TOWARD A NEUROSCIENCE MODEL OF TORT LAW: HOW FUNCTIONAL NEUROIMAGING WILL TRANSFORM TORT DOCTRINE

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INTRODUCTION

As the study and practice of law become increasingly interdisciplinary, the law has looks beyond itself for explanations of human behavior.[1] Over the past several decades, research employing functional neuroimaging technologies has sought to explain a vast array of human thought processes and behavior, and the law has taken notice. Although functional neuroimaging is not yet close to being a staple in the courtroom, the information acquired from these studies has featured in some cases and has been

[1] *See* Owen D. Jones & Timothy H. Goldsmith, *Law and Behavioral Biology*, 105 COLUM. L. REV. 405, 407 (2005) (stating that "human behavior is the very currency in which law deals," but recognizing that no clear consensus exists about the interaction of law and behavior).

acknowledged by the United States Supreme Court. In 2005, in *Roper v. Simmons*,[2] the Supreme Court used neuroscience theories of child development to support its reasoning in prohibiting the death penalty for older juveniles. More recently, in the 2011 case of *Brown v. Entertainment Merchants Association*,[3] functional neuroimaging research on the relationship between violent video games and violent behavior in children formed the basis of the challenged statute which contained age restrictions for video game sales. Although the Court held the statute unconstitutional on First Amendment grounds,[4] the neuroscience research captured the attention of Justice Breyer, who discussed it at length in his dissent.[5] As these cases indicate, these new developments – which we refer to in this Article as the new neuroscience[6] – are beginning to appear in courtrooms, where judges may soon be awash in functional neuroimaging evidence and in need of substantial guidance.

The word "revolution" is rarely used to describe the law, and then perhaps only in retrospect. Rather, the law evolves slowly over time, often with almost imperceptible shifts, but eventually accommodating broad social developments. The Industrial Revolution was one such defining social development, acting as the impetus for the creation of workers' compensation, modern product liability law, and insurance law.

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[2] 543 U.S. 551, 578 (2005).

[3] 131 S. Ct. 2729 (2011).

[4] *Id.* at 2738.

[5] *Id.* at 2767-70 (Breyer, J., dissenting).

[6] This Article employs the term "new neuroscience" to encompass the various technologies used by neuroscientists to identify and interpret brain activity. We mean the term to refer to the technologies that are relevant to legal issues, particularly issues in tort law. Although most of our discussion centers on functional neuroimaging, we intend the term "new neuroscience" to be broad enough to include structural neuroimaging and the study of brain waves, where relevant. These technologies are briefly summarized in Section I.A, *infra*.

Society is now in the midst of the technological revolution, with impacts already felt in intellectual property law, procedural law, and constitutional law, with many more certain to come. The "neuroscience revolution" has now gained the attention of legal thinkers and is poised to be the catalyst for significant changes in society and the law.

Tort law is likely to be among the first areas of the law impacted by the neuroscience revolution. Tort doctrine contains a variety of mental states which are rooted in the common law, in the elements of specific torts and privileges or defenses. Traditionally, the jury determines whether these mental states existed at the time of the tort by weighing direct behavioral evidence and indirect circumstantial evidence. Less frequently, however, is the jury presented with medical or scientific evidence of the actor's cognitive state. This is likely to change in the near future. New technologies in brain imaging have given the neuroscience community an unprecedented look into the brains of subjects. Tests such as functional magnetic resonance imaging (fMRI)[7] are beginning to rival psychometric testing for the purpose of ascertaining mental capacity, decision making, and brain development.[8] As these studies find their way into the legal system, the criminal courtroom has become an early testing ground for the application of the studies to cognitive mental states in the law. The courts have shown interest, tempered by caution, and suspicion of the reliability of the evidence. As we demonstrate in this Article, evidence based upon the new neuroscience will soon spread to all areas of the law, especially to tort law with its emphasis on mental states.

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[7] *See infra* notes 18-34 and accompanying text.

[8] *See* Lisa T. Eyler et al., *Brain Response Correlates of Decisional Capacity in Schizophrenia: A Preliminary fMRI Study*, 19 J. NEUROPSYCHIATRY & CLIN. NEUROSCI. 137, 138 (2007) (stating that "functional imaging may be a better tool for examining sources of variability in decisional capacity than neuropsychological measures alone").

As the courts become saturated with neuroimaging evidence, it is imperative to be prepared with a framework for addressing the many legal questions that the new neuroscience will pose. This Article sets forth such a framework for tort law. Science is about process; the law is about normative decisions. As legal scholars with interdisciplinary backgrounds, our perspective focuses on legal doctrine and on developing a new way of thinking about tort law that accommodates emerging neuroscience. Without a scientific agenda, we believe we are uniquely positioned to evaluate the tort-law impact of the new neuroscience. This Article approaches the subject of the new neuroscience purely from the perspective of the legal profession in general, and tort law in particular, analyzing the direct impact that this science could have on tort doctrine.

Part One of this Article begins by briefly summarizing the new neuroscience, with emphasis on functional neuroimaging technology and other neurological tests used to investigate areas of the brain associated with various tasks and behaviors. This Part also notes some of the conclusions researchers have reached using these tests to correlate cognition or behavior with brain activity. We also discuss examples of the current uses of the studies in a variety of contexts, including the law. In Part Two, we turn our attention to basic tort doctrine, discussing the mental states inherent in intentional torts and negligence law. We identify the areas of tort law in which the new neuroscience is likely to alter the legal community's perspective on and understanding of those mental states and, ultimately, alter tort doctrine. Part Three examines some of the major challenges in bringing together neuroscience and tort law, with special emphasis on the legal rules for admitting scientific evidence in the courtroom. In Part Four, we develop a

framework for a neuroscience model of tort law. Our model is constructed broadly enough to anticipate and incorporate future developments in neuroscience. But we also recognize that the legal system will soon be confronted with neuroscientific evidence, theories, and arguments in record amounts. Now is the time to prepare for the inevitable deluge. We conclude that the new neuroscience will have a use both in the decisions of individual tort cases and in the evolving norms of tort doctrine, but that numerous challenges and obstacles must be addressed before it can realize its full potential in tort law.

I. THE PROMISE OF THE NEW NEUROSCIENCE

A. The Technology and Its Limitations

The so-called "new" neuroscience is not really new at all. Versions of the brain scan technologies currently capturing the law's attention have been in use for decades. The study of cognitive neuroscience is relatively recent, however.[9] Long before the advent of functional magnetic resonance imaging (fMRI) – the current gold standard of behavioral neuroscientific imaging – scientists and medical practitioners used a variety of technologies to delve into the complex world of the human body and brain. Only recently have scientists begun to understand the full implications of the information obtained through these scans. With increased sophistication of the technologies, the challenges of interpreting that information have multiplied. The more traditional techniques have found some measure of acceptance in the courtroom. But the extent to

[9] *See* Michael S. Gazzaniga, *What is Cognitive Neuroscience?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 2, 3 (Law and Neuroscience Project & SAGE Center for the Study of the Mind, eds. 2011), *available at* http://www.sagecenter.ucsb.edu/sites/staging.sagecenter.ucsb.edu/files/file-and-multimedia/A_Judges_Guide_to_Neuroscience[sample].pdf. "Cognitive neuroscience" has been defined as "the field of scientific endeavor that is trying to understand how the brain enables the mind." *Id.* at 2.

which they may be used and the degree to which the more sophisticated technologies may gain acceptance are matters currently open to vigorous debate in scientific and legal circles.

Neuroscience and brain scan technology have evolved significantly over time, from the basic static x-ray technology to more complicated technologies that seek to understand how various areas of the subject's brain are functioning in real time. The pioneering cranial computed tomography (CT) scan uses a combination of x-rays and dyes to detect physiological anomalies in the brain, head, and neck.[10] The technique scans the designated area from many angles, and then uses computer software to create a cross-section image from the many static images obtained. The technique can yield much information about the structure of the brain, including abnormalities, and is useful in medical diagnoses, but does not measure or visualize brain function.[11] Another conventional technology, the electroencephalogram (EEG), measures electrical impulses in the brain as waves, recording the signals from electrodes placed on the scalp.[12]

The positron emission tomography (PET) scan was developed to test brain function.[13] This test involves the use of small quantities of radioactive chemicals that are injected into the person undergoing analysis.[14] Technicians observe brain function by

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[10] *See* Henry T. Greely & Anthony D. Wagner, *Reference Guide on Neuroscience*, *in* REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 747, 762-63 (Federal Judicial Center & National Research Council of the National Academies eds., 3d ed. 2011); http://www.nlm.nih.gov/medlineplus/ency/article/003786.htm.

[11] Owen D. Jones, Joshua W. Buckholtz, Jeffrey D. Schall, & Rene Marquis, *Brain Imaging for Legal Thinkers: A Guide for the Perplexed*, 2009 STAN. TECH. L. REV. 5, ¶ 13 [hereinafter Jones et al.].

[12] Greely & Wagner, *supra* note 10, at 772.

[13] *Id.* at 765.

[14] *See* http://my.clevelandclinic.org/services/pet_scan/hic_petscan.aspx.

detecting the collection of radioactivity in various parts of the brain and analyzing this activity over time in a series of static images.[15] The single photon emission computed tomography (SPECT) scan combines the radioactive element of the PET scan with the x-ray imaging of the CT scan so as to visualize the flow of blood through the veins and arteries of the brain to observe brain function.[16] Like the CT scan, a computer creates cross-sectional images, which may then be assembled into a three-dimensional image of the brain.[17] Essentially, both PET and SPECT scans indicate which parts of the brain are most active during an assigned task.

The fMRI technique developed in the early 1990s as a variation of the widely used magnetic resonance imaging (MRI) technology. MRI scans use a strong magnet and radio waves to yield detailed structural images of the brain.[18] Using a modified conventional MRI scanner,[19] fMRI technology examines brain function in real time by observing two additional physiological phenomena. First, the technician examines blood oxygen levels by detecting the activity of iron atoms in the blood. Iron atoms cause small

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[15] *See* Jones et al., *supra* note 11, ¶ 14.

[16] *See* Greely & Wagner, *supra* note 10, at 765.

[17] *See* Mayfield Clinic, *SPECT (single photon emission computed tomography) Scan*, http://www.mayfieldclinic.com/PE-SPECT.htm.

[18] Baylor College of Medicine, *What is fMRI?*, http://www.bcm.edu/news/packages/trust-fmri.cfm; Greely & Wagner, *supra* note 10, at 768.

[19] The workings of the conventional MRI scanner have been described as follows:

> The magnet causes some of the atoms (or, more precisely, particles inside the atoms, called protons) inside the patient's head to align with the magnetic field. A pulse of radio waves is then directed at the patient's head and some of it is absorbed by the protons, knocking them out of alignment. The protons, however, gradually realign themselves, emitting radio waves as they do. These radio waves are captured by a radio receiver and are sent to a computer, which constructs the brain image.

Id.; *see also* Daniel D. Langleben, Frank M. Dattilio, & Thomas G. Guthrei, *True Lies: Delusions and Lie-Detection Technology*, 34 J. PSYCHIATRY & L. 351, 358-60 (2006) (discussing fMRI in studying truth and deception).

distortions in the magnetic field around them, detectable by the fMRI scanner. If the subject is engaged in a particular mental activity, certain changes may be associated with that activity.[20] Second, fMRI is based on the physiological principle that whenever any part of the brain becomes active,[21] the small blood vessels in that localized region dilate, causing more oxygenated blood to rush in. The analytical process used to detect this physiological function is referred to as blood oxygen level dependent (BOLD) contrast.[22]

fMRI has considerable advantages over PET and SPECT technology for obtaining information about brain function. First, the image generated by fMRI is superior, both spatially and temporally, to the images produced by PET and SPECT scans.[23] fMRI produces more images of "slices" of the brain, and over a period of time, with higher resolution than the earlier technologies.[24] Second, fMRI scans are noninvasive, thus allowing subjects to submit to testing more frequently and for longer periods of time, leading to more complete results.[25]

In principle, fMRI can be used to observe the activation of brain structures in response to almost any kind of brief stimulation, ranging from sounds to visual images to

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[20] Jones et al., *supra* note 11, ¶ 18.

[21] The term "active" refers to the detected oxygen level in a particular region of the brain in response to various stimuli. *See* Michael D. Fox & Marcus E. Raichle, *Spontaneous Fluctuations in Brain Activity Observed with Functional Magnetic Resonance Imaging*, 8 NATURE REVS. NEUROSCIENCE 700, 701 (2007).

[22] Langleben, Dattilio, & Guthrei, *supra* note 19, at 359 ("BOLD fMRI can be used to track the changes in blood flow that correspond to changes in local brain activity and is the premiere tool of research focusing on the brain activity correlates of particular behavior.").

[23] *See* Neal Feigenson, *Brain Imaging and Courtroom Evidence: On the Admissibility and Persuasiveness of fMRI*, 2 INT'L J. L. IN CONTEXT 233, 234 (2006).

[24] Jones et al., *supra* note 11, ¶ 18.

[25] Feigenson, *supra* note 23, at 234 (stating that fMRI is able to "test for people's performances more often and under many more tasks or conditions [than PET or SPECT], thus enhancing the potential reliability and validity of the results").

gentle touching of the skin.[26] The subject is presented with various stimuli or asked to perform a series of decision making tasks. The resulting images provide real-time information on the areas of the brain that are active during the period of stimulation, by comparison to images obtained pre-stimulus and post-stimulus.[27] Translating the results from the artificial conditions of a laboratory setting to situations in the real world relevant to the law is a task that requires accurate correlation, something that neuroscience has not yet fully achieved.[28]

Debate over the uses of fMRI focuses primarily on interpretation of the images. fMRI images are not snapshots; rather, their meaning turns on sophisticated interpretational techniques.[29] The brain images generated by fMRI are an interpreted composite of multiple images in space and time, with the researcher repeating the same test. Currently, results are typically an average, not an absolute.[30] Professor Owen D. Jones and colleagues have characterized fMRI image interpretation succinctly as follows:

> . . . fMRI brain images are built statistically, not recorded photographically. In the typical fMRI case, hundreds of recordings are made of each voxel [i.e. small volume of brain tissue] in the brain, at slightly different times (e.g., every two seconds). Each recording of each voxel within a given trial is analogous to a single frame in a movie. . . . [T]here are subsequently many repeat recordings of

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[26] *Id*.; Greely & Wagner, *supra* note 10, at 768-72.

[27] For an example of the process, see *The Future Role of Functional MRI in Medical Applications*, http://www.fmri.org/fmri/htm (Program for Imaging and Cognitive Sciences (PICS) at Columbia University Medical Center).

[28] Stephen J. Morse, *The Future of Neuroscientific Evidence*, *in* THE FUTURE OF EVIDENCE 137, 142 (Carol Henderson & Jules Epstein, eds. 2011).

[29] Marcus Raichle, *What is an fMRI?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 4, 6 (Law and Neuroscience Project & SAGE Center for the Study of the Mind, eds. 2011).

[30] Jones et al., *supra* note 11, ¶ 30. Other researchers have noted that not all results of fMRI testing are averages. Under some circumstances, data can be retrieved from an individual without the need to average out the group. Martha J. Farah, *An Introduction to Neuroscience and Neuroimaging for Lawyers*, Remarks at the Law and the Brain Conference (Mar. 15, 2011).

> that voxel under similar conditions, on many consecutive trials – the results of which are typically then *averaged* across trials. Complicating matters further is that there are about one hundred thousand voxels within the brain, and what typically matters is how neural activity within those voxels is varying over time, in relation to some task the subject(s) undertake while being scanned.[31]

The fMRI image is then superimposed on a standard MRI structural image of a particular slice of the brain. At each point in the process, the researcher makes a choice from a number of options. Ultimately, as Jones and colleagues state, "[s]canners don't create fMRI brain images; people create fMRI brain images."[32] The interpretation of a particular series of fMRI scans is complex and contextual.[33] Thus, the legal context in which the fMRI images are to be used largely dictates the interpretive process; the images do not have an inherent meaning independent of the interpreting expert and the interpretive context.[34]

Even newer technologies have developed from EEG. On such technology is "brain fingerprinting" testing, developed by Lawrence A. Farwell who holds a trademark on the technology. Through this technology, Farwell claims the ability to ascertain information that has been stored in the brain of a particular person. Deriving from EEG technology, this technique employs multifaceted electroencephalographic response analysis (MERA) to detect information in the brain by measuring a certain brain wave in

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[31] Jones et al., *supra* note 11, ¶ 30 (emphasis added).

[32] *Id*. ¶ 32 (stating that "[m]ultiple choices and multiple steps go into determining exactly what data will be collected, how, and when – as well as into how the data will be analyzed and how it will be presented."); *see also* Colin Klein, *Philosophical Issues in Neuroimaging*, 5 PHILOSOPHY COMPASS 186, 187 (2010) (stating that "neuroimages are laden with theoretical assumptions").

[33] *See* Raichle, *supra* note 29, at 6 (stating that the results of the test are "dependent on the design of behavioral paradigms that approach human behavior in a principled and qualitative manner while accommodating the constraints of the imaging environment").

[34] *See* Jones et al., *supra* note 11, ¶¶ 35-37 (stating that "[n]o fMRI brain image has automatic, self-evident significance").

response to a stimulus.[35] The technology compares brain wave analysis generated by exposure to a particular stimulus under investigation (such as a crime scene) to various baseline measurements. The presence of a "memory and encoding related [MERMER]" indicates that the subject has the information stored in his or her brain. As with fMRI, the resulting data is not meaningful without computer analysis and comparison to the baseline studies.[36] Brain fingerprinting and related technologies have been the subject of much skepticism in the absence of peer-reviewed studies.[37]

B. The Uses of the New Neuroscience

Notwithstanding the limitations of the technology, fMRI has been used in a variety of contexts, legal and otherwise. Although fMRI images are not photographic images in the conventional sense, and require substantial interpretation, they are still considered valuable in demonstrating cognitive processes. The correlation between the brain and behavior is a complex matter that extends beyond neural activity to multiple

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[35] The technique and its nomenclature are the proprietary information of Farwell. More information on the technique and the technology of brain fingerprinting is available on Farwell's web site, http://www.brainwavescience.com/TechnologyOverview.php. *See generally* Martha J. Farah, *Neuroethics: The Practical and the Philosophical*, 9 TRENDS IN COGNITIVE SCIENCES 34, 34-35 & fig.1 (2005) (providing a neuroscientist's overview of the subject), *available at* http://repository.upenn.edu/cgi/viewcontent.cgi?article=1008&content=neuroethics_pubs.

[36] *See* Lawrence A. Farwell & Sharon S. Smith, *Using Brain MERMER Testing to Detect Knowledge Despite Efforts to Conceal*, 46 J. FORENSIC SCIENCES 1, (2001) (describing the technology).

[37] A related technology is known as the Brain Electrical Oscillation Signature (BEOS) test. This test claims to be able to distinguish memory brain patterns associated with witnessing an event and those associated with participating in the event. *See* Anand Giridharadas, *India's Use of Brain Scans in Courts Dismays Critics*, N.Y. TIMES, Sept. 15, 2008, *available at* http://www.nytimes.com/2008/09/15/world/asia/15iht-15brainscan.16148673.html. This technology was developed by an Indian neuroscientist, Champadi Raman Mukundan, and has been admitted into evidence in an Indian court to obtain a conviction. *Id*. Other technologies purporting to achieve similar lie-detection results have been reported, such as Near-Infrared Spectroscopy (NIRS) which uses near-infrared light to detect changes in blood flow in the brain. *See* Henry T. Greely & Judy Illes, *Neuroscience-Based Lie Detection: The Urgent Need for Regulation*, 33 AM. J.L. & MED. 377, 388 (2007) (citing, among other sources, Britton Chance et al., *A Novel Method for Fast Imaging of Brain Function, Non-invasively, with Light*, 2 OPTICS EXPRESS 411, 413 (1998)). In general, "[v]ery substantial scientific questions exist about each system," including lack of peer review and replication. Greely & Wagner, *supra* note 10, at 791 & n.28.

psychological and moral factors. Human decision making is a conglomerate of genetic, physiological, and social factors.[38] The extent to which fMRI images can provide information about the decisions that humans make varies depending upon the circumstances.[39]

Before examining the uses of the new neuroscience in the law, this Section provides a brief overview of some of the types of studies emerging from the new neuroscience. On the most basic level, fMRI provides a substantial additional layer of information in the diagnosis and treatment of organic diseases and conditions, including addiction.[40] This is particularly true where more conventional scans are unable to visualize the nature or extent of a patient's condition, allowing accurate diagnosis and treatment. Although substantial further study is necessary to fully comprehend brain function,[41] the new neuroscience may provide new understandings of certain conditions, thereby setting the stage for policy making and treatment parameters. One such area in which fMRI has been used is understanding mental illness in the psychiatric setting. For example, a study on the decisional capacity of schizophrenics looked at the ability of subjects to give informed consent to research. The investigators concluded that certain brain function abnormalities among schizophrenic patients correlated with deficits in

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[38] Jones et al., *supra* note 11, at ¶ 27. The authors note that virtually all behavior is "biological" in the sense that it "originates in the physical and chemical activities of the brain." *Id.* But biological reality does not necessarily result in behavioral determinism, and each person will have his or her own complex mix of factors that determine behavior. *Id.*

[39] *See* Stephen J. Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO. ST. J. CRIM. L. 397, 404 (2006) (stating that "the causation of virtually any complex behavior is affected by psychological and sociological variables, even when brain causation has been identified").

[40] *See, e.g.*, Murat Yücel & Dan Lubman, *Neurocognitive and Neuroimaging Evidence of Behavioral Dysregulation in Human Drug Addiction: Implications for Diagnosis, Treatment and Prevention*, 26 DRUG & ALCOHOL REV. 33, 34 (2007).

[41] *See* Greely & Wagner, *supra* note 10, at 759.

understanding the consent forms.[42] Such information is valuable to health care providers and care givers – and, indeed, to the community in general.

On the study of addiction, researchers have engaged in using neuroimaging to identify the regions of the brain associated with addiction and addictive behavior. The prefrontal cortex of the brain has been associated with self-control,[43] and research indicates that persons addicted to drugs or alcohol have decreased function in that region.[44] Whether this information should become the basis for legal doctrines – such as excuse from criminal acts – is a matter of significant debate.[45]

Interest is also high in the diagnostic uses of the new neuroscience for the purpose of assessing pain both quantitatively and qualitatively. Although true utility in the courtroom is years away,[46] current research is promising, at least for assessing subjective reports of pain. Recent studies using the PET and fMRI technologies suggest that certain regions of the brain are activated by pain and increase in activity when the intensity of the

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[42] *See* Eyler et al., *supra* note 8, at 141-43. Another study looked at self-focus in diagnosed schizophrenics to examine brain activity when subjects perceived a neutral source, such as a voice on television, to be talking directly to them. *See Scientists Obtain New Functional Imagery of Schizophrenia*, http://medgadget.com/archives/2009/01/scientists_obtain_new_functional_imagery_of_schizophrenia.html.

[43] *See, e.g.*, Adam R. Aron, Trevor W. Robbins, & Russell A. Poldrack, *Inhibition and the Right Inferior Frontal Cortex*, 8 TRENDS IN COGNITIVE SCIENCES 170, 173 (2004).

[44] *See, e.g.*, J. David Jentsch, & Jane R. Taylor, *Impulsivity Resulting from Frontostriatal Dysfunction in Drug Abuse: Implications for the Control of Behavior by Reward-Related Stimuli*, 146 PSYCHOPHARMACOLOGY 373, 381 (1999).

[45] *See* Stephen J. Morse, *Addiction, Genetics and Criminal Responsibility*, 69 L. & CONTEMP. PROBS. 165, 170-73, 178-79 (2006) (discussing the differences between the neuroscientific/medical model of addiction and the criminal law model of responsibility).

[46] *See* Howard Fields, *Can Neuroscience Identify Pain?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 32, 32-33 (Law and Neuroscience Project & SAGE Center for the Study of the Mind, eds. 2011) (noting that while it is theoretically possible to assess an individual's pain through fMRI, technical problems must be resolved before the information can be used in the law); Adam J. Kolber, *Pain Detection and the Privacy of Subjective Experience*, 33 AM. J.L. & MED. 433, 449 (2007).

pain increases.[47] These studies are promising for use in substantiating patients' claims of pain and suggesting how pain impacts quality of life.[48] Such studies could prove important in personal injury actions to support or refute claims of chronic pain.[49] In a related matter, some researchers have begun to focus on connecting brain activity to emotional distress.[50] In the absence of conventional, objective physical symptoms, neuroimaging could identify an observable, physical basis for emotional disturbance.

Another use for fMRI is exploring the bases for the development of child behavior. In particular, researchers have examined the effect of viewing violence on children's behavior. In one study, for example, researchers observed eight children viewing televised violent and nonviolent video sequences, while simultaneously recording brain activity with fMRI.[51] The researchers concluded that viewing violence activates a network of brain regions involved in emotional arousal and processing and in episodic memory encoding and retrieval.[52] The researchers concluded from the data that children have difficulty distinguishing between actual violence and entertainment

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[47] See studies cited in Kolber, *supra* note 46, at 433 n.3.

[48] Professor Kolber has observed: "It is questionable whether neuroimaging can ever, even in principle, give us direct access to the seat of a person's thoughts or experiences. There is little dispute, however, that neuroimaging can, in principle, allow us to make reasonable inferences about the thoughts or experiences of others." *Id*. at 452.

[49] *See generally* Greely & Wagner, *supra* note 10, at 809-10 (noting that the availability of such neuroscience evidence in specific cases could provide more accurate and efficient resolution of pain claims).

[50] *See, e.g.*, Naomi I. Eisenberger, *Identifying the Neural Correlates Underlying Social Pain: Implications for Developmental Processes*, 49 HUMAN DEVELOPMENT 273 (2006) (summarizing the state of the research); *see also* Greely & Wagner, *supra* note 10, at 810 (suggesting that such research could become useful in cases involving emotional distress, but noting that the accuracy of current studies in unknown).

[51] John P. Murray et al., *Children's Brain Activations While Viewing Televised Violence Revealed by fMRI*, 8 MEDIA PSYCHOLOGY 25, 27-28 (2006).

[52] *Id*. at 31.

violence. They developed a theory that children who frequently view television violence are likely to store a large number of aggressive scripts in their long-term memory on which they could draw for their own future behavior.[53]

An emerging use for fMRI is the so-called practice of "neuromarketing." The purpose to which manufacturers and advertisers seek to put this information is similar to consulting a focus group. The test subjects are placed into the fMRI scanner and then shown a variety of products, with the researchers hoping to retrieve information to allow for strategic marketing and advertising campaigns designed to reach the consumers most likely to buy their products. In one study, subjects were shown public service announcements about the importance of sunscreen use. Ultimately the data obtained from the fMRI images, coupled with follow-up questionnaires, indicated that subjects who viewed the announcements were more likely to increase their use of sunscreen in the week following the scan, to a greater degree than the subjects themselves had predicted.[54] While this result may make psychological sense, the new development is in both documenting the neural basis for the behavior and in predicting the behavior to a degree not consciously predicted by the subjects.

In an area of special interest to the law, various studies have emerged, using fMRI technology, that purport to identify the regions in the brain that control a person's ability

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[53] *Id*. at 33.

[54] Mallory Creveling, *Study: Brain Scans Can Predict Your Behavior Better Than You Can*, http://www.aolhealth.com/2010/06/24/study-brain-scans-can-predict-your-behavior-better-than-you-can/; *see also* Maggie Fox, *Now Scientists Read Your Mind Better Than You Can*, http://www.reuters.com/article/2010/06/22/brain-reading-idUSN2214937420100622 (reporting study that fMRI scans predicted consumer choices 75% of the time, while consumers consciously predicted their behavior only 50% of the time); *Neuromarketing: Is fMRI Unveiling Consumer's [sic] Unsconscious Behaviors?*, http://www.imagilys.com/neuromarketing-imagilys-brain-impact/ (noting that research suggests that conscious purchasing behavior may represent only 5% of consumer's purchasing choice process).

to take responsibility for his or her actions. The relevant brain processes involved reasoning and moral judgment. Thus, for example, in one study researchers examined brain activity in subjects presented with opportunities to be rewarded for dishonesty. The researchers identified an area of the pre-frontal cortex in the brain that showed increased activity in the subjects who behaved dishonestly, with higher levels of activity associated with greater frequencies of dishonesty in an individual.[55] Other studies have focused on identifying regions of the brain associated with moral reasoning[56] and even the elusive concept of wisdom.[57]

Studies such as these necessarily invoke centuries-old philosophical debates, and philosophers have both engaged in brain imaging research[58] and commented on the theories of neuroscientists in an effort to reconcile biology with philosophy.[59] Some

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[55] *See* Joshua D. Greene & Joseph M. Paxton, *Patterns of Neural Activity Associated with Honest and Dishonest Moral Decisions*, 106 PROCEEDINGS NAT'L ACAD. SCIENCES USA 12506 (2009) (observing that the subjects who behaved dishonestly showed increased activity in the particular brain region whether they were engaging in or refraining from dishonest behavior), *available at* http://www.pnas.org/content/106/301/12506.pdf+html; *cf. also* Greely & Wagner, *supra* note 10, 801 (stating that "[i]t seems highly unlikely that a 'responsibility region' will ever be found" in the human brain, but recognizing that research on this subject is in its early stages); Joshua D. Greene, *The Cognitive Neuroscience of Moral Judgment*, *in* THE COGNITIVE NEUROSCIENCES 987, 987, 995 (Michael S. Gazzaniga ed., 4th ed. 2009) (providing a progress report on attempts to understand how the human brain makes moral judgments and stating that "moral judgment emerges from a complex interaction among multiple neural systems whose functions are typically not (and might not ever be) specific to moral judgment").

[56] *See, e.g.*, Adrian Rain & Yaling Yang, *Neural Foundations to Moral Reasoning and Antisocial Behavior*, 1 SOC. COGNITIVE & AFFECTIVE NEUROSCI. 203 (2006).

[57] *See, e.g.*, Thomas W. Weeks & Dilip V. Jeste, *Neurobiology of Wisdom*, 66 ARCHIVES GEN. PSYCHIATRY 355 (2009).

[58] *See, e.g.*, Joshua D. Greene et al., *The Neural Bases of Cognitive Conflict and Control in Moral Judgment*, 44 NEURON 389 (2004) (reporting fMRI study tending to provide neuroscientific support for the philosophical tension between the utilitarians (acting to promote the greater good) and the deontologists (recognizing certain absolute rights or duties that trump the greater good)).

[59] *See* Adina Roskies, *Neuroscientific Challenges to Free Will and Responsibility*, 10 TRENDS IN COGNITIVE SCI. 419 (2006) (discussing questions of free will and moral judgments, and whether these philosophical and religious concepts will be undermined by the new neuroscience).

commentators have had strong negative reactions to the notion that such studies could replace traditional understandings of the "mind" with mere brain activity.[60] Studies in this area of cognitive neuroscience have yielded important and tantalizing information about the role that brain imaging may play in numerous issues in the law that involve moral reasoning and normative judgments.[61]

C. Inroads Into the Law

In light of the proliferation of neuroscientific studies on so many aspects of human brain function relating to competency and moral judgment, it is unsurprising that some studies have first made their way into the courtroom in a variety of criminal cases. Criminal defendants have sought to use these studies at all phases of criminal adjudication – pre-trial, guilt, sentencing, and post-conviction.[62] Deferring the considerable problems of evidentiary admissibility to a later section of this Article,[63] a

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[60] *See, e.g.*, Steven K. Erickson, *Blaming the Brain*, 11 MINN. J.L. SCI. & TECH. 27, 32 (2010) (observing "that there appears to be no limit to explaining all aspects of humanity under the neuro-person model," but stating that "[b]ehavior and brains influence each other; brains are dynamic and constantly in flux; and behavior is the outcome of a range of responses to stimuli"); Michael S. Pardo & Dennis Patterson, *Philosophical Foundations of Law and Neuroscience*, 2010 ILL. L. REV. 1211, 1220 ("As we see it, many of the proponents of an increased role for neuroscience in law rest their case on a controversial and ultimately untenable account of the nature of mind.").

[61] For the purpose of this Article, we adopt the general definition of "normative judgment" put forth by Oliver R. Goodenough and Kristin Prehn – "an inclusive description of the many flavours humans find among those things that ought to be done and those that ought not to be done." Oliver R. Goodenough & Kristin Prehn, *A Neuroscientific Approach to Normative Judgment in Law and Justice*, 359 PHIL. TRANS. R. SOC'Y LOND. B 1709, 1710 (2005).

[62] *See* Scott T. Grafton, *Has Neuroscience Already Appeared in the Courtroom?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 54, 55 (Law and Neuroscience Project & SAGE Center for the Study of the Mind, eds. 2011). Grafton refers to the introduction of mitigating evidence in capital cases as the "front line" for testing the new neuroscience in the courtroom because of the courts' willingness to admit more evidence for that purpose. *See id*. Some criminal defendants have argued ineffective assistance of counsel because their attorneys did not seek court-ordered functional neuroimaging to support the diagnostic testimony of their experts. This argument has generally been unsuccessful. *See, e.g.*, Ferrell v. State, 918 So. 2d 163, 175-76 (Fla. 2005) (determining that failure to obtain a SPECT scan was not deficient performance).

[63] *See infra* notes 211-33 and accompanying text.

few brief examples serve to provide a glimpse into the efforts of attorneys to apply the new neuroscience in criminal cases. Thus, for example, in *United States v. Hammer*,[64] the court allowed neuroscientific data obtained from brain scans (MRI, PET) to be considered in the guilt phase of a criminal proceeding on the issue of the defendant's incompetence.[65] The court ruled, however, that the expert's conclusion that the defendant was incompetent was not credible.[66] On a similar issue, in *State v. Marshall*,[67] the Washington Supreme Court vacated a guilty plea on the ground that the trial court erred in failing to conduct a competency hearing.[68] The court ruled that ample evidence – including MRI brain scans – existed to call the defendant's competency into question.[69] In *Harrington v. State*,[70] an Iowa trial court admitted evidence derived from the brain fingerprinting technique.[71] The scientist who had developed the technique conducted the testing and concluded that "Harrington's brain did not contain information about [the] murder. On the other hand, he testified, testing did confirm that Harrington's brain contained information consistent with his alibi."[72] Ultimately, the Iowa Supreme Court

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[64] 404 F. Supp. 2d 676 (M.D. Pa. 2005).

[65] *Id*. at 723. The defendant pleaded guilty for the murder of his prison cellmate, and the jury recommended a death sentence. Eventually, the court appointed new counsel for him, who argued that the defendant had been incompetent at the time of the initial plea. *Id*. at 691.

[66] *Id*. at 792-93.

[67] 27 P.3d 192 (Wash. 2001).

[68] *Id*. at 200. The trial court had denied the defendant's motion to withdraw his guilty plea to aggravated first-degree murder on incompetency grounds and had sentenced the defendant to death. *Id*. at 193.

[69] *Id*. at 199.

[70] 659 N.W.2d 509 (Iowa 2003).

[71] *See supra* notes 35-37 and accompanying text.

[72] *Harrington*, 659 N.W.2d at 516 n.6.

granted post-conviction relief to the defendant on the basis of newly discovered evidence. But because the Iowa Supreme Court based its ruling fully on other legal issues raised, it did not rule on the admissibility of the scientific evidence, nor discuss its validity or relevance.[73]

Neuroscientific evidence also formed a basis for a high-profile criminal case involving the sentencing of juvenile offenders. In *Roper v. Simmons,*[74] the United States Supreme Court ruled that the Eighth and Fourteenth Amendments to the United States Constitution prohibit the death penalty for a person under the age of eighteen at the time of the capital crime for which he or she was convicted.[75] The Court referenced with approval the science of adolescent brain development cited by amici. The amicus brief of the American Medical Association, the American Psychiatric Association, and other professional organizations submitted in support of the respondent-defendant discussed structural and functional brain studies on adolescents.[76] Citing fMRI studies, among others, the amicus brief stated: "To a degree never before understood, scientists can now demonstrate that adolescents are immature not only to the observer's naked eye, but in the very fibers of their brains."[77] The conclusion drawn, and accepted by the Court,[78]

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[73] *Id*. at 516. *Cf*. Slaughter v. State, 108 P.3d 1052 (Okla. Crim. App. 2005) (rejecting "brain fingerprinting" evidence in a post-conviction proceeding).

[74] 543 U.S. 551 (2005).

[75] *Id*. at 578.

[76] Brief of Amici Curiae American Medical Association, American Psychiatric Association, American Society for Adolescent Psychiatry, American Academy of Child & Adolescent Psychiatry, American Academy of Psychiatry and the Law, National Association of Social Workers, Missouri Chapter of the National Association of Social Workers, & National Mental Health Association in Support of Respondent, Roper v. Simmons, 543 U.S. 551 (2005) (No. 03-633) [hereinafter AMA Brief].

[77] *Id.* at 10.

[78] *Roper*, 543 U.S. at 568.

was that the adolescent brain was insufficiently developed to support functions such as long-term planning, impulse control, and risk assessment.[79] The Court used the information to make a judgment about juvenile capacity *generally*, not about the defendant's mens rea in the individual case.

The new neuroscience has also featured in some cases in the non-criminal context. In June, 2011, the United States Supreme Court decided *Brown v. Entertainment Merchants Association*,[80] in which the Court perfunctorily rejected evidence on the relationship between violent video games and violent behavior and held that California's law limiting the sale of violent video games to children violated the First Amendment to the United States Constitution.[81] Among the findings of the legislature in enacting the statute was a declaration that "[e]xposing minors to depictions of violence in video games . . . makes those minors more likely to experience feelings of aggression, to experience a reduction of activity in the frontal lobes of the brain, and to exhibit violent antisocial or aggressive behavior."[82] In *Entertainment Merchants*, the Supreme Court acknowledged the state's reliance on the studies to support the law in question, but gave the studies no credence because they demonstrated a correlation rather than a causal connection.[83] In

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[79] AMA Brief, *supra* note 76, at 12 ("Research shows that adolescent brains are more active in regions related to aggression, anger, and fear, and less active in regions related to impulse control, risk assessment, and moral reasoning than adult brains.").

[80] 131 S. Ct. 2729 (2011).

[81] *Id*. at 2738.

[82] 2005 Cal. Legis. Serv. 638(1)(a) (West).

[83] *Brown*, 131 S. Ct. at 2739; *see also* Entertainment Software Ass'n v. Blagojevich, 404 F. Supp. 2d 1051, 1074 (N.D. Ill. 2005) ("At most, researchers have been able to show a correlation between playing violent video games and a slightly increased level of aggressive thoughts and behavior. . . . [I]t is impossible to know which way the causal relationship runs: it may be that aggressive children may also be

his dissent, Justice Breyer cited many studies, including functional neuroimaging studies, demonstrating a relationship between violent video games and violent behavior. For example, he stated that "[c]utting-edge neuroscience has shown that 'virtual violence in video game playing results in those neural patterns that are considered characteristic for aggressive cognition and behavior.'"[84] Justice Breyer conducted research on the subject and gave extensive consideration to the existing peer reviewed studies, which he listed in two appendices to his dissent, concluding that substantial support existed for the Court of Appeals' decision that the statute did not offend the First Amendment.[85]

Entertainment Merchants is significant because the Supreme Court, once again, has addressed neuroscientific evidence. Although Justice Scalia, writing for the majority, suggested without reaching the issue that the evidence connecting violent video games to violent behavior in children would not pass the federal admissibility test, Justice Breyer clearly concluded otherwise, embracing the studies and finding them relevant to the issues in the case. The case also demonstrates that legislatures are considering neuroscientific evidence in enacting public health legislation. *Entertainment Merchants* makes a powerful statement that the new neuroscience is appearing in all aspects of the law and has already made its way to the highest Court in some high-profile cases.

This brief survey is far from exhaustive, and it is fair to say that neuroscience researchers have addressed – or soon will – most areas of human behavior that touch

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attracted to violent video games.") In *Entertainment Merchants*, Justice Scalia also said that the studies "have been rejected by every court to consider them." *Id*. (citing six cases).

[84] *Brown*, 131 S. Ct. at 2768 (citing Weber, Ritterfeld, & Mathiak, *Does Playing Violent Video Games Induce Aggression?: Empirical Evidence of a Functional Magnetic Resonance Imaging Study*, 8 MEDIA PSYCHOL. 39, 51 (2006)) (Breyer, J., dissenting).

[85] *Id*. at 2771-79 (Breyer, J., dissenting).

upon the law. For example, the new neuroscience will impact such areas of the law as health information privacy[86] and employment discrimination.[87] The next sections of this Article focus attention exclusively on the doctrines of tort law and propose a model for looking at tort doctrine in the light of the new neuroscience.

II. THINKING ABOUT TORT LAW IN NEUROSCIENTIFIC WAYS

A. The New Neuroscience and Tort Law

The law in general, and tort law in particular, employs concepts of what has been referred to as "folk psychology" to explain and categorize human behavior. This model "explains behavior in terms of desires, beliefs, and intentions."[88] Neuroscience is making inroads into explaining human behavior according to a different model. To what extent will that new way of understanding human behavior transform the model of tort law away from the folk psychology model? In this Part, we explore the existing and long-standing common-law tort rules and suggest that neuroscience could provide a new way of understanding human behavior in tort law.

A person's choice to act and the selection of the specific action to undertake under a certain set of circumstances are functions of more complicated processes than the law originally contemplated. One observer has commented that fMRI technology has "the

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[86] *See* Stacey A. Tovino, *Functional Neuroimaging and the Law: Trends and Directions for Future Scholarship*, 7 AM. J. BIOETHICS 44, 47 (2007) (discussing the HIPAA privacy rule and stating that commentators "almost uniformly agree that the ability of functional neuroimaging to reveal the neural correlates of conditions, behaviors, preferences, and characteristics, some or all of which individuals may prefer to keep secret, 'threatens to invade a last inviolate area of "self"'").

[87] *See id*. at 48-49 (discussing the Americans with Disabilities Act (ADA) and the problems associated with employers seeking access to fMRI information on individual employees).

[88] Stephen J. Morse, *Determinism and the Death of Folk Psychology: Two Challenges to Responsibility from Neuroscience*, 9 MINN. J.L. SCI. & TECH. 1, 2-3 (2008).

potential to discriminate between the cognitive processes that individuals appear to use when engaging in various tasks . . . such as deciding to pursue one course of action versus another."[89] The law of torts categorizes human decisions to determine when those decisions require accountability to persons injured by them.

Tort law is primarily retrospective, examining the parties' past behavior and deciding whether and to what extent the defendant should be held liable for injuries caused by that behavior. In this respect it has much in common with criminal law. And just as criminal law has an important deterrent purpose, tort law has an analogous prospective purpose.[90] Tort judgments cannot force people to act in a responsible and reasonable manner, but they can economically (and perhaps morally) encourage good behavior. The economic goals of tort law extend further: The threat of tort judgments encourages enterprises and individuals to minimize transaction costs, thereby realizing economic benefits from their good behavior. In turn, tort doctrine seeks to encourage an assessment of risks prior to action.[91]

The mental states required for tort law have labels that sound similar to those used in criminal law. But in both definition and operation, tort law has its own set of rules. American criminal law has two fundamental underlying requirements – a voluntary act

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[89] Sabrina J. Pagano, *Social Cognitive Neuroscience: The Neuroscience of Intent*, *in* FROM THE MIND TO THE FEET: ASSESSING THE PERCEPTION-TO-INTENT-TO-ACTION DYNAMIC 68, 69 (Larry Kuznar, Allison Astorino-Courtois, & Sarah Canna eds. July 2009) (inter-agency white paper produced by the Strategic Multi-Layer Assessment (SMA)), *available at* http://aupress.au.af.mil/digital/pdf/book/From_The_Mind_To_The_Feet_Kuznar.pdf.

[90] A major purpose of criminal law is punishment, which is largely absent from tort law, except insofar as punitive damages may be warranted. For a discussion of the purposes of punitive damages, see Jean Macchiaroli Eggen, *Punitive Damages and the Public Health Agenda*, *in* RECONSIDERING LAW AND POLICY DEBATES: A PUBLIC HEALTH PERSPECTIVE 221 (John G. Culhane, ed. 2010).

[91] The best known example of tort doctrine's cost-benefit analysis was *United States v. Carroll Towing*, 159 F.2d 169, 173 (2d Cir. 1947), in which Judge Learned Hand set forth his famous balancing test as a formula, B<PL.

and mens rea, commonly known as "guilty mind."[92] Although the presence of criminal mens rea in a defendant will often support a tort claim – such as battery or conversion – torts have no identical requirement of a guilty mind. Most torts, however, do include a mental state element, but there is no real requirement that the defendant know or have reason to know that his or her actions were wrong. With the possible exception of strict or absolute liability,[93] tort law relies on certain mental decision processes undertaken by the defendant before liability may be imposed.

The distinction between tort law and criminal law may have legal ramifications, as one illustration demonstrates. *Polmatier v. Russ*[94] was a tort action for the intentional torts of battery and assault resulting in the death of the defendant's father-in-law. In a prior criminal proceeding arising out of the same incident, the defendant had been found not guilty by reason of insanity for killing his father-in-law. He had offered various irrational reasons for the attack and had been diagnosed as paranoid schizophrenic.[95] In the civil wrongful death lawsuit, by contrast, the court held that his irrational thoughts were irrelevant to whether he had the requisite intent to commit battery. The court

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[92] 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, 1128 (2010).

[93] The so-called strict liability torts usually do not impose liability either strictly or absolutely. Strict product liability has migrated away from that concept to a concept close to negligence principles, at least for design defect and failure to warn claims. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2 (1998) (providing discrete liability tests for the three types of product defects). In the *Third Restatement*, only claims based upon manufacturing defects impose strict liability. Negligence principles also apply to claims based upon strict liability for abnormally dangerous activities. *See* RESTATEMENT (THIRD) OF TORTS: PHYSICAL AND EMOTIONAL HARM § 20(b)(1) & cmt. h (2010) (referring to foreseeability of harm and stating that reasonable care is relevant in determining whether an activity is abnormally dangerous). Vicarious liability, such as that imposed under doctrines of respondeat superior, remains true to the concept of strict liability; but the underlying basis of liability must be tortious conduct of the employee within the scope of employment. *See, e.g.*, Mary M. v. City of Los Angeles, 814 P.2d 1341, 1344 (Cal. 1991).

[94] 537 A.2d 468 (Conn. 1988).

[95] *Id*. at 469.

followed the general rule that in intentional torts, the defendant must have had the capacity to form the requisite intent for the tort in question, regardless of the person's mental illness or mental limitation generally.[96] Because the defendant had intended to make a harmful contact with the person of his father-in-law, and in fact had intended to kill him, he could be held liable regardless of the irrationality of his motives and regardless of whether he knew the conduct was wrong.[97]

Several questions emerge from this simple example. First, is the new neuroscience capable of determining a person's intent to commit battery in a situation such as the *Polmatier* case?[98] One writer has stated that the major advantage of using neuroimaging in evaluating legal or other forms of social responsibility is in "making it possible to directly inspect people's brains and to bypass the filter of their own and of other people's agendas."[99] Is the new neuroscience capable of fulfilling this promise? Can it live up to this level of hype? Second, will functional neuroimaging replace more

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[96] For example, the Second Restatement states the following in discussing assault: "To make the actor liable for an assault . . . it is not necessary that the actor be inspired by personal hostility or desire to offend." RESTATEMENT (SECOND) OF TORTS § 34 (1965).

[97] The court stated:

> [I]t is not necessary for a defendant's reasons and motives for forming his intention to be rational in order for him to have the intent to invade the interests of another. Considering his statements . . . that he intended to punish Polmatier and to kill him, we are persuaded that the defendant intended to beat and shoot him.

537 A.2d at 473. The *Polmatier* case reflects a long-standing majority rule in the law of intentional torts. The Supreme Court of Connecticut bolstered its decision with a discussion of several perennial policy interests. First, the court noted the tort system's goal of loss-shifting and its correlate, corrective justice – that all things being the same and all parties being innocent, the loss should be borne by the person who caused it. *Id*. at 471 (citing Seals v. Snow, 254 P. 348 (Kan. 1927)). Second, the court pointed to the more specific policy of encouraging family members of a mentally challenged person to take an interest in preventing the person from causing injury to others. *Id.* (citing McIntyre v. Sholty, 13 N.E. 239 (Ill. 1887) (stating that "[t]here is more injustice in denying to the injured party the recovery of damages for the wrong suffered by him")).

[98] An analogous question is whether the new neuroscience is capable of demonstrating whether a person had the mens rea to commit the crime(s). This is a purely criminal law question and is beyond the scope of this Article.

[99] Nicole A. Vincent, *Neuroimaging and Responsibility Assessments*, 4 NEUROETHICS 35, 38 (2011).

conventional types of evidence in determining whether the requisite mental state for a tort has been met? Third, if individualized proof is not possible, feasible, or allowable, at least at the present time, will neuroscience nevertheless be useful in illuminating the broader, more generalized standards of tort law? And what can we anticipate for its future use in tort law?

Commentators have warned that the new neuroscience has effectively separated "people" from their brains in a way that may eliminate the blameworthiness of certain conduct by showing that it was predetermined by a series of neurological events.[100] While this is primarily a criminal law question, which focuses on whether the defendant had the mens rea to commit a particular crime, it raises a similar question for other areas of the law. If, as the argument goes, the defendant was predetermined to act in a certain way because of the neuronal activity in his or her brain, what impact might that have on the operation of tort law if the concept of "choice" is eliminated or greatly diminished in human behavior?

B. Fault and Mental States in Tort Law

With notable exceptions, tort law is fault based.[101] Since the 1850 Massachusetts Supreme Court case of *Brown v. Kendall*,[102] the fault basis of tort law has been a pervasive concept.[103] Around the same time, the bifurcation of tort fault between intentional and negligent conduct began to crystallize, with different mental state

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[100] Erickson, *supra* note 60, at 28 (stating that much of contemporary neuroscience suggests that "[m]inds and brains are . . . synonymous – thoughts, desires, and behaviors are regarded as no more than the yield of fixed neuronal tissue").

[101] DAN B. DOBBS, THE LAW OF TORTS § 1, at 2 (2000).

[102] 60 Mass. 292 (Mass. 1850) (rejecting strict liability as the basis of tort law).

[103] DOBBS, *supra* note 101, § 112, at 266 (citing O.W. HOLMES, THE COMMON LAW 77 (1881)).

requirements for each. Tort law has been primarily a function of the common law, with concepts of fault evolving through the application of tort doctrine to the many circumstances presented in the case law of each jurisdiction. In neither intentional torts nor negligence is motive generally a required element. Rather, other mental processes are factors in establishing the existence of a tort.[104]

Furthermore, the law generally requires that actors exercise some measure of control over their actions. This concept is sometimes referred to as responsibility, but in tort law it often translates into the concept of reasonable care. As neuroscience techniques and studies progress, identifying the control factor may eventually become possible, and this information could find its way into individual tort cases.[105]

The new neuroscience raises the intriguing possibility that neuroimaging may create a window, literally and figuratively, into the neurological basis of human behavior. Accordingly, we begin this Section with a brief survey of mental states in intentional torts. Our purpose is to demonstrate that mental states – and various cognitive processes – permeate the elements of intentional torts and that tort law would welcome new ways to determine precisely what a defendant or plaintiff was thinking. We then identify ways in which mental state infuses the law of negligence. We focus on the important distinction between the individual mental states of intentional torts and the reasonable person standard of negligence law. This overview is critical to understanding the role that the

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[104] *See generally id.* § 25, at 49-50 (discussing the difference between intentional conduct and acting with a bad motive).

[105] *See* Patricia Smith Churchland, *Moral Decision-Making and the Brain, in* NEUROETHICS: DEFINING THE ISSUES IN THEORY, PRACTICE, AND POLICY 3, 10-11 (Judy Illes ed. 2006) (stating that the current state of neuroscience "suggests that eventually we will be able understand [sic], at least in general terms, the neurobiological profile of a brain that is in control, and how it differs from a brain that is not in control ").

new neuroscience may eventually play in the evolution of tort law and forms an important basis of our model.

1. Intentional Torts

One of the first definitions learned by students of tort law is the meaning of intent. The most recent version of the *Restatement of Torts* provides that "[a] person acts with the intent to produce a consequence if: (a) the person acts with the purpose of producing that consequence; or (b) the person acts knowing that the consequence is substantially certain to result."[106] Thus, in a claim for battery, which is generally defined as intentionally causing a harmful or offensive contact,[107] the plaintiff must prove that the defendant desired to cause the harmful or offensive contact and that such contact did occur, or that the defendant believed that the harmful or offensive contact was substantially certain to occur.[108] Moreover, if this requirement is met, "it is immaterial that the actor is not inspired by any personal hostility to the other, or the desire to injure him."[109] The focus of the intent is the consequence that results, not the act itself.[110] This meaning of intent is consistent throughout the intentional torts.[111]

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[106] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 1 (2010).

[107] RESTATEMENT (SECOND) OF TORTS § 13(a) (1965).

[108] *Id.* § 8A.

[109] *Id.* § 13 cmt. c.

[110] *Id.* § 8A cmt. a ("'Intent,' as it is used throughout the Restatement of Torts, has reference to the consequences of an act rather than the act itself."). Thus, in trespass to land, for example, the defendant need only intend to enter the land of another. "Intent" is defined to mean acting with the purpose of entering the land or knowing with substantial certainty that entry onto the land would occur. *See* Malouf v. Dallas Athletic Country Club, 837 S.W.2d 674, 676 (Tex. App. Ct. 1992). The defendant need not have meant to deprive the plaintiff of a possessory interest in the property or to damage the property; and it is irrelevant to liability that the defendant may have caused no harm to the land. RESTATEMENT (SECOND) OF TORTS § 163 (1965) ("One who intentionally enters land in the possession of another is subject to liability to the possessor for a trespass, although his presence on the land causes no harm to the land . . . ."). Other property-related intentional torts define intent in the same way. Thus, for trespass to chattels, intent is satisfied "when an act is done for the purpose of using or otherwise intermeddling with a chattel or with

What goes into determining whether the defendant has "intended" a particular action, either through conscious purpose or knowledge to a substantial certainty? As Dobbs has observed, intent is both specific and subjective – "specific" in the sense that the defendant must have a specific aim, and "subjective" in the sense that it is only what the particular defendant intended or knew that is relevant, not what others would do under similar circumstances.[112] Accordingly, the evidence that supports a showing of intent must be directed toward the mental state of the specific defendant[113] at the time of

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knowledge that such an intermeddling will, to a substantial certainty, result from the act." *Id*. § 217, cmt. c. Intent to enter is sufficient to provide a basis for liability if the other elements of the tort are met. Similarly, for the personal intentional tort of false imprisonment, the defendant must intend – consistent with the same definition – to confine the plaintiff within a defined space for a measurable period of time.[110] The defendant need not intend that the plaintiff suffer distress or be injured or miss an important appointment. The defendant's motive is once again irrelevant. *See* RESTATEMENT (SECOND) OF TORTS § 35(1) cmt. d (1965) (stating that the requisite intent is met "if [the defendant's] act was done for the purpose of imposing confinement upon the other or with knowledge that such confinement would, to a substantial certainty, result from it.").

[111] Intentional infliction of emotional distress (IIED), a tort that evolved after the traditional intentional torts, requires intent to cause severe emotional distress in the plaintiff through acting in an extreme and outrageous manner or acting with reckless disregard of whether the plaintiff will suffer severe emotional distress. *See* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 46 & cmts. b & i (Tentative Draft No. 5, 2007). Although the *Third Restatement* refers to the IIED intent requirement as "more expansive" than the intent requirement in the traditional intentional torts, that is explained by the other requirements (i.e. outrageous conduct) and by the addition of the recklessness option. *See id*. cmt. g. The definition of intent remains the same as for other intentional torts: "An actor intends severe emotional disturbance when the actor acts with the purpose of causing severe emotional disturbance or acts knowing that severe emotional disturbance is substantially certain to result." *Id*.

Fraud is another intent-based tort which uses a variation of the traditional definition of intent. Fraudulent intent, generally characterized as "scienter," is defined as "referring solely to the maker's knowledge of the untrue character of his representation." RESTATEMENT (SECOND) OF TORTS § 526 (1977). Section 526 provides:

> A misrepresentation is fraudulent if the maker
> (a) knows or believes that the matter is not as he represents it to be,
> (b) does not have the confidence in the accuracy of his representation that he states or implies, or
> (c) knows that he does not have the basis for his representation that he states or implies.

Id. *See generally* Derry v. Peek, 14 App. Cas. 337 (H.L. 1889) (seminal English case articulating the meaning of fraudulent intent). Thus, the tort is supportable, at a minimum, by the defendant's knowledge that there is no basis for the representation.

[112] DOBBS, *supra* note 101, § 25, at 49.

[113] This is true even when the concept of extended liability or transferred intent is invoked. These doctrines hold that a defendant may be held liable for unintended consequences of an intentional act under certain circumstances. *See, e.g.*, RESTATEMENT (SECOND) OF TORTS § 16(a) (1965). This section provides:

the tort. Intent may therefore be characterized as subjective, individualistic, and historical.

Some characteristics of the defendant, such as legal incapacity, infancy, and mental incapacity, while not constituting absolute privileges, have received special consideration in determining the ability to formulate intent. As noted in the previous discussion of *Polmatier v. Russ*,[114] the general rule is that if a person is capable of forming the requisite intent for the particular tort, he or she may be held liable, notwithstanding the existence of a legal incapacity or a diagnosed mental condition. Thus, in the well-known case of *Garratt v. Dailey*, in which a five-year-old child was alleged to have committed battery for pulling a lawn chair from under the plaintiff, who was in the process of sitting down, the court stated:

> [T]he law of battery as we have discussed it is the law applicable to adults, and no significance has been attached to the fact that [the defendant] was a child less than six years of age when the alleged battery occurred. The only circumstance where [his] age is of any consequence is in determining what he knew, and there his experience, capacity, and understanding are of course material.[115]

> (1) If an act is done with the intention of inflicting upon another an offensive but not a harmful bodily contact, or of putting another in apprehension of either a harmful or offensive bodily contact, and such act causes a bodily contact to the other, the actor is liable to the other for a battery although the act was not done with the intention of bringing about the resulting bodily harm.

Id. Likewise, if the defendant intended a harmful or offensive contact toward one person, but caused such contact to another person, the defendant may be found liable to the injured person. *See* Hall v. McBryde, 919 P.2d 910, 914 (Colo. App. Ct. 1996); RESTATEMENT (SECOND) OF TORTS § 16(b) (1965). In both instances, proof of intent is required for the underlying tort. It is the extent of harm that need not be intentional.

[114] *See supra* notes 94-97 and accompanying text.

[115] 279 P.2d 1091, 1094 (Wash. 1955).

In other words, if he was unable to formulate the requisite intent for battery, the plaintiff would not be able to establish a prima facie case.[116] A similar rule applies to defendants with a mental incapacity, such as intoxication, Alzheimer's and other cognitive brain disorders, or diagnosed insanity. Thus, "it is not necessary for a defendant's reasons and motives for forming his intention to be rational in order for him to have the intent to invade the interests of another."[117] Nor is it necessary for a child to have the maturity of an adult to be able to formulate the requisite intent.

2. The Consent Privilege

In the traditional intentional torts to persons and property, mental state is also an important aspect of the privilege of consent. The plaintiff need not have consented to the harm – physical or mental – that he or she suffered for consent to bar the claim.[118] Consent to the act suffices to bar the claim. Consent necessarily incorporates notions of capacity. The *Second Restatement of Torts* provides: "To be effective, consent must be . . . by one who has the capacity to consent or by a person empowered to consent for him."[119] A comment qualifies this statement:

> If the person consenting is a child or one of deficient mental capacity, the consent may still be effective if he is capable of appreciating the nature, extent and probable consequences of the conduct consented to, although the consent of a parent, guardian or other person responsible is not obtained or is expressly refused. If, however, the one who consents is not capable of appreciating the nature, extent or probable consequences of the conduct, the consent is not effective to bar liability . . . .[120]

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[116] In *Garratt*, the record before the appellate court was lacking in sufficient information about the circumstances surrounding the incident, and the court remanded the case. *Id*. at 1095.

[117] Polmatier v. Russ, 537 A.2d 468, 473 (Conn. 1988).

[118] DOBBS, *supra* note 101, § 95, at 217-18.

[119] RESTATEMENT (SECOND) OF TORTS § 892A (1965).

[120] *Id*. cmt. b.

This rule mirrors the rules of intent: A plaintiff who is mentally challenged or a child may consent to a tort if he or she was capable of appreciating the "nature, extent and probable consequences" of the other person's conduct.[121] If not, the consent of the incapacitated plaintiff will not be deemed to be valid consent, and the defendant will not be allowed to rely on the privilege.

In addition, for the plaintiff's incapacity to bar his or her consent, the defendant must have known, or had reason to know, of the incapacity. If the defendant has no knowledge of the underlying incapacity, and the plaintiff gives the reasonable appearance of consent, the defendant may raise the privilege to avoid liability.[122] This rule injects yet another mental requirement into the mix – that of the defendant's knowledge of the plaintiff's incapacity. Consistent with the other rules of intentional tort law, this knowledge may be actual or constructive.[123]

As this Section has demonstrated, the mental processes underlying intentional torts and the privilege of consent focus on specific mental states at a particular point in the past. These factors are significant when thinking about the law of intentional torts in terms of neuroscience. If the law is interested in using functional neuroimaging evidence to demonstrate intent, knowledge, or consent, the neuroimaging evidence needs to provide a reliable insight into the particular person's subjective mental state at that historical point in time. As Part Four will explain, the new neuroscience has not yet arrived at the point where this is fully possible. Understanding the extent to which

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[121] *See supra* notes 115-17 and accompanying text.

[122] *See, e.g*. Reavis v. Slominski, 551 N.W.2d 528, 538 (Neb. 1996).

[123] *Id*. at 539-40.

neuroimaging evidence may illuminate intent and consent at the present time, and the limitations of neuroimaging evidence for these purposes is important to judges and lawyers as neuroscience makes its way into the courtroom. Our model takes this into account.

3. Negligence: The Reasonable Person

In a very different way, mental states feature in the law of negligence. In one sense, negligence differs from intentional torts because negligence is based on the risk-creating conduct of the parties.[124] In contrast to intentional torts, which focus on subjective and individualized intent and/or knowledge relating to the actor's conduct, the mental state that underlies negligence law is, at least theoretically, objective.[125] The actor in negligence law is always the reasonably prudent person[126] who is judged by that standard,[127] not by what he or she subjectively knew or intended.[128] Liability in negligence law does not depend upon the actor intending a particular consequence – such as offensive contact in battery – or even knowing that the consequence is substantially

[124] *See* DOBBS, *supra* note 101, § 116, at 275 ("A bad state of mind is neither necessary nor sufficient to show negligence, and conduct is everything.").

[125] Dobbs gives a section of his treatise the title "The Objective Reasonable Person Standard." *Id*. § 117, at 277; *see also* W. PAGE KEETON ET AL., PROSSER AND KEETON ON THE LAW OF TORTS § 32, at 173-74 (5th ed. 1984) ("The standard of conduct which the community demands must be an external and objective one, rather than the individual judgment, good or bad, of the particular actor").

[126] KEETON ET AL., *supra* note 125, § 32, at 173 ("The whole theory of negligence presupposes some uniform standard of behavior.").

[127] *See* OLIVER WENDELL HOLMES, THE COMMON LAW 108 (1881).

[128] *See* DOBBS, *supra* note 101, § 116, at 275 ("The legal concept of negligence as unduly risky conduct distinct from state of mind reflects the law's strong commitment to an objective standard of behavior.").

certain to occur. The riskiness of the activity, judged by what a reasonable person would do under the same or similar circumstances, is the foundation for liability.[129]

Who is the "reasonable person?" Holmes referred to the reasonable person standard as a "featureless generality."[130] Prosser and Keeton have called it "something in the nature of a formula," while recognizing that its application depends on the individual circumstances of the case.[131] And Dobbs has noted that "the reasonable and prudent person standard, though beautifully general in its formulation, is painfully imprecise as a guide for particular cases."[132] Notwithstanding its many flaws as the basis for the law of negligence, the reasonable person is generally viewed as an idealized person acting under a variety of circumstances.[133] Holmes explained the reasonable person as follows:

> The standards of the law are standards of general application. The law takes no account of the infinite varieties of temperament, intellect, and education which make the internal character of a given act so different in different men. . . . [W]hen men live in society, a certain average of conduct, a sacrifice of individual peculiarities going beyond a certain point, is necessary to the general welfare.[134]

The *Second Restatement of Torts* characterized the reasonable person as "a person exercising those qualities of attention, knowledge, intelligence, and judgment which

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[129] Brown v. Kendall, 60 Mass. (6 Cush.) 292, 296 (1850) (stating that "the plaintiff must come prepared with evidence to show either that the *intention* was unlawful, or that the defendant was *in fault*; for if the injury was unavoidable, and the conduct of the defendant was free from blame, he will not be liable"); DOBBS, *supra* note 101, § 26, at 50.

[130] HOLMES, *supra* note 127, at 111.

[131] KEETON ET AL., *supra* note 125, § 32, at 173.

[132] DOBBS, *supra* note 101, § 113, at 266.

[133] *See id.* (stating that the reasonable person standard "provides a common set of ideals"); KEETON ET AL., *supra* note 125, § 32, at 173 (stating that the reasonable person "is required to do what . . . an ideal individual would be supposed to do in his place").

[134] HOLMES, *supra* note 127, at 108.

society requires of its members for the protection of their own interests and the interests of others."[135] Moreover, "[t]he standard which the community demands must be an objective and external one, rather than that of the individual judgment, good or bad, of the particular individual."[136] The *Third Restatement of Torts* has eschewed the term "reasonable person" in favor of a functional definition, stating that "[a] person acts negligently if the person does not exercise reasonable care under all the circumstances,"[137] but acknowledges that this standard is no different from that of the reasonable person.[138] In all instances, the law imposes a community standard[139] on the conduct of the defendant, or the plaintiff where the defense of contributory negligence is raised.

Negligence law views the reasonable person situationally, recognizing that the reasonable person's conduct varies depending upon the circumstances. As the *Second Restatement of Torts* explained: "In determining whether the [reasonable person] should realize the risk which his conduct involves, the qualities which are of importance are those which are necessary for the perception of the circumstances existing at the time of

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[135] RESTATEMENT (SECOND) OF TORTS § 283 cmt. b (1965).

[136] *Id*. cmt. c (also referring to the reasonable person as an "ideal individual"). The *Second Restatement* states that the reasonable person is required to know the following community standards: "(a) the qualities and habits of human beings and animals and the qualities, characteristics, and capacities of things and forces in so far as they are matters of common knowledge at the time and in the community." *Id*. § 290. The Reporter's Notes contain numerous cases illustrating qualities that the reasonable person is expected to be aware of, including such examples as the law of gravity, dangers of fire, water, smoke, and explosives, and the limits of the person's own strength. *Id.* Rptr's Notes.

[137] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 3 (2005).

[138] *Id*. cmt. a ("Because a 'reasonably careful person' (or a 'reasonably prudent person') is one who acts with reasonable care, the 'reasonable care' standard for negligence is basically the same as a standard expressed in terms of the 'reasonably careful person' (or the 'reasonably prudent person').").

[139] *See, e.g.*, RESTATEMENT (SECOND) OF TORTS § 283 cmt. c (1965) (stating that the standard "enables the triers of fact . . . to look at a community standard rather than an individual one").

his act or omission . . . ."[140] But this situational view is grounded in the presumption that all, or at least most, persons should be expected to respond in the same manner to a given set of circumstances.

The objective reasonable person in negligence law contrasts with the subjective actor in intentional torts. To a large extent, however, the notion that intentional torts are subjective and negligent torts are always objective is a false dichotomy, as it suggests that individuality has no place in the law of negligence. Negligence law is intensely interested in the individualized *circumstances* of the litigation and the way in which the reasonable person should have acted under those circumstances. Thus, negligence law is both generalized ("objective") and particular ("individualistic"). This dual nature of negligence law is typically framed as the first two elements of a cause of action for negligence – duty and breach of duty. In most cases, duty is a legal issue for the court to determine, whereas breach of duty is a question of fact for the jury. The task of the jury is to consider the individualized circumstances of the case and apply them to the standard of the objective reasonable person.[141]

It is axiomatic that although the nature of the circumstances may vary, the standard of reasonable care remains the same. Negligence law's treatment of emergency circumstances provides a classic example. Defendants sometimes seek to be held to a lesser standard of care when they acted in the midst of a sudden emergency not of their own making. The majority rule, however, is that the emergency will be deemed to be

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[140] *Id*. cmt. d.

[141] *See, e.g.*, White River Rural Water Dist. v. Moon, 839 S.W.2d 211, 212 (Ark. 1992) ("Negligence is the failure to do something which a reasonably careful person would do."); Driscoll v. Erreguible, 482 P.2d 291, 294 (Nev. 1971) ("The standard of care is that of the ordinary prudent man, not that of extraordinarily prudent man.").

merely one of the circumstances that form the basis for how the reasonable person should have acted, but that the standard of reasonable care does not change.[142] This rule still presupposes that all reasonable persons would have reacted the same way when confronted with the circumstances under which the defendant acted.[143] As the emergency example demonstrates, certain presumptions about human judgment and behavior underlie the standard of reasonable care in the law of negligence.

One of the flaws of negligence law is the absence of clear normative standards to apply to the concept of reasonable care under all circumstances.[144] The law finesses this issue by allocating to the jury the task of applying community standards of reasonableness to the circumstances of the case. But there is little to guarantee that these standards are objectively reasonable. The trial judge, and later the appellate courts, may examine the record to determine whether it supported the jury's findings, but the

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[142] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 9 (2005) ("If an actor is confronted with an unexpected emergency requiring rapid response, this is a circumstance to be taken into account in determining whether the actor's resulting conduct is that of the reasonably careful person."). Thus, a defendant confronted with a sudden emergency may fail to choose the best alternative of several under the circumstances. But the jury may appropriately determine that the circumstances were such that the reasonable person would not have had sufficient time to process the alternatives and, therefore, acted reasonably. *See* Bettis v. Thornton, 662 So.2d 256, 258 (Ala. 1995); RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 9 cmt. c (2005).

[143] *See* Coyne v. Peace, 863 A.2d 885, 889 (Maine 2004) ("The test for reasonableness of the actions of a person confronted by an emergency is how a reasonably prudent person would have acted when confronted by the same or similar circumstances."). As the New York Court of Appeals characterized the doctrine:

> This doctrine recognizes that when an actor is faced with a sudden and unexpected circumstance which leaves little or no time for thought, deliberation or consideration, or causes the actor to be reasonably so disturbed that the actor must make a speedy decision without weighing alternative courses of conduct, the actor may not be negligent if the actions taken are reasonable and prudent in the emergency context.

Rivera v. New York City Transit Authority, 569 N.E.2d 432, 434 (N.Y. 1991). Conversely, the jury could find that the person reasonably should have exercised more care to avoid the harm. Accordingly, what would be considered reasonable under the circumstances may, in fact, have been a range of responses.

[144] *See generally* Kenneth S. Abraham, *The Trouble with Negligence*, 54 VAND. L. REV. 1187 (2001) (arguing that negligence law is the act of "norm creation"). While Professor Abraham would likely agree with the statement in the text, he has argued that negligence law is highly problematic and not deserving of the prominence that it enjoys in the law of torts.

determination of what was reasonable in the context of the facts of the case remains with the jury. Thus, objective reasonableness remains an elusive concept. The new neuroscience may be progressing toward lending some measure of concrete objectivity to this elusive concept.[145]

4. Special Reasonable Person Rules

As with all rules of law, certain adjustments to the objective reasonable person standard have inevitably developed. Although the standard contemplates an idealized adult actor,[146] the law of negligence recognizes certain sub-categories of reasonable persons based upon the subjective characteristics of the party. The primary example is children. Minors are held to a standard of care appropriate for a person of the actor's age, intelligence, and mental capacity.[147] This standard is both objective (looking at the reasonable child of the actor's age, intelligence, and mental capacity) and subjective (referencing the age, intelligence, and mental capacity of the child in question). Following this rule, and in contrast to the adult standard, a mentally challenged child would not be held to the standard of care of a non-mentally challenged child of the same

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[145] *See infra* notes 282-91 and accompanying text.

[146] DOBBS, *supra* note 101, § 119, at 280 (stating that "[t]he standard holds a real and particular defendant mainly to the standards of the ideal reasonable person").

[147] *See, e.g.*, Bragan ex rel. Bragan v. Symanzik, 687 N.W.2d 881, 884-85 (Mich. App. Ct. 2004); Yarborough v. Berner, 467 S.W.2d 188, 190 (Tex. 1971); RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 10(a) (2005) ("A child's conduct is negligent if it does not conform to that of a reasonably careful person of the same age, intelligence, and experience"); RESTATEMENT (SECOND) OF TORTS § 283A (1965). *But cf.* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 10(c) (2005) (stating that the special rule for children "does not apply when the child is engaging in a dangerous activity that is characteristically undertaken by adults"). Most jurisdictions that have considered the matter have adopted the position reflected in the *Third Restatement*, whereby minors may be held to the reasonable adult standard if they caused injuries while engaging in certain adult activities, such as operating motorized vehicles. *See, e.g.*, Dellwo v. Pearson, 107 N.W.2d 859 (Minn. 1961); Robinson v. Lindsay, 598 P.2d 392 (Wash. 1979). This rather arbitrary rule is a direct function of public policy considerations – including the availability of insurance, the deterrent effect on parents to closely supervise their children, and the inherent danger of the activities – rather than any notion of the child's mental capacity.

age and intelligence. Rather, the individual child's mental challenges would be taken into consideration in determining the appropriate standard of care.[148] The jury would be asked to consider objectively what a reasonable child with the limiting characteristics of the individual child in the case would have done under the circumstances. Courts recognize that this general rule for children means that the youngest children may not be capable of negligent conduct at all.[149]

The rationale for a special rule for children is based upon a series of assumptions and generalizations about child development. Thus, the *Third Restatement of Torts* states:

> Children are less able than adults to maintain an attitude of attentiveness toward the risks their conduct may occasion and the risks to which they may be exposed. Similarly, children are less able than adults to understand risks, to appreciate alternative courses of conduct with respect to risks, and to make appropriate choices from among those alternatives.[150]

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[148] *See, e.g.*, Sherry v. Asing, 531 P.2d 648, 661 (Haw. 1975).

[149] *See, e.g.*, Mastland, Inc. v. Evans Furniture, Inc., 498 N.W.2d 682, 684-85 (Iowa 1993) (child of two years and nine months held incapable of negligence as a matter of law); RESTATEMENT (SECOND) OF TORTS § 283A, cmt. b (1965) ("A child may be so young as to be manifestly and utterly incapable of exercising any of those qualities of attention, perception, knowledge, experience, intelligence, and judgment which are necessary to enable him to perceive a risk and to realize its unreasonable character."). The *Third Restatement* provides that "[a] child less than five years of age is incapable of negligence." RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 10(b) (2005). Some jurisdictions retain the "rule of sevens," which is a hybrid rule according to which children under the age of seven are deemed incapable of negligence; those between seven and fourteen are rebuttably presumed incapable of negligence; and those above fourteen are rebuttably presumed capable of negligence. *See id.* cmt. b. The child standard applies to contributory negligence on the part of a minor plaintiff, as well as the negligence of a minor defendant. *See* RESTATEMENT (SECOND) OF TORTS § 283A, cmt. a (1965). Indeed, most cases in which the standard has been invoked have involved the minor's contributory negligence. DOBBS, *supra* note 97, § 125, at 294.

[150] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 10 cmt. b (2005).

The *Restatement* references two treatises on developmental psychology in support of its position, but does not discuss the psychological or physiological basis for the rule.[151] Some commentators, however, have analyzed the child standard according to the evolution of theories of child development, noting that modern cognitive psychology, which posits that intelligent choices depend upon deductive reasoning, has abandoned arbitrary rules based on age and is developmentally based.[152] This cognitive view of child development is consistent with the approach of most jurisdictions and the *Third Restatement*. Thus, for a child to be found negligent, he or she must have developed such skills as the ability to plan and the understanding of his or her ability to cause a particular result.[153]

The ability to foresee and avoid or minimize risks is a fundamental notion underlying duty in tort law, including the ability to plan, understand causal consequences, and self-regulate. Thus, what a reasonable person could objectively foresee may be

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[151] *Id*. cmts. b & d (2005) (stating that "[i]t can be noted that modern developmental psychology tends to divide the years before adulthood into several phases" and citing LAURA E. BERK, INFANTS, CHILDREN, AND ADOLESCENTS (5th ed. 2005) and MICHAEL COLE ET AL., THE DEVELOPMENT OF CHILDREN (5th ed. 2005)).

[152] Lisa Perrochet & Ugo Colella, *What a Difference a Day Makes: Age Presumptions, Child Psychology, and the Standard of Care Required of Children*, 24 PAC. L.J. 1323, 1336-37 (1993) (discussing the relationship of Piaget's developmental psychology theories to the rule of sevens, and further discussing the displacement of Piaget's theories by concepts of cognitive psychology which reject age-based presumptions). The authors described the theories of cognitive psychology as follows:

> Unlike Piaget, who assumed children's thinking was qualitatively and structurally different from that of an adult, cognitive psychologists presume that the structure of children's thinking is identical to adults and that differences in capacity are due to the child's limited grasp of language, knowledge, and experience rather than some inherent defect or immaturity in thought processes.

Id. at 1337-38 (footnotes omitted). The authors proceeded to argue that the child standard of care in negligence law should be completely subjective because of the developmentally subjective nature of the child's mind. *See id*. at 1402-09.

[153] *Id*. at 1339-42. The authors explained that cognitive psychology recognizes several important elements in the ability of a child to plan: "A child must (1) have the ability to understand cause and effect relationships in the physical world; (2) believe that actions produce outcomes in the physical world; and (3) have the ability to exercise self-regulation." *Id*. at 1339 (citing Ellin Kofsky Scholnick & Sarah L. Friedman, *The Planning Construct in the Psychological Literature*, *in* BLUEPRINTS FOR THINKING: THE ROLE OF PLANNING IN COGNITIVE DEVELOPMENT 6 (Sarah L. Friedman et al. eds., 1987)).

different from what the specific person could have foreseen given the circumstances involved in the case. Both are relevant; and this distinction is important in considering the effect of the new neuroscience on tort law.

With regard to children, foreseeability includes an additional element. First, the objective developmental cognitive stage of a child of the actor's age is critical to determining the standard of care to which he or she should be held. Second, the subjective developmental cognitive stage of the specific child in question is relevant because factors such as mental challenges, intelligence, and experience may place the child at a different developmental stage than his or her age would suggest. Finally, and separately from the standard of care, the jury may be presented with a complex task in determining whether the child *breached* the duty – a task that may involve the subtle interaction of the cognitive elements under the facts and circumstances of the case. The new neuroscience may offer solutions for easing this task.

Another traditional adjustment to the reasonable person standard is the bifurcated rule for adults with mental and physical disabilities.[154] A party's individual physical disabilities are recognized as circumstances to which the traditional reasonable person standard of care applies. The jury decides what the reasonable person with the person's physical disability would have done under the same or similar circumstances.[155] Similarly, an individual's special skills or knowledge – such as professional expertise or

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[154] The *Restatements* use the term "disability" for a broad range of mental or physical limitations, and we use the term in the same sense.

[155] *See* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11(a) (2005) ("The conduct of an actor with a physical disability is negligent only if the conduct does not conform to that of a reasonably careful person with the same disability."); RESTATEMENT (SECOND) OF TORTS § 283C (1965) ("If the actor is ill or otherwise physically disabled, the standard of conduct to which he must conform to avoid being negligent is that of a reasonable man under like disability.").

training with a particular type of equipment – are viewed as circumstances that the jury is allowed to consider when applying the reasonable person standard to the circumstances of the case.[156] The test to determine the standard of care owed by a person with physical disabilities, according to the *Third Restatement*, is

> whether the individual has acted as a reasonably careful person with the particular disability. With physical disabilities, then – just as with childhood – tort law tailors the negligence standard to acknowledge the individual situation of the actor. To this extent, tort law employs what can be called a subjective rather than a fully objective standard of care.[157]

In contrast, traditional negligence law holds that individual variations in an adult's mental capacity or mental condition are not to be taken into consideration in determining whether that person acted negligently. In general, mentally challenged persons,

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[156] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 12 (2005). This section states: "If an actor has skills or knowledge that exceed those possessed by most others, these skills or knowledge are circumstances to be taken into account in determining whether the actor has behaved as a reasonably careful person." *Id*. The emphasis here is on "exceed," as the same is not true of what the *Restatement* calls "substandard judgment, knowledge and skills," which are ignored. *Id.* cmt. b. Similarly, if the actor is a novice and/or lacks experience in the activity at issue in the case, the actor will still be held to the standard of the reasonable person with general experience in the activity. *See id*. Many courts apply to experts, particularly physicians, a standard of the reasonable expert. *See, e.g*., Starcher v. Byrne, 687 So. 2d 737, 740 (Miss. 1997) (stating that a physician in a medical malpractice case has a duty to treat "each patient with such reasonable diligence, patience, skill, competence, and prudence as are practiced by minimally competent physicians in the same specialty or general field of practice throughout the United States, who have available to them the same general facilities, services, equipment, and options"). This standard is virtually identical to the traditional rule applying the reasonable person standard to the circumstances of the physician's expertise and available facilities, etc. Dobbs has noted that "[a]lthough the standard for physicians and some other professionals has widely been regarded as a standard that differs from the reasonable person standard, it seems fairly certain that not all such formulations are intended to represent a departure from the reasonable person standard." DOBBS, *supra* note 101, § 117, at 278.

[157] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11, cmt. b (2005). The *Second Restatement* explained this rule in the context of the reasonable person standard as follows:

> Physical handicaps and infirmities, such as blindness, deafness, short stature, or a club foot, or the weaknesses of age or sex, are treated merely as part of the "circumstances" under which a reasonable man must act. Thus the standard of conduct for a blind man becomes that of a reasonable man who is blind. This is not a different standard from that of the reasonable man . . . , but an application of it to the special circumstances of the case

RESTATEMENT (SECOND) OF TORTS § 283C, cmt. a (1965); *see also id*. cmt. b (applying the same rule to physical illness).

intoxicated persons, and persons who are intellectually slower than average are held to the objective standard of a reasonable adult without those limitations for reasons of public policy.[158] The *Third Restatement* provides: "An actor's mental or emotional disability is not considered in determining whether conduct is negligent, unless the actor is a child."[159] The rationales offered for this rule range from protecting innocent third parties to the effect of deinstitutionalizing those with mental or emotional disabilities who, when permitted to live in the word, are asked to bear reciprocal duties.[160] Furthermore, ignoring mental and physical disabilities avoids placing the court in the position or distinguishing, in close cases, whether the party has a mental disability or whether the party's mental condition is a variation of what might be considered "normal."[161]

The viability of this bifurcated rule – setting different standards for mental and physical disabilities – may be in doubt, as neuroimaging can now identify at least some of

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[158] *See* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11(c) (2005); DOBBS, *supra* note 101, § 119, at 280 (stating that the reasonable person is deemed to have "[n]ormal intelligence; [and] normal perception, memory, and at least a minimum of standard knowledge"). For the analogous rule for intoxicated persons, see *id*. § 123, at 291.

[159] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11(c) (2005). The *Third Restatement* notes that the cases are fragmented on how to apply this rule when the mentally challenged plaintiff's contributory negligence is the issue. *Id*. cmt. e (listing cases taking various positions on this issue).

[160] *See* Creasy v. Rusk, 730 N.E.2d 659, 668 (Ind. 2000) (stating that ignoring a party's mental or emotional disability when applying the reasonable care standard "creates an inducement for those responsible for a person with a mental disability to prevent harm to others"); Stephanie I. Splane, Note, *Tort Liability of the Mentally Ill in Negligence Actions*, 93 YALE L.J. 153, 163-64 (1983) ("The objective standard helps minimize the burden on the community from deinstitutionalization, helps foster community acceptance of the mentally ill, and encourages the mentally ill to become self-sufficient, responsible members of the community.").

[161] *See* Colman v. Notre Dame Convalescent Home, Inc., 968 F. Supp. 809, 811-12 (D. Conn. 1997) (applying Connecticut law) (citing RESTATEMENT (SECOND) OF TORTS § 283B, cmts. (1965)).

the organic bases of mental disability. One example is old age, which is discussed separately in the *Third Restatement*. Comment c to section 11 states:

> Old age, as such, is not taken into account in assessing the negligence of an actor's conduct. In many individual cases, however, old age is affiliated with particular physical disabilities. . . . [T]hose physical disabilities are taken into account. Thus, an 80-year-old actor who is no longer able to run will not be found negligent in failing to run as a hazard approaches. On the other hand, such an actor may be found negligent for engaging in an activity where running away from dangers is an important precaution.[162]

This rule becomes more difficult to apply where the mental state and physical condition are closely associated, such as where the physical disability is age-related dementia. Extrapolating from the old-age example, the bifurcated standard is subject to challenge when the mental incapacity may be shown to have a physical, or more precisely an organic brain, basis. Should these persons be treated under the rule for mental incapacity or physical disability? In *Burch v. American Family Mutual Insurance Company*,[163] the defendant was a fifteen-year-old girl who had been diagnosed with cerebral palsy and related mental retardation. Psychological testing indicated that her mental and cognitive abilities were in the range of a child of three to six years of age.[164] Because the allegations in the complaint involved the use of a motor vehicle, the court ruled that the defendant should be held to the adult standard of care.[165] Notwithstanding the physical

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[162] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11, cmt. c (2005); *see* Loring v. Yellow Cab Co., 337 N.E.2d 428, 432 (Ill. App. 1975) (jury was allowed to consider eighty-year-old plaintiff's slow physical movements on the issue of contributory negligence).

[163] 543 N.W.2d 277, 281 (Wis. 1996).

[164] *Id.* at 280 n.5.

[165] *Id.*; *see supra* note 147.

diagnosis as the basis of the girl's mental disability, the court held that her mental disability was not to be considered by the jury.[166]

The *Third Restatement* briefly addresses the bifurcation dilemma, but without resolving it. Comment e to section 11 acknowledges that "many mental disabilities have organic causes" and that, therefore, the trend in society – though not in the case law – is to treat mental and physical disabilities the same.[167] The comment instead provides a justification for ignoring all mental disabilities, regardless of severity, and presumably also regardless of demonstrable organic origin, in determining whether an actor was negligent. Less severe mental disorders "are disregarded partly because they ordinarily are not especially important as an explanation for conduct and also because of the problems of administrability that would be encountered in attempting to identify them and assess their significance."[168] Regarding severe mental disorders, comment e states:

> The disregard of more serious mental disorders is also based in part on administrative considerations. . . . [I]t can be difficult in many cases to ascertain what the causal connection is between even a serious mental disorder and conduct that appears to be unreasonable. Furthermore, if a person is suffering from a mental disorder so serious as to make it likely that the person will engage in substandard conduct that threatens the safety of others, there can be doubts as to whether the person should be allowed to engage in the normal range of society's activities.[169]

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[166] *Burch*, 543 N.W.2d at 280.

[167] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11 cmt. e (2005).

[168] *Id.*

[169] *Id.*

Thus, this argument goes, it is justifiable from a public policy standpoint to require persons who have severe mental disorders and who are living in society to be held to the legal standards of conduct to which others are held.[170]

The issue of the organic basis of mental disabilities is an area in which the new neuroscience may be able to lend clarity and certainty. Arguably, virtually all mental disabilities have an organic origin.[171] Tort law generally has ignored this reality, as the general refusal of courts to take mental disabilities into account in applying the reasonable person standard demonstrates.[172] But an intuitive understanding of this reality may have induced the Wisconsin Supreme Court, in *Breunig v. American Family Insurance Company*,[173] to search for a way to treat mental disabilities as physical disabilities for the purpose of applying tort doctrine. The plaintiff truck driver in *Breunig* brought suit against the insurer of the driver of an automobile alleged to have caused an

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[170] Over the years, commentators have taken issue with the rule and its underlying policy justifications. *See, e.g.*, Daniel W. Shuman, *Therapeutic Jurisprudence and Tort Law: A Limited Subjective Standard of Care*, 46 SMU L. REV. 409, 419-20 (1992) (partially supporting the objective standard, but recommending that some measure of subjectivity is warranted for tort law to have a therapeutic effect); Kristin Harlow, Note, *Applying the Reasonable Person Standard to Psychosis: How Tort Law Unfairly Burdens Adults with Mental Illness*, 68 OHIO ST. L.J. 1733, 1757-60 (2007) (recommending that the objective standard be abandoned). Yet, the rule has persisted, as the *Third Restatement* amply demonstrates.

[171] *See* Farah, *supra* note 35, at 35 ("Psychological traits . . . have physical correlates that are measurable with current brain imaging technology."). Professor Farah has made the following observation: "Like the field of genetics, neuroscience concerns the biological foundations of who we are, of our essence. The relation of self to brain is, if anything, more direct than that of self to genome." *Id*. at 34. For a lawyer's assessment of this matter, see Harry J.F. Korrell, *The Liability of Mentally Disabled Tort Defendants*, 19 L. & PSYCHOL. REV. 1, 14 (1995) (stating that "[t]he courts' continued distinction between mental and physical disabilities ignores decades of research and discovery in the fields of neurology and psychiatry" and discussing numerous psychological disorders associated with physical conditions, including physical trauma, disease, exposure to toxins, genetic abnormalities, and structural and metabolic brain abnormalities). *See also* Goodenough & Prehn, *supra* note 61, at 1713 ("By combining the best of traditional psychology and its related disciplines with the new approaches of cognitive neuroscience, mental activities as diverse as visual perception, memory, language use, emotion, deduction and consciousness have begun to yield some of their secrets.").

[172] *See generally* Harlow, *supra* note 171 (discussing the historical basis for and legal entrenchment in the general rule and recommending that it be abandoned).

[173] 173 N.W.2d 619 (Wis. 1970).

accident resulting in injury to the plaintiff. The insurance company alleged that its insured could not be found negligent because "just prior to the collision she suddenly and without warning was seized with a mental aberration or delusion which rendered her unable to operate the automobile with her conscious mind."[174] On appeal from a jury verdict for the plaintiff, the Wisconsin Supreme Court began its opinion by categorically stating that at the time of the accident, the insured was in the throes of "an insane delusion" that interfered with her ability to drive the automobile as a reasonably prudent person would.[175] The court held that the jury should have been allowed to consider the evidence of the insured's mental illness in determining whether she had been negligent because sufficient evidence existed to place the case within the absolute defense of sudden incapacitation.

The long-recognized sudden incapacitation defense is retained in the *Third Restatement*, which states: "The conduct of an actor during a period of sudden incapacitation or loss of consciousness resulting from physical illness is negligent only if the sudden incapacitation or loss of consciousness was reasonably foreseeable to the actor."[176] Two points stand out from this statement of the traditional elements of the defense. First, it has been applied when the sudden incapacitation is due to "physical illness," not mental illness. Second, liability is foreclosed only if the party could not have reasonably foreseen the onset of the incapacitation. In *Breunig*, the insured fit the latter

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[174] *Id*. at 621-22.

[175] *Id*. at 622. The conclusion was supported by the testimony of the insured's treating psychiatrist, who stated that at the time of the accident she suffered from acute paranoid schizophrenia and had no advance warning that she would be overtaken by a delusion to the extent that she could not operate her automobile. *Id*. at 622-23. The opinion contained nothing that would suggest that the psychiatrist's testimony included any discussion of the physical basis of the insured's mental illness.

[176] RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 11(b) (2005).

requirement, but not the former. Nevertheless, the Wisconsin Supreme Court held that the sudden incapacitation defense applied to the insured. The *Breunig* court stated:

> The effect of the mental illness or mental hallucinations or disorder must be such as to affect the person's ability to understand and appreciate the duty which rests upon him to drive his car with ordinary care, or . . . it must affect his ability to control his car in an ordinarily prudent manner. And in addition, there must be an absence of notice of forewarning to the person that he may be suddenly subject to such a type of insanity or mental illness.[177]

Accordingly, the court extended the sudden incapacitation defense to the situation where a motor vehicle driver is overcome by a mental illness or episode that prevents the driver from operating the vehicle as a reasonably prudent person. Thus, the Wisconsin Supreme Court's rule recognized the similarity, at least in some circumstances, between the mentally disabled person and the physically disabled person, without analyzing the mental disability as a physical illness.

Should all mental disabilities be treated in negligence law according to the rule of physical disabilities? In the model we set forth in the next Section, we acknowledge that the issue is complex, both scientifically and legally, and suggest that the new neuroscience may lead to abandonment of the bifurcated rule in tort doctrine. Our proposal recognizes a role for the technological developments of the new neuroscience in conjunction with traditional fact finding.

III. APPLYING THE NEW NEUROSCIENCE TO TORT LAW

A. The Law-Science Problem

Law and science engage in fundamentally different processes with very different goals. Scientific investigation is progressive; the scientific method is based upon the

[177] *Breunig*, 173 N.W.2d at 623.

process of disproving hypotheses which, in turn, lead to further hypotheses. Indeed, scientists often disagree on the existence of scientific fact, and even where consensus is reached, that consensus may be subject to revision.[178] The United States Supreme Court has said that "it would be unreasonable to conclude that the subject of scientific testimony must be 'known' to a certainty; arguably, there are no certainties in science."[179] The Court explained that science constitutes "'a *process* for proposing and refining theoretical explanations about the world that are subject to further testing and refinement.'"[180] Science and the law are often at odds in explaining human behavior, largely because the law applies normative thinking and judgments[181] to observable phenomena. Professor Stephen Morse has stated: "The law's concept of a person is a practical reasoning, rule-following being, most of whose legally relevant movements must be understood in terms of beliefs, desires, and intentions."[182] Current neuroscientific studies have examined the neurological basis of emotion and intuition in

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[178] See the discussion of the extreme example of the move away from Newtonian physics to the general theory of relativity, discussed in Laurence J. Tribe, *The Curvature of Constitutional Space: What Lawyers Can Learn from Modern Physics*, 103 HARV. L. REV. 1, 4-5 (1989).

[179] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 590 (1993).

[180] *Id*. at 590 (quoting the brief for the American Association for the Advancement of Science et al. as amici curiae at 7-8); *see also* Goodenough & Prehn, *supra* note 61, at 1715 (stating that the methodology employed in cognitive neuroscience is "postulating and testing functionally based hypotheses about thought"). In *Smith v. Gen. Elec. Co*., 2004 WL 870832 (D. Mass. 2004), the court described the distinction as follows:

> Science, by and large, rejects binary decision making in favor of a more nuanced quest for understanding. While a scientist might testify that a supposed fact has been proven to be false, the same scientist, when asked about conflicting data, will say only that an asserted fact has not been disproved or 'falsified,' and could therefore 'possibly' be true.

Id. at *2.

[181] For a philosophical and historical discussion of normative thinking in the law, see Goodenough & Prehn, *supra* note 61, at 1710-13.

[182] Stephen J. Morse, *Brain and Blame*, 84 GEO. L.J. 527, 529 (1996).

normative judgments.[183] While there is widespread acceptance of the role of emotion and intuition in decision making, there is no current consensus about the precise relationship between the physical brain and normative judgments, such as those required in the law.[184]

As the literature has demonstrated, the use of neuroimaging in legal decision making is complicated by the multifarious brain functions recruited to process the relevant information.[185] Further, the results of neuroscientific studies reveal individual differences among subjects. Thus, when exposed to the same stimulus, individual subjects' brain patterns – and accordingly, individual test responses – will vary. Conversely, identical behavior in multiple subjects will not be accompanied by uniform brain patterns.[186] While it is possible for neuroscientists to average their results, satisfying legal standards may be more difficult.[187]

The Supreme Court has noted the tension between law and science in the courtroom and characterized it as follows:

> Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly. The scientific project is advanced by

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[183] *See* Goodenough & Prehn, *supra* note 61, at 1717. The authors summarize some of the scientific studies as follows:

> The totality of the evidence suggests that normative judgment consists of one or more sets of higher mental abilities, which in turn rely on a variety of disparate cognitive and affective processes, such as understanding of a situation, appraising its emotional valence, activating norms from long-term memory, maintaining a norm in working memory, comparing the norm with the present behaviour, and deciding if there is a transgression, all of which take place under the influence of emotional processes. Therefore the neural basis of normative judgments is likely to involve several brain systems and to be distributed across large portions of the brain.

Id. The authors conclude that while it is important to acknowledge the role of emotion and intuition in normative judgments, they "are concerned that the pendulum may swing too far." *Id*. at 1716.

[184] *Id*. at 1717 (stating that "there is still a lack of clarity as to what [emotion and intuition] consist of in the brain").

[185] *See id*. at 1719.

[186] Morse, *supra* note 182, at 534.

[187] *See infra* notes 209-37, 317-28 and accompanying text.

> broad and wide-ranging consideration of a multitude of hypotheses, for those that are incorrect will eventually be shown to be so, and that in itself is an advance. Conjectures that are probably wrong are of little use, however, in the project of reaching a quick, final, and binding legal judgment – often of great consequence – about a particular set of events in the past.[188]

Of course, determining which scientific theories are "probably wrong" requires non-scientists (judges, juries) to make scientific and quasi-scientific assessments.[189] In 2011, in his dissent in *Brown v. Entertainment Merchants Association*, Justice Breyer acknowledged that he, "like most judges, lack[s] the social science expertise to say definitively who is right" in the debate over violent video games.[190] And the science will only grow more sophisticated and complex and less familiar to courts.[191] Indeed, the fact finder in the courtroom may reach a conclusion that is "contrascientific," but that is not incorrect as a matter of law.[192] Part of the reason for the imprecise fit between science and law involves the very different approaches to fact finding in the two disciplines. The scientific method in the laboratory, which is based on attempting to falsify hypotheses and replicate results, is a deductive process.[193] Legal truth in the courtroom, by contrast, is a process of building factual "truth" from pieces of evidence; the approach is accretive

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[188] *Daubert*, 509 U.S. at 596-97.

[189] *See* Lappe v. Am. Honda Motor Co., 857 F. Supp. 222, 228 (N.D.N.Y. 1994) (stating that the trier of fact may discount scientific evidence that is challenged at trial through the use of traditional trial methods), *aff'd without opinion*, 101 F.3d 682 (2d Cir. 1996).

[190] 131 S. Ct. 2729, 2769 (2011) (Breyer, J., dissenting).

[191] Following the *Daubert* decision, the Federal Judicial Center embarked on a project to provide assistance to judges on matters related to the sciences in the REFERENCE MANUAL ON SCIENTIFIC EVIDENCE. The third edition of the *Reference Manual*, which includes a chapter on neuroscience, was published in September, 2011.

[192] SHEILA JASANOFF, SCIENCE AT THE BAR: LAW, SCIENCE, AND TECHNOLOGY IN AMERICA 10 (1995).

[193] DAVID L. FAIGMAN, DAVID H. KAYE, MICHAEL J. SAKS, JOSEPH SANDERS & EDWARD K. CHENG, I MODERN SCIENTIFIC EVIDENCE § 4:5, at 140 (2005-06) (noting that "[t]esting is capable only of disconfirming," but that repetition of results leads to greater acceptance).

and inferential. By necessity, however, there is an accommodation between law and science, as science is at the basis of many legal decisions, whether legislative or judicial.

What can the new neuroscience demonstrate, and what is beyond its reach at this point in time? Several issues are relevant to this inquiry. First, disagreement and debate in the neuroscience community is relevant to assessing the utility of any type of neuroscience evidence. In fMRI studies, for example, scientific consensus on how to interpret the relationship between the observable BOLD response and conclusions regarding brain activity or the mental states of subjects is, at best, evolving.[194] Similarly, scientists' understanding of what is meant by "activity" in the brain or "brain function" is developing as more studies accumulate.[195] In legal circles, this lack of certainty will result in many neuroscience studies being treated as novel science, and thus with skepticism by the courts.

Second, the ability of neuroimaging to provide information about brain activity retrospectively is limited.[196] An example is the information gleaned from the studies of informed consent among persons diagnosed with schizophrenia.[197] Those studies focused on the brain activity of the subjects when confronted with a task at the time of the clinical study. Because all subjects shared the same diagnosed mental condition,

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[194] *See* Brown & Murphy, *supra* note 92, at 1140-41 (reporting the efforts of current researchers to understand this relationship); 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, 278-80 (2007).

[195] Brown & Murphy, *supra* note 92, at 1141.

[196] *See* Greely & Wagner, *supra* note 10, at 797. The authors characterize the dilemma as follows:

> [T]he best [neuroscience] may be able to do is to say that, based on your current mental condition or state, as shown by the current structure or functioning of your brain, you are more or less likely than average to have had a particular mental state or condition at the time of the relevant event.

Id. For tort law, this could be significant in some circumstances.

[197] *See* Eyler et al., *supra* note 8, at 141-43.

these studies could yield (1) current and prospective insight into the ability of schizophrenics, in general, to understand informed consent, as well as (2) retrospective insight into how the subjects, and others similarly situated, may have acted in the past, provided that evidence of schizophrenia existed at the time of the tort. But attempts to genralize about past behavior, particularly as to a specific event, are highly problematic and require expert extrapolation which may or may not be acceptable in court. Professor Owen D. Jones and colleagues have noted that human brains simply change over time and that an fMRI scan conducted at some point in time after the event under scrutiny (such as a criminal act) does not necessarily allow for a conclusion that the same results would have been seen at the earlier date.[198] Furthermore, individual results may vary from the average scan.[199] While this example may seem simplistic, the issues it raises present fundamental and complex questions for the application of neuroimaging evidence to the law.

B. Mind and Matter

Within the neuroscience community, there is no dearth of opinions on the degree to which the organic brain determines human behavior.[200] Thus, for example, Professor Martha Farah has stated that the brain will likely be found to explain all human behavior, but has urged society – and the law in particular – to manage that information in an

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[198] Jones et al., *supra* note 11, ¶ 39.

[199] *Id*. ¶ 33 ("Do not assume that the averaged scan of any group will necessarily be representative of any individual.").

[200] *See* Adina Roskies, *How is Neuroscience Likely to Impact the Law in the Long Run?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 66, 70 (Law and Neuroscience Project & SAGE Center for the Study of the Mind, eds. 2011) (stating that some "scientists and philosophers have worried that science will reveal free will to be an illusion, and that morality and responsibility will fall with freedom," but opining that the fears are "overstated").

ethical way.[201] Professor Stephen K. Erickson has accused the neuroscientific community of operating with an agenda, that of eliminating the normative concept of "blame" and replacing it with blame-free biological determinism.[202] In contrast, Professor Stephen J. Morse, has taken a compatibilistic approach to the debate and has offered the view that whatever neuroscientists may conclude about neurological determinism does nothing to alter the way in which the law views human action.[203] According to this view, "[e]ven if human beings were never aware of the causes of their intentions to act and of their actions, it would not necessarily follow that they were not acting consciously, intentionally and for reasons that make eminent sense to anyone under the circumstances."[204] This view would not directly alter the law's concept of fault. Similarly, Professor Michael S. Gazzaniga has emphasized that moral responsibility as a normative concept is distinguishable from its neural correlates.[205] Moreover, it is clear that the relationship between "cognitive variables and any physical measurements in the brain will not be deterministic," but will require expert testimony to draw inferences from the data to support conclusions about cognition or behavior.[206]

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[201] Farah, *supra* note 35, at 38-39.

[202] *See* Erickson, *supra* note 60, at 28.

[203] Morse, *supra* note 88, at 15; *see also* Stephen J. Morse, *Moral and Legal Responsibility and the New Neuroscience*, in NEUROETHICS: DEFINING THE ISSUES IN THEORY, PRACTICE, AND POLICY (Judy Illes ed. 2006) 33, 44-47 (noting that "we do not necessarily have more control over social causal variables than over biological causal variables").

[204] Morse, *supra* note 88, at 25-26.

[205] Michael S. Gazzaniga, THE ETHICAL BRAIN 101 (2005).

[206] Read Montague, *How is Neuroscience Likely to Impact Law in the Near Future?*, *in* A JUDGE'S GUIDE TO NEUROSCIENCE: A CONCISE INTRODUCTION 60, 60 (Law and Neuroscience Project & SAGE Center for the Study of the Mind, eds. 2011). Montague states that the gap between cognitive variables and fMRI data is "a crucially underdeveloped area of human neuroscience." *Id*. at 61.

The new neuroscience has also ignited philosophical and religious debates. Some commentators have noted that the law has always attempted to reconcile notions of free will with biological predetermination.[207] Neuroscientists point out that as advancements in neuroimaging technologies progress, some notions of spirituality have also begun to be explained by organic conditions. For example, Professor Farah reports a study that showed patients with temporal lobe epilepsy to have feelings described as religious that were organically related to their seizures.[208] While the debate on determinism versus free will is beyond the scope of this Article, we acknowledge that strong opinions exist and their resolution is unlikely. As neuroscience moves closer to explaining all human perception and behavior in physical terms, it is unlikely that we as humans, and the law as a human institution, will completely abandon our notions of "self" or the "mind." Our model of tort law takes this into consideration.

C. Evidentiary Challenges

As the discussion of the mental states of tort law in Section Two demonstrates, there are two broad categories of neuroscience evidence that may be relevant in a tort case. The first type is the individualistic and subjective type, most prominent in intentional torts, but necessary in some aspects of negligence law as well.[209] The second is the generalized and objective type, as evidenced by the discussion of the reasonable person in negligence law.[210] At the present time, functional neuroimaging and other

[207] *See, e.g.*, Roskies, *supra* note 59, at 423. Roskies suggests that the new neuroscience is not incompatible with notions of free will, but rather will lead to a different understanding of the relationship between the neuroscientific view of the brain and traditional notions of intuition and legal responsibility.

[208] Farah, *supra* note 35, at 38.

[209] *See supra* notes 106-13 and accompanying text.

[210] *See supra* notes 124-41 and accompanying text.

neuroscience studies are more likely to offer useful evidence of the latter type than the former. But any type of functional neuroimaging evidence will present substantial admissibility problems in the courtroom.

All American courts demand assurances that scientific evidence is reliable and relevant to the issues for which it is offered. Evidentiary reliability is directly related to the scientific validity of the evidence.[211] The traditional test for the admissibility of scientific evidence, known as the *Frye* rule, was concerned only with whether the technology was generally accepted in the field from which it derived.[212] The *Frye* rule was superseded in the federal courts by the *Federal Rules of Evidence*, which imposed a multifactored test for determining the admissibility of expert evidence, and the *Federal Rule* test has been adopted by some states.[213] *Frye* remains the rule in other jurisdictions.[214]

The federal admissibility rule is more comprehensive than the *Frye* rule, requiring greater scrutiny of expert evidence. In *Daubert v. Merrell Dow Pharmaceuticals, Inc*.,[215] the United State Supreme Court held that the *Federal Rules of Evidence* supplanted the *Frye* rule in the federal courts. The Court offered a list of "general observations" to assist

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[211] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 590 n.9, 592-93 (1993).

[212] *See* Frye v. United States, 293 F. 1013 (D.C. Cir. 1923). The court stated that "while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field to which it belongs." *Id*. at 1014.

[213] *See, e.g*., Ranes v. Adams Labs., Inc., 778 N.W.2d 677 (Iowa 2010); E.I. duPont de Nemours & Co. v. Robinson, 923 S.W.2d 549 (Tex. 1995).

[214] *See, e.g*., Slay v. Keller Indus., Inc., 823 So. 2d 623 (Ala. 2001); Blackwell v. Wyeth, 971 A.2d 235 (Md. 2009); Goeb v. Tharaldson, 615 N.W.2d 800 (Minn. 2000).

[215] 509 U.S. 579 (1993).

trial courts in determining whether proffered scientific evidence is reliable: (1) whether the scientific theory or method has been tested, presumably through the principles of the scientific method; (2) whether the study has been published or has undergone another form of peer review; (3) the known rate of error of the technique; and (4) whether the methodology has been generally accepted in its field.[216] *Daubert* itself was a tort case, two consolidated drug product liability actions,[217] and the scientific studies on which the plaintiffs' experts relied were a mix of toxicological studies and epidemiology.[218] One study in particular was novel: The plaintiffs offered an epidemiological study that had reanalyzed data from numerous earlier epidemiological studies, all of which had failed to make the necessary causal connection. The reanalysis, which had not been published or peer reviewed, concluded that a causal connection existed. The Supreme Court remanded the case, and based upon the factors announced by the Court, the lower court ultimately held the plaintiffs' expert evidence inadmissible, leaving them without evidence of causation.[219]

The *Daubert* reliability test, though ostensibly less restrictive than *Frye*, is not particularly friendly to novel scientific evidence. Although the Court did not insist that general acceptance be present in every case,[220] the other factors tend to disfavor novel

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[216] *Id*. at 593 (stating that "[m]any factors will bear on the inquiry, and we do not presume to set out a definitive checklist or test").

[217] *Id*. at 582.

[218] *Id.* at 583-84.

[219] *See* Daubert v. Merrell Dow Pharmaceuticals, Inc., 43 F.3d 1311 (9th Cir. 1995).

[220] The Court stated that some theories may be "too new" to have been published and that publication was "not a sine qua non of admissibility." *Daubert*, 509 U.S. at 593. But the Court emphasized that peer review is important to assessing the reliability of a technique, stating that "submission to the scrutiny of the scientific community is a component of 'good science,' in part because it increases the likelihood that substantive flaws in methodology will be detected." *Id.*

techniques, as they are less likely to have been tested to the same extent as more established techniques, the rate of error may not yet be known, and peer review or publication may not have been achieved. Indeed, the Court acknowledged that "a gatekeeping role for the judge, no matter how flexible, inevitably on occasion will prevent the jury from learning of authentic insights and innovations."[221]

On the relevancy aspect of scientific evidence, the Supreme Court has described the relevant standard as one of "fit." In *Daubert*, the Court said that scientific reliability by itself is not sufficient to support admissibility of the evidence. Rather, the relevance "standard requires a valid scientific connection to the pertinent inquiry as a precondition to admissibility."[222] The relevancy standard was a particularly important aspect of the Supreme Court's decision in *General Electric Company v. Joiner*,[223] another tort case involving epidemiological and toxicological studies offered in support of personal injury claims. In *Joiner*, the Court was concerned with the expert's interpretation of the scientific evidence and whether the evidence was an appropriate "fit" with the issues in the case. The Court found that a series of epidemiological and animal studies that the plaintiff sought to introduce to demonstrate that his lung cancer had been caused by his exposures to certain chemicals failed the relevancy arm of the federal test. Recognizing that "[t]rained experts commonly extrapolate from existing data"[224] to reach conclusions on the issues in the case, the Court stated that expert opinion evidence is inadmissible if it

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[221] *Id*. at 597.

[222] *See id*. at 592.

[223] 522 U.S. 136 (1997).

[224] *Id*. at 146.

"is connected to existing data only by the *ipse dixit* of the expert."[225] When the "analytical gap"[226] is too great between the scientific data and the expert's conclusions, the evidence will not be admitted.[227] In *Joiner*, this analytical gap existed because the studies either did not involve the precise substances to which the plaintiff had been exposed or the illnesses studied were not identical to the plaintiff's illness.[228]

The 2000 amendment to Federal Rule 702 reflects *Daubert* and *Joiner* without explicitly adopting the general observations of *Daubert*. Rule 702 provides:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert . . . may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.[229]

The advisory committee note to the 2000 amendment lists the *Daubert* factors, but explicitly states that they were not codified so as to permit maximum flexibility.[230] The

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[225] *Id.*

[226] *Id.* The Court also held that an abuse of discretion standard applied when reviewing the admissibility of expert evidence under Federal Rule of Evidence 712. *Id*. at 146-47.

[227] *See, e.g*., O'Conner v. Commonwealth Edison Co., 13 F.3d 1090, 1106-07 (7th Cir. 1994) (excluding expert testimony that radiation was the cause of the plaintiff's cataracts because the opinion was merely subjective and did not have a sufficient scientific basis); Chikovsky v. Ortho Pharmaceutical Corp., 832 F. Supp. 341, 346 (S.D. Fla. 1993) (excluding expert testimony that drug caused the plaintiff's birth defects because the opinion relied on studies conducted on a drug similar, but not identical, to the drug involved in the case).

[228] *Joiner*, 522 U.S. at 145-46.

[229] FED. R. EVID. 702. The companion rule is Federal Rule 703 which permits an expert to rely on studies generated by others, if they are the type of studies reasonably relied upon in the field.

[230] FED. R. EVID. 702 advisory committee's note. The Supreme Court discussed the need for flexibility in the third case in the "*Daubert* trilogy." In *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), the Court held that *Daubert* and *Joiner* applied to all forms of expert evidence governed by Rule 702. *Id*. at 147-48. Accordingly, the trial judge must have "broad latitude" to formulate the factors that are appropriate to determining the reliability and relevance of the particular evidence before the court. Both *Daubert* and *Joiner* involved the same kinds of "hard science" – i.e. methodologies employing the scientific method – but *Kumho Tire* recognized the need to adjust or revise the *Daubert* factors when the methodology was observational or experiential. *See id*. at 152-53. On the subject of a particular kind of experiential

note adds several factors to be considered in appropriate cases, including (1) whether the expert evidence was developed specifically for the litigation, (2) whether the analytical gap between the data and the expert's conclusion is too great, (3) whether the expert has addressed other theories, (4) whether the expert has shown appropriate intellectual rigor, and (5) whether the expert's field is considered reliable for offering an opinion on the issue.[231]

Regardless of whether the jurisdiction follows *Daubert* or *Frye*, the practicalities of applying the tests for the admissibility of scientific evidence are often problematic for courts.[232] And the degree to which *Daubert* and *Frye* have presented challenges to courts ruling on the admissibility of scientific evidence is certain to grow as neuroscientific evidence becomes commonly offered in all types of cases.[233]

Most of the literature examining the impact of neuroimaging in the courtroom has been in the context of criminal law. These commentators tend to focus on the feasibility of using neuroimaging evidence to show the defendant's subjective state of mind at a historical point in time. Thus, criminal law commentators have been particularly interested in recent studies attempting to identify areas of the brain associated with intent

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evidence, see generally Jean Macchiaroli Eggen, *Clinical Medical Evidence of Causation in Toxic Tort Cases: Into the Crucible of Daubert*, 38 HOUS. L. REV. 369 (2001) (discussing the methodology of clinical differential diagnosis and concluding that evidence of causation acquired through that methodology should not be absolutely excluded).

[231] FED. R. EVID. 702 advisory committee's note.

[232] *See* Hon. Jed S. Rakoff, *Science and the Law: Uncomfortable Bedfellows*, 38 SETON HALL L. REV. 1379, 1388 (2008) (stating that applying *Daubert* and Rule 702 "in practice in an actual legal case is not so easy" and discussing his experience applying the rules in the Ephedra Product Liability Litigation).

[233] Judge Rakoff stated in 2008: "[T]he kinds of difficulties I faced in being the scientific gatekeeper in the Ephedra Litigation is small potatoes compared with what I and other federal judges are likely to face in the next few years as the law comes ever more tightly to grips with determining what is, and what is not, good science." *Id*. 1392 (specifically referencing "the fast-developing discipline called neuroscience").

and morality.[234] If a particular defendant is shown to have damage in one or more of those areas of the brain, the defendant may have an argument that he or she did not have the capacity to form the mens rea for the crime.[235] In addition to focusing on mens rea, criminal law cases and commentators have also recognized the promise of neuroscience generally to support an argument of incapacity, including insanity,[236] or to serve as a reliable lie-detection technique.[237] Many of the points raised by these commentators shed some light on the issues relevant to tort law and neuroscience, as we indicate in the discussion that follows.

IV. DEVELOPING A NEUROSCIENCE MODEL OF TORT LAW

A. The Model

Our neuroscience model of tort law is both simple and complex. Its simplicity lies in the fact that the model is intended to use the information summarized so far in this Article to formulate a workable framework for allowing the law to move forward in considering the use of functional neuroimaging evidence in tort law. We offer a dynamic

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[234] *See* Michael S. Gazzaniga, *The Law and Neuroscience*, 60 NEURON 412, 414 (2008) (citing studies).

[235] Brown & Murphy, *supra* note 92, at 1128-32; Nita A. Farahany & James E. Coleman Jr., *Genetics, Neuroscience and Criminal Responsibility*, *in* THE IMPACT OF BEHAVIORAL SCIENCES ON CRIMINAL LAW 183, 192-95 (Nita A. Farahany ed. 2009); Gazzaniga, *supra* note 234, at 414; Morse, *supra* note 39, at 399-403; Amanda C. Pustilnik, *Violence on the Brain: A Critique of Neuroscience in Criminal Law*, 44 WAKE FOREST L. REV. 183, 206-14 (2009). *See generally* Symposium, *The Mind of a Child: The Relationship Between Brain Development, Cognitive Functioning, and Accountability Under the Law*, 3 OHIO ST. J. CRIM. L. 317 (2006). This is only a very small sample. Pustilnik noted that more than 200 law review articles on neuroscience and criminal law were published between 2000 and 2009. Pustilnik, *supra*, at 186 n.10.

[236] *See, e.g.*, Farahany & Coleman, *supra* note 235, at 195-98; Tovino, *supra* note 86, at 50-52.

[237] *See, e.g.*, Daniel D. Langleben, *Detection of Deception with fMRI: Are We There Yet?*, 13 LEGAL & CRIMINOLOG. PSYCHOL. 1 (2008); Jane Campbell Moriarty, *Visions of Deception: Neuroimages and the Search for Truth*, 42 AKRON L. REV. 739 (2009); Frederick Schauer, *Neuroscience, Lie-detection, and the Law*, 14 TRENDS IN COGNITIVE SCIENCES 101 (2010); Joseph R. Simpson, *Functional MRI Lie Detection: Too Good to be True?*, 36 J. AM. ACAD. PSYCHIATRY & L. 491 (2008).

process-based approach to the model, not a fixed outcome-oriented approach. The complexity of the model lies in the challenges posed by interpretation of the neuroscience studies and by extrapolation from the scientific data to the legal issues. Accordingly, the model is not bonded to any particular scientific studies or neuroimaging theory. Rather, we offer a proposal for beginning a discussion about integrating neuroimaging into tort law as the technologies grow in reliability and inform the issues frequently raised in tort cases. Moreover, our proposal is sufficiently flexible to form the basis for shifting paradigms in tort doctrine.

Consistent with our process-based approach, we reject the notion that the introduction of neuroimaging evidence establishes an evidentiary presumption that must be rebutted. Rather, we maintain that such evidence, if admitted, would provide a permissible inference of a fact in issue, absent more persuasive evidence. In essence, it would be a piece of evidence like any other admitted in the case, and the expert introducing it could be appropriately and vigorously cross-examined by the opposing party's attorney.[238] Evidence of the specific circumstances of the individual case would be available for the jury's consideration along with the neuroimaging evidence, and the instructions to the jury should reflect the parameters of its permitted use. In the absence of contrary or mitigating evidence, the jury would be permitted to rely on – or to fully reject – the neuroimaging evidence in making its finding; if contrary or mitigating

[238] The Supreme Court in *Daubert* recognized the value of traditional means of challenging evidence in the courtroom, once that evidence has been admitted. The Court emphasized the continuing role of the judge and cited several *Federal Rules of Civil Procedure* in making its point. In particular, the Court mentioned cross-examination, clear instructions on the burden of proof, summary judgment per Rule 56, and judgment as a matter of law per Rule 50(a). *See Daubert*, 509 U.S. at 596. The Court also noted that the *Federal Rules of Evidence* permit the trial court to appoint an expert of its own choosing to advise the court on the matters related to the specialized evidence. *See id*. at 595; FED. R. EVID. 706.

evidence is admitted, the neuroimaging evidence would be among the evidence weighed by the jury.

Our model is not intended to be an immutable standard, but rather is intended to commence the discourse about ways in which tort law may be enhanced or improved through an understanding of, and appropriate use of, information acquired through the newest technologies of functional neuroimaging. We intend this model to provide guidance to judges and attorneys when confronted with functional neuroimaging evidence in tort cases, and we anticipate that serious consideration of the model will propel courts toward incorporating these relevant social and scientific advances into the evolving principles of tort law. We recognize that the new neuroscience is a high-speed train of biological information with social implications that will soon bear down upon the courts with vast amounts of evidence. Our model provides analytical compartmentalization for management of that evidence in tort cases in a measured and nuanced manner.

The model presumes that tort law could benefit from two types of neuroscience evidence – loosely described as subjective[239] and objective – which mirror, albeit imperfectly, the mental states of tort law. Because much of the science of functional neuroimaging is designed around averaging group results, these averaged results could provide useful generalized information. Although individual subjects may vary substantially in their responses, these studies provide information about the collective, not the individuals. When information is needed to support subjective and historical

[239] Martha J. Farah, *An Introduction to Neuroscience and Neuroimaging for Lawyers*, Remarks at the Law and the Brain Conference (Mar. 15, 2011). Professor Farah indicated that new developments in neuroimaging have made it possible to obtain good data on individuals in some instances without group averaging.

matters, however, the averaging may confound the process and hamper its use in resolving individual issues. On the other hand, studies of individuals may be useful for individual diagnostic reasons related to mental capacity.

We emphasize once again that we are not neuroscientists, but rather legal scholars with lawyers' sensibilities and intellectual priorities. Our model takes the promise of the new neuroscience and postulates its impact on tort doctrine. The model does not suggest that all necessary scientific studies to support the proposals have been conducted or appropriately peer reviewed, or that scientific consensus has been reached on the underlying neuroscience. We consider this an advantage to our model, which does not claim to reach any particular outcome, but is instead interested in the process of applying the science to the law, and vice versa. The rules of evidence provide the legal limitations on the reliability and relevance of the scientific studies. Our goal is to draw the law and neuroscience together into a cooperative symbiosis.

1. Intentional Torts and the Privilege of Consent

Our neuroscience model of tort law begins with an examination of the extent to which neuroimaging evidence may be able to assist the judge and jury in accurately assessing the law and facts of an intentional tort case. As previously discussed, the requirement of "intent" in intentional torts does not include a motive to harm the plaintiff or even to accomplish a particular result.[240] Rather, the defendant, at a minimum, must have known with substantial certainty that the result would occur. The required knowledge is both subjective and historical, thereby rendering difficult the application of

[240] *See supra* notes 106-11 and accompanying text.

neuroimaging evidence in an intentional tort case. But some neuroimaging evidence may still be useful in a particular case. We address those issues in order.

First, the need for intentional torts to examine the mental state – intent – of the defendant at the time of the tort creates a relevancy problem for neuroimaging evidence, which was most likely obtained during the pretrial phase of the tort litigation or at some other time before or after the time of the tort. Brain activity is constantly changing,[241] and there is no certainty that a person's capability of forming intent at one point in time is identical at another point. Thus, the primary difficulty with using functional neuroimaging to support or refute a claim of intent is the highly subjective and historical nature of the legal issues in intentional torts. It may be a long time before the science develops to a point where the pertinent information is available and even longer before it is considered reliable or relevant. There is a body of research on the subject of intent, however, and investigation is ongoing. One recent study, for example, used fMRI technology to examine the areas of brain function during intention-based task preparation in subjects before the subjects' actual choice of action was finalized.[242] Such studies show promise in using neuroimaging to identify the brain processes associated with choosing one course of conduct over another, which is precisely the issue in intentional torts. Use of these studies in tort law remains problematic because of the subjective and

[241] *See* Jones et al., *supra* note 11, ¶ 39.

[242] *See* Hannes Ruge, Sven C. Müller, & Todd S. Braver, *Anticipating the Consequences of Action: An fMRI Study of Intention-based Task Preparation*, 2010 PSYCHOPHYSIOLOGY 1, 7 (2010). *See generally* Richard A. Andersen & He Cui, *Intention, Action Planning, and Decision Making in Parietal-Frontal Circuits*, 60 NEURON 568 (2009) (reviewing recent research on decision making action planning).

historical nature of intent. For now, there is no reliable methodology for reading a subject's mind to the degree that would be useful in the courtroom.[243]

Nevertheless, for those intentional tort cases in which the defendant's capacity to form the requisite intent – or the plaintiff's capacity to consent, when consent is raised as a privilege – is an issue in the case, the diagnostic uses of functional neuroimaging evidence may be valuable in assisting the jury. Averaged studies identifying the brain processes associated with decision making could be compared with individual studies of the relevant party in a tort action to determine diagnostically whether the person has functional brain impairment in that area which could interfere with the ability to form the requisite tortious intent or consent. For the evidence to be used effectively, however, the proponent of the evidence would need to surmount the historical-relevancy problem.[244]

In *White v. Muniz*, the defendant suffered from Alzheimer's-type dementia; the court approved the jury instruction given below that allowed the jury to find her liable for battery if she intended the act and intended that the consequence be harmful or offensive.[245] The court acknowledged that "[j]uries may find it difficult to determine the mental state of an actor, but they may rely on circumstantial evidence . . . to conclude what another must have been thinking."[246] The court offered the example of a person throwing a stone into a crowd, stating that it is general knowledge that the stone will likely cause injury; on that basis, "the jury can determine that the actor had the requisite

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[243] Langleben, *supra* note 237, at 6 (stating that the "demand for objective lie detection is not met by the existing technology," but recognizing that "fMRI is unquestionably a qualitative leap forward in our ability to correlate brain activity with behaviour and cognition").

[244] *See* Grafton, *supra* note 62, at 58 (discussing the issue in the context of criminal law).

[245] 999 P.2d 814, 818 (Colo. 2000).

[246] *Id*. at 817.

intent to cause a harmful or offensive contact, even though the actor denies having such thoughts."[247] Neuroscience promises a way to minimize the amount of supposition and guesswork involved in that process when the facts are less clear. To the extent that fMRI and other technologies may eventually be able to identify brain processing, this evidence could be relevant in many tort cases involving intent and consent.

For the privilege of consent to apply, apparent consent suffices – what the defendant reasonably understood from the words, conduct, or silence of the plaintiff. When the issue is the incapacity of the plaintiff to consent, the issue is complicated because often the plaintiff has given apparent consent which would operate to bar the claim in the absence of incapacity. Functional neuroimaging may be helpful in answering two questions related to consent. First, testing could be useful to determine the existence – and extent – of the plaintiff's incapacity.[248] Second, neuroimaging could develop into a useful tool for determining what the defendant understood generally about whether apparent consent existed, or knew explicitly about the incapacity of the plaintiff. We recognize the complexity of the issues involved in the legal issue of consent, but offer our analysis as a framework for approaching these issues.

Finally, one might argue that brain fingerprinting technology and similar brain wave tests have the potential to assist in determining the knowledge of the defendant at the time of the tort, but this technology is not yet viewed as reliable in the profession or by the courts.[249] In tort law, such studies must be designed to determine a party's

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[247] *Id.*

[248] If the alleged incapacity was transient (e.g. intoxication) or experience-based (e.g. childhood abuse), neuroimaging may not be useful in identifying the existence of the incapacity.

[249] In *Harrington v. State*, 659 N.W.2d 509, 516 (Iowa 2003), the trial court had admitted evidence derived from the brain fingerprinting technique that tended to exculpate the defendant, but because the

knowledge of a particular location or certain events. The evidence would be directed at assisting the fact finder in drawing a conclusion of fact and would not be offered for normative judgments such as honesty and deceit. As intriguing as this technique seems, observers have insisted that this technology is generally too imprecise and misleading to pass the tests for evidentiary admissibility.[250] For example, memory storage has been shown to be selective,[251] and various factors may alter memories between the time of storage and the time the person reports the memory.[252] Furthermore, at the time of retrieval of a memory, the person may unwittingly fill in gaps in the memory by using other sources.[253] These criticisms suggest that significant reliability problems about this type of evidence will persist until and unless substantial peer review and replication occur.

Iowa Supreme Court based its decision to grant post-conviction relief on other evidence and legal issues, it did not rule on the scientific evidence or address it. *Id*. at 516 & n.6; *see supra* notes 66-69 and accompanying text.

[250] *See, e.g.*, Deborah W. Denno, *Crime and Consciousness: Science and Involuntary Acts*, 87 MINN. L. REV. 269, 334-35 (2002); Greely & Illes, *supra* note 37, at 388 (stating that "Farwell's claims are widely discounted in the relevant scientific community and his credibility is not helped by his inflated claims for the judicial acceptance of his technique"); J. Peter Rosenfeld, *"Brain Fingerprinting": A Critical Analysis*, 4 SCI. REV. MENTAL HEALTH PRAC. 20, 24 (2005) (stating that "it is well known from the memory literature that, in fact, not all details of experience are recorded, or if recorded, then often recorded with major distortion; the fragility of memory is well documented"). Rosenfeld also pointed out that a person in the process of committing a serious crime is likely to be in a state of agitation or substance-influenced to an extent that the process of making memories may be impaired. *See id*. In contrast, Farwell has maintained that the technology has a 100% accuracy rate. Interview with Dr. Lawrence Farwell, at http://www.brainwavescience.com/FreqAskedQuestions. php ("In cases where a determination of 'information present' or 'information absent' was made, 100% of the determinations were correct."); *see* Tom Paulson, *Brain Test Could be Next Polygraph: Seattle Scientist Making his Pitch*, SEATTLE POST-INTELLIGENCER, Sept. 15, 2008, at B1 (quoting Farwell as stating that the technique is "100 percent reliable").

[251] Peter A. Ornstein, Stephen J. Ceci, & Elizabeth F. Loftus, *Adult Recollections of Childhood Abuse: Cognitive and Developmental Perspectives*, 4 PSYCHOL., PUB. POL'Y & L. 1025, 1027 (1998) (reviewing the studies and discussing the process of encoding memories in the brain).

[252] *Id.* at 1028-29.

[253] *Id*. at 1030.

2. Recognizing the Neural Bonds Between Mental and Physical Conditions

In negligence law, the neuroscience model we propose would abandon the distinction between the treatment of mental and physical disabilities upon the introduction of reliable and relevant neuroscience evidence. Where the neuroscience evidence shows an organic basis in the brain for a party's mental illness, evidence satisfying the rules of admissibility would effectively transform a mental disability into a physical disability, and would allow the mental disability to be considered as one of the circumstances the jury may assess when determining breach of duty. Arguably, transforming this rule would undermine the public policy bases of the rule ignoring mental disabilities in negligence actions. Assuming those policies ever had or continue to have validity,[254] the distinction is not justified when an organic basis for the mental disability can be demonstrated.

Why not simply abandon the rule for mental disabilities altogether and treat all mental disabilities the same as physical disabilities, whether or not the mental disabilities have a demonstrable organic basis? It may well be that the rule will move in that direction as the organic bases of all mental illnesses and disabilities are eventually discovered. For the present, however, in situations in which no organic cause is demonstrable, retaining the traditional rule ignoring the mental disability is not unreasonable. At the least, in those cases the rule serves the concern for objectively verifiable claims of mental disability.

3. Children

[254] *See supra* notes 158-70 and accompanying text.

A neuroscience model of tort law would be especially effective in matters related to the brain development of children, either for negligence or intentional torts. As discussed previously, the general rule for intentional torts is that the child must be capable of formulating the requisite intent for the particular tort for liability to be imposed.[255] In negligence law, the child party is evaluated by the standard of the reasonable child of the party's age, experience, and intelligence.[256] Both issues relate to the developmental capacity of the child and will be discussed together here.

The application of our model to children provides a balance between the objective-generalized evidence of children's brain development and the subjective-individualized needs of the law, taking into account the historical nature of the evidence required. Accordingly, the model proposes that neuroimaging studies showing the level of functional brain development in children of the age of the child in the tort action should be admitted on the issue of the capacity of the reasonable child of the party's particular age. In intentional torts, this evidence would help determine whether the child could have formed the requisite intent for the tort. Keeping in mind that "intent" in the context of intentional torts includes the substantial knowledge that a particular result will occur, the evidence would help clarify the capacity of the child to know and understand what is necessary for the tort. Once again, *Garratt v. Dailey*[257] is helpful. To be liable for battery, the five-year-old child would have had to mean for the plaintiff to fall or know with substantial certainty that the plaintiff would fall (and thereby suffer harm or

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[255] *See* Garratt v. Dailey, 279 P.2d 1091, 1094 (Wash. 1955); *supra* notes 115-17 and accompanying text.

[256] *See* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 10(a) (2005); *supra* notes 147-53 and accompanying text.

[257] 279 P.2d 1091 (Wash. 1955).

offense).[258] The Supreme Court of Washington concluded that the trial court had not fully considered the evidence in light of this rule and remanded the case for clarification.[259] On remand, the trial court determined that the child defendant could be liable for battery.[260] The Washington Supreme Court, upon its second review of the case, stated that "it was necessary for the [trial judge] to consider carefully the time sequence . . .; and this resulted in his finding that the arthritic woman had begun the slow process of being seated when the defendant quickly removed the chair and seated himself upon it."[261] Accordingly, the trial court concluded that "he knew, with substantial certainty, at that time that she would attempt to sit in the place where the chair had been."[262] Neuroscience evidence could add a helpful dimension to the process of determining the child's capacity at the time of the tort.

The traditional approach to determining the developmental capability of the child relies on conventional testimonial and circumstantial evidence. Indeed, in the *Garratt* case, the evidence consisted of two eyewitnesses – the plaintiff and the defendant – with different versions of the events.[263] Until now, conventional evidence has been recognized as legally sufficient. But without neuroscience, the result is a well-reasoned, but imprecise factual conclusion. The new neuroscience offers the promise of greater accuracy.

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[258] *Id*. at 1095.

[259] *Id.*

[260] *See* Garratt v. Dailey, 304 P.2d 681, 681 (Wash. 1956) (reviewing the case for the second time following remand to the trial court).

[261] *Id.* at 682.

[262] *Id.*

[263] *Id.*

With advancements in science, legal paradigms sometimes shift. Indeed, on many occasions new developments have necessitated a move away from established principles in the law. An example from criminal law illustrates this point. When the United States Supreme Court held in *Roper v. Simmons*[264] in 2005 that imposing the death penalty on sixteen- and seventeen-year-old juveniles violated the United States Constitution, the Court overruled a 1989 case in which it had held that capital punishment for juveniles of those ages did not violate the Eighth Amendment's prohibition of cruel and unusual punishment.[265] In 1988, a plurality of the Court had held that principles of decency mandated that persons under the age of sixteen should not be subjected to capital punishment.[266] In 1989, in *Stanford v. Kentucky*, however, the Supreme Court, rejected the "socioscientific" evidence submitted by amici that the death penalty "fails to deter because juveniles, possessing less developed cognitive skills than adults, are less likely to fear death."[267] The Court added that with regard to an Eighth Amendment challenge, "in that struggle, socioscientific, ethicoscientific, or even purely scientific evidence is not an available weapon."[268] Rather, the Court deferred to evolving majoritarian standards of decency, noting the states' lack of a consensus against capital punishment for juveniles.[269] Accordingly, the Court, in a plurality opinion written by Justice Scalia,[270]

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[264] 543 U.S. 551 (2005).

[265] *See* Stanford v. Kentucky, 492 U.S. 361, 380 (1989).

[266] Thompson v. Oklahoma, 487 U.S. 815 (1988).

[267] *Stanford*, 492 U.S. at 377.

[268] *Id*. at 378. The Court vaguely explained its use of the term "ethicoscientific" by stating that "insofar as evaluation of moral responsibility is concerned perhaps the adjective 'ethicoscientific' would be more apt" than "socioscientific." *Id.*

[269] *Id.* at 377.

held that the Constitution did not preclude the imposition of capital punishment on all juveniles.[271]

In reconsidering the juvenile punishment issue in *Roper v. Simmons*, the Supreme Court relied once again on majoritarian standards of decency, but with a significant difference both in its assessment of the states' positions and its willingness to consider scientific evidence. On the question whether a consensus of the states continued to support capital punishment for these older juveniles, the Court concluded that the balance had shifted. Although the Court did not discuss the scientific evidence directly, it referenced the evidence presented by amici demonstrating significant cognitive differences between juveniles and adults.[272] The amicus briefs summarized various scientific and sociological studies, including studies based upon neuroimaging.[273] For example, amici cited neuroimaging studies concluding that in older adolescents, the "regions of their brains involved in governing . . . behavior-control capacities are

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[270] Justice Scalia dissented in *Roper*. *See Roper*, 543 U.S. at 607-30 (arguing that no significant shift in national consensus existed that would support overruling *Stanford*) (Scalia, J., dissenting).

[271] *Stanford*, 492 U.S. at 380 ("We discern neither a historical nor a modern societal consensus forbidding the imposition of capital punishment on any person who murders at 16 or 17 years of age.").

[272] *Roper*, 543 U.S. at 569. In his dissent, Justice Scalia objected to the Court's uncritical adoption of the scientific evidence in the record. He stated: "Given the nuances of scientific methodology and conflicting views, courts – which can only consider the limited evidence on the record before them – are ill equipped to determine which view of science is the right one." *Id.* at 618 (Scalia, J., dissenting).

[273] The amicus brief of the American Psychological Association and the Missouri Psychological Association included a summary of fMRI studies examining individual brains as the persons progressed through adolescence, with particular emphasis on the development of the individuals' frontal lobes. Brief of Amici Curiae American Psychological Association and Missouri Psychological Association at 9-10, Roper v. Simmons, 543 U.S. 551 (2005) (No. 03-633). These amici concluded that the available research at the time demonstrated that "the human brain does not settle into its mature, adult form until after the adolescent years have passed and a person has entered young adulthood." *Id*. at 9. Similarly, the amicus brief of the American Medical Association, the American Psychiatric Association, et al. stated that the available science "reveals that these older adolescents do not have adult levels of judgment, impulse control, or ability to assess risks." AMA Brief, *supra* note 76, at 4. These amici pointed out that much of the information obtained from neuroimaging studies on adolescents developed after the Supreme Court decided *Stanford* in 1989. *Id*. at 9. Discussing the technique of fMRI, the amici emphasized that "[a]dolescents' behavioral immaturity mirrors the anatomical immaturity of their brains." *Id*. at 10.

anatomically immature."[274] These developmental differences between juveniles and adults, the Court said, affect both the reprehensibility of the juvenile defendant's conduct[275] and the deterrent effect of capital punishment.[276] Ultimately, the Court, in a five to four decision, overruled *Stanford* and held that sixteen- and seventeen-year-olds could not constitutionally be subjected to the death penalty.

In *Roper*, it is apparent that the Supreme Court was willing to adjust legal standards to the emerging scientific evidence reflected in evolving majoritarian views of juvenile punishment. In addition, *Roper* is significant for our purposes because the highest Court in the country used the evidence to support a shift in the law. In his dissent in *Roper*, Justice Scalia criticized the Court's reliance on the scientific evidence, saying that "[a]t most, these studies conclude that, *on average*, or *in most cases*, persons under 18 are unable to take moral responsibility for their actions. Not one of the cited studies opines that all individuals under 18 are unable to appreciate the nature of their crimes."[277] But the "average" nature of the evidence before the Court seems to have been exactly why the Court found it valuable. Similarly, "averages" may be especially valuable in tort law to determine the capacity and capabilities of a reasonable child of a particular age.

The amicus brief of the American Medical Association submitted in the *Roper* case in support of the respondent contained generalized information about juveniles that is also relevant in tort actions. Thus, for example, the amici summarized some of the fMRI research data as follows:

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[274] AMA Brief, *supra* note 76, at 4.

[275] *Roper*, 543 U.S. at 570.

[276] *Id*. at 571.

[277] *Id*. 618 (Scalia, J., dissenting).

> First, adolescents rely for certain tasks, more than adults, on the amygdala, the area of the brain associated with primitive impulses of aggression, anger, and fear. Adults, on the other hand, tend to process similar information though the frontal cortex, a cerebral area associated with impulse control and good judgment. Second, the regions of the brain associated with impulse control, risk assessment, and moral reasoning develop last, after late adolescence.[278]

This last point had been demonstrated in numerous studies, and the amici emphasized that full cognitive functioning is not complete until and unless the prefrontal cortex has matured.[279] At least one commentator has criticized the Court for relying on this data without attempting to update it or parse its component studies or determine which studies should be given greater weight.[280] Regardless of the legitimacy of this criticism, the Court made a strong statement in *Roper* that for at least some legal purposes, such scientific data is useful. Accordingly, it is fair to say that similar studies will be introduced in future cases and will find a place in courts' decisions in all areas of the law.[281]

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[278] AMA Brief, *supra* note 76, at 11 (citing numerous fMRI studies). For a discussion of the development of the AMA Brief, from an insider, see Aliya Haider, Roper v. Simmons*: The Role of the Science Brief*, 3 OHIO ST. J. CRIM. L. 369 (2006). The author explained that the authors of the brief received specific guidance from, among others, a panel of research scientists with expertise in brain development, including adolescent brain development. *Id*. at 370.

[279] AMA Brief *supra* note 76, at 16.

[280] *See* Deborah W. Denno, *The Scientific Shortcomings of* Roper v. Simmons, 3 OHIO ST. J. CRIM. L. 379, 396 (2006) (stating generally that "the Court does not treat the research well, either by neglect or misuse"). On the legal implications of *Roper*'s approach to the scientific studies, Professor Denno stated:

> [T]he Court has broken new ground in a scientific venture to decipher the young minds of those who disobey the law. The Court's broadness could also suggest that these different kinds of research studies are comparably eligible for later use in case law. Presumably, the Court felt no need to . . . [draw] lines between which was weak, which was most applicable, which was not. . . . It appears that because the overwhelming amount of evidence supported the *Roper* Court's result, the Court did not think it necessary to push the matter further despite the potential repercussions for other courts.

Id. at 384-85.

[281] *See, e.g*., *supra* notes 80-85 and accompanying text (discussing *Brown v. Entertainment Merchants Ass'n*).

Taking into consideration the developing nature of neuroscience, we believe, on balance, opening the courts to using studies on brain development in children and adolescents is salutary. Our model therefore proposes that this process begin at the trial level with assessment of any neuroimaging evidence proffered for the purpose of explaining generally and objectively the mental capacity and brain development of a child of the party's age. If admitted, such evidence could provide the baseline for the notion of the reasonable child of that age. This evidence would not be dispositive, as individualistic evidence about the child in question – obtained either through neuroimaging or conventional evidentiary methods – would still be required. The jury would be free to weigh the neuroscience with other evidence in reaching its conclusion.

4. The Reasonable Adult Standard

The reasonable person standard at the foundation of negligence law is considered both generalized and objective. In the courtroom, there is little that is truly generalized or objective about the reasonable person, however. Rather, the reasonable person is a random mix of whatever the jury members determine it is when asked to decide what a reasonable person would have done under the circumstances of the specific case.[282] The new neuroscience offers the promise of developing a neuroimage library of the reasonable person. Although the practical utility of such evidence is not on the immediate horizon, courts will increasingly be asked to address such evidence in all types of cases.[283]

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[282] For an example of a state pattern jury instruction defining the duty of care, see Pennsylvania Bar Institute, Pennsylvania Suggested Standard Civil Jury Instructions 13.20 (2011).

[283] *See* Brown & Murphy, *supra* note 92, at 1124-25 (noting, in the criminal law context, the "increasing frequency" with which functional neuroimaging evidence is appearing in state trial courts).

The concept of fault underlying negligence law presumes that a party chooses a course of action based upon multiple factors, such as utilitarian decisions, moral codes, and emotions. Unsurprisingly, neuroscientists have been involved in studying how the brain responds to utilitarian, moral, and emotional dilemmas. Recent studies, including neuroeconomic studies, have sought to understand the distinctions in brain activity when the choice is personal (i.e. more highly emotional) for the subject compared to when the choice is impersonal (i.e. un- or less emotional).[284] The consensus is that emotions play varying roles in moral decisions, and neuroscience is beginning to identify the parts of the brain involved in those processes.[285] Some commentators have recommended that neuroeconomic researchers – those involved in studying choices made on the basis of economic reward – should systematically investigate the role of morality in decision making;[286] the information obtained from such an investigation could illuminate the concept of the reasonable person in tort law.

To the extent that these studies increase in number and consistency, our neuroscience model of tort law would make room for reliable and relevant functional neuroimaging evidence to demonstrate, on average, which brain patterns of the average adult subject's brain relate to choice of conduct and responsibility. One frequent criticism of the testing is that the hypothetical scenarios presented to the subjects for decision making tend to be extreme and highly unusual, thus leaving open the question

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[284] *See, e.g.*, Joshua D. Greene, et al., *An fMRI Investigation of Emotional Engagement in Moral Judgment*, 293 SCIENCE 2105 (2001).

[285] Trevor Kvaran & Alan G. Sanfey, *Toward an Integrated Neuroscience of Morality: The Contribution of Neuroeconomics to Moral Cognition*, 2 TOPICS IN COGNITIVE SCI. 579, 584-85 (2010).

[286] *See id*. at 591-92 ("This will in turn allow for more complete theoretical models of decision making.").

whether the tests have any correlation to more mundane moral decisions.[287] As the scenarios used in the laboratory begin to approximate real-life situations,[288] even in simulation, the picture of the reasonable adult may become clearer. Of course, for the technology to be useful in negligence actions, expert testimony would be required to correlate the studies to the behavior patterns of the reasonable person.

We do not intend to suggest that studies purporting to provide data on the average person would ever be sufficient, on their own, in the courtroom.[289] Substantial obstacles to their use will persist. Any neuroimaging evidence of this sort would need to be compared to the behavior of the defendant under the circumstances of the case and at the historical time of the tort. Currently, a data gap exists between what can be determined generally and what the law demands in individual cases.[290] To the extent that neuroscientists begin to close that gap, the rules of admissibility would eliminate evidence that is not reliable, is irrelevant, or is overly prejudicial. Moreover, courts should cautiously circumscribe its use. Careful jury instructions indicating that information gleaned from fMRI and other studies is merely a single piece of evidence among potentially many would be necessary to avoid over-reliance on the data. As with all new technologies, commentators have expressed concern that the neuroscience will

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[287] *Id*. at 591 (stating that "the dramatic and often times hard to believe cases used in many studies may constitute such a marginal aspect of our everyday life that they cease to tell us much about the topic at all").

[288] *Id*. at 591-92 (noting a series of studies using a model of charitable giving, which does a better job merging the study of moral and economic decisions).

[289] *Cf.* Greely & Wagner, *supra* note 10, at 780 (stating that group averaging of neuroscientific data presents a problem for the law because "the law, for the most part, is not concerned with 'average' people, but with individuals").

[290] Montague, *supra* note 206, at 64.

dazzle the jurors who will place inappropriate emphasis on the neuroscience evidence.[291] These concerns are certainly valid, and the court is well advised to fashion explicit instructions on how the evidence should be used by the jury, including an instruction that the jury has a right to disregard it. As the scientific studies and theories evolve, the legal system must give close scrutiny to the challenges presented by the evidence.

5. Substantiating Harm

Harm is an element of all torts. Under a variety of discrete rules, tort law recognizes both physical harm and emotional harm. In intentional torts, the harm need not be physical injury to person or property. Thus, for example, a battery may offend the person's "reasonable sense of personal dignity,"[292] or a trespass to land may simply invade the possessory interest of the plaintiff in the land.[293] In negligence law, actual harm is required to establish a prima facie case, with compensation available for both the physical harm and any directly associated emotional distress damages.[294]

Pain is an element of physical harm, and in negligence law pain-and-suffering is typically the largest monetary category of damages. Some elements of pain are easy to measure because the injury is one that is common to the medical community or to society in general, such as a broken arm. In addition, some objective measures of pain intensity – such as the need for medication and changes in the person's lifestyle – may be present

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[291] *See, e.g.*, Brown & Murphy, *supra* note 92, at 1190, 1199; Feigenson, *supra* note 23, at 246-48.

[292] RESTATEMENT (SECOND) OF TORTS § 19 (1965).

[293] *Id.* § 163, cmt. d.

[294] RESTATEMENT (THIRD) OF TORTS: PHYSICAL AND EMOTIONAL HARM § 4 & cmt. d (2005).

in the case.[295] But how should pain be measured in tort cases that rely mostly on the subjective reporting of the plaintiff? Professor Adam J. Kolber has examined how functional neuroimaging could be used in substantiating pain and suffering claims in the law,[296] particularly where structural neuroimaging does not yield an organic basis for the reported pain. He has noted that scientific investigation of this issue has begun, and that the research, in its infancy, suggests that functional neuroimaging may be able to play a role in substantiating subjectively reported pain.[297] With the caveats he expressed,[298] we welcome the role that functional neuroimaging may eventually play in demonstrating the existence of pain, and substantiating or refuting subjective reports of pain, in cases in which more traditional structural imaging does not yield a result.

Similarly, if the technology becomes available, the model could allow functional neuroimaging to demonstrate an organic basis for emotional distress in support of a claim of either intentional or negligent infliction of emotional distress. Some commentators have suggested that such neuroscientific studies could transform the face of emotional

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[295] *See* Kolber, *supra* note 46, at 440. Of course, if an issue in the case is whether the pain claim is fraudulent or whether the person is malingering or exaggerating, these objective criteria may be unsatisfactory.

[296] As with our neuroscience model of tort law set forth herein, Professor Kolber has acknowledged that the use of neuroimaging to evaluate pain in litigation is likely years away. *See id*. at 434 (noting the "many conceptual and technological challenges").

[297] *See id*. at 447-48 (discussing Robert C. Coghill, John G. McHaffie, & Ye-Fen Yen, *Neural Correlates of Interindividual Differences in the Subjective Experience of Pain*, 100 PROC. NAT'L ACAD. SCI. 8538 (2003)).

[298] *See id*. at 452 ("It is questionable whether neuroimaging can ever, even in principle, give us direct access to the seat of a person's thoughts or experiences.") Professor Kolber also discussed the privacy implications of using neuroimaging to identify subjective reporting of pain. He concluded that pain privacy interests in tort law, on balance, are weak. *Id*. at 453. In personal injury litigation, plaintiffs are deemed to have waived their privacy interests in their physical and mental conditions relevant to the case, as the plaintiffs themselves have placed these conditions in issue. See, e.g., FED. R. CIV. P. 35, which allows, upon motion, a court-ordered physical or mental examination of a party on showing that the matter is "in controversy" and for "good cause" shown. Rule 35 withstood an early challenge that it infringed upon substantive privacy rights. *See* Sibbach v. Wilson, 312 U.S. 1, 14-16 (1941).

distress claims, although the data is still developing.[299] Indeed, neuroscience could play a significant role in substantiating claims for emotional distress. Intentional infliction of emotional distress claims are viewed as reliable because the defendant's conduct must be objectively outrageous.[300] Still, neuroscientific data could eventually confirm or disprove a plaintiff's claims; thus, notwithstanding the outrageousness of the defendant's conduct, the science could be used to demonstrate fraudulent or exaggerated claims.

In contrast, courts distrust claims for negligent infliction of emotional distress (NIED) when the plaintiff has no physically manifested symptoms, and rules have evolved that require some objective symptomatology.[301] Neuroscience may eventually prompt a move away from the physical symptom rule for NIED, which would constitute a major shift in doctrine. Up to the present, however, functional neuroimaging studies on emotion have tended to concentrate on the role of emotion in decision making.[302] We argue that if studies are able to identify not just emotion, but the seat of mental distress in the brain, such studies could significantly transform NIED. In essence, demonstrating the

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299 *See* Betsy J. Grey, *Neuroscience, Emotional Harm, and Emotional Distress Tort Claims*, 7 AM. J. BIOETHICS 65, 66 (2007) (stating that "[n]euroscience studies are giving us an increasingly better picture of the neural correlates of emotional pain"); Tovino, *supra* note 86, at 46 (stating that "neuroimaging might be able to contribute to either the objective or subjective elements of a plaintiff's negligent infliction of emotional distress claim"); A.M. Viens, *The Use of Functional Neuroimaging Technology in the Assessment of Loss and Damages in Tort Law*, 7 AM. J. BIOETHICS 63, 65 (2007) (discussing the promise of neuroscience in helping to assess non-physical injuries in tort law and the need for more accurate assessments).

300 *See* McQuay v. Guntharp, 963 S.W.2d 583, 585-86 (Ark. 1998); KEETON ET AL., *supra* note 125, § 12, at 56.

301 In *Payton v. Abbott Labs*, 437 N.E.2d 171, 181 (Mass. 1982), for example, the court set out a test for NIED, allowing claims where either the distress arose from the plaintiff's physical injuries, caused by the defendant, or the plaintiff had manifested physical symptoms caused by the distress.

302 *See, e.g.*, Jessica M. Salerno & Bette L. Bottoms, *Emotional Evidence and Jurors' Judgments: The Promise of Neuroscience for Informing Psychology and Law*, 27 BEHAVIORAL SCI. & L. 273 (2009) (discussing neuroscience studies demonstrating the impact of highly emotional evidence on jurors' decision making process).

presence of distress over time in an individual could lead to an extension of the majority physical symptom rule. While the images would not document a particular set of symptoms, they could help corroborate the plaintiff's claims that his or her emotional distress was real. This would bear some relationship to cases in which the presence of a toxin in the plaintiff's body has been deemed sufficient physical symptomatology to support a claim for NIED.[303] In both, a hidden basis for emotional distress could be objectively substantiated, but not in the traditional sense. Doctrine could shift to accommodate these physical manifestations of distress as physical injuries compensable in tort. Conceivably, the physical symptom rule could become a thing of the past as objective means of identifying and verifying distress could render it unnecessary.

B. Challenges Applying the Model

1. The Laboratory

From the foregoing discussion, it is apparent that the neuroscientific studies must continue to progress and improve in sophistication, accuracy, and interpretive consistency to be useful in tort cases. In the laboratory, the accuracy and credibility of the studies could be affected by several factors. First, the experimental design may be subject to challenge for bias or for an unreliable number or composition of subjects.[304] Second, the limitations of the hardware and software in creating fMRI images may inhibit accurate collection and interpretation of the data. Moreover, the scanners and software used for similar studies in different venues is not identical, and results may vary for that reason.[305]

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[303] *See* DiStefano v. Nabisco Inc., 767 N.Y.S.2d 891 (N.Y. App. 2003).

[304] Greely & Wagner, *supra* note 10, at 778-79.

[305] Grafton, *supra* note 62, at 58; Greely & Wagner, *supra* note 10, at 781 (noting that MRI machines can be "finicky").

Third, determining statistical significance of the data is a difficult task, often fraught with controversy.[306] Subtle changes in brain activity, particularly when testing the brain functions used in complex cognitive processes, require high resolution images and accurate statistical models.[307]

Given the current limitations of the technology, and recognizing that the accuracy of the technology will improve, interpretation of the images will continue to be a major challenge. Researchers currently disagree over the interpretive analysis, both in relating the functional images of the brain to the structural images and in deciding what the resulting information means.[308] The debate in the scientific community will continue.

Even with greater accuracy, the scientific data will remain interpretive by nature.[309] For example, to understand brain patterns in a specific individual, researchers examining BOLD signals in fMRI studies must differentiate between activated areas of the brain associated with the task under study, and those not associated with the task.[310] Professors Greely and Illes have pointed out some of the interpretive challenges related to individual variations among subjects involving identical tasks: "It is . . . possible that two independent subjects will show different patterns of [brain] activation while their behavioral performances are comparable. Although subjects perform the same behavioral task, they might employ different strategies, thereby recruiting different neural

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[306] Greely & Wagner, *supra* note 10, at 782.

[307] Greely & Illes, *supra* note 37, at 381 (discussing voxel size, filters, and the reliability of statistical comparisons in fMRI).

[308] Brown & Murphy, *supra* note 92, at 1162 (stating that "the relationships within the human brain between structure and function are not one-to-one").

[309] *See id*. at 1162-63 (stating that "we are at present a considerable distance away from the precise mapping of complex mental state onto unique brain activation patterns").

[310] Greely & Illes, *supra* note 37, at 383.

networks, resulting in different patterns of activation."[311] Interpretation of these variations will be crucial to their use in the law.[312]

Another challenge of using functional neuroimaging is that the concept of the "reasonable" adult is not often the focus of the neuroscience studies. Rather, neuroscientists are more frequently engaged in understanding abnormalities,[313] but the absence of an abnormality does not necessarily indicate the presence of what could be deemed "normal" or "reasonable" behavior.[314] Moreover, in the absence of an abnormality detected through neuroimaging, a subject may still have an undetected abnormality.[315] The scientific community anticipates the development of databases of neuroscientific information, including the parameters of what is considered "normal."[316] Such databases would provide the legal community with an important resource for using and understanding neuroscientific data.

What is clear is that the influx of the new neuroscience into the legal mainstream is gaining speed and complexity. Neuroscience evidence will only become more

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311 *Id*. at 382.

312 *See* Morse, *supra* note 28, at 147 (urging caution even where there exists a "good neuromarker for a legal criterion").

313 Tancredi & Brodie, *supra* note 194, at 287-88 (stating that what is considered normal "most likely represents the non-state that is being investigated").

314 What is considered "normal" is open to question on many levels, as many factors affect human behavior. *See* Grafton, *supra* note 62, at 57.

315 Tancredi & Brodie, *supra* note 194, at 288.

316 Montague, *supra* note 206, at 61; *see also* Michael S. Gazzaniga, *We are the Law: The Human Mind, Free Will and the Limits of Determinism*, Remarks at the Law and the Brain Conference (Mar. 15, 2011) (stating that the field is moving toward data-oriented statistical analysis). Montague has summarized the need for databases as follows: "(1) lack of measures across populations of humans, and (2) the lack of methods and efforts to compare individual responses (brain or behavior) to the distributions yet-to-be-characterized." Montague, *supra* note 206, at 64. He has also expressed the need for "a new style of data collection (very large scale)." *Id.*

prevalent and more sophisticated, not less so. It will become the job of the law to sort out the ways in which these technologies assist – or confound – the application of the law. Increased interaction and information sharing among all participants in the law and neuroscience endeavor, including neuroscientists, psychologists and psychiatrists, judges, and attorneys, is essential.

2. *The Courtroom*

The scientific methodologies that yield the neuroscientific evidence relevant to tort law are, for the most part, accepted techniques. As Greely and Wagner noted in the judicial *Reference Manual on Scientific Evidence*, they "are generally accepted scientific procedures, both for use in research and, in most cases, in clinical care. Each one is a good scientific tool in general."[317] The utility of the data acquired through these techniques, when subjected to evidentiary standards in the courtroom, is more problematic, however.

We have suggested that the new neuroscience has the potential to minimize error in tort actions by providing greater accuracy in decision making. In the courtroom, the expert testimony must meet the applicable evidentiary standards. To date, neuroimaging studies have had difficulty meeting the standards.[318] Increasingly, however, courts will be asked to consider such evidence for many purposes. Until the studies have been sufficiently replicated and peer reviewed and/or accepted in the relevant scientific community as reliable, admissibility problems will continue. For studies accepted as reliable, relevancy to the issues of the case will persist as a problem.

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[317] Greely & Wagner, *supra* note 10, at 776.

[318] *See, e.g.*, United States v. Semrau, No. 07-10074 M1/P (W.D. Tenn. May 31, 2010) (discussing at length fMRI evidence proffered for lie-detection purpose in relation to the *Daubert* test).

In *Frye* jurisdictions, a party seeking to introduce neuroscience evidence will face the single reliability question of general acceptance. Accordingly, novel science, such as neuroimaging techniques, must meet this general acceptance test to the satisfaction of the court. It is far from a foregone conclusion that these technologies would satisfy the *Frye* test, as they are new enough to be in the midst of considerable debate about exactly what they can demonstrate. Because of the studies' novelty, experts supporting the introduction of such studies in tort actions will be asked to demonstrate that the studies have achieved a level of peer acceptance that will make them legally reliable. General acceptance requires replication of the studies and an acceptable rate of error.[319] fMRI scans are expensive and require equally costly experts to interpret them in litigation,[320] thus rendering their current use prohibitive in many legal contexts.

The same problems occur in the federal courts and other *Daubert* jurisdictions, where the novelty of functional neuroimaging technologies will continue to be problematic. The *Daubert* Court stated that "well-established propositions are less likely to be challenged than those that are novel, and they are more handily defended."[321] Neuroscience evidence based on functional neuroimaging is new to the courts and still evolving; accordingly, the courts will consider it to be novel evidence, even if it has been a feature in neuroscience and cognitive psychology circles for several decades.[322]

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[319] *See* Greely & Wagner, *supra* note 10, at 787 (stating that neurosciences has not yet "undergone the kind of standardization seen, for example, in forensic DNA analysis").

[320] Id. at 797.

[321] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 593 n.11 (1993).

[322] The courts should consider, however, the extent of its use and its value in nonjudicial contexts when determining the reliability of the evidence.

Will courts seek ways to give the benefit of doubt to emerging technologies, such as neuroimaging, as they move closer to satisfying the evidentiary standards for admissibility? Not necessarily, and some courts have applied the rules of admissibility stringently.[323] But some precedent exists for assessing novel evidence with lenity. In *Smith v. General Electric Company*, the plaintiff presented a "novel and controversial scientific theory of causation that, while plausible, [was] nonetheless on the outer rim of supportable science."[324] Although the federal court stated that the defendant's expert evidence likely had more weight than the plaintiff's evidence, the court deferred to the fact-finding role of the jury and held the plaintiff's evidence admissible. The court stated that the plaintiff's experts were "serious scientists with controversial views that are in many respects on the periphery of the mainstream, but views that are not so divorced from a scientific method of investigation that they can be dismissed as quackery or armchair conjecture."[325] Still, even the *Smith* court would agree that some limits are necessary to meet the letter and spirit of *Daubert*.

Who should set the admissibility standards for neuroimaging evidence in the courtroom – the scientific community or the legal community?[326] The *Daubert* general observations attempt, somewhat awkwardly, to transform scientific standards into legal

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[323] *See, e.g*., O'Conner v. Commonwealth Edison Co., 13 F.3d 1090 (7th Cir. 1994); Chikovsky Ortho Pharmaceutical Corp., 832 F. Supp. 341 (S.D. Fla. 1993).

[324] 2004 WL 870832, at *1 (D. Mass. 2004).

[325] Smith, at *4.

[326] *See* Schauer, *supra* note 237 (arguing that legal standards of evidentiary admissibility should have an important role in relation to neuroimaging evidence, but acknowledging that brain-based lie detection is likely not yet warranted in the courtroom).

standards.[327] There is a certain incompatibility between science's focus on methodology and the law's focus on normative judgments. Scientists refrain from drawing causal conclusions – such as a conclusion that a person's brain rendered that person incapable of formulating the mens rea to commit a particular crime – absent an empirical certainty. For scientists, observations and conclusions depend solely on the validity of the methodology.[328] In contrast, the law asks experts to extrapolate from their observations to answer normative questions generated by the law applicable to the particular case. The courts have not yet resolved this tension, and there is no precise method for translating scientific knowledge into legal certainty or factual truth in the courtroom. Neuroimaging evidence is currently situated at the crossroads of these conflicting notions of truth.

3. The Purposes and Goals of the Tort System

Arguably, the introduction of neuroscience into tort doctrine and tort cases could be viewed as undermining several fundamental goals and policies of tort law. Those who embrace a pure corrective justice model of tort law may find a model of tort law that includes neuroimaging evidence to conflict with the moral basis of corrective justice. Corrective justice is based upon the notion of equality when one person has committed wrongdoing and the other is divested of something that he or she possessed prior to the

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[327] *See supra* notes 220-28 and accompanying text.

[328] *See* FAIGMAN ET AL., supra note 193, § 4:2, at 137 (2005-2006). The authors state the scientists' perspective as follows:

> To real scientists a finding of fact is only as good as the methods used to find it. Scientific method is the logic by which the observations are made. Well designed methods permit observations that lead to valid, useful, informative answers to the questions that had been framed by the researcher. For scientists, the key word in the phrase "scientific method" is *method*. Methodology – the logic of research design, measures, and procedures – is the engine that generates knowledge that is scientific.

Id. Lawyers, by contrast, ask a different set of questions. The fit between the product of scientific inquiry and the product of legal inquiry, particularly in the courtroom, is not a close or natural one. Rather, it is forced and artificial.

wrongdoing.[329] Corrective justice presupposes that one party has gains and enrichment from the wrongdoing to the other person, and justice in this sense means shifting these gains to the injured person.[330] Corrective justice, however, does not eliminate the need for causation.[331] A neuroscience model of tort law would not offend corrective justice, but would rather remain neutral toward or even enhance it by aiming toward greater accuracy in determining, variously, whether a tort has occurred, whether a loss has occurred, and even the wrongful nature of the act.

Instrumentalists may also object to a neuroscience model of tort law on the ground that it would undermine the social policies of tort law, regardless of which criterion is chosen as the basis. Thus, for example, supporters of a policy to hold mentally challenged persons liable for their torts under all circumstances would argue that our proposal to treat mental disability the same as physical disability in some cases would countermand the social policy of encouraging relatives and caregivers of the mentally challenged to better monitor and supervise their activities so as to avoid tort liability. In contrast, however, the model would support other social policies, in this case encouraging society to make available diagnosis and treatment of organically-based mental conditions.

Process goals of deciding cases on the merits and encouraging truth in the courtroom would be advanced through appropriately admitted neuroscientific evidence. Some might argue that this would produce a counter-effect in that juries would give

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[329] *See* Ernest J. Weinrib, *Corrective Justice*, 77 IOWA L. REV. 403, 408 (1992).

[330] *Id*. at 409; *see* DOBBS, *supra* note 101, § 8, at 12.

[331] *See* DOBBS, *supra* note 101, § 9, at 14; John G. Culhane, *Tort, Compensation, and Two Kinds of Justice*, 55 RUTGERS L. REV. 1027, 1073 (2003).

undue weight to the neuroscience in making their decisions. But the same has been said of most kinds of scientific and technical evidence, and such evidence appears regularly in the courtroom. The attorneys, through appropriate cross-examination, and the court, through careful jury instructions, must address neuroscience as they do the other expert evidence. This could mean sometimes preventing the jury from hearing the evidence at all.

Although theorists like to debate the underlying purposes of tort law as though each could be achieved in a vacuum, the reality is that tort law does not exist merely in theory. Rather, it is informed by state interests,[332] community standards, and economic goals in what is a complex mixture of purposes that sometimes conflict. Indeed, some tort cases result in a kind of hybrid of corrective justice and distributive justice.[333] With the notable exception of true strict liability,[334] tort law requires fault. While we propose that the new neuroscience should be used to assist decisions on wrongdoing, it should not be used as a substitute for fault in tort law.[335]

CONCLUSION

Developments in neuroscience through the use of functional neuroimaging and other recent technologies have set the stage for a new era in tort law, one in which

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[332] *See* Culhane, *supra* note 331, at 1074 (stating that corrective justice "cannot be completely 'walled off' from the broader society in which it exists").

[333] *See, e.g.*, *id.* at 1079 (discussing, in particular, Justice Traynor's famous concurrence in *Escola v. Coca-Cola Bottling Co*., 150 P.2d 436, 440 (Cal. 1944)).

[334] Most notably, this category would include vicarious liability, certain product liability claims, and, to a lesser degree, claims based upon abnormally dangerous activities.

[335] We recognize that consideration of the new neuroscience within the context of the purposes and goals of the tort system is well beyond the scope of this Article and leave complete analysis of this matter for future amplification.

evidence of brain activity may eventually transform our comprehension of the underlying doctrinal rules. Neuroscience studies that explain many mental processes may soon deepen our understanding of such frequently used tort-doctrine terms as "reasonable person," "intent," and "mental disability". Although the neuroscience developments are fascinating, they face cautious interest in the courtroom and frequent exclusion. The number and frequency of the developments in neuroscience will only increase. Tort law must be responsive to these developments and must be prepared to address the challenges posed by them. It is not too early to begin to fashion a neuroscience model of tort law to prepare the legal system for the sweeping changes to come.