In this comment, Roth, the author, develops the thesis that neuroscience evidence in its current stage of development has little utility with regard to proving contractual incapacity or criminal insanity in Louisiana. She has concluded, in both instances, that the essential elements of incapacity, especially those related to behavior, have been defined through the codification of societal rules, rather than through scientific inquiry. In handling the various questions created by her inquiry, she has elevated a secondary theme of the comment, the relationship between law and science, to a position of primacy. In so doing she has, in this well-organized, well-analyzed, and well-written comment, left room for some clarifying observations about this relationship.

An obvious place to commence clarifying scrutiny is with the term “neuroscience” in the title and the body of the comment. In support of this selection is the author’s opinion that “lawyers and judges ought to be aware of the special issues that may arise in cases involving offers of neuroscience evidence.”1 Somewhat troubling in
the abstract; this mysterious word seems to have elicited an almost hysterical reaction, generating references that could be talking points at a Luddite conference on the matter: a “neuroscience revolution,” “fears of a neuroscience takeover,” “neuroscience research does invite us to question our traditional conceptions of human nature, decision making, morality, and free will.”

Scientific research on any part of the human body with the prefix “neuro” in its name could be referred to by this title. However, with a question mark or two, it turns out the author is referring primarily to “sophisticated and intricate brain-scanning technology,” the discipline of neuroimaging. The effect is as if one took a history course titled “World War II,” and studied only the D-Day invasion. Thus, in the comment and this review, one should consider brain imaging when the word “neuroscience” is used, unless it is specifically stated otherwise. This experience underscores the admonition that lawyers who write about science must become familiar with the methodologies of literature research of science and become comfortable in seeking primary sources for the science of their immediate interests.

Increasingly in Louisiana, imaging of the head is being used in personal injury cases to reveal to the jury the physical disruption of the brain in explaining the outcome of injury, treatment, or both. Technology such as magnetic resonance imaging (MRI), with increasingly more powerful magnets (to 3.0 tesla or greater), is being used to define in research what at this time is not useful in the clinical treatment of patients. Expert imaging results are reported in two

2. The troublesome note is that the term “neuroscience” not only detracts from the idea of imaging technology, but also from the concept of medical science, at the base for all the technology referenced in the comment.
4. Roth, supra note 1, at 199.
5. Id.
6. The development of a dual need for expertise in law and medicine has spurred growth in the M.D./J.D. programs in the United States. For a good example of the results of combining techniques for legal research and for medical research, see Jay A. Gold et al., Daubert v. Merrell Dow: The Supreme Court Tackles Scientific Evidence in the Courtroom, 270 JAMA 2964 (1993).
7. Tesla is a unit of magnetic flux density, related to the power of the magnet in, for example, an MRI.
8. Generally, in the medical sciences, there are two classes of professional literature. The first, and principal location of original scientific work, are the journals of the profession of medicine. See, e.g., A.E. Mamere et al., Evaluation of Delayed Neuronal and Axonal Damage Secondary to Moderate and Severe Traumatic Brain Injury Using Quantitative MR Imaging Techniques, 30 Am. J. Neuroradiology 947 (2009). An example of a secondary source for medical science in a review article or a chapter in a textbook is Brian J. Jellison et
Architectural imaging reveals the anatomy of the brain along with any physical disruption. Functional imaging focuses primarily on the metabolic activity of the brain considered injured. Collectively, the two imaging technologies are referred to as structural imaging. The current problem with the results so far is the inability to relate the imaging evidence of structural injury to clinical evidence of injury. In other words, there has yet to be shown a consistent relationship between anatomy and metabolic injury and cognitive (behavioral) outcome.

A good example of this problem is seen in the management of cerebral concussion. With the standard MRI (1.5 tesla or less), the brain usually appears normal. With the more powerful MRI, scanning reveals a very chaotic brain in some areas. While finer and more sophisticated research protocols are uncovering more subtle proof of physical injury to the brain, questions of causation must await results of more protracted study of behavior of cognition. The time and money spent on these studies is directly proportional to the perceived social and economic costs of the injuries. The separate gathering of clinical data and imaging data can lead to confusion and apparent distrust in the interpretation of their results. It is as though the author has joined the frustrated line of dualists who recognize our abilities to look upon the brain, but have yet to “look in upon the human mind, and see its operations and true condition[s].”

One of the more important side issues the author addresses is group-to-individual inference, a critical law/science interface, where science is translated into law. Most scientific population studies address profiles of groups reduced to averages, with probabilities of individuals deviating from those averages becoming scientifically significant when the chance of an occurrence is one in twenty or less. When the odds are 5% or less, chance was involved in an occurrence, and science will declare it could (or can) happen, unrelated to chance. However, in an individual case, it cannot tell us it did happen. Once science tells us in a population something could happen, it is up to the

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9. A philosophy advanced by and since Aristotle that the human interacts with their environment through their mind that is separate from the brain, the organ responsible for the data input into the mind. See MIND AND BRAIN: THE MANY-FACETED PROBLEMS (Sir John Eccles ed., 1982).

law to tell us if something *did* happen, based upon a preponderance of the evidence (more likely than not, 51%-49% probabilities). While experts in medical science may be called to explain the science to a jury, the jury still decides. It is often the nature of the circumstantial evidence accompanying the science that may dictate the burden for the jury.  

Roth’s comment is a serious look at the relationship that exists between law and medical science as both come to grips with constant change. It is fitting that we let Roth summarize and close with these additional observations: First, “[P]hysical damage to the brain ‘do[es] not conclusively cause immoral behavior or make one unable to abide by the law.’” Second, “[S]cientific research and data typically depend on generalizations at the ‘population level,’ [while] legal analyses are generally concerned with capacities relating to particular parties and particular transactions at the ‘individual level.’”

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11. In medicine and public health, the most common science format is that of epidemiology, the science of Daubert. See Gold et al., supra note 6.


13. *Id.* at 216.