking medical benefits.”¹⁰² Whether “a pain claim is being made in a court proceeding or an administrative proceeding can make a huge difference in terms of what evidence can get in and how it gets weighted, and what sorts of processes it goes through.”¹⁰³ Professor Greely also cautioned that it is easy to overemphasize what happens during adjudication of a claim.¹⁰⁴ Instead, we must keep in mind that “90 plus percent of cases get resolved” through settlement.¹⁰⁵ In these cases, judges or juries’ thoughts of pain disorders, or the issue of what neuroimaging [information] could perhaps be admitted (subject to *Daubert*)¹⁰⁶ does not become an explicit issue. Instead, the majority of resolutions in such cases consist of “bargaining in the shadow of the law.”¹⁰⁷

1. *State and federal tort claims*

In a tort claim in a state or federal court, “the scientific evidence gets examined, at least in theory, very closely.”¹⁰⁸ Judge Davis and Professor

102. *Id.* at 7.

103. *Id.* at 8.

104. *Id.* (noting that the adjudication of these claims are rare as many settle before trial).

105. *Id.*; see also James Herby, *Pre-trial Settlement Percentage: Statistics on Personal Injury Settlements*, THE LAW DICTIONARY, <http://thelawdictionary.org/article/pre-trial-settlement-percentage-statistics-on-personal-injury-settlements/> (last visited Mar. 8, 2015) (noting that 90 percent of personal injury cases are settled pretrial).

106. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993). The Supreme Court, interpreting the Federal Rules of Evidence governing the admissibility of expert evidence, held that the trial judge should independently evaluate the expert evidence based on factors that include whether or not it is the product of scientific methodology (particularly whether the technique or theory is falsifiable), whether it has been subjected to peer review and publication, has a known or potential error rate, and the degree to which the theory or technique is generally accepted in the relevant expert community. *Id.* at 594 (interpreting FED. R. EVID. 702). Not all states have adopted this standard. See MARTIN S. KAUFMAN, ATL. LEGAL FOUND., *THE STATUS OF DAUBERT IN STATE COURTS 1–3* (2006), <http://www.atlanticlegal.org/daubertreport.pdf> (noting that 13 states and D.C. have rejected the standard, and 7 states have neither accepted nor rejected the standard).

107. See Panel 1, *supra* note 1, at 8.

108. See *id.* at 7 (explaining that the evidence must go through the judge, which is then again examined by the jury).

Greely both described the *Daubert* standard for the admissibility of scientific or other expert evidence, which applies in federal courts and the majority of state courts.¹⁰⁹ Under both *Daubert* and the Federal Rule of Evidence 702, the judge is tasked with acting as a “gatekeeper” to determine whether the proffered expert evidence is sufficiently reliable and whether it will be helpful to the jury.¹¹⁰ Jurors are then supposed to carefully evaluate admitted evidence in light of the judge’s instructions, which is a task that may be a great deal to ask of any juror.¹¹¹

Judge Gertner expressed further skepticism about the expectations that *Daubert* imposes on jurors, and explained particular reservations she had about the impact of the adversary process on pain based claims.¹¹² She described her experience as a district judge, which made her “less sanguine” about the ability of jurors to interpret sophisticated expert evidence.¹¹³ Often, she remarked, it comes down to the level of the parties’ resources.¹¹⁴ *Daubert* and the Federal Rules provide “a very flawed, flexible standard, and then we bury everything by giving it to a jury, and the jury doesn’t necessarily give a reason [for their decision].”¹¹⁵ Further, the adversary process creates an “atmosphere of skepticism.”¹¹⁶ Yet, she noted that the “law is already so skeptical about pain and suffering. So how is that going to play out? And what I fear is that you’re going to have cases that will over weigh it, and cases that will under weigh it.”¹¹⁷

2. ERISA

Cases may also come into federal court pursuant to the Employment Retirement Income Security Act of 1974 (“ERISA”), which governs the relationship between employees and employer provided benefits such as

109. *Id.* at 5–7.

110. *See id.* at 7–8; *see also* Cassandra H. Welch, *Flexible Standards, Deferential Review: Daubert’s Legacy of Confusion*, 29 HARV. J.L. & PUB. POL’Y 1085, 1090 (2006) (discussing the effect of Rule 702 and *Daubert* on the judge’s role as gatekeeper in assisting the jury as the jury deciphers scientific and other types of knowledge).

111. *Id.* at 10.

112. *Id.* at 25. For a detailed discussion of the evidentiary process and considerations relating to neuroscientific evidence, *see* Panel 2, *supra* note 20 at 12–13.

113. Panel 1, *supra* note 1, at 25.

114. *Id.*

115. *Id.*; *see also* *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579, 595–96 (1993) (discussing how the jury is charged with determining the validity of what scientific evidence is believable).

116. Panel 1, *supra* note 1, at 25.

117. *Id.* at 25–26.

health insurance and, in some cases, disability insurance.¹¹⁸ Judge Davis noted that just about all people employed in the United States who have employer sponsored health plans are covered by ERISA.¹¹⁹ In an ERISA action, a claimant may allege that an insurer inappropriately denied coverage for needed services or denied a claim for short- or long-term disability.¹²⁰ In these matters, federal courts do not receive evidence (e.g., expert witness testimony), but rather review whether the insurance company made an appropriate, non-arbitrary decision pursuant to the terms of the insurance plan.¹²¹ Professor Greely noted that it is “very, very hard for a claimant to win an ERISA claim” because of the deferential standard with which courts must review a plan’s determination.¹²²

Judge Davis noted that the court on which he sits, the United States Court of Appeals for the Fourth Circuit, recently issued a significant opinion in *Cosey v. Prudential Insurance Company of America*¹²³ that concerned ERISA, which involved a “a white collar worker with a senior and responsible position . . . who started to have chronic, largely unexplained pain” that she alleged disabled her from working.¹²⁴ The worker filed a claim for short term disability that her insurer initially approved; the insurer later withdrew its approval.¹²⁵ Under ERISA, Judge Davis noted, “the companies have an awful lot of authority. They actually have the authority to say ‘we will decide who is disabled.’”¹²⁶ In this case, the insurer contended that it had discretion to find that the claimant was not disabled because she had not come forward with objective evidence of her

118. See 29 U.S.C. § 1001 (2012) (stating that ERISA was intended to govern the relationship between employees and employer provided health insurance benefit plans).

119. Panel 1, *supra* note 1, at 6. See also William Pierron & Paul Fronstin, *ERISA Preemption: Implications for Health Reform and Coverage*, EBRI ISSUE BRIEF, Feb. 2008, at 1, 11, available at http://www.ebri.org/pdf/briefspdf/ebri_ib_02a-20082.pdf (stating that 82 percent of people covered by employment-based health benefits fall under ERISA plans).

120. See 29 U.S.C. § 1132 (2012) (stating that a civil action may be brought by a policy holder to recover benefits due to them).

121. See *Metro. Life Ins. Co. v. Glenn*, 554 U.S. 105, 115 (2008) (discussing the standard of care for insurance plan administrators and the judicial review under ERISA for failing to meet that standard.); see also *id.* at 118 (noting that the Court heard medical testimony gathered and supplied by the insurance company rather than testimony from a medical expert).

122. Panel 1, *supra* note 1, at 7; see also Sarah L. Whipple, *Piercing ERISA’s Shield of Immunity: The First Step—Saving External Review Laws from ERISA Preemption—Rush Prudential HMO, Inc. v. Moran and the Massachusetts Act Relative to Managed Care Practices in Insurance Industry*, 36 SUFFOLK U. L. REV. 863, 896 (2003) (noting the various challenges to a successful ERISA claim).

123. 735 F.3d 161 (4th Cir. 2013).

124. Panel 1, *supra* note 1, at 19; see also *Cosey*, 735 F.3d at 163.

125. *Cosey*, 735 F.3d at 163.

126. Panel 1, *supra* note 1, at 6. See also *Glenn*, 554 U.S. at 108 (discussing the discretionary authority of insurance companies in determining valid claims).

pain based disability.¹²⁷ What *Cosey* holds, according to Judge Davis, “is that for chronic pain type claims, objective evidence is not a sine qua non” of a disability finding.¹²⁸ In Judge Davis’ view, this holding could be “very significant” for individuals with chronic pain.¹²⁹

3. *Administrative adjudication and appeals*

A majority of pain related claims are heard in administrative settings.¹³⁰ These include state administrative proceedings that adjudicate workers’ compensation cases and federal administrative settings that adjudicate SSDI disability claims.¹³¹ In these administrative proceedings, Professor Greely noted that the context of proof is sharply different: “the rules of evidence are slacker, and in some cases close to non-existent, and there is no jury, and there are no instructions.”¹³² Compared to federal and state courts, there often may not be “the same level of written opinions and precedent—it varies from system to system, but it’s a very different kind of world.”¹³³ These cases can eventually proceed on appeal into a state or federal court where state or federal judges (without the aid of a jury) may review the determination made by an administrative law judge (“ALJ”).¹³⁴ This standard of review is less deferential than in ERISA cases, and judges frequently may comb the record to evaluate independently whether the denied claim appears meritorious.¹³⁵

The role of the ALJ as an ultimate decision maker in administrative courts and in state and federal review of ERISA and administrative claims means that these ALJs are vested with tremendous authority relative to

127. *Cosey*, 735 F.3d at 164 (discussing how the insurer concluded there was a lack of medical evidence to conclude that Cosey had a disability).

128. Panel 1, *supra* note 1, at 6; *see also Cosey*, 735 F.3d at 163 (holding that objective proof is not necessary for a disability claim).

129. Panel 1, *supra* note 1, at 6.

130. *See, e.g.,* EMP. BENEFITS SECURITY ADMIN., *FAQs About The Benefit Claims Procedure Regulation*, U.S. DEP’T LAB., http://www.dol.gov/ebsa/faqs/faq_claims_proc_reg.html (last visited Mar. 8, 2015) (discussing how ERISA claims must first go through administrative process).

131. *Id.*

132. Panel 1, *supra* note 1, at 8.

133. *Id.*

134. For example, in Maryland, an unsatisfied party may request that “any question of fact involved in the case” be submitted to a jury, which essentially affords claimants (and employers) an opportunity to retry the case in front of a jury. MD. LAB. & EMPL. CODE ANN. § 9-745(d) (2014). There is also a more traditional review option, where the Circuit Court merely examines the Commission’s decision in light of the facts already gathered. § 9-745(c).

135. *See* § 9-745 (noting the different standards of review as compared to ERISA cases).

claims involving chronic pain.¹³⁶ The ways in which these ALJs review and evaluate the parties' evidence is not bounded by *Daubert* (as it would be in the trial context), which proves that ALJs are the crucial decision makers in interpreting and applying the law relative to evidence of chronic pain.¹³⁷ Their understandings and beliefs about what kinds of chronic pain claims seem credible and what types of evidence tend to substantiate a claim of chronic pain may be the most important across the three types of cases that Professor Greely described, and across all of the legal contexts in which those types of cases may arise.

V. COULD PAIN NEUROIMAGING EVIDENCE BE USED IN COURT?

Aside from pain neuroimaging studies informing legal systems through aggregate findings, there is also the potential for the fMRI to "decode" a person's experience.¹³⁸ In an ideal materialization of this decoding for pain, a person would simply go into a scanner and the readout would tell you if she were experiencing pain.¹³⁹ While the technology might not be available today, there was general agreement that it could arrive in the foreseeable future for decoding acute pain, and eventually it could possibly be able to decode chronic pain.¹⁴⁰ There are several limitations to this approach that will need to be addressed. Professor Davis pointed out some of these limitations, and Professor Greely shared his views on the nature of those limitations in a legal setting.¹⁴¹

A particular problem in decoding a person's brain activity to see if s/he is in pain is known as the "reverse inference" problem.¹⁴² Professor Davis described the problem through an example:

136. See e.g., *Metro. Life Ins. Co. v. Glenn*, 554 U.S. 105, 109 (2008) (noting the role of the administrative law judge in determining issues of fact in ERISA claims); *Papendick v. Sullivan*, 969 F.2d 298, 701 (7th Cir. 1992) (stating that the court's role is to only review the administrative law judge's decision for substantial evidence, which may be less than a preponderance of evidence).

137. Compare *Sullivan*, 969 F.2d at 701 (stating that the role of the court is to review the administrative law judge's decision for substantial evidence), with *Daubert v. Merrell Dow Pharm.*, 509 U.S. 579, 597 (1993) (discussing how even though the judge plays the role of "gatekeeper," the jury is charged with determining the validity of scientific evidence).

138. See Stephen M. LaConte, *Decoding fMRI Brain States in Real-Time*, 56 *NEUROIMAGE* 440, 440 (2011) (stating that fMRI data can be used to decode brain states).

139. See Panel 1, *supra* note 1, at 23 (discussing how it would be easier to determine pain if a scanner simply revealed whether a person was actually experiencing it).

140. *Id.* at 4, 11.

141. *Id.* at 23.

142. See NICHOLAS MACKINTOSH ET AL., *THE ROYAL SOC'Y, BRAIN WAVES MODULE 4: NEUROSCIENCE AND THE LAW* 6 (2011) (discussing the reverse inference problem in determining the meaning of signals through existing imaging technology in the brain).

if you deliver a painful stimulus, or if people are in pain, you can definitely see certain kinds of signatures—pain signatures—in the brain. But there are other things you could do, [such as to] have somebody think about something very salient, or all sorts of other things, that actually will give you the exact same brain map, the same response. The same areas of the brain are going to respond, because the pain system shares resources—real estate—with many of these other cognitive and emotional systems.¹⁴³

The essence of the reverse inference problem is that you cannot infer a specific behavior just by looking at a brain pattern.¹⁴⁴ An example of the reverse inference problem is illustrated with spinal malformations and low back pain. Often, spine imaging is used when a person complains of back pain.¹⁴⁵ In a case where a herniated disc, degenerative disc, or other anomaly is identified, it is easy to assume that the pain is associated with that anomaly. It turns out, however, that these same spinal anomalies are very common in healthy, asymptomatic people.¹⁴⁶ The imaging finding in that case could be spurious and it should not guide the intervention approach.

Professor Davis warned that even in the future, when machine learning and similar technologies might be able to provide predictions of whether someone is in pain, even with all of the proper controls and countermeasures and with high (e.g., over 95 percent) accuracy and specificity, there is still uncertainty; what will happen to those 5 percent of

143. *See id.* (discussing how reactions from one part of the brain does not necessarily coordinate with any single particular emotion, feeling, or act).

144. *Id.* There are a few notable exceptions to this reverse inference problem, such as a paper by Jack Gallant and colleagues describing a method to decode visual scenes from brain activity recorded with fMRI. Jack Gallant et al., *Encoding and Decoding in fMRI*, 56 *NEUROIMAGE* 400, 407 (2011) (discussing how the fMRI can decode brain activity).

145. *See* Pradeep Suri et al., *Longitudinal Associations Between Incident Lumbar Spine MRI Findings and Chronic Low Back Pain or Radicular Symptoms: Retrospective Analysis of Data from the Longitudinal Assessment of Imaging and Disability of the Back (LAIDBACK)*, *BMC MUSCULOSKELETAL DISORDERS* 2 (May 13, 2014), <http://www.biomedcentral.com/1471-2474/15/152> (discussing how MRI technology is ineffective in discerning pain caused by lower back problems and spinal malformations).

146. *Id.*

people for whom the tests fail?¹⁴⁷ As Professor Greely notes, “the law would like to have 100 percent certain evidence, but it rarely does.”¹⁴⁸

To Professor Greely, the concern about reverse inference was less imperative. He suggested that there simply would need to be some acknowledgement that the test was good even if it was not perfect.¹⁴⁹ If it could be accurate 85–95 percent of the time, it would still be useful in providing some objective evidence, which, along with the other evidence, could strengthen (or weaken) a case. In the end, Professor Greely suggested that, in this domain as in all others, it will be the judge’s role to sort out whether the evidence is strong enough.¹⁵⁰ By analogy, Professor Greely described a case where an eyewitness account is admitted in court as evidence, even though the accuracy of such witnesses is far less than perfect.¹⁵¹ In addition to the evidence itself, there is a matter of convincing a judge or jury that the quality of the evidence is generally sufficiently reliable to influence a final decision.¹⁵² Professor Greely noted that explaining to a jury how to use neuroimaging evidence would be an additional potential challenge.¹⁵³ Yet, despite those challenges, Professor Greely states that having a test that provides objective evidence in the majority of cases would be beneficial to society, as more cases would be decided correctly and more cases would settle, leaving fewer cases requiring an expensive court process.¹⁵⁴ That is, even if the accuracy of the test and difficulty in their interpretation pose potential additional obstacles, then as long as they improve the quality of the evidence, their value in providing some form of objective evidence in a case that can only otherwise provide subjective claims will likely be worth the problems.

147. Panel 1, *supra* note 1, at 25.

148. *Id.* at 23.

149. *Id.* at 25 (discussing how testing may be only 95 percent accurate, but the degree of accuracy will force settlements, which he contends is a good thing).

150. *Id.* at 23.

151. *Id.*

152. See *The Criminal Justice Systems: A Guide for Law Enforcement Officers and Expert Witnesses in Impaired Driving Cases*, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, <http://www.nhtsa.gov/people/injury/enforce/GuideforOfficers/pages/Glossary.html> (last visited Mar. 11, 2015) (describing that a judge, under the *Daubert* test, must determine if the evidence is “relevant” and “reliable”).

153. See Panel 1, *supra* note 1, at 21 (questioning whether somebody at trial can say, based on neuroimaging, that this person is in pain or that this person is not in pain).

154. *Id.* at 24–25.

VI. LIMITATIONS, CAUTIONARY LESSONS FROM OTHER SCIENCE-LAW INTERACTIONS, AND FUTURE DIRECTIONS

A. *A Call for Better Technology to Decode Brain Activity?*

The panelists disagreed on whether incremental improvements to existing neuroimaging protocols will result in reliable evidence of pain in an individual, or whether it will be necessary to develop new protocols and technologies.¹⁵⁵ According to Professor Davis, we need new technology, not just a better version of what we have: “We can’t just get incrementally better. We need a different approach, and so I’m hoping that something is on the horizon.”¹⁵⁶ She pointed to recent advances in the area of optogenetics as one potential future development—it is not yet available for humans, but it is making rapid progress with likely applications in human research in the not-so-distant future.¹⁵⁷

From many neuroimaging studies on evoked pain in healthy subjects, we now have a firm understanding of the neural circuits involved in acute pain.¹⁵⁸ Professor Davis pointed out that the most difficult cases for the law to deal with will be those with claims of chronic pain conditions in which spontaneous or ongoing pain is prevalent.¹⁵⁹ Relatively few neuroimaging studies have examined ongoing pain,¹⁶⁰ and it is not yet clear whether this type of imaging paradigm would be able to distinguish someone with chronic pain from a healthy, pain free person. As Professor Davis stated:

155. *Compare id.* at 12–13 (indicating that Prof. Davis described how we need all new technology rather than getting incrementally better with neuroimaging), *with id.* at 3–4 (reporting that David Seminowicz described the advances made in neuroimaging research and how chronic pain can now be identified).

156. *Id.* at 13.

157. *Id.* at 13. *See generally* Travis May et. al., *Detection of Optogenetic Stimulation in Somatosensory Cortex by Non-Human Primates - Towards Artificial Tactile Sensation*, PLOS ONE (Dec. 26, 2014), <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0114529> (describing the use of optogenetics on non-human primates).

158. Emma G. Duerden & Marie-Claire Albanese, *Localization of Pain-Related Brain Activation: A Meta-Analysis of Neuroimaging Data*, 34 HUMAN BRAIN MAPPING 109, 109–11 (2013).

159. Panel 1, *supra* note 1, at 23.

160. *See, e.g.*, Matthew A. Howard et. al., *Beyond Patient Reported Pain: Perfusion Magnetic Resonance Imaging Demonstrates Reproducible Cerebral Representation of Ongoing Post-Surgical Pain*, PLOS ONE (Feb. 23, 2011), <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0017096> (explaining that there are relatively few neuroimaging reports describing the cerebral representation of ongoing pain, and fewer still describe clinical ongoing pain).

This has been the reason why using imaging to look at chronic pain, instead of acute pain, which you can evoke, is really, really hard. To determine if somebody is in chronic pain, you want to put somebody in a scanner or do some sort of test and not do anything to them, just look, and say, “is that brain firing on its own, abnormally?”¹⁶¹

B. Pictures in the Courtroom

Judge Davis added a cautionary note on the use of technology in the courtroom:

Courts [and] judges have a real concern about imaging because of the potential of the misuse of pretty pictures. And the cautionary note that [Professor Davis] struck will not be struck by those with skin in the game, as [Professor Greely] [previously] mentioned very astutely. There will be those, as there already are those out there, ready to push the technology way beyond the limits of legitimacy. And courts are very worried about that.¹⁶²

He recalled when PowerPoint slides were used for the first time in courtrooms:

it was very controversial. It was very controversial, because . . . better moneyed, better financed, perhaps better lawyers, were ahead of the game, and were able, in various kinds of cases, to bring pretty pictures and great graphics and great texts on this new phenomenon, and there were some on the other side [saying], “Judge, that’s not fair! The jury’s going to be overwhelmed by the pretty pictures” And, so we worked that out, and so the price came down, and the word went out, and so everybody uses PowerPoint now in the courtroom, but that’s the kind of concern, one of the concerns, about too early [and] too untested kinds of imaging that, if I were a plaintiff’s lawyer, I certainly

161. Panel 1, *supra* note 1, at 23.

162. *Id.* at 13.

would try to get pretty pictures of brains in pain before the jury. And courts will have to guard against that.¹⁶³

C. *Examples of Other Scientific Evidence in the Legal System*

Looking to other examples of the introduction of scientific evidence in the courtroom, there was concern about the poor quality of the forensic sciences along with suggestions that we need to take an approach similar to what was done with the introduction of DNA evidence: establishing a robust research culture around that evidence.¹⁶⁴ From the audience, Judge Nancy Gertner pointed out other areas where law has depended on science, including:

forensic science, ballistics, eyewitnesses, [etc.] . . . [experts have been] trying to come up with standards in advance [and] to inform what courts do, because otherwise this is going to be a patchwork quilt. [An ALJ] is in a different situation because [they are] the decision maker, and [they] have to write something with respect to this. And so, arguably, Social Security Disability claims will be where there is some development of the standards, as opposed to the jury box, which is a black hole. . . . But, again, we're dealing with a new world and old standards. . . . One thing that we ought to think about is what kind of standards to do in advance—to create a gold standard, not have it percolate through the courts, because it's not going to percolate through the courts. You want to have it in advance by lawyers, scientists, judges, panels, or whatever, to percolate the gold standard, not the courts.¹⁶⁵

Professor Davis disagreed with this point, suggesting that it should be the neuroscientists who set up the way to determine the gold standard or at least the criteria for how to achieve such a goal, which applies not only to

163. *Id.*

164. *Id.* at 26; see also *Advancing Justice Through DNA Technology: Using DNA to Solve Crimes*, U.S. DEP'T JUSTICE, <http://www.justice.gov/ag/advancing-justice-through-dna-technology-using-dna-solve-crimes> (last updated Sept. 9, 2014) (describing how DNA research is understood and relied upon as evidence in the courtroom).

165. Panel 1, *supra* note 1, at 13.

chronic pain, but also to other areas of neuroimaging research that involve “mind reading.”¹⁶⁶ She was concerned that

the brain imaging community has not been overly responsive to get onboard with this People are, for whatever reason, either not interested or worried about getting involved or not feeling that it’s their responsibility. I’ve been trying to figure out whose responsibility it is. Is it the American Medical Association? Is it the brain imagers? Is it the pain community? Is it governments? Whose responsibility is it to set up the gold standard for medical tests? And, so, I’m hoping that this meeting today will actually help promote that and move that forward, because there are small group of folks that do want to do this, and we’re just kind of stuck in terms of not quite knowing what channels to go through politically and medically.¹⁶⁷

Professor Greely added his thoughts on the need to have a systematic research program in place in order to get scientific evidence to a point where it is useful in court. He stated that

DNA is a nice example, [which involved] two national academy reports to sort of set the population science side of it, and then [the] FBI sponsored laboratory accreditation to get the standards and procedures down. I think those two things—having good science and having good standardized procedures—are really helpful in any of this stuff.¹⁶⁸

Judge Gertner made the comment that much of the discussion on the panel sounded like “a classic lawyer-scientist conversation. Scientists are asking for a gold standard, and the law is talking process.”¹⁶⁹ She then asked how this lack of a gold standard in pain cases differs from other types of gold standards (namely with mental disorders).¹⁷⁰

166. *Id.* at 26.

167. *Id.*

168. *Id.*

169. *Id.* at 25.

170. *Id.*

Professor Greely commented that while he thought the issues were similar in some ways, pain is likely a more common matter in the legal system. He stated that

Neuroimaging can contribute something to some kinds of mental—or things that look like mental—problems, like orbital frontal dementia will show up pretty strongly on a neuroimaging scan [and] there are some neuroimaging indications that can be consistent or inconsistent with Alzheimer’s [although] that’s neurological rather than mental.¹⁷¹

It was unclear whether the distinction between “mental” and “neurological” made any difference in court, and Professor Greely suggested that could be the topic of a future conference.¹⁷² From the audience, Deborah Runkle from the American Association for the Advancement of Science (“AAAS”) added that “[t]hey say the diseases are called mental until you can find the physical causes, in which case they shift over and become neurological.”¹⁷³

D. Standards of Pain Measurement and the Need for Objective Measures in the Law

While many points were raised and discussed in this panel, it was clear that several issues would not be easily resolved. The panelists described a disconnect between the way pain is viewed in clinical and research settings compared to the courts, and the way neuroimaging data could be used and misused in the legal system.¹⁷⁴ Currently, the gold standard for pain measurement is self reporting,¹⁷⁵ where on a 10 point numerical rating scale, 0 is no pain and 10 is the worst pain imaginable.¹⁷⁶ In clinical trials

171. *Id.* at 18.

172. *Id.*

173. *Id.*

174. *See, e.g., id.* at 3 (describing the complexity in the way pain is viewed in neurological studies).

175. *See* Panel 2, *supra* note 20, at 15 (discussing moving the gold standard away from diagnostic testing).

176. *See* M. Gabrielle Page et al., *Validation of the Numerical Rating Scale for Pain Intensity and Unpleasantness in Pediatric Acute Postoperative Pain: Sensitivity to Change Over Time*, 13 J. PAIN 359, 359 (2012) (describing how pain is evaluated using a numerical rating scale).

on chronic pain (excluding headache/migraine trials), the numerical rating scale continues to be the gold standard.¹⁷⁷

Professor Davis pointed out that—at least in the medical world—only a very small minority (small enough to be considered negligible) of chronic pain patients are malingerers or fakers.¹⁷⁸ In fact, it would be highly unlikely that a group of patients with a given diagnosis would all fake the same pattern of symptoms and somehow fake their brain patterns in a common way.¹⁷⁹ The point that Professor Davis touched upon here was that researchers have been trying to establish “pain signatures” or “biomarkers” for chronic pain disorders.¹⁸⁰ Such signatures could be in the form of functional patterns of pain related activity, functional connectivity patterns at rest, or structural anatomical patterns.¹⁸¹ While this area of research is still in its infancy and requires considerable replication and additional proofs, it points to the potential for signatures of disease to become a reality in the near future. A neuroimaging based signature or biomarker could be used for diagnosis, prognosis, or treatment outcome prediction. Even in the absence of such an objective biomarker in the medical setting, clinicians will generally take a patient’s claim of pain at face value.¹⁸²

While self reporting might be fine for clinical and research purposes, it might simply be not enough in the legal system. Professor Greely argued that despite the limitations of pain neuroimaging, the need for objective evidence in the legal system outweighs them.¹⁸³ He said that there must be some additional evidence to back self reporting in order to determine if claimants are exaggerating the pain or if they are lying about it:

177. *Id.*

178. Panel 1, *supra* note 1, at 16.

179. *Id.*

180. *Id.* at 22. *See, e.g.*, Irene Tracey & Patrick W. Mantyh, *The Cerebral Signature for Pain Perception and Its Modulation*, 55 NEURON REV. 377, 377 (2007) (discussing the latest data regarding the cerebral signature of pain and its modulation in humans); Tor D. Wager et al., *An fMRI-Based Neurologic Signature of Physical Pain*, 368 N. ENG. J. MED. 1388, 1388 (2013) (describing two different studies that used machine-learning analyses to identify neurological pain signatures); Marwan Baliki et al., *Brain Morphological Signatures for Chronic Pain*, PLOS ONE (Oct. 13, 2011), <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0026010> (illustrating several studies that have tried to establish various neurological pain signatures for chronic pain disorders).

181. *See* Michael E. Robinson, *Pain Measurement and Brain Activity: Will Neuroimages Replace Pain Ratings?*, 14 J. PAIN, 323, 325 (2013) (describing the various forms that a pain related signature could take).

182. *See, e.g.*, Boadie W. Dunlop & Helen S. Mayberg, *Neuroimaging-Based Biomarkers for Treatment Selection in Major Depressive Disorder*, 16 DIALOGUES CLINICAL NEUROSCIENCE 479, 479–80 (2012) (describing the use of neuroimaging based signatures for treatment outcome predictions in patients suffering from depression disorder).

183. Panel 1, *supra* note 1, at 10.

“[determining] [w]hat that evidence is is often going to be really tough, but I think that, along with that question of value in the pain and suffering, [those] are the two big problems the legal system has in dealing with pain.”¹⁸⁴ Professor Greely further noted that “[w]e can’t just accept people’s self assessments. . . . if we did, we’d have a country which was entirely on disability payments, because getting paid to do nothing is, for some people, at least for many people, better than getting paid to work.”¹⁸⁵ Thus, pain remains a challenge for the legal system as it is hard to quantify, verify, or deny; with little precedent to set standards for dealing with pain, each case will follow its own course and rely on different types of evidence.

VII. CONCLUSION

While there is not yet—and perhaps might never be—an objective measurement of pain, the panel agreed that pain neuroimaging could provide useful information for the legal system in the form of aggregated data from healthy people and chronic pain patients. Additionally, pain neuroimaging could provide this kind of information possibly in the near future through a pain measurement neuroimaging test using existing or new technology. The panel, however, pointed out several reasons to proceed with caution.¹⁸⁶ These reasons included limitations of the neuroimaging technology and the need for systematic research in a way that is comparable to the development of DNA testing, as well as the need for limitations of the judge and jury in assessing neuroimaging evidence.¹⁸⁷

184. *Id.*

185. *Id.*

186. *See, e.g., id.* at 13 (describing the limitations of neurological imaging and potential issues with using neurological imaging in court).

187. *See id.* at 26 (discussing the importance of having standardized procedures for evaluating scientific evidence such as DNA).