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# VIOLENCE ON THE BRAIN: A CRITIQUE OF NEUROSCIENCE IN CRIMINAL LAW

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VIOLENCE ON THE BRAIN:  
A CRITIQUE OF NEUROSCIENCE IN CRIMINAL LAW

*Amanda C. Pustilnik\**

*Abstract*

*Is there such a thing as a criminally “violent brain”? Does it make sense to speak of “the neurobiology of violence” or the “psychopathology of crime”? Is it possible to answer on a physiological level what makes one person engage in criminal violence and another not, under similar circumstances?*

*Current research in law and neuroscience is promising to answer these questions with a “yes.” Legal scholars working in this area claim that we are close to realizing the “early criminologists’ dream of identifying the biological roots of criminality.” In the grip of a “neuroeverything” craze, legal scholars, practitioners, and lawmakers have already begun incorporating new “neurolaw” into criminal adjudications, lawmaking, and criminal law scholarship. These breathless hopes for a neuroscientific transformation of the criminal law, although based in the newest research, are part of a very old story. Criminal law and neuroscience have been engaged in an ill-fated and sometimes tragic affair for over two hundred years. Two failures have appeared in current work that mirror precisely the prior failures. First is the claim is that the various phenomena we call “criminal violence” comprise a single entity, which arises causally from dysfunction within specific locations in the brain (“localization”). Second is that violent crimes are committed by people who are essentially biologically different from typical people (“otherization”). This Article first demonstrates the parallels between current neurolaw claims and past movements in law and neuroscience: phrenology, Lombrosian biological criminology, and lobotomy. It then engages in a scientific critique of the shortcomings of current neurolaw claims about the neurological bases of criminal violence. Drawing on research and interviews with leading neuroscientists, this Article shows that causally localizing what we call “criminal violence” to bits of the brain is highly scientifically contestable and epistemologically untenable. In viewing the criminal law-neuroscience relationship through the lens of history of science, this Article hopes to offer caveats to legal users of “neurolaw” and a realistic and constructive portrait of how current neuroscience might inform criminal law discourse about regulating violence.*

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## INTRODUCTION

Is there such a thing as a criminally “violent brain”? Does it make sense to speak of “the neurobiology of violence”<sup>1</sup> or the “psychopathology of crime”<sup>2</sup>? Is it possible to answer on a physiological level what makes one person engage in criminal violence and another not, under similar circumstances?

Current research in law and neuroscience is promising to answer these questions – and to answer each of them with a “yes.” Legal scholars working in this area claim that we are “close[] to realizing the early criminologists’ dream of identifying the biological roots of criminality.”<sup>3</sup> They further urge the sweeping proposition not that some criminals suffer from mental diseases but that “‘crime [is] a disease.’”<sup>4</sup> This “disease” does not arise from metaphorically “sick” personal choices or social conditions; rather, they claim that neuroscientists have discovered in criminal offenders a “‘biological brain-proneness’ toward violence” that substantially explains the existence of violent crime.<sup>5</sup>

These breathless promises, although based in the newest findings and technologies, are part of a very old story. Criminal law and neuroscience<sup>6</sup> have been engaged in an episodic and ill-fated love affair for over two hundred years. In each era, it

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<sup>1</sup> JAN VOLAVKA, *NEUROBIOLOGY OF VIOLENCE* 1 (1995).

<sup>2</sup> ADRIAN RAINE, *THE PSYCHOPATHOLOGY OF CRIME: CRIMINAL BEHAVIOR AS A CLINICAL DISORDER* 3 (1993).

<sup>3</sup> Richard E. Redding, *The Brain-Disordered Defendant: Neuroscience and Legal Insanity in the Twenty-First Century*, 56 *AM. U. L. REV.* 51, 56 (2006).

<sup>4</sup> Jeffrey L. Kirchmeier, *A Tear in the Eye of the Law: Mitigating Factors and the Progression Toward a Disease Theory of Criminal Justice*, 83 *OR. L. REV.* 631, 631 (2004).

<sup>5</sup> Redding, *supra* note 3, at 56 (quoting Nathaniel J. Pallone & James J. Hennessy, *Brain Dysfunction and Criminal Violence*, 35 *SOCIETY* 21, 21 (1998)).

<sup>6</sup> I am using “neuroscience” here as an umbrella term referring generally scientific investigations of human brain structure and function, including those that occurred prior to the coinage of “neuroscience” as the term for such investigations.

starts with hope and bold promises and a belief in the genuine mutual compatibility between the two fields, but ends in disappointment and even tragedy. With every resurgence in this mutual infatuation, lawmakers and scientists swear that they won't make the same mistakes this time – principally because this time, science has matured. The fraught relationship between criminal law and neuroscience is worth re-examining now, in light of its history, because we are at a moment of renewed infatuation. Indeed, we are at the threshold of what some claim is no less than a neuroscientific revolution within law that promises biologically-based explanations of general features of human conduct.<sup>7</sup> Neuroscience evidence and principles have already begun to find their way into criminal adjudications, lawmaking, and criminal law scholarship. This explosion of interest in neuroscience to illuminate the (presumably universal) workings of the human mind has spawned a veritable neuro-everything craze – from neuroethics,<sup>8</sup> neuroeconomics,<sup>9</sup> and neurohistory,<sup>10</sup> to neurolaw<sup>11</sup> and neurojurisprudence.<sup>12</sup> From these developing explanations of what happens inside the black box of the mind,

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<sup>7</sup> See, e.g., Semir Zeki & Oliver R. Goodenough, *Law and the Brain: An Introduction*, 359 PHILOS. TRANS. R. SOC. LOND. 1661, 1661 (2004) (calling development of neurolaw an all but “ineluctable consequence of the current assault on the secrets of the brain.”).

<sup>8</sup> See, e.g., MICHAEL S. GAZZANIGA, *THE ETHICAL BRAIN* (2005) [“GAZZANIGA, ETHICAL BRAIN”] (defining neuroethics as the study of the relationship between ethical reasoning and in-built brain mechanisms or patterns; arguing that there is a universal ethical template built into the brain); cf. DAI REES & STEVEN ROSE, *NEW BRAIN SCIENCES: PERILS AND PROSPECTS* (2004) (arguing that while people self-evidently use their brains for ethical reasoning, the content of ethical judgments is not biologically encoded into people's brains). The University of Pennsylvania has founded a Center for Neuroethics (see <<<http://neuroethics.upenn.edu/>>>) and there is, of course, a Neuroethics & Law Blog (see <<<http://kolber.typepad.com/>>>).

<sup>9</sup> See, e.g., Morris B. Hoffman, *The Neuroeconomic Path of the Law*, 359 PHILOS. TRANS. R. SOC. LOND. 1667 (2004); Paul J. Zak, *Neuroeconomics*, 359 PHILOS. TRANS. R. SOC. LOND. 1737 (2004).

<sup>10</sup> DANIEL LORD SMAIL, *ON DEEP HISTORY AND THE BRAIN* (2007) (arguing that the field of history should be expanded to include “neurohistory”; Smail contends, generally, that aspects of human prehistory can be divined from the structure of, and inheritance evidenced by, our brains).

<sup>11</sup> Jeffrey Rosen, *The Brain on the Stand*, N.Y. TIMES MAGAZINE, Mar. 11, 2007 (coining “neurolaw” to describe uses of neuroscience in lawmaking and in legal doctrine).

<sup>12</sup> Redding, *supra* note 3, at 53 (arguing that the criminal law must develop “neurojurisprudence” to account for knowledge being developed in the brain and cognitive sciences).

lawmakers will, some argue, be able to craft criminal law regimes that for the first time in human history incorporate a “biologically based – and hence, totally accurate – view of human nature.”<sup>13</sup>

No doubt, our knowledge of the brain has progressed over time. At the same time, the yearning for scientific, deterministic knowledge of the human nature and the nature of evil remains insatiable. Criminal law seems to be once again falling to the allure of the overly-imperialistic claims that some neuroscientists are making about the potential of their field to transform the our understanding and ability to predict and interdict criminality. And it is falling for much the same elements of the claims as it did in the previous iterations of the love affair. Two failures seem to have appeared again that mirror precisely the failures of the prior rounds. The first is the claim is that the multifarious phenomena we call “violence” is a single entity, which arises causally from dysfunction located within a few brain regions (“localization”). The second, related notion is that violent crimes are committed by people who are essentially biologically different from neurotypical people (“otherization”).

In viewing the criminal law-neuroscience relationship through the lens of history of science, this Article hopes to offer both caveats to legal users of “neurolaw” and a realistic and constructive portrait of how current neuroscience might inform criminal law discourse about controlling or regulating violence. Three past episodes in the criminal law-neuroscience affair show how asking the wrong questions about the brain and violence can lead systematically to the wrong answers. Each of these movements – phrenology, Lombrosian biological criminology, and psychointervention

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<sup>13</sup> GAZZANIGA, *ETHICAL BRAIN*, *supra* note 8, at 4.

(lobotomy and electrode implantation) – focused on localizing where violence takes place in the brain and then understanding and controlling the putative neurological bases of criminal violence. These episodes are well known. Usually, they are dismissed as unfortunate historical curiosities, errors we have now graduated beyond in contemporary science. In fact, however, they prefigure the problems already arising in the law and neuroscience of the twenty-first century: A misleadingly simplistic localization of complex individual and interpersonal behaviors (all called “violence”) to isolated parts of the brain, and, concomitantly, the construction of people who engage in violence as biologically – if not even racially – “other.”

There are obvious reasons why criminal law scholars and practitioners would take particular interest in any insight neuroscience could shed on violent conduct: The criminal law takes as its object the definition, deterrence, and punishment of proscribed violent behavior; indeed, the regulation of interpersonal violence (and the arrogation to the state of the prerogative to inflict violence) arguably is the primary focus of criminal lawmaking and theory.<sup>14</sup> So explanations of the causes of – and potential ways to identify and address people prone to – violence are, at least in theory, of tremendous criminal law significance.

This Article will contend that neuroscience cannot provide complete, or even sufficient, explanations of criminal violence by reference primarily to purported neurobiological dysfunctions within isolated parts of offenders’ brains. Rather, people

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<sup>14</sup> See, e.g., DAVID GARLAND, PUNISHMENT AND MODERN SOCIETY: A STUDY IN SOCIAL THEORY 69-81 (1990) (discussing Durkheim’s view of the criminal law as institutionalized vengeance). See also, e.g., James Q. Whitman, *Between Self-Defense and Vengeance/Between Social Contract and Monopoly of Violence*, 39 TULSA L. REV. 901, 922-23 (2004) (Symposium: Twenty-Five Years of George P. Fletcher’s Rethinking Criminal Law) (discussing the “the monopoly of violence theory” as a compelling “account of the purposes of criminal law”).

participate in and construct a biosocial reality that consists in part of internal states, and in part of external factors, which are in constant dialogue. Causally localizing the phenomena we call “criminal violence” to bits of the brain is both highly scientifically contestable and historically and epistemologically untenable.

Part I of this Article, A History of Violence, examines three movements in law and brain science that prefigure and inform current efforts. Going back to the late 18<sup>th</sup> century, criminologists and lawmakers have attempted to place criminal law on a “scientific” footing. The tragic shortcomings of the work of earlier eras now are dismissed as unfortunate historical curiosities.<sup>15</sup> This Part will contend, however, that past efforts to invent a scientific criminal law based on brain science foundered on many of the same shoals that could undermine current neurolaw efforts; the history of these failures thus provides a highly relevant and instructive set of lessons.

This Part examines the major historical attempts to tackle violence scientifically within law: phrenological studies of criminal behavior in the late 18<sup>th</sup> and early 19<sup>th</sup> centuries, Cesare Lombroso’s “scientific” criminology in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, and psychointervention – psychosurgery and electrode implantation – arising out of the social turmoil of the mid-20<sup>th</sup> century. In each of these subsections, I will show how these seemingly disparate (although equally ill-fated) attempts to scientifically solve the problem of violent crime evolved similarly: Each started out with a pre-commitment to the idea of brain localization of violence, often based on studies either of extreme human pathology or studies of animals with substantially different

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<sup>15</sup> Brent Garland & Mark S. Frankel, *Considering Convergence: A Policy Dialogue About Behavioral Genetics, Neuroscience, and Law*, 69 SPG LAW & CONTEMP. PROBS. 101, 109 (2006) (calling prior efforts to integrate brain sciences with criminal law through, *e.g.*, phrenology and lobotomy, “misguided” because they were based on “immature science”).

neuroanatomy and evolutionary histories than humans. The scientific and medical proponents of each had an express interest in the social implications of their work and sought to reform or revise criminal law through their work. And, legal scholars and criminal law actors embraced and put into practice regimes based on the work before an ultimate backlash shut it down.

Moving from historical to current efforts to ground criminal law in brain science, Part II describes current scholarship on the putative neurobiology of violence. It presents arguments of influential scholars that there is a deterministic relationship between violent behavior and what they identify as brain dysfunction. Such scholars embrace the view that the “mechanistically determined” brain contains “all the essential ingredients of the human condition”;<sup>16</sup> accordingly, this renders each individual’s brain the most relevant level at which to understand criminal (and all other legal and social) phenomena. This Part also will examine causal claims made from neuroimaging studies through examining an exemplary study on brain differences between pedophiles and typical adults. Because scholarship described in this Part emphasizes the biology of individual brains above other modes of explaining criminality, it could be termed neuroreductionism. A full-scale critique of reductive individualism in legal uses of brain sciences is beyond the scope of this paper. However, this Part will set up the Article’s consideration of the “practical, technical, and epistemic concerns”<sup>17</sup> posed by such neuroreductionism in criminal law.

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<sup>16</sup> Dean Mobbs, *et al.*, *Law, Responsibility, and the Brain*, 5 PLOS BIOLOGY 693, 693 (2007).

<sup>17</sup> O. Carter Snead, *Neuroimaging and the “Complexity” of Capital Punishment*, 82 NYU L. REV. 1265, 1287 (2007).

Part III shows that the scientific hurdles to the proposed brain-based view of violent crime are formidable, perhaps insurmountable. Engaging in a scientific critique of the current neuroreductionist claims within legal scholarship, it demonstrates the major barriers to the causal localizability of violence to specific parts of the brain (particularly, the prefrontal cortex<sup>18</sup> and the amygdala<sup>19</sup>). This Part looks first at the state of knowledge in neuroscience about the localizability of brain function generally, starting with sensory-motor localization. It then presents the major scientific and conceptual challenges that leading neuroscientists have raised in relation to attempts to localize higher cognitive functions. Finally, it engages in a close critique of unsupportable extrapolations from animal models and other design flaws in the science on which legal scholars are relying to substantiate their localization claims.

The final Part draws out the conceptual and epistemological commonalities among current and historical criminal law efforts to understand violence neurobiologically. It will argue that past and current efforts to develop a purely brain-based understanding of violence in criminal law manifest a central epistemological error: the localization fallacy.<sup>20</sup> Localization, as the name suggests, is the endeavor of isolating violence in specific parts of the brain. For phrenologists, this was the “instinct to kill” bump, while for Lombrosians, the putatively primitive, atavistic brain features of

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<sup>18</sup> The prefrontal cortex comprises the “associational” part of the frontal lobes of the brain. The frontal lobes contain motor and associational areas. The motor areas are involved in the initiation of skilled motor activities; the associational areas are involved in “distinctly human” activities including planning, memory, problem solving, and social conduct. THOMAS C. PRITCHARD & KEVIN D. ALLOWAY, *MEDICAL NEUROSCIENCE* 199 (1999). The many functions of the pcf are discussed further, *infra*, at nn. 180 - 190, and accompanying text.

<sup>19</sup> The amygdala is a small structure deep within the brain that is believed to play a role in regulating emotion. *Id.* at 174.

<sup>20</sup> Certainly there are other important epistemological shortcomings. A comprehensive treatment would be suitable for a book; while I focus here on the important issues of treating criminals as Others and of the localization fallacy, I do not pretend that these are the only issues worth addressing in the history of law and brain science.

criminals showed their violent natures. While contemporary researchers now use sophisticated techniques to image or stimulate parts of the brain, today's neuroimagers' claims that a general cause of violence is overactivity or hypometabolism in certain brain regions are not conceptually distinct from lobotomists' claims that violence could be cured through cutting out the violent part of the brain<sup>21</sup> and phrenologists' assertion that there is a murder bump.

In conclusion, this Article will contend that current "neurolaw" on the biological bases of violence exemplifies a general tendency in legal uses of science. Arising out of a deep Western intellectual commitment to ontological reductionism, which will be explored further in a future Article, legal scholars and scientists tend to reify complex social phenomena (like "violence") into simple physical states without accounting for the interaction between the physical and the social – what some call the "co-creation" or "co-evolution" of the biological and the social. While generally problematic, this reductionist approach is particularly ironic in the context of brain sciences because the brain's plasticity literally shows how aspects of the mind/brain respond to and are products of broader contextual conditions – rather than merely being rooted in fixed givens.

#### I. A HISTORY OF VIOLENCE (IN CRIMINAL JURISPRUDENCE)

The criminal law takes as its object the definition, deterrence, and punishment of proscribed violent behavior (arguably through arrogating to the state the

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<sup>21</sup> Amygdalotomy is a type of psychosurgery (lobotomy) in which the surgeon excises or destroys the amygdala.

sole prerogative to inflict violence).<sup>22</sup> Theories of the causes of, and potential ways to identify and address people prone to, violence thus have historically exerted a tremendous pull over many criminal law scholars and practitioners. This Part looks at several examples of historical efforts to tackle violence scientifically within law: phrenological studies of criminal behavior in the early 19<sup>th</sup> century, Cesare Lombroso’s “scientific” criminology in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, and psychosurgery and subsequent, related efforts on the neurobiological control of violence arising in part out of mid-20<sup>th</sup> Century US race riots. This history of these failed scientific approaches to violence in the criminal law highlights general methodological and epistemological traps; it thus provides a highly relevant and instructive set of lessons. The sometimes uncanny similarities between past and current efforts also provide a useful counterbalance to the current untempered enthusiasm for “neurolaw” solutions to problems of violence.

A. *The Original Scientific Criminologies*

1. *Phrenology: You Should Have Your Head Examined*<sup>23</sup>

Phrenology was the nineteenth century’s science of the mind. Scientists and doctors who practiced phrenology, starting with the Austrian anatomist Franz Josef Gall, contended that a person’s character could be determined from the bumps and hollows on the outside of the skull.<sup>24</sup> From the beginning, Gall’s work intersected with

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<sup>22</sup> See, e.g., GARLAND, *supra* note 14, at 69-81 (1990) (discussing Durkheim’s view of the criminal law as institutionalized vengeance). See also, e.g., James Q. Whitman, *Between Self-Defense and Vengeance/Between Social Contract and Monopoly of Violence*, 39 TULSA L. REV. 901, 922-23 (2004) (Symposium: Twenty-Five Years of George P. Fletcher’s Rethinking Criminal Law) (discussing the “the monopoly of violence theory” as a compelling “account of the purposes of criminal law”).

<sup>23</sup> AMERICAN HERITAGE DICTIONARY OF IDIOMS 239 (1997) (the expression “to get one’s head examined” is “thought to allude to ... phrenology”; probable origin in “early 1900s”).

<sup>24</sup> MADELINE B. STERN, HEADS AND HEADLINES: THE PHRENOLOGICAL FOWLERS X (1971) (describing Gall’s role in originating the science of phrenology). See also JOHN D. DAVIES, PHRENOLOGY: FAD AND

the criminal law, as he principally developed his observations and theories through examining the heads of criminals and those confined for insanity.<sup>25</sup> Specific bumps and depressions were said to correspond to qualities like “wit, joking,” and “poetic ability.”<sup>26</sup> Others corresponded more closely to the study of violent crime: and “instinct to kill,”<sup>27</sup> “combativeness,” and “destructiveness.”<sup>28</sup> All was not lost, though, if your skull revealed you to be, for example, hopelessly humorless (or murderous): You could increase the size of your brain’s funny bone, as it were, through the right sorts of exercise, changing both your character, your brain, and (presumably) the shape of your skull.

Fashionable citizens flocked to phrenologists to have their “heads examined” – sometimes with mixed results. Samuel L. Clemens (better known as Mark Twain) visited a prominent phrenologist in 1873, under another assumed name.<sup>29</sup> The good doctor discovered something remarkable about his anonymous patient: A “total absence of the sense of humor.”<sup>30</sup> Three months later, the same phrenologist was delighted to welcome a very famous new patient: Mark Twain. During the examination

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SCIENCE 6-7 (1955) (describing phrenology); Pierre Schlag, *Law and Phrenology*, 110 HARV. L. REV. 877, 880 (1997) (same).

<sup>25</sup> Franz Josef Gall, *Letter from Dr. F. J. Gall to Joseph Freiherr von Retzer, upon the Functions of the Brain, in Man and Animals*, (reprinted in DAVID G. GOYDER, *MY BATTLE FOR LIFE: THE AUTOBIOGRAPHY OF A PHRENOLOGIST* 143-52 (1857). See also Donald Simpson, *Phrenology and the Neurosciences: Contributions of F.J. Gall and J.G. Spurzheim*, 75 ANZ J. OF SURG., 475, 476 (2005) (noting that Gall regularly “palpated the heads of criminals; wherever possible, he obtained their skulls. His skull collection benefited from his association with the deputy chief of police...who presumably had his own ways of obtaining the heads of criminals.”); Kenneth J. Weiss, *Isaac Ray’s Affair with Phrenology*, 34 J. PSYCH. & LAW, 455, 460 (2006) (describing Gall’s development of his theories through his work with criminal offenders) [hereinafter, “Weiss, *Affair with Phrenology*”]; John Van Wyhe, *The Authority of Human Nature: The “Schädellehre” of Franz Joseph Gall*, 35 BJHS 17, 20 – 22 (2002) (discussing Gall’s work in prisons and with criminals to develop and perfect his cranial measurements and trait localizations).

<sup>26</sup> Simpson, *supra* note 25, at 476 (reproducing list of traits).

<sup>27</sup> *Id.*

<sup>28</sup> THOMAS SEWALL, *AN EXAMINATION OF PHRENOLOGY* 18 (1838) (discussing phrenology critically; noting that phrenologists generally claimed “impulsive” murders had unusually pronounced faculties of combativeness).

<sup>29</sup> MARK TWAIN, *THE AUTOBIOGRAPHY OF MARK TWAIN* 64 – 6 (Charles Neider, ed., 1959).

<sup>30</sup> *Id.*

of *Mr. Twain*, the phrenologist discovered a “‘Mount Everest’ of a ‘bump of humor’”.<sup>31</sup>

Twain’s experience makes phrenology seem a source of innocent fun – like a palm reading at a fair – but phrenology had serious impact on the criminal law in the United States and Europe. Phrenology informed criminal law reform proposals,<sup>32</sup> jurists used phrenology to separate the criminal from the insane, and to provide reliable ways to identify both;<sup>33</sup> expert phrenology testimony was introduced in mitigation at sentencing;<sup>34</sup> the founder of forensic psychiatry embraced phrenology as a way of showing the trier of fact the relationship between brain and behavior;<sup>35</sup> and “prophylactic” phrenology was proposed to determine who might be a risk for criminal behavior in the future.<sup>36</sup> Indeed, “[s]ome police departments claimed to put this theory into practice, training their detectives to arrest ‘criminal types’ – who had not yet to their knowledge committed any crime – on sight. ‘Keen observers have over and over again marked and arrested apparently inoffensive rogues, whom they had never seen before in person or in pictures’ [.]”<sup>37</sup> Phrenology also profoundly influenced the McNaughten test for insanity; that test’s separation of the ability to know right from wrong from the rest of the accused’s state of mental disease reflects the phrenological notion of distinct mental

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<sup>31</sup> *Id.*

<sup>32</sup> Stacey A. Tovino, *Imaging Body Structure and Mapping Brain Function: A Historical Approach*, 33 AM. J.L. & MED. 193, n. 124 & accompanying text (2007).

<sup>33</sup> See discussion of *Ferrer v. State*, 2 Ohio St. 54, 54 (1853), *infra* at nn. 40 - 42 and accompanying text.

<sup>34</sup> Weiss, *Affair with Phrenology*, *supra* note 25, at 460.

<sup>35</sup> Kenneth J. Weiss, *Isaac Ray at 200: Phrenology & Expert Testimony*, 35 J. PSYCH. & LAW, 339, 344 (2007).

<sup>36</sup> Weiss, *Affair with Phrenology*, *supra* note 25, at 465 (describing the development of skull collections for research purposes to help develop preventative identification programs); see also Nicole Rafter, *The Murderous Dutch Fiddler: Criminology, History and the Problem of Phrenology*, 9 THEORETICAL CRIMINOLOGY, 65, 75 (2005).

<sup>37</sup> SIMON A. COLE, SUSPECT IDENTITIES: A HISTORY OF FINGERPRINTING AND CRIMINAL IDENTIFICATION 24 (2001) (quoting the work of Boston Superintendent of Police, BENJAMIN P. ELDRIDGE, OUR RIVAL THE RASCAL, A FAITHFUL PORTRAYAL OF THE CONFLICT BETWEEN THE CRIMINALS OF THIS AGE AND THE POLICE (1896)).

“organs,” in significant contrast to other, integrative, views of mind and mental disorder.<sup>38</sup>

Judges turned to phrenology to determine the sanity of murders (and for many civil uses, as well, such as ascertaining the capacity of testators and witnesses).<sup>39</sup> In *Ferrer v. State*, for example, an 1853 murder case, the Ohio Supreme Court turned to phrenology in considering whether a housekeeper could be held criminally responsible for poisoning a young boy.<sup>40</sup> The judge wrote that the housekeeper was “remarkably ugly.”<sup>41</sup> All but diagnosing her from the bench, the judge noted that a phrenologist would just have to look at the shape of her head to know she was criminally insane, with murderous impulses.<sup>42</sup>

Another judge, in an 1840 civil case concerning the capacity of a testator, spoke for the pervasive influence of phrenology on legal culture when he stated that:

[N]o man having any regard for his reputation in medical science, would dispute that the brain ... consist[s] of distinct organs, each having a distinct function, and that power of function is influenced by organic size.<sup>43</sup>

Yet, by the mid-1900s, phrenology, this “true science of the mind” that had influenced criminal laws, criminal and civil trials, and the course of peoples’ lives, had the status of a joke. Not only was phrenology discarded as a tool of justice – much

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<sup>38</sup> *United States v. Freeman*, 357 F.2d 606, 616 (2d Cir. 1966) (providing history of M'Naughten test; discussing influence of phrenology on development of the same).

<sup>39</sup> Tovino, *supra* note 32, at 201-2.

<sup>40</sup> 2 Ohio St. 54, 54 (1853) (cited in Tovino, *supra*, at 202).

<sup>41</sup> *Id.* at 60 (1853) (such a shape of the skull, the judge remarked, was “unfavorable to the usual presumption of sound mind and full capacity.”).

<sup>42</sup> *Id.*

<sup>43</sup> *Brock v. Lockett's Executors*, 5 Miss. 459, 1840 WL 2421 (Miss. Err. & App. 1840) (cited in Tovino, *supra* note 32, at 202).

less the path to “Perfect our Republic ... [and] Reform The World.”<sup>44</sup> But rather, it was banned in many U.S. jurisdictions alongside “fortune telling” and “astrology.”<sup>45</sup> In recent jurisprudence, phrenology has been classed with “voodoo.”<sup>46</sup>

This spectacular fall from grace came in the normal way: Scientists challenged phrenology internally to science, while social theories about the nature of the mind – particularly with the advent of Freudian psychoanalysis in the early 20<sup>th</sup> century – challenged it externally, ultimately resulting in an integrative paradigm of mind with no place for fixed “brain organs.” As early as 1838, neuroanatomists had shown that the brain did not have enough discrete regions to support the claim that all major personality traits could arise from specialized brain organs.<sup>47</sup> Many showed, as well, that the various parts of the brain need to work in concert to produce most types of actions.<sup>48</sup> Further, it became clear – over much social contestation, particularly about race and sex – that brain size (and the size of parts of the brain) bear no clear relationship to aptitude,<sup>49</sup> and that people could retain particular traits or abilities when the part of the brain in which the trait allegedly resided was destroyed by illness or injury.<sup>50</sup>

If phrenology’s approach to the relationship between brain structure and character sounds unscientific, or even silly, pause: It is very close in certain respects to

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<sup>44</sup> Tovino, *supra* note 32, at n.125.

<sup>45</sup> *Id.* at 203.

<sup>46</sup> *United States v. Gipson*, 24 M.J. 246, 249 (1987) (describing the hierarchy of scientific evidence, stating that “[a]t the bottom lies a junk pile ... so universally discredited that a trial judge may safely decline even to consider [its contents], as a matter of law. To that level have been relegated such enterprises as phrenology, astrology, and voodoo.”).

<sup>47</sup> SEWALL, *supra* note 28, at 34-7 (1838) (criticizing phrenology for its nonfalsifiability, among other grounds) (“Neither the cortical nor the fibrous part of the brain reveals, upon dissection, any of those compartments or organs, upon the existence of which the main fabric of phrenology is based.” *Id.* at 37).

<sup>48</sup> WALTHER RIESE, *A HISTORY OF NEUROLOGY* 96 (1959) (describing the work of 19<sup>th</sup> Century French neurologist Pierre Flourens on the integrated functions of the brain).

<sup>49</sup> STEPHEN JAY GOULD, *THE MISMEASURE OF MAN* 105-141 (1986).

<sup>50</sup> SEWALL, *supra* note 28, at 58.

modern approaches. Phrenologists ascribed significance to outer bumps and lumps based on reasonable-seeming and thoroughly modern logic: That a person's character results from the structure of his or her brain; the brain has different capacities, which arise from its particular parts (or "organs"). The place where phrenology parts company from modern theories of brain localization relates to relationship between innate brain capacities and skull anatomy; the phrenologists, unlike neuroscientists of today, believed that the size and shape of the brain's parts affect the size and shape of the skull; therefore, if a particular part of the brain were over- or under-developed, that skill would have a corresponding bump or dent.<sup>51</sup> Proceeding from the other direction, one need only read the bumps and dents on a person's head to know which "organs" of her brain are larger or smaller; thus, one would know her abilities and character.<sup>52</sup> We will revisit several of these notions – identifying the character of a person with the structure of the brain; reifying acts and beliefs as innate characteristics; and the localization of capacities in brain "organs" – later in current incarnations of popular neuroscience.

Although "phrenology ultimately failed as a science," and may be the pseudo-science *par excellence* in the public and judicial imagination,<sup>53</sup> "it left behind a formalized concept of cerebral localization[.]"<sup>54</sup> And this idea of cerebral localization left the door open to the notion that "a science not too different from ... phrenology, could be used to investigate the functions of different regions of the brain."<sup>55</sup> That legacy

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<sup>51</sup> SEWALL, *supra* note 28, at 14-15 (describing general principles of phrenology)

<sup>52</sup> *Id.*

<sup>53</sup> See Gipson, 24 M.J. at 249, *supra* note 46.

<sup>54</sup> Tovino, *supra* note 32, at 207 (citing WILLIAM R. UTTAL, THE NEW PHRENOLOGY: THE LIMITS OF LOCALIZING COGNITIVE PROCESSES IN THE BRAIN 20 (2001); SCOTT A. HUETTEL, ET AL., FUNCTIONAL MAGNETIC RESONANCE IMAGING 2 (2004); STERN, HEADS AND HEADLINES, *supra* note 24, at 34.

<sup>55</sup> Tovino, *supra* note 32, at 207.

soon would be picked up by a young doctor whose *zeitgeist* included phrenology, Cesare Lombroso.

## 2. *Lombrosian Biological Criminology*

Shortly after the demise of phrenology, “biological criminology” (or “criminal anthropology”)<sup>56</sup> sprang from the brain of a criminal. When Cesare Lombroso was a young doctor at the asylum in Pavia, he was asked to conduct a post-mortem on an infamous serial rapist and murderer. Opening the criminal’s skull to reveal his brain, young Dr. Lombroso had an insight “like a flash of light.”<sup>57</sup> He claimed to have found numerous abnormal features of the brain (as well as the skull), including an enlargement of the cerebellum<sup>58</sup> “like that found in the lower types of apes, rodents, and birds.”<sup>59</sup> In this moment, from this brain, Lombroso formed his famous theory of atavistic criminality – that is, that criminality results from a person having a “throw-back” brain to something lower than the “primitive races”; indeed, back to the “carnivores.”<sup>60</sup> Although biological criminology later embraced other “atavistic” features of “born criminals” that linked them to the “primitive races” (such as longer forearms and, absurdly, “the prehensile

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<sup>56</sup> For a history of this movement, see DAVID G. HORN, *THE CRIMINAL BODY: LOMBROSO AND THE ANATOMY OF DEVIANCE* (2003) (excellent general history both of Lombroso’s work and of the development and influence of the school of criminal anthropology).

<sup>57</sup> GINA LOMBROSO-FERRERO, *CRIMINAL MAN* (1911), *excerpted in* *BIOLOGY, CRIME & ETHICS* 37, 38 (Frank H. Marsh & Janet Katz, eds. 1985); MARY GIBSON, *BORN TO CRIME: CESARE LOMBROSO AND THE ORIGINS OF BIOLOGICAL CRIMINOLOGY* 19 (2002).

<sup>58</sup> The cerebellum is a structure at the base of the brain involved in basic voluntary motion, such as the unconscious regulation of gait and motion, and the integration of sensory information to facilitate motion. PRITCHARD & ALLOWAY, *supra* note 18, at 332.

<sup>59</sup> *Id.* at 38.

<sup>60</sup> *Id.*

foot”),<sup>61</sup> it is the head of the criminal – the house of the “criminal mind” – that gave rise to the entire biological criminology movement.

In her well-known treatise *Criminal Man*, Gina Lombroso-Ferrero wrote of the biological differences between criminal and noncriminal individuals, particularly emphasizing differences in the head and “psychic and sensitive [nervous system] functions.”<sup>62</sup> Leaving no doubt about her view of the origins of these differences, she entitled her central chapter: “The Born Criminal.”<sup>63</sup> In it, she writes, that the “Modern, or Positive, School of Penal Jurisprudence” maintains that become criminals primarily as a result of their atavistic “psychic organization,” which “differs essentially from that of normal individuals,”<sup>64</sup> because criminals’ brain structure and nervous systems “strongly resemble primitive races [sic].”<sup>65</sup>

Lombroso’s claims that criminals have atavistic brains sparked a craze for brain dissection.<sup>66</sup> Generally, the results of these dissections proved disappointing: They

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<sup>61</sup> *Id.* Note that the features Lombroso and his followers identified as atavistic features of criminals are not, in fact, found upon physical examination of criminals. In their desire to see criminals as lower than the “primitive races,” and, indeed, akin to the lower “carnivores,” Lombroso asserted that born criminals had long, fierce canine teeth and “cheek pouches,” in addition to the prehensile foot. Later biological criminologists abandoned these measures because they failed to prove the atavistic nature of criminals or the superiority of Europeans. The measure of longer forearms, in particular, had to be abandoned because Europeans on average have a slightly longer forearm-to-body ratio than East and South Asians. Since Europeans must occupy a higher place on the great chain of being subscribed to by these investigators, but longer forearms were viewed as more apelike, the forearm ratio had to be rejected as not probative of the degree of a race’s so-called development. GOULD, *supra* note 49, at 118 (discussing forearm ratios); *see also id.* at 159 (on the prehensile foot).

<sup>62</sup> *Id.* at 38.

<sup>63</sup> *Id.*

<sup>64</sup> *Id.*

<sup>65</sup> *Id.*

<sup>66</sup> Robert Fletcher, President, Anthropological Society of Washington, The New School of Criminal Anthropology, Address Before the Anthropological Society of Washington (April 21, 1891), in AM. ANTHROPOLOGIST 1, 20-2 (July, 1891) (summarizing brain dissection work of noted anthropological criminologists; describing results). For a general introduction to Lombroso’s work, *see, e.g.*, CESARE LOMBROSO, CRIME: ITS CAUSES AND REMEDIES (Henry P. Horton ed. & trans. 1911) (1899); *see also* Marvin Wolfgang, *Cesare Lombroso, 1835-1909*, in PIONEERS IN CRIMINOLOGY 232, 246-57 (Hermann

did not confirm any systematic differences in the gross anatomy of violent criminals' brains relative to those not convicted of criminal offenses.<sup>67</sup> But Lombroso and his followers were not dissuaded by these facts: While they acknowledged that the abnormalities Lombroso described in his first specimen were not present in "other degenerates," different brain abnormalities nevertheless were "prevalent in criminals." The absence of any consistent correlations between structural brain defects and criminality seemed to them to reflect only that the brain is "a very recalcitrant organ [that] gives us an infinite deal of trouble when we attempt to establish positive relations between its substance and the operations of the faculties of the mind[.]"<sup>68</sup>

The failure of brain dissection to confirm systematic differences between criminals and noncriminals tempered some of the claims of Lombrosians. Interestingly, however, it did not cause them to retreat from claims about the brain differences related to violence. Gina Lombroso-Ferrero acknowledged that "lesser criminals" may not possess atavistic brains; yet, she asserted, those who commit the majority of "peculiarly monstrous" crimes, like murders and other crimes of violence, nearly always demonstrate the "atavistic" brains of animals.<sup>69</sup> There is no evidence that the brain dissections of this era did produce evidence of structural brain differences between perpetrators of violent crimes versus nonviolent crimes (or of noncriminals); yet, this insistence on the existence of physical differences in the brains of violent criminals seemed particularly "sticky," difficult to dislodge in light any countervailing evidence. This emphasis on identifying

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Mannheim ed., 2d ed. 1972) (1955) (describing Lombroso's work on the putative physical abnormalities of convicted criminals).

<sup>67</sup> Fletcher, *supra* note 66, at *id.*

<sup>68</sup> *Id.* at 22.

<sup>69</sup> LOMBROSO-FERRERO, *supra* note 57, at 38.

violence as a physical characteristic of the individual brain remains constant through the later and current movements to ground criminal law in neuroscience.

A review of Lombrosian biological criminology reveals fascinating parallels to contemporary claims about the neurological bases of violent crime. Today's assertion that "crime is a disease" flowing from disordered "neurobiology" echos almost perfectly the claims of early 20<sup>th</sup> century biological criminologists. Consider the remarks of L. Hamilton McCormick: "Crime is ... pathological"; it is "pathological, as it is owing to morbid affections of the brain that men frequently adopt crime as a profession."<sup>70</sup> Indeed, placed side-by-side and without citations, a reader would have difficulty distinguishing the Lombrosian statement from the new neurolaw statement – one claims that "crime is a disease" and the other that "crime is ... pathological"; one says it flows from "neurobiology," and one says it flows from the "brain." The current view is that violence emerges from disorders of the prefrontal cortex, which is said to regulate executive function and judgment; the nineteenth century criminal anthropologists claimed a relationship to deficits in the "the antero-superior district of the brain," roughly equivalent to the pfc, "which betokens morality and trustworthiness[.]"<sup>71</sup>

If the ghosts of Lombroso were those of mere bad science – faulty data or superseded hypotheses – we could look back but fleetingly at the specter. But it signifies more. Lombroso is a synecdoche for the hope that a biological criminology is possible, that the laws of man can yield to the laws of science. A contemporary critic of biological

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<sup>70</sup> L. HAMILTON MCCORMICK, CHARACTEROLOGY: AN EXACT SCIENCE 560 (1920).

<sup>71</sup> *Id.* at 563.

criminology (or “criminal anthropology”) spoke to its shortcomings in language that could apply equally to the neurolaw of today, saying that the field:

[O]ccupies the debatable ground between science and philosophy. As a science, it is positive and aggressive. As a philosophy, it consists almost wholly of negations, the chief of which are the negation of spirit, of freedom of the will, and of moral responsibility.<sup>72</sup>

C. *Raging Bulls & Listless Monkeys: 20<sup>th</sup> Century Psychointervention*

I. *Psychointervention’s Promise to Cure Violence*

While biological criminology fell into disrepute, like phrenology before it, it nevertheless helped spawn the next set of tragic errors in the relationship between criminal law and brain science: Direct brain interventions against the putative neurobiology of violence. In the tumultuous middle of the twentieth century, it seemed that “[h]uman violence [was] the most threatening problem in our world.”<sup>73</sup> But the so-called violence problem, fortunately, appeared “solvable” – through the modern miracles of psychosurgery (lobotomy)<sup>74</sup> and electrode implantation.<sup>75</sup>

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<sup>72</sup> FREDERICK H. WINES, PUNISHMENT AND REFORMATION: AN HISTORICAL SKETCH OF THE RISE OF THE PENITENTIARY SYSTEM 254 (1895) (special agent of the eleventh United States Census on Crime, Pauperism, and Benevolence).

<sup>73</sup> VERNON H. MARK & FRANK R. ERVIN, VIOLENCE AND THE BRAIN 1 (1970).

<sup>74</sup> There are several terms for surgical interventions in the brain aimed at modifying behavior. While the term “lobotomy” has the greatest common currency, it actually refers to one specific type of brain surgery, excision or destruction of a portion of the brain’s frontal lobes – hence, “lobe – otomy.” Other terms for brain surgeries aimed at changing mood or behavior (rather than correcting a medical pathology) include psychiatric neurosurgery, mental surgery, functional neurosurgery, sedative neurosurgery, and psychosurgery. See Stephan L. Chorover, *The Pacification of the Brain*, 7 PSYCHOLOGY TODAY 59, 59 (May 1974). This type of surgery is not “directed at treating specific kinds of neuropathology (e.g., tumors and strokes) or disorders of movement (e.g., tremors and paralysis).” *Id.* I use “psychosurgery” throughout because it is common in the scientific literature and because it encompasses a broader range of behavioral-focused neurosurgeries than the more limited term “lobotomy.”

<sup>75</sup> MARK & ERVIN, *supra* note 73, at 1 (calling violence problem “solvable”; advocating psychosurgery and other brain interventions).

This enthusiasm for psychointervention carried forward beliefs about the localization of violence and about the essential biological differences between people who do and do not commit violent crimes. Thus, in the relationship between mid-century psycho-intervention and the criminal law, we again see the pattern of early enthusiasm for a totally brain-based construction of criminal violence – one that considers violence apart from any contextual factors and that identifies the person who engages in a violent act as essentially different or “other.” This episode of the neuroscience-criminal law *follie à deux* again shows the characteristic claims that “violence” is a unitary phenomenon (consistent with aggression in animals), and that it is localized to specific parts of the brain.

These continuities between mid-century psychointervention and prior brain science-criminal law movements are not only thematic but actually historical: Psychosurgery’s founder, Gottlieb Burckhardt, drew his inspiration directly from the ideas of innate brain difference and localization found in Lombrosian criminology and phrenology. Reasoning that “our psychological existence is composed of single elements, which are localized in separate areas of the brain,” Burckhardt believed that he could literally “extirpat[e]” unwanted behaviors by removing specific portions of the brain.<sup>76</sup> In 1891, Burckhardt tested this idea by removing the cerebral cortices<sup>77</sup> of six

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<sup>76</sup> Stephan L. Chorover, *Psychosurgery: a Neuropsychological Perspective*, 54 B.U. L. REV. 231, 232-33 (1974) [hereinafter “Chorover, *Psychosurgery*”] (quoting GOTTLIEB BURCKHARDT, UEBER RINGDENEXCISIONEN, ALS BEITRAG ZUR OPERATIVEN THERAPIE DER PSYCHOSEN, ALLG. Z. PSYCHIAT. (1891) (in which Burckhardt urges his colleagues to “tread the path of cortical extirpation.”)).

<sup>77</sup> The cerebral cortex is the outer layer of the brain, with all the characteristic convolutions and folds. It is believed to be an evolutionarily later development and the site of many of “higher” or distinctively human brain functions.

people confined in his asylum in Prefargier, Switzerland.<sup>78</sup> His results were poor (one patient died and five remained at least as psychotic<sup>79</sup>) and so it wasn't until nearly 50 years later that psychosurgery took off – following the chance encounter of a Portuguese politician and some apathetic monkeys.<sup>80</sup>

In 1935, Antonio Egas Moniz, a successful Portuguese politician and retired ambassador with training in neuroscience, attended the International Congress of Neurology in Boston.<sup>81</sup> There, two American researchers, John Fulton and Carlyle Jacobsen, presented their results on lesions in the frontal lobes and/or amygdalae of monkeys and chimpanzees.<sup>82</sup> These primates ordinarily were hostile to handling by researchers but, after receiving bilateral lesions in their frontal lobes, were “strikingly indifferent to stimuli that previously had provided extreme agitation.”<sup>83</sup> They showed “a host of ... drastic behavioral changes,” including deficits in learning and memory, and also were generally listless or “tame.”<sup>84</sup> Moniz asked the presenters if similar surgery could “tame” violent impulses and agitation in people.<sup>85</sup>

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<sup>78</sup> Chorover, *Psychosurgery*, 54 B.U. L. REV. at 232-33, *supra* note 76 (quoting GOTTLIEB BURCKHARDT, UEBER RINGDENEXCISIONEN, ALS BEITRAG ZUR OPERATIVEN THERAPIE DER PSYCHOSEN, ALLG. Z. PSYCHIAT. (1891)). This is the first instance of psychosurgery reported in any western medical journal. *Id.* It is beyond the scope of this Article to address brain surgeries performed by other cultures such as, *e.g.*, trepanning by ancient American civilizations.

<sup>79</sup> *Id.*

<sup>80</sup> *Id.*

<sup>81</sup> *Id.* at 232 (quoting Moniz).

<sup>82</sup> *Id.*

<sup>83</sup> *Id.*

<sup>84</sup> *Id.*

<sup>85</sup> *Id.*

Fulton and Jacobsen were “shocked” at Moniz’s suggestion, but Moniz put his idea into action immediately.<sup>86</sup> Upon his return to Portugal later that year, Moniz and a colleague performed 20 surgeries in a 10-week period on human subjects in which they destroyed portions of the patients’ frontal lobes.<sup>87</sup> Touting his successes, Moniz claimed that these people were miraculously “cured,” that those “who had previously been violent ... became calm, tractable, and easier to manage.”<sup>88</sup> Lobotomy, cloaked in a heavy degree of possibly unintentional or self-deluding scientific fakery, was born.

Moniz’s purported successes with frontal lobe surgery (“lobotomy”) led him to receive the Nobel Prize in 1949.<sup>89</sup> And, it led to tens of thousands of psychosurgeries in the United States and around the world. In the United States alone, about 70,000 people were subjects of lobotomy between the 1940s and mid-1960s.<sup>90</sup>

The fascination with the brain-based causes and potential “cures” for violence pervaded brain sciences in the mid-century. Animal studies, particularly with monkeys, rats, and one very famous bull seemed to point the way toward controlling

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<sup>86</sup> *Id.*

<sup>87</sup> *Id.* Moniz’s original technique consisted of injecting alcohol and wax into portions of the brain, causing brain tissue to coagulate and die. Later, he refined his technique into what he termed the “leucotomy,” using a specially-designed cutting instrument, the leucotome, to remove portions of brain tissue. Later techniques were both more and less crude. Walter Freeman notoriously pioneered the “ice pick” lobotomy, a simple procedure in which an ice pick-like device was driven through the orbits of the skull and into the frontal lobes; given its simplicity, it was performed in a near-assembly line fashion. An innovation of greater sophistication was stereotactic neurosurgery, which, using three-dimensional maps of the brain and highly specialized surgical equipment, allowed for precise surgeries anywhere in the brain, including in its deeper structures. STANLEY FINGER, *ORIGINS OF NEUROSCIENCE: A HISTORY OF EXPLORATIONS INTO BRAIN FUNCTION* 292-4 (1994).

<sup>88</sup> *Id.*

<sup>89</sup> JEROME KAGAN, *AN ARGUMENT FOR MIND* 52-53 (2006).

<sup>90</sup> *See Hearings on S. 974, S. 878 and S.J. Res. 71 Before the Subcomm. On Health of the Senate Comm. On Labor and Public Welfare, 93d Cong., 1st Sess., pt. 2, at 340 (1973) (noting that about 50,000 Americans received lobotomies between the 1940s and mid-1950s); see also ELLIOT S. VALENSTEIN, BRAIN CONTROL: A CRITICAL EXAMINATION OF BRAIN STIMULATION AND PSYCHOSURGERY* 58 (1974) (stating that approximately 4,000 psychosurgeries per year were performed on U.S. patients from 1960 through about 1964).

man's more animal nature. American proselytizers for the criminal law applications of "sedative psychosurgery," as they called it, Vernon Mark and Frank Ervin, drew heavily on the same kind of monkey studies that first inspired Moniz. Mark and Ervin noted that "after both temporal lobes have been removed," monkeys are "placid, can be easily handled, and do not respond aggressively even to attack ...."<sup>91</sup> They also seem without anxiety, putting objects in their mouths "that ordinarily provoke fear, such as small snakes."<sup>92</sup> Showing even more dramatic examples of subduing primal violence, "[l]ocalized removal of the amygdala will tame a predatory and vicious lynx or a wolverine."<sup>93</sup> Analogizing people who have committed criminal violence to the "lynx or [] wolverine," they note that, "[i]ndeed, neurosurgeons have surgically removed areas of the amygdala to treat assaultive behavior in patients[.]"<sup>94</sup>

Around the same time, "an alternate form of psychosurgery"<sup>95</sup> – electrical stimulation of parts of the brain – also promised a solution to the "violence problem." Throughout the 1950s and 1960s, the criminal law and scientific communities together explored electrical brain stimulation as a method to "effectively wipe out violence" in

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<sup>91</sup> MARK & ERVIN, *supra* note 73, at 28.

<sup>92</sup> *Id.*

<sup>93</sup> *Id.* at 29. Sampling here just some of the work summarized and relied upon by Mark and Ervin, *id.* at 38-46: B.N. Brunnell, et al., *Septal Lesions and Aggressiveness in the Cotton Rat, Sigmodon Hispidus*, 6 PSYCHONEUROLOGICAL SCI. 443 (1966); C.E. Davis, *The Physiological Analysis of Aggressive Behavior*, in SOCIAL BEHAVIOR AND ORGANIZATION AMONG VERTEBRATES 53 (W. ETKIN, ED. 1964); M.D. Egger & J.P. Flynn, *Effects of Electrical Stimulation of the Amygdala on Hypothamically Elicited Attack Behavior in Cats*, 26 J. NEUROPHYSIOL. 705 (1963); H. Ursin & B. Kaada, *Functional Localization within the Amygdaloid Complex in the Cat*, 12 EEG CLIN. NEUROPHYSIOL. 1 (1960); L. Weiskrantz, *Behavioral Changes Associated with Ablation of the Amygdaloid Complex in Monkeys*, 49 J. COMP. PHYSIOL. PSYCHOL. 381 (1956).

<sup>94</sup> MARK & ERVIN, *supra* note 73, at 29.

<sup>95</sup> Lauren Slater, *Who holds the clicker? Neuroscientists hope that brain implants can treat intractable mental illness*, MOTHER JONES, 2005 WLNR 17886179 (Nov. 1, 2005).

society.<sup>96</sup> The majority of this work consisted of electrical stimulation of parts of animals' brains to evoke or suppress what the researchers characterized as violent behavior or inappropriate sexual behavior.

The feats that some neuroscientists seemed able to perform through electrical stimulation of animals' brains seemed nothing short of extraordinary. In perhaps the most dramatic piece of theater a scientist ever mounted, Dr. Jose Delgado of Yale University staged a bullfight – a special bullfight designed to show the triumph of neuroscience over animal aggression. Delgado arranged a “brave bull, a variety bred to respond with a raging charge when it sees any human being.”<sup>97</sup> Delgado implanted an electrode the caudate nucleus of the bull's brain. Before a packed audience of scientists, media, and others, Delgado demonstrated that he could stop the charging bull in its tracks by activating the electrode with the flick of a switch – the power of science stopping animal aggression literally in its tracks.

Delgado characterized the bull as becoming quite “tame” and docile after several stimulations, and that it wandered off with no further desire to charge.<sup>98</sup> One impressed reporter for The New York Times noted, “the bull's naturally aggressive behavior disappeared. It was as placid as Ferdinand.”<sup>99</sup> Delgado's work seemed to hold tremendous and direct promise for law enforcement. Recruited by government agencies,

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<sup>96</sup> *Id.*

<sup>97</sup> Boyce Rensberger, *A Pill Can Be More Powerful than an Army*, N.Y. TIMES, Sept. 12, 1971, at 9.

<sup>98</sup> JOSE M. R. DELGADO, PHYSICAL CONTROL OF THE MIND: TOWARD A PSYCHOCIVILIZED SOCIETY 170-71 (1969).

<sup>99</sup> Rensberger, *supra* note 97, at 9. “Ferdinand,” of course, is the much-beloved gentle bull of the children's book, *The Story of Ferdinand*, by Munro Leaf (1936).

Delgado worked for many years on a brain-computer interface and on brain stimulation techniques to control human violence.<sup>100</sup>

While Delgado's demonstration was the most theatrical, other investigators also claimed to produce striking results in other animals and even humans. Robert Heath, for example, took mental patients from Louisiana's public hospitals and implanted their brains with electrodes.<sup>101</sup> Through different positioning of the electrodes, Heath claimed he could bring about or suppress "fear" and "rage."<sup>102</sup> (Heath and his colleague, the sex researcher Dr. Moan, also claimed that through targeted electrostimulation they could "cure" homosexuality.)<sup>103</sup>

By far the greatest body of research on electrostimulation, however, took place not on fearsome bulls or human subjects, but more obtainable and tractable experimental animals: cats and rats, and certain other rodents (mice, hamsters, and others). From these animals, a tremendous body of research developed on the relationship between evoked fear or rage, or the suppression of normal fear and aggression, through stimulation or inhibition of different parts of the brain – particularly the amygdala, although others as well.

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<sup>100</sup> NPR Morning Edition, *Neuroscientists Gather in Washington to Discuss Cutting-Edge Research*, 2005 WLNR 25360638 (May 20, 2005) (noting that Delgado's goal was to develop technologies such that governments could use brain stimulation to control people's behavior).

<sup>101</sup> Slater, *supra* note 95.

<sup>102</sup> *Id.*

<sup>103</sup> Heath and Charles Moan "treated" a homosexual man by stimulating areas of the brain believed to provoke pleasure while having the man watch heterosexual pornography. In an interesting comment on the social construction of mental illness, although the subject was hospitalized for suicidality, Heath determined that the subject's sexual orientation was the root pathology that required treatment. After 17 days of repeated brain stimulation while watching heterosexual pornography, the subject consummated a sex act with a female prostitute (in the lab, while connected to the wires recording his brain impulses) whom Heath procured for those purposes. The case history does not relate the impact on the subject much beyond this one encounter or his subjective experience of the experiment. See Charles E. Moan and Robert G. Heath, *Septal Stimulation for the Initiation of Heterosexual Behavior in a Homosexual Male*, 3 J. BEHAV. THER. & EXPERIMENTAL PSYCH. 23 (1972) (reporting on experiment with B-19).

## 2. *Psychointervention and Criminal Law Initiatives*

Under the view of mind and behavior that animated psychointervention, it is axiomatic that violence only arises from brain disorder. Indeed, with a “well-ordered brain,” a person “need never be out of control.”<sup>104</sup> If a person does “go out of control,” then, under this view, there are only two possible reasons: “either the limbic system [which includes the amygdala] has become pathologically hyperactive” or “its neocortical [frontal lobe – executive function] inputs have become abnormal.”<sup>105</sup> In other words, if a person commits a proscribed, violent act, then either his amygdala made him do it, his pfc failed to stop him from doing it, or both.

Thus, while psychointervention, like phrenology and biological criminology, started out in asylums, it, too, soon made inroads into the criminal law through its participation in the discourse on violence.<sup>106</sup> Indeed, if psychosurgery could fix the brain “dysfunction” causing violent conduct amongst the mentally ill, then why stop at the asylum gates? Psychointervention might quell civil unrest and all kinds of other criminal violence.<sup>107</sup> Particularly, psychosurgery might treat urban rioters, leaders of civil unrest (*i.e.*, those involved in the civil rights movement), and violent prisoners of all kinds.<sup>108</sup> As the heralds of this transition of psychosurgery from a psychiatric treatment to an all-purpose social curative wrote: Psychointervention offers “a new and biologically oriented approach to the problem of human violence.”<sup>109</sup>

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<sup>104</sup> MARK & ERVIN, *supra* note 73, at 32-33.

<sup>105</sup> *Id.*

<sup>106</sup> Chorover, *Psychosurgery*, *supra* note 76, at 232.

<sup>107</sup> MARK & ERVIN, *supra* note 73, at 1.

<sup>108</sup> Chorover, *supra* note 76, B.U. L. Rev. at 245.

<sup>109</sup> MARK & ERVIN, *supra* note 73, at xi.

In their landmark book *Violence and the Brain*, Professors Mark and Ervin of Harvard and MIT argued that “brain dysfunction” causes “a low threshold for impulsive violence,” and that people convicted of a crime involving violence likely suffer from such brain disease.<sup>110</sup> Deriding views that crime rates reflect rates of policing or socioeconomic or demographic factors, these researchers asserted that criminal violence is both caused and explained exclusively by the perpetrators’ disordered neurobiology.<sup>111</sup> Thus, they recommended that people convicted of crimes of violence should have psychosurgery to remove their amygdalae.<sup>112</sup> In this, Mark and Ervin were emblematic of a broader movement in the biological control of violence, and particularly of proposals to perform psychosurgery or electrode implantation on prisoners.<sup>113</sup>

While mass lobotomization of prisoners never did take place, a few experiments on prisoners tested out the idea.<sup>114</sup> In 1968, under the auspices of the California Department of Corrections, several prisoners (including one minor) at the Vacaville State Penitentiary in Vacaville, California, underwent surgical implantation of electrodes for the purpose of destroying amygdalar tissue; the goal was to eradicate their ability to engage in violent behavior.<sup>115</sup> The experiment was carried out by a military

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<sup>110</sup> *Id.* at 2.

<sup>111</sup> *Id.* at xi (deriding theories that relate rates of violent crimes either to levels of policing or to social and economic factors).

<sup>112</sup> ELIOT VALENSTEIN, *BRAIN CONTROL* 255 (1974) (discussing the work of Mark and Ervin).

<sup>113</sup> For example, in 1970, the International Conference of Psychosurgeons entertained proposals to “initiate pilot programs for precise rehabilitation [through psychosurgery] of the prisoner-patient who is often young and intelligent, yet incapable of controlling various forms of violence.” E. VALENSTEIN, *BRAIN CONTROL* 255 (1974) (quoting remarks of M. Hunter Brown).

<sup>114</sup> Robert J. Trotter, *A Clockwork Orange in a California Prison*, *SCIENCE NEWS* at 174 (Mar. 11, 1972).

<sup>115</sup> *Id.*

surgeon from a nearby air force base, and Vacaville used its metalwork shop to craft a special device to hold the prisoners' heads in place for the procedure.<sup>116</sup>

The Vacaville experiment produced poor results: the one prisoner whose surgery the prison authorities deemed “successful,” and who was paroled, was re-arrested for robbery almost immediately after his release.<sup>117</sup> Nevertheless, enthusiasm for solving criminal problems through psychointerventions went on unabated. In 1972, the Neuropsychiatric Institute of the University of California at Los Angeles proposed to develop a Center for the Study and Reduction of Violence, intended to identify violent predispositions and develop techniques for preventing and treating violent behavior.<sup>118</sup> The Center was to be funded primarily by the federal Law Enforcement Assistance Administration.<sup>119</sup> Additionally, in furtherance of this violence-prevention strategy, the federal Law Enforcement Assistance Administration extensively funded research into brain implants and other brain intervention techniques. Those subscribing to the most reductive view of the relationship between brain and violence believed that urban race riots were born not of rage at poverty or oppression but of physiological “dysfunction” in the rioters.<sup>120</sup>

Ultimately, the once-heralded efforts to address criminal problems through psychosurgery and electrostimulation led lawmakers and neuroscientists alike to call to

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<sup>116</sup> Leroy F. Aarons, *Brain Surgery Is Tested on 3 California Convicts*, WASH. POST, Feb. 25, 1972, at A1.

<sup>117</sup> *Id.*

<sup>118</sup> Dorothy Nelkin & Judith P. Swazey, *Science and Social Control: Controversies Over Research on Violence*, in *BIOLOGY, CRIME AND ETHICS* 344, 346 (Frank H. Marsh & Janet Katz, eds., 1985).

<sup>119</sup> *Id.*

<sup>120</sup> Vernon H. Mark, William H. Sweet, & Frank R. Ervin, *Role of Brain Disease in Riots and Urban Violence*, letter to the editor, 201 J. AM. MED. ASSOC. (JAMA) 217, 217 (1967).

restrict the procedures, particularly on prisoners and children.<sup>121</sup> Psychointervention is easy to dismiss as horrifying but irrelevant; the technology seems primitive, and there is little risk that similar technologies would be tested on prisoners and incompetents today, given the advent of rigorous Internal Review Boards for human experimentation and heightened ethical awareness.<sup>122</sup> Yet, psychointervention has immediate lessons for us now.

While we (again) now know that the claims of psychointervention were inflated and we reject its abuses, its logic – like that of phrenology – is both elegant and fully consistent with prior movements in understanding violence entirely internally to the brain: Violent people have thoughts that are disordered or disturbed,<sup>123</sup> and the frontal lobes play an undeniably important role in thought processes – or, they have abnormally excessive fear and rage reactions, which in some fashion are related to activity in the amygdala.<sup>124</sup> Therefore, as Moniz reasoned, if the frontal lobes could be cut off from communication with the rest of the brain, disturbed thoughts would cease;<sup>125</sup> and, as Ervin, Mark, and numerous others reasoned, if the amygdala could be ablated, then fear and rage would cease.<sup>126</sup> As with prior brain sciences that have made criminal law

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<sup>121</sup> See, e.g., S.J. Res. 86, 93d Cong., 1st Sess. (1973) (remarks by Sen. Beal, introducing a resolution calling for a two-year moratorium on psychosurgery during which the Secretary of Health, Education and Welfare would assess available data and make recommendations on the procedures); Chorover, *supra* note 76, B.U. L. Rev. at 247 (proposing creation of regulatory agencies at the state and federal level to recognize that psychosurgery is experimental; safeguard prisoners, children, and the mentally retarded; and develop a registry of all psychosurgery procedures to allow follow-up of patients who undergo psychosurgery).

<sup>122</sup> Slater, *supra* note 95 (describing review boards and FDA oversight for experimental neurosurgical medical devices and procedures).

<sup>123</sup> KAGAN, *supra* note 89, at 52-53.

<sup>124</sup> *Id.*

<sup>125</sup> *Id.*

<sup>126</sup> See *supra*, Section II.C.1.

inroads, and as with contemporary thinking about the “neurobiology of violence,”<sup>127</sup> this theory reifies complex behavior, like “violence” or “aggression,” into a single phenomenon, and localizes it to a part of the brain. The investigator then tries to solve what he has defined as the brain’s violence problem through brain intervention – a seductively simple solution to so multifaceted and complex a set of problems. In this, we see a version of the same argument currently advanced in reductionist neurolaw – that some unspecified dysfunction of the amygdala (or other parts of the limbic system), or of the frontal lobes, is the most prevalent, and most relevant, cause of violent crime.

## II. THE NEW NEUROREDUCTIONISM IN LOCALIZING VIOLENCE

While many behaviors ranging from “an individual’s tendency to be honest” to his or her “willingness to follow authority”<sup>128</sup> might be of legal and social interest, there “is a marked tendency” in new neurobiological discussions of crime “to focus on violent behaviors.”<sup>129</sup> Indeed, the “[p]rediction of violence,” as well as its control, is a central, shared interest of “science [and] the legal system” that is likely to remain a core area of collaboration between these fields.<sup>130</sup> For this reason, there is “a massive (and growing) body of scientific literature on both the neuroanatomical and neurochemical bases” of violence.<sup>131</sup> This Part will present the current state of the art in

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<sup>127</sup> JAN VOLAVKA, *NEUROBIOLOGY OF VIOLENCE passim* (1995).

<sup>128</sup> *NEUROSCIENCE AND THE LAW – BRAIN, MIND AND THE SCALES OF JUSTICE: A SUMMARY REPORT ON AN INVITATIONAL MEETING CONVENED BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE DANA FOUNDATION* 9 (Brent Garland ed. 2004).

<sup>129</sup> Owen D. Jones, *The Impact of Behavioral Genetics on Criminal Law*, 69-SPG *LAW & CONTEMP. PROBS.* 81, 90 (2006).

<sup>130</sup> *NEUROSCIENCE AND THE LAW*, *supra* note 128, at 9 (in a section entitled “Predicting Violence”; no other section of the report expressly was dedicated to predicting any other type of behavior).

<sup>131</sup> Professor Snead has conducted an admirable literature review of the recent neuroimaging work on violence and aggression. See Snead, *supra* note 17, at 1298-99 (citing Antoine Bechara et al., *Insensitivity to Future Consequences Following Damage to Human Prefrontal Cortex*, 50 *COGNITION* 7, 8 (1994)).

neurolaw discussions of criminal violence, showing their (generally unintended) parallels to prior movements in criminal law and neuroscience. The core tenet of this new movement is cerebral localization – the notion that violence (and other complex and contextual behaviors) can be traced to dysfunctions in particular parts of the brain. In this way, neurolaw participates both in the specific history of prior localization efforts and in those movements’ implicit motivating belief that the perpetrator of violence, the bad man, is “other” – is physiologically and neurobiologically not like us.

A. *Determinism & Localization in Current Law & Neuroscience Scholarship on Violence*

Members of several fields who work on criminal violence assert that criminal violence arises as a result of dysregulation of the prefrontal cortex (“pfc”) and the amygdala – indeed, that these parts of the brain “are thought to play preeminent roles in [violent] behavior.”<sup>132</sup> “We are placing the question of violence right in the middle of our basic research on the neurobiology of emotion,” says clinical psychologist Richard Davidson. So far, the “core findings” on violence and the brain are that the amygdala is “involved in fear and other negative emotions,” while the orbitofrontal cortex contributes

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(demonstrating connection between prefrontal lobe damage and impaired decision-making through neuropsychological testing); R. James R. Blair, Editorial, *Neurobiological Basis of Psychopathy*, 182 BRIT. J. PSYCHIATRY 5 (2003) (discussing neuroimaging studies finding association between amygdala dysfunction and psychopathy and noting probable impairment of orbitofrontal cortex in psychopathic individuals); R.J.R. Blair, *Neurocognitive Models of Aggression, the Antisocial Personality Disorders, and Psychopathy*, 71 J. NEUROLOGY, NEUROSURGERY & PSYCHIATRY 727 (2001) (discussing neurocognitive models of aggression and relating them to explanations of antisocial personality disorder); Antonio R. Damasio, *A Neural Basis for Sociopathy*, 57 ARCHIVES GEN. PSYCHIATRY 128, 128- 29 (2000) (noting that the observed reduction in prefrontal white matter volume in psychopaths supports the view that sociopathy is “related to the malfunction of . . . critical components in the prefrontal cortex”); Kent A. Kiehl et al., *Limbic Abnormalities in Affective Processing by Criminal Psychopaths as Revealed by Functional Magnetic Resonance Imaging*, 50 BIOL. PSYCHIATRY 677 (2001) (examining correlation between affective processing anomalies in criminal psychopaths and deficient input from limbic structures).

<sup>132</sup> Christopher M. Filley et al., *Toward an Understanding of Violence: Neurobiological Aspects of Unwarranted Physical Aggression: Aspen Neurobehavioral Conference Consensus Statement*, 14 NEUROPSYCHIATRY NEUROPSYCHOLOGY & BEHAV. NEUROLOGY 1, 1 (2001) (discussing conclusions of the Aspen Neurobehavioral Conference’s consensus statement on the relationship between mind, brain, and violence); see also Snead, *supra* note 17, at 1294.

to “constraining impulsive outbursts[.]”<sup>133</sup> According to proponents of this view, a diverse body of research, including new neuroimaging and older animal studies, supports the notion that violent behavior’s initiation implicates the amygdala and that its expression is regulated by the pfc.<sup>134</sup>

Impressive, even astounding, statistics support the claim that frontal lobe or pfc dysfunction is *the* major cause of all kinds of violent crime. Professor Richard Redding, citing brain function studies of incarcerated criminals, contends that “the prevalence rate [sic] of brain dysfunction ... [is] *ninety-four percent* among homicide offenders, [and] sixty-one percent among habitually aggressive adults[.]”<sup>135</sup> By contrast, the claimed “prevalence rate [of brain dysfunction] in the general population is only *three*

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<sup>133</sup> *Brain Study Sheds Light on Impulsive Violence*, ScienceDaily (Aug. 15, 2000) available at <<  
<http://www.sciencedaily.com/releases/2000/08/000814021300.htm>>> (accessed on March 12, 2008).

<sup>134</sup> See Snead, *supra* note 17 at 1294-95 and nn. 146, 148, & 150 (reviewing research on the relationship between amygdala and pfc function, and violent behavior). Some of the most significant work in this area includes: Richard L. Frierson & Ryan D. Finkenbine, *Psychiatric and Neurological Characteristics of Murder Defendants Referred for Pretrial Evaluation*, 49 J. FORENSIC SCI. 604, 605 (2004) (discussing studies observing frontal lobe dysfunction in murderers); M.C. Brower & B.H. Price, *Neuropsychiatry of Frontal Lobe Dysfunction in Violent and Criminal Behaviour: A Critical Review*, 71 J. NEUROLOGY NEUROSURGERY & PSYCHIATRY 720, 722-23 (2001) (surveying eighteen neuroimaging or neuropsychological studies touching on frontal lobe dysfunction and violent behavior); Adrian Raine *et al.*, *Prefrontal Glucose Deficits in Murderers Lacking Psychosocial Deprivation*, 11 NEUROPSYCHIATRY NEUROPSYCHOLOGY & BEHAV. NEUROLOGY 1, 2 (1998) (examining whether “prefrontal dysfunction may specifically characterize violent offenders who lack psychosocial deficits”); Adrian Raine *et al.*, *Reduced Prefrontal and Increased Subcortical Brain Functioning Assessed Using Positron Emission Tomography in Predatory and Affective Murderers*, 16 BEHAV. SCI. & L. 319, 321 (1998) (assessing “differences between affective and predatory murderers in cortical and subcortical brain functioning”); Adrian Raine *et al.*, *Brain Abnormalities in Murderers Indicated by Positron Emission Tomography*, 42 BIOL. PSYCH. 495 (1997); Adrian Raine *et al.*, *Selective Reductions in Prefrontal Glucose Metabolism in Murderers*, 36 BIOL. PSYCH. 365, 365-66, 370-71 (1994). In 2005, Jana L. Bufkin and Vickie R. Luttrell reviewed seventeen neuroimaging studies of aggressive, violent, and antisocial psychiatric patients, and concluded that prefrontal dysfunction is “consistently related to aggressive and/or violent behavior[.]” Jana L. Bufkin & Vickie R. Luttrell, *Neuroimaging Studies of Aggressive and Violent Behavior*, 6 TRAUMA, VIOLENCE, & ABUSE 176, 182 (2005).

<sup>135</sup> Redding, *supra* note 3, at 57 (citing Nathaniel J. Pallone & James J. Hennessy, *Brain Dysfunction and Criminal Violence*, 35 SOCIETY 21, 21 (1998)). Note that Pallone and Hennessy used a particularly expansive definition of brain dysfunction.

percent.”<sup>136</sup> While some more careful legal scholars and neuroscience researchers tease apart correlation from causation, and note that the causal relationship between the degree of frontal lobe activity and any specific conduct that the person may engage in is at best unestablished,<sup>137</sup> others leap forward: We are asked to believe that “neuroscience research ... provides *compelling explanatory evidence*” that frontal lobe dysfunction plays “a *causal* role” in most types of violent crime.<sup>138</sup> Following this view, understanding pfc dysfunction should provide the foundation for future “criminology, crime prevention efforts, and the functioning of the criminal justice system.”<sup>139</sup>

Support for these claims about the causal role of specific parts of the brain in violent behavior comes primarily from two investigatory modes: animal studies – primarily on cats, rats, and monkeys (and one famous bull) – and fMRI studies of people. Below, I analyze in depth a representative example of each research modality.

### 1. *Animal Fantasies: Are Cats Like Terrorists?*

In *Law, Responsibility, and the Brain*, Professor Owen Jones and a team of legal scholars and neuroscientists make claims about the neurobiological bases of

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<sup>136</sup> *Id.* (emphasis added) (citing self, *Why It Is Essential to Teach About Mental Health Issues in Criminal Law (And a Primer on How to Do It)*, 14 WASH. U. J. L. & POL'Y 407, 408-10 (2004) (reviewing data on the prevalence of mental disorders among adults who come into contact with the criminal justice system)).

<sup>137</sup> See, e.g., Jedediah Purdy, *The Promise (And Limits) of Neuroeconomics*, 58 ALA. L. REV. 1, 3 (2006) (noting that, “[e]ven at its most sophisticated, brain imaging can only give us a map of correlations, which are physical events in the brain that correspond to the activity of the mind.”); *id.* at 14 (describing some neuroeconomics studies based on neuroimaging as “flirt[ing] with the emptiness of mere correlation.”).

<sup>138</sup> Redding, *supra* note 3, at 57-8 (emphasis added). See also, e.g., Adrian Raine et al., *Reduced Prefrontal and Increased Subcortical Brain Functioning Assessed Using Positron Emission Tomography in Predatory and Affective Murderers*, 16 BEHAV. SCI. & L. 319, 327-28 (1998); Adrian Raine et al., *Selective Reductions in Pre-Frontal Glucose Metabolism in Murderers*, 36 BIOLOGICAL PSYCHIATRY 365-66 (1994) (finding lower than average glucose metabolism in the lateral and medial prefrontal cortex of murderers who agreed to be tested; hypothesizing decreased activity in these brain regions may be predictive of one’s propensity to violence).

<sup>139</sup> Bufkin & Luttrell, *supra* note 134, at 176.

human violence based heavily on studies of cats and rats.<sup>140</sup> The studies on which Jones, et al., rely were designed to evoke two kinds of aggressive behavior in cats and rats – what the investigators call “defensive rage” or “predatory aggression.”<sup>141</sup> In these studies, cats and rats display different patterns of brain activation depending on whether the animals were provoked to display “defensive rage” or “predatory aggression.”<sup>142</sup>

In ordinary English, “defensive rage” and “predatory aggression” translate roughly to “guarding territory” and “attacking mice.” Male cats and rats both have evolved to be territorial animals (unlike humans); further, both species prey on mice – also generally unlike humans. From the different brain circuits that become active during cats’ and rats’ defense of their territory from an animal intruder placed into their space, versus those that become active when they prey on a mouse, these scholars – following decades of work by other scholars – conclude that there are unique brain activation patterns specific to the general categories of behavior that could be called defense and attack. Moreover, they claim that this is *universal* circuitry that would underlie people’s actions when people engage in a “defensive” violent act (like self-defense, or a defensive response to what objectively is not a threat but subjectively is perceived as such) versus a “predatory” aggressive act, like a premeditated crime.

This work follows an extensive body of work by other scholars, who have argued from this animal data that people, similarly, may have different neurological bases for “hot” violence – heat of passion crimes – and “cold” crimes involving

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<sup>140</sup> Mobbs, *et al.*, *supra* note 16, at 695 (this article represents a collaboration between specialists in neuroimaging and legal scholars, including Owen D. Jones of Vanderbilt Law School).

<sup>141</sup> *Id.*

<sup>142</sup> *Id.*

premeditation.<sup>143</sup>) Accordingly, they contend, different types of brain dysfunction may cause people to engage in these types of offenses.<sup>144</sup> Extrapolating from the categories of defensive “rage” and “predatory aggression” in cats and rats, Professor Jones and his coauthors propose that distinct “neural topographies” may underlie highly specific types of crimes.<sup>145</sup> Indeed, they suggest, there may be a unique brain pattern for crimes ranging from “sadistic murder” to “political terroris[m].”<sup>146</sup> Adverting glancingly to the animal studies described above, they conclude that lawmakers ought to approach different types of criminal violence differently based on the (putatively) distinct *neurobiology* of each.<sup>147</sup>

On one level, Jones et al.’s assertions must be trivially true: Insofar as there is a materialist basis for all human thought and action, there probably is a distinct neurobiological correlate for thinking of or engaging in any *X* versus any *Y*. Likely there are distinct “neural topographies” that underlie skipping and hopping.<sup>148</sup> But those who advocate for this position are not after trivial truth; their claim is not that brain activation patterns reflect and enable everything that people do, but that people engage in particular crimes *because of* specific, disordered neurobiology. Thus, at the least, the brain of a “political terrorist” would be different from that of a child molester; at the most, a person would become a “political terrorist” or pedophile because he possessed a certain neurobiological defect. Only if their case is the latter is it even meaningful to speak of

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<sup>143</sup> *Id.*

<sup>144</sup> *Id.*

<sup>145</sup> *Id.* at 695.

<sup>146</sup> *Id.*

<sup>147</sup> *Id.*

<sup>148</sup> Although such correlates might be specific to each individual, and to his or her personal history and associations. As will be discussed in Part III, *infra*, individual responses to the same stimulus vary tremendously both across subjects and even within the same subject over time.

“the neurobiology of violence” or to propose that the Lombrosian dream of a biological criminology could be realized through new technologies.

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## 2. *Thought Crimes in the Scanner*

Imaging is contributing to efforts to understand the roles that different parts of the brain may play in criminal behavior. A recent and particularly striking example of this type of imaging study Professor Martin Walter’s article, *Pedophilia Is Linked to Reduced Activation in Hypothalamus and Lateral Prefrontal Cortex During Visual Erotic Stimulation*.<sup>149</sup> Walter’s study is the first to use fMRI<sup>150</sup> to compare the neurological responses of self-described pedophiles and self-described normal adults to erotic material featuring adults.<sup>151</sup> The researchers scanned the subjects’ brains while the subjects looked at erotic pictures of adults. The fMRIs of pedophiles during the experiment showed “reduced activation” of the hypothalamus and prefrontal cortex “as compared to healthy individuals when they were viewing sexually arousing pictures of adults.”<sup>152</sup>

This sounds astounding – biological basis of pedophilia discovered! And indeed, several of the study’s authors commented in the press (although not in the article)

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<sup>149</sup> Martin Walter, *et al.*, *Pedophilia Is Linked to Reduced Activation in Hypothalamus and Lateral Prefrontal Cortex During Visual Erotic Stimulation*, 62 BIOL. PSYCH. 698 (September 15, 2007).

<sup>150</sup> For a synopsis of how brain images are made and interpreted, see, *e.g.*, Laurence R. Tancredi & Jonathan D. Brodie, *The Brain and Behavior: Limitations on the Legal Use of Functional Magnetic Resonance Imaging*, 33 AM. J.L. & MED. 271, 272-76 (2007) (in a section entitled “Basics of Brain Imaging,” describing the mechanics of EEG, PET, and fMRI image production and interpretation). For a discussion of the “limitations and distortions” of fMRI, see *id.* at 278-80, noting that, among other difficulties, brain images can “vary significantly both between subjects and across sessions [with the same subject].” Further, “there is much unexplained variability of the signal within brain regions among individuals tested.” *Id.* at 280.

<sup>151</sup> Walter, *supra note* 149, at 698.

<sup>152</sup> *Id.*

that their work shows how the “health problem” of pedophilia may flow from defective neurological activation patterns. They further speculated that pedophilia may be treatable through pharmacological or other interventions to increase the activation of the parts of the brain that appeared hypoactive in their study. But, translated into ordinary language, the results seem considerably less surprising or meaningful. Essentially, researchers here correlated sexual arousal with activity in certain parts of the brain, within the limbic system, and the inhibition of arousal elsewhere, in the pfc. The subjects who said they were attracted to adults showed activity in the limbic structures when they looked at erotic pictures of adults. They also showed some degree of pfc activity, hypothesized by the researchers to represent the brain’s “no” to the subjects about the extent to which the arousal could proceed under the circumstances. The subjects who said in advance of the scanning that they were *not* attracted to adults did *not* show the same degree of activity in the limbic areas or the concomitant “inhibitory” activity in the pfc. This study thus neatly demonstrates that people show arousal when they see what turns them on and that they don’t when they don’t.<sup>153</sup>

These results would hardly be unexpected to anyone who subscribes to a materialist view of consciousness – that is, that all our thoughts and emotions have a physical and detectable reality. Indeed, it is unclear why there would be any expectation that a group of subjects would have any response (neurological or otherwise) to an erotic category in which they have no interest. A group of shoe fetishists might show arousal in response to a red, patent leather stiletto but not to a handbag: Handbags are the wrong

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<sup>153</sup> Or, at least, it illustrates what is going on in one’s brain during arousal in response to printed erotic images. Surely different and additional neurological responses would occur in response to erotic sound, scent, and touch, or possibly just to the visual presence of a real person, but those experiments may be more challenging to run inside of a scanner.

accessory. To take a slightly more serious example, typical heterosexual women might not show hypothalamic activation and pfc inhibition in response to viewing gay male pornography. Their (possible) lack of activation might be indicative of their female “straightness,” but they are not straight women *because* their brains fail to respond to gay male porn. Rather, that activation pattern (or lack thereof) is the end product of a complex physiological, psychological, and genetic mix that could not readily be altered just by juicing up the activity in the hypothalamus. Nor can the lack of activation in these (hypothetical) women be constructed as a disease state or, in the words of the researchers on the pedophilia imaging study, a “health problem.”

Relatedly, this pedophilia study shows the degree to which scans may not reveal brain pathology *per se* but simply patterns that may be harmful or anti-social in relation to socioculturally-specific norms. If another experiment were run in which normal adults failed to show brain arousal in response to *child* pornographic images, one might see the same lack of hypothalamic activation and concomitant absence of inhibitory pfc activity. Yet, we would not define that as evidence of a brain dysfunction or speak of hypothalamic “deficits” in the subjects; for good reasons, we do not consider lack of sexual attraction to children to be pathological.

So, we are reasoning from conclusions about abnormality and back-fitting them into scanner patterns; we know in advance whether a particular behavior or thought process is atypical, abhorrent, and/or actually criminal; associating brain activation patterns with that proscribed thing, we may know, at the most ... what brain activation patterns are associated with that proscribed thing. But we have no basis on which to

conclude that the activation pattern causally produces the proscribed thing or represents a medical pathology.

3. *Tales of the Good Man Gone Bad – Brain Damage as Catalyst to Crime*

Finally, legal writers who draw on neuroscientific notions of the localization of violence often point to fantastical one-off case studies to “prove” the claim that violence “comes from” pfc disinhibition. These stories support the claim that damage to the prefrontal cortex causes previously law-abiding folk to transmogrify into impulsive, violent criminals.

The paradigmatic story of the relationship between frontal lobe dysfunction and violence, repeated in nearly all legal and popular science literature on the subject, is that of Phineas Gage.<sup>154</sup> Phineas Gage was a law-abiding railway worker who, in 1848, suffered a bizarre industrial accident: An explosive charge meant to drive an iron tamping rod into the ground backfired – and drove the rod through Gage’s forehead and out the top of his skull.<sup>155</sup> Amazingly, Gage’s injuries healed and he lived another thirteen years. Yet, according to his physicians and friends, Gage went through a marked change: He became ill-tempered, obstreperous, and prone to fits of rage.<sup>156</sup> For the rest

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<sup>154</sup> See UTTAL, *supra* note 54 at 165, n.4, calling the Gage story a “mainstay of pop psychology.” Among many sources repeating the Gage story, see, e.g., Sasso, *supra* note **Error! Bookmark not defined.** at 792-94 (devoting a section of the article to the Gage case; describing it as the seminal case on the relationship between damage to the prefrontal cortex and violent and/or sexual disinhibition of conduct); Joseph H. Baskin, Judith G. Edersheim, & Bruce H. Price, *Is a Picture Worth a Thousand Words? Neuroimaging in the Courtroom*, 33 AM. J.L. & MED. 239, 244 (2007) (describing Phineas Gage case to show relationship between orbitofrontal damage and violent behavior); Redding, *supra* note 3, at 70-72 (discussing Gage case as exemplary of the relationship between orbitofrontal damage and violence); Raymond J. Dolan, *On the Neurology of Morals*, 2 NATURE NEUROSCIENCE 927, 927-28 (1999) (citing J.M. Harlow, *Passage of an Iron Rod Through the Head*, 39 BOSTON MED. & SURGICAL J. 389 (1848)) (discussing Gage’s treatment by his physician, Harlow).

<sup>155</sup> Hanna Damasio, et al., *The Return of Phineas Gage: Clues About the Brain from the Skull of a Famous Patient*, 264 SCIENCES 1102, 1102-1105 (1994).

<sup>156</sup> *Id.*

of his life, Gage suffered a variety of deficits and frequently was (in relatively minor ways) in trouble with the law.<sup>157</sup>

A few modern stories follow a similar pattern: In these cases, a socially respectable man – a teacher, a stock broker – suffers a brain injury and morphs into a perpetrator of violence or sex crimes.<sup>158</sup> When the brain injury heals (or the tumor is removed), the man returns to his gentle and law-abiding ways. The role that these stories play in the literature on criminal violence is to show that violence is a pathology – that it can be produced by brain trauma and alleviated by brain correction.<sup>159</sup> Thus, under this view, the most relevant level at which to understand criminal violence is internal to the individual – at the level of his neurobiology or neurochemistry – and, specifically, at the level of his prefrontal cortex.

### III. SCIENTIFIC DIFFICULTIES WITH TODAY’S CRIMINAL ANTHROPOLOGY

Bringing together anecdote and image, stories about the localization of violence in the brain are almost irresistible. They have the most current and sexy science, fMRI, apparently behind them, as well as decades of animal and human trauma research. Yet, there is “an enormous chasm” between what it is scientifically legitimate to say about “the localization problem” and what has “been concluded from well-intentioned, but inadequately reasoned research[.]”<sup>160</sup> While it may not at first seem legitimate to

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<sup>157</sup> *Id.*

<sup>158</sup> See, e.g., Jeffrey M. Burns & Russell H. Swerdlow, *Right Orbitofrontal Tumor with Pedophilia Symptoms and Constructional Apraxia Signs*, 60 ARCHIVES OF NEUROLOGY 437, 437-38 (2003) (describing case of 40-year old man who engaged in uncharacteristic and unlawful sexual behavior incident to development of tumor in the orbitofrontal cortex, and whose behavior returned to normal after removal of the tumor); Becky Sheaves, *The Freak Accident that Left My Son Obsessed with Sex*, Daily Mail (London), July 4, 2006, at 49 (describing the case of Andrew Laing, who, incident to a concussive injury to the frontal lobe he sustained while skiing, became physically and sexually aggressive).

<sup>159</sup> Burns & Swerdlow, *supra*, at *id.*

<sup>160</sup> UTTAL, *supra* note 54, at 6.

lump the neuroscience of the new millennium with the science of lumps from the eighteenth hundreds, this Section will show that scientific infirmities continue to plague localization efforts – and that, for reasons inherent to the structure of the brain and to the ways in which localization questions are posed, likely always will.

The threshold question to ask of a scientific assertion supporting a legal claim is: Is it accurate? To assess the credibility of the claims that criminal violence is the result of brain dysfunction, this Section will examine the current state of research on the localization of basic and higher brain processes. Starting with sensory-motor, it will show that, even for these relatively simple functions, the localization enterprise runs into problems. These problems include the difficulty in distinguishing which parts of the brain are necessary versus sufficient for any action, the difficulties of localizing any function in a complex, interactive system, and problems posed by the important differences in brain structure across individuals.

Keeping these general challenges to localization in mind, this Part then examines the state of research concerning the localizability of violence to the amygdala and prefrontal cortex. Neuroscientists disagree amongst themselves as to the functions of the amygdala and pfc, attributing to them vastly disparate functions unrelated to violence. Further, the conclusions from animal studies linking these brain regions with violence suffer from a host of experimental design and interpretive problems. Moving from animals to humans, some efforts to localize violence have relied upon brain injury case, like the celebrated case of Phineas Gage; yet, brain injury studies produce idiosyncratic and unreliable information that raise more questions than they answer. In intact people, efforts to localize violence, and emotions like fear, to specific parts of the brain, have

fared little better; the broad discrepancies between what activation scans show and what people subjectively self-report about their emotions raises the important question of what to believe – what a scan indicates is going on in a person’s head or what the person claims to feel.

Each of these issues that presents a scientific or formal barrier to the simplistic localization of violence could be the subject of entire article or book – indeed, many are. It is beyond the scope of this Article to address any of these issues comprehensively. Rather, the purpose of presenting a sketch of these issues is to inform the legal reader of the active scientific controversies surrounding the localization enterprise. While contemporary science has made phenomenal strides over the brain sciences of earlier eras, the current state of science provides more reasons to be skeptical of the localization enterprise than to embrace it.

A. *What We Know About Localization Generally*

Theories of the localization of complex psychological phenomena, like violence, start from the premise that the brain is made up of specialized modules with distinct functions. Yet, the localization of even very basic brain functions is not as precise as generally is depicted in literature advocating for the localizable nature of violence. Because basic sensory and motor functions cannot be localized to independent, isolated parts of the brain, there is little foundation from which to hypothesize that higher functions are discretely localized. Even sensory and motor components of the brain are not neatly and distinctly divided by function; there is a great deal more interplay between these regions and the rest of the brain than popular literature reflects.

The brain is clearly not an undifferentiated, equipotential mass: it is composed of various regions, which are visibly different both in their gross anatomy and cytoarchitecture (cell structure).<sup>161</sup> Sensory and motor functions, in particular, occupy relatively specialized regions of the brain.<sup>162</sup> Some functional differences among these different regions are well-established: the brain stem regulates the most basic functions of the body's survival, such as breathing; the motor cortex, as the name implies, relates to motion and locomotion; specific, identified parts of the brain also are involved in processing and interpreting sensory input such as visual images, smell, and sound. Some areas involved in uniquely human faculties, like speech, also have been identified: Broca's and Werneke's regions, for example, play important (although not exclusive) roles in producing speech, and lesions in these areas can cause different kinds of aphasias. Neuroscientists consider these sensory and motor functions to be the most easily localized and the most strictly confined to particular regions of the brain.

However, even for these "simple" brain functions, localization is imperfect because the brain is an incredibly complex, interacting system. Many parts of the brains are involved in processing even simple stimuli – and it is not yet known what the contributions are of the different parts or how they relate to each other. Rather, it appears that no one part of the brain is sufficient, in isolation, to accomplish any function of a living being.<sup>163</sup> Further, individual variation in brain structure is enormous – particularly among human beings – meaning that the locations in the brain that are involved in one process in one person will not be identical in another person.

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<sup>161</sup> UTTAL, *supra* note 54, at 11.

<sup>162</sup> *Id.*

<sup>163</sup> KAGAN, *supra* note 89, at 214.

Three beautiful and careful examples of neuroscience research on sensory and motor systems – specifically, the auditory, visual, and motor systems – illustrate the difficulties with localizing even these more basic brain functions.

Processing sound, a basic sensory operation, involves several, known regions of the brain. Yet, putting those components together into “hearing” is not localized to any one part of the brain or even to one general region. If a person is surprised with the sound of a whistle, fMRI imaging shows that twenty four distinct areas in the brain become active.<sup>164</sup> As far as is known, most of these areas are not strictly necessary for detecting sound. Prior to this and related experiments, neuroscientists would not have presumed that many of the active areas were implicated in sound processing at all.<sup>165</sup> It may be that some of the regions that become active are associated with surprise, with memory, with sound-identification (What made that sound? Where have I heard that before?), and with associating sound and meaning (What does a whistle mean to me, based on my personal history? What feelings does the sound of a whistle evoke for me?). Thus, a brain scan showing these twenty four areas lit up with activity would not translate directly to ... anything. No conclusion can be drawn from such a scan about the necessity or sufficiency of any of these regions to processing sound generally or to the identification of a whistle specifically. It is quite likely that a person still would be able to hear the whistle without the contribution of many of these sites, although which are dispensable are at this point unclear. Nor would it be possible to read backward from the scan that the person heard a whistle.

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<sup>164</sup> *Id.*

<sup>165</sup> *Id.*

The fact that multiple sites are activated in response to a simple auditory task, hearing a whistle, means that “scientists [and legal scholars] cannot assume that a brain site is necessary for a psychological process just because it was active during the process.”<sup>166</sup> This issue with sound processing represents the more general problem of “necessary but not sufficient.” For although “it is clearly true that we can say of particular brain regions that they are *necessary* for given behaviors (or their expression),” decades of experiments show that “there is no region of the human brain [including the amygdala or pfc] of which we can say that it is *sufficient* for such functions.”<sup>167</sup>

The visual system presents greater complexity and demonstrates a distinct problem. Neuroscientists working on how the brain processes visual stimuli to create “seeing” have made tremendous progress. Going back to the early 1990s, neuroscientists have been able to discern and describe a series of feedback and feedforward systems between brain “modules” that contribute distinct visual processing functions to the overall gestalt of “seeing.”<sup>168</sup> These “modules” have been organized by researchers into a hierarchical model that purports to show the distinct contributions that each one makes to seeing.<sup>169</sup> And yet even here, there may not be the degree of functional localization previously assumed.

Because of the “basic properties of interconnected networks,” a body of researchers contend that “complex systems like this cannot be organized into a unique

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<sup>166</sup> *Id.*

<sup>167</sup> RICHARD C. LEWONTIN, ET AL., NOT IN OUR GENES: BIOLOGY, IDEOLOGY, AND HUMAN NATURE 145-46 (1989) (emphasis in original) [“LEWONTIN, ET AL., NOT IN OUR GENES”].

<sup>168</sup> UTTAL, *supra* note 54, at 162 (emphasis in original) (citing Hilgetag et al. (1996)).

<sup>169</sup> *Id.*

hierarchical organizational chart.”<sup>170</sup> According to systems biologists, who work on the mathematics of complex, non-linear systems, there is “an *in principle* barrier to the specification of a network hierarchy” like the brain processes that interrelate to create “seeing,” “*no matter how many experiments may be carried out.*”<sup>171</sup> While scans of auditory activity raise the necessary/sufficient/incidental problem, the current understanding of the visual system raises the issue that, in a complex networked system, it may be *formally* (that is, mathematically) impossible to determine the independent contributions of different components.

Work in the motor system highlights a third challenge to localization – individuality; the unique make-up of every person. Cutting-edge experiments in neuro-robotics (brain-robot interfaces) demonstrate that brains are unique in important ways even as to simple motor functions, like moving one’s arm. MacArthur-prize winning neuroroboticist, Yoky Matsuoda, is showing that the motor neurons of every person’s brain are organized with important differences that defy precise localization.

Professor Matsuoda’s work focuses on designing cybernetic limbs that an amputee can control through thinking about moving the missing limb.<sup>172</sup> To do this, Professor Matsuoda introduces electrodes into the specific neurons within the part of the subject’s brain responsible for activating arm movement.<sup>173</sup> This would sound as if it supports the localization notion, at least for motor functions. And yet, this is not the case. She explains:

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<sup>170</sup> *Id.* at 162 (emphasis in original) (citing Hilgetag, et al. (1996)).

<sup>171</sup> *Id.*

<sup>172</sup> Dr. Yoky Matsuoda, personal communication, February 16, 2007 (Renaissance Conference, Santa Barbara, Ca.).

<sup>173</sup> *Id.*

A person's history determines which neurons control the arm. Even in identical twins, the same neuron in one person could activate the arm, but in the other twin, it could activate the leg. It depends on what the person has touched, seen, done, at critical points in his or her development.<sup>174</sup>

For this reason, it is not possible to identify a general "arm movement location." Rather, she finds it necessary to work individually with each subject – at this point, mostly monkeys – to understand that subject's particular "wiring."<sup>175</sup> This is not surprising, she says, because "if our brains were not individual, we could not be individuals."<sup>176</sup>

Sensory-motor localization poses challenges of its own; yet, these problems proliferate as to the localization of higher cognitive functions. Sensory and motor aspects of cognition are anchored to dimensions of time, space, quality (e.g., hot, cold, wet, rough), intensity; the "further we move from the sensory aspects of cognition ... the more difficult it becomes to find particular brain regions exclusively and uniquely associated with a particular cognitive process."<sup>177</sup> Neuroscientists active in localization research concerning higher cognitive functions confront the following problems:

- Regions are not sharply demarcated in the brain;
- Cognitive functions activate broadly distributed regions of the brain;
- Brain regions are complexly interconnected;
- Lesion experiments [or accidents] cannot confirm sufficiency of any region to the function under study; and
- Human neuropsychological and experimental data are idiosyncratic.<sup>178</sup>

These are but a few of the issues that "shadow[]" efforts to localize complex cognitive functions "with serious and complex conceptual troubles."<sup>179</sup>

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<sup>174</sup> *Id.*

<sup>175</sup> *Id.*

<sup>176</sup> *Id.*

<sup>177</sup> UTTAL, *supra* note 54, at 25.

<sup>178</sup> This list is reproduced from Uttal, *supra* note 54, at 153. Uttal discusses each of these issues in depth, at UTTAL, *supra* note 54, at 153-66.

B. *The Limits of Localizing Violence to the Amygdala and PFC*

The localization of higher functions like social behavior incorporates the problems inherent in the localization of lower functions, as well as a set of even more intractable issues. The claims in the prior sections about the simple relationship between violence and dysfunction of the amygdala or pfc are rife with these problems, including: (1) disagreements between scientists about the functions of the amygdala and pfc, (2) unsupportable conclusions from animal studies, (3) irreproducible claims from a handful of celebrated brain injury cases, and (4) broad discrepancies between what scans show and subjects' self-reports of what they are feeling.

1. *Problems with Multiple Claims About PFC and Amygdalar Function*

Legal scholarship advocating for a primarily brain-based understanding of violence hangs substantially on claims about the pfc and the amygdala. Yet, different neuroscientists have come to vastly disparate conclusions about the functions of the pfc and the amygdala, implicating them in diverse mental processes unrelated to fear and violence. This lack of consensus should give legal scholars pause before adopting a single belief about the localization of violence to these parts of the brain.

Looking at research on the pfc first: The prefrontal cortex is without doubt one of the most intricate and sophisticated parts of the brain. Indeed, there is hardly a higher-level cognitive process that one or another researchers has not localized to the frontal lobes. These include, among others:

- general intelligence<sup>180</sup>
- problem solving<sup>181</sup>

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<sup>179</sup> *Id.* at 26.

<sup>180</sup> J. Duncan, *Attention, Intelligence, and the Frontal Lobes*, in *THE COGNITIVE NEUROSCIENCES* 721 (Michael Gazzaniga, ed. 1995).

- executive control<sup>182</sup>
- attention<sup>183</sup>
- decision-making<sup>184</sup>
- semantic memory<sup>185</sup>
- perceptual analysis<sup>186</sup>
- self-awareness; sense of self<sup>187</sup>
- “the creation and maintenance of explicit relational representations that guide thought and action”<sup>188</sup>
- “free won’t”<sup>189</sup>

This list of functions, which is itself extremely broad, only shows the tip of the proverbial iceberg: A literature review by several neuroscientists of the functions imputed to the pfc produced a seven-page list of different attributions.<sup>190</sup>

The pfc may be involved in all of these activities, and others yet to be determined. If so, what would decreased activation of a person’s pfc in a particular

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<sup>181</sup> ANTONIO R. LURIA, HIGHER CORTICAL FUNCTIONS IN MAN 2 (1966).

<sup>182</sup> MICHAEL J. POSNER & MARCUS E. RAICHLE, IMAGES OF MIND 32 (1997); Jennifer S. Beer, Arthur P. Shimamura, & Robert T. Knight, *Frontal Lobe Contributions to Executive Control of Cognitive and Social Behavior*, in THE COGNITIVE NEUROSCIENCES 1077 (Michael Gazzaniga, ed. 2004).

<sup>183</sup> Glyn W. Humphries & Dana Samson, *Attention and the Frontal Lobes*, in THE COGNITIVE NEUROSCIENCES 607, 608 (Michael Gazzaniga, ed. 2004).

<sup>184</sup> ANTONIO R. DAMASIO, HANNA DAMASIO, & YVES CHRISTEN, NEUROBIOLOGY OF DECISION MAKING (1996).

<sup>185</sup> Anthony D. Wagner, Silvia A. Bunge, and David Badre, *Cognitive Control, Semantic Memory, and Priming: Contributions from the Prefrontal Cortex*, in THE COGNITIVE NEUROSCIENCES 709 (Michael Gazzaniga, ed. 2004).

<sup>186</sup> B. Milner, *Effects of Different Brain Lesions on Card Sorting*, 9 ARCHIVES OF NEUROLOGY 90, 90 (1963).

<sup>187</sup> C. Neil Macrae, Todd F. Heatherton, & William M. Kelly, *A Self Less Ordinary: The Medial Prefrontal Cortex and You*, in THE COGNITIVE NEUROSCIENCES 1067 (Michael Gazzaniga, ed. 2004).

<sup>188</sup> N. Robin & Keith J. Holyoak, *Relational Complexity and the Functions of the Prefrontal Cortex*, in THE COGNITIVE NEUROSCIENCES 987, 996 (Michael Gazzaniga, ed. 1995).

<sup>189</sup> “Free won’t” is what Michael Gazzaniga describes as the ability to stifle inappropriate thoughts, speech, or action. Even if the pfc is the site of “free won’t,” it is unclear how or where the brain determines what is or is not appropriate under the circumstances. Gazzaniga’s localization of “free won’t” to the pfc is a wonderful companion to, among others, Renee Descartes’ localization of free will to the pineal gland. See, e.g., PETER A. SCHOOLS, DESCARTES AND THE ENLIGHTENMENT 169 (1989). In Gazzaniga’s schema, however, people are without such a construct as “free will”; rather, our thoughts and actions are totally determined *ex ante* by the structure of our brains. GAZZANIGA, ETHICAL BRAIN, *supra* note 8, at 98.

<sup>190</sup> UTTAL, *supra* note 54, at 23-24 (describing and citing J. Grafman, A. Partiot, and C. Hollnagel, *Fables of the Prefrontal Cortex*, 18 BEHAV. & BRAIN SCI. 349 (1995)).

situation tell us? The answer is: Nothing very specific – and nothing unambiguously related to the disinhibition of violent conduct. Since activity in the pfc could be related to some, all, or none of the functions above, pfc activity cannot translate directly into impulse control; lower activation does not mean that a person *will* act on a violent urge and higher activation does not mean that a person will *not* act on (or form in the first place) a violent urge.

Similarly, numerous respected brain researchers question the localization of “fear” to the amygdala,<sup>191</sup> and the leap from fearfulness to violence, because “the amygdala can be activated by many events that have no relation to fear.”<sup>192</sup> Pictures of food, the face of an old friend, and couples hugging or kissing, among other images, provoke amygdalar activity as long as the images are unexpected.<sup>193</sup> If a subject thinks he is in an experiment to identify playing cards, and the researcher “shows you a picture of scrambled eggs, your amygdala will light up.”<sup>194</sup> This would not be because one is afraid of scrambled eggs, or wants to attack them, but just because the eggs were unexpected.<sup>195</sup> This group of researchers believes that “the amygdala gets involved when there’s news.”<sup>196</sup>

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<sup>191</sup> These include, *e.g.*, Eliot Valenstein, William Uttal, Jerome Kagan, and Stephan Chorover, whose work is discussed throughout. *See* KAGAN, *supra* note 89, at 92 (describing various types of stimuli that lead to activation of the amygdala).

<sup>192</sup> KAGAN, *supra* note 89, at 92.

<sup>193</sup> *Id.*

<sup>194</sup> Interview with Stephan L. Chorover, Department of Brain & Cognitive Sciences, Massachusetts Institute of Technology, Jan. 29, 2008 [“Chorover, Interview”].

<sup>195</sup> *Id.* *See also* KAGAN, *supra* note 89, at 86-87 (“The brain’s first question to every intrusion is: Was this event expected or unexpected? Less than two-tenths of a second later, it evaluate the specific meaning of the event and may generate an emotional response.”)

<sup>196</sup> Chorover, Interview, *supra* note 194. *See also* KAGAN, *supra* note 89, at 86 (noting that an equal degree of amygdalar activity occurs in response to images of, *e.g.*, nudes as to angry or fear-provoking images). There could be a relationship between how sensitive a person is to “news” and how fearful he or she is; the two might be related at the level of how easily aroused or startled the person might be. A person who is

Other prominent contemporary researchers depict the amygdala's role as mediating between emotion and cognition,<sup>197</sup> and providing a basis for interpreting social information.<sup>198</sup> Still another view, discussed *infra* in Section III.B.2, is that the amygdala plays a role in visual memory. On this view, any connection between amygdalar activity and fear is illusory; the apparent fearlessness of an amygdalotomized animal comes from its failure to recognize the scary thing.

The role of the amygdala could be (and is) the subject of numerous books and scholarly articles. The purpose of this brief discussion is to show the unreliability of drawing any linear relationship between amygdalar activity and violence.

## 2. *Problems with extrapolation from animal models*

While researchers may have implicated the pfc and amygdala in a huge range of functions distinct from violence, the researchers who advocate for a close violence-amygdala/pfc connection often show empirical support for their claims through animal studies. These animal studies provide what appear to be direct and compelling evidence of the role of the amygdala, in particular, in causing violence. The raging bull and the wild monkeys reduced to tameness through interference with their limbic systems – did they not show an amazing absence of aggression? In fact not. Classic animal studies strongly qualify the view that the amygdala's role is related to fear and “reactive violence.” These problems are related to two general issues – poor experimental design

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easily startled *might* be excessively fearful, and thus *might* be prone to a greater degree of reactive violence – but that hypothetical relationship is, on current information, pure story-telling.

<sup>197</sup> Elizabeth A. Phelps, *The Human Amygdala and Awareness: Interactions Between Emotion and Cognition*, in *THE COGNITIVE NEUROSCIENCES* 1005 (Michael Gazzaniga, ed. 2004).

<sup>198</sup> Ralph Adolph, *Processing of Emotional and Social Information by the Human Amygdala*, in *THE COGNITIVE NEUROSCIENCES* 1017 (Michael Gazzaniga, ed. 2004).

and problems with extrapolating from non-analogous animal behaviors to people's social behaviors.

After initial reports that destruction of the amygdala could render “wild” and “aggressive” animals “tame,” further experiments showed that the likely animals were suffering from a disruption to their visual memory systems. So, it was not the case that the animals were without fear, but that they failed to recognize what they were looking at and connect it with any memory. Thus, their normal fearful or aggressive reaction disappeared because of interference with contextual thinking, not because the amygdala is the storehouse of fearful or aggressive impulses. Indeed, these animals still acted with equal “aggressiveness” to threatening physical stimuli, like being prodded. Their “violent” responses to unpleasant touch but apparent tameness toward everything else makes perfect sense as an unintended consequence of disruption to visual memory: If you do not know what a snake is, you might pick it up and be curious about it. But if it bit you, you'd still throw it down – a “violent” reaction.

Similarly, Delgado's production of a placid and submissive Spanish bull was an illusory result. Implanting the electrode in the bull's caudate nucleus, Delgado accidentally interfered with one aspect of the brain's motor control; thus the bull did not suddenly lose his “aggressive” desire to charge but rather his ability. Examination of old footage of Delgado's experiment shows the bull turning repeatedly in small, right-hand circles every time the electrode was switched on; this speaks to the nature of the electrode's motor and/or sensory interference. So much for discovering the seat of “animal violence.”

Beyond sheer experimental error – misidentifying loss of visual recognition for loss of aggressiveness, or partial paralysis for “tameness” – the use of animal models in studying human violence presents certain inherent problems. As discussed in Section III.B.2, most research on the relationship between the amygdala and animal aggression on cats and rats. These experiments are designed to monitor the role of the amygdala in two types of behavior, which the researchers call “defensive rage” and “predatory aggression.” “Defensive rage” is what the animal is said to show when a strange animal is placed into its territory. “Predatory aggression” is what the animal is said to show when it attacks a familiar prey animal, like a mouse. In these studies, researchers stimulate or extirpate the amygdala and see what effect it has on the cat or rat’s degree of “defensive rage” or “predatory aggression.”

Research on cats and rats makes sense from one perspective: these experimental animals are cheap, easily available, and small enough to keep large numbers of them in the lab. But it is worth remarking on two features cats and rats share, and that humans do not: First, cats and rats, unlike humans, are territorial. Second, and also unlike humans, they normally prey on mice. And yet, researchers do not remark upon the distinction between animal territoriality and human notions of “defense,” or between normal animal predation and human premeditated violence. Rather, they presume that all “violence” is the same thing, with the same mechanisms animating all “violent” conduct. In each case, the animal is engaging in an action that is a regular and important part of what it means to be a cat or a rat. Cats and rats have evolved brain systems that enable them be territorial and to identify and attack certain prey; the amygdala may play some role in these stereotypical cat and rat behaviors that it does not play in the human

being.<sup>199</sup> Indeed, these aspects of being a cat or a rat may not have any direct homologue in a human being.

Not only is it possible that the amygdala could play different roles in different animals, it would be expected. Evolution is conservative – that is, it does not proliferate new structures for new purposes but generally recruits existing structures to new purposes.<sup>200</sup> In mammalian species, much of the basic brain anatomy is the same and yet the functions facilitated by the same brain structures differ between different genres. This has been shown to be true of the amygdala. Lesions to the amygdala “disrupt[s] social communication” in many primates, but not in humans.<sup>201</sup> Conversely, lesions near certain language processing areas cause people to have serious social deficits related to loss of language comprehension, but “social communication of other primates is unaffected.”<sup>202</sup> If such differences in amygdalar function exist between people and our closest primate relatives, it is logical to ask whether the differences might not be even greater in the amygdalar function of people and rats.

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<sup>199</sup> Evolution is conservative – that is, it does not proliferate new structures for new purposes but generally recruits existing structures to new purposes. For a classic statement of this principle, see Steven J. Gould & Richard C. Lewontin, *The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme*, 205 Proc. Royal Soc. of Lon., Series B, Biol. Sci., 581, 594 (1979) (discussing phyletic and developmental constraints on evolutionary innovation). In the brains of different mammalian species, much of the basic brain anatomy is the same and yet the functions facilitated by the same structures of the brain may be different. This has been shown to be true of the amygdala. Lesions to the amygdala “disrupt[s] social communication” in many primates, but not in humans. Conversely, lesions near certain language processing areas causes people to have serious social deficits related to loss of language comprehension, but “social communication of other primates is unaffected.” BEN BEST, THE AMYGDALA AND THE EMOTIONS §9.5 (available at: <<<http://www.benbest.com/science/anatmind/anatmd9.html#function>>>) (accessed on March 8, 2008). See also THE AMYGDALA (John P. Aggleton ed., 1992). If such differences in amygdalar function exist between people and primates, it is logical at least to ask whether the differences might not be even greater between the amygdalar function of people and rats.

<sup>200</sup> For a classic statement of this principle, see Gould & Lewontin, *supra* note 199, at 594 (discussing phyletic and developmental constraints on evolutionary innovation).

<sup>201</sup> BEN BEST, THE AMYGDALA AND THE EMOTIONS §9.5 (available at: <<<http://www.benbest.com/science/anatmind/anatmd9.html#function>>>) (accessed on March 8, 2008). See also THE AMYGDALA (John P. Aggleton ed., 1992).

<sup>202</sup> BEST, *supra* note 201, AT §9.5.

Extrapolating freely from these experiments, though, in which cats and rats are quicker to attack an intruder if their amygdalae are stimulated and slower to attack if the amygdala is excised, researchers claim that the amygdala plays an important role in human “defensive rage.” They hypothesize that a person who is overly violent – prone, say, to attacks of road rage or domestic violence – is someone whose (hypothesized) over-active amygdala interprets innocuous stimuli as provocative insults. This kind of excessively violent reaction, springing from amygdalar overactivation, is then (rather circularly) claimed to show that violence is a type of brain pathology. So: researchers claim that a person who engages in inappropriate “defensive rage” or “predatory aggression” displays a pathology, a brain *dysfunction*. Thus, there are two unremarked-upon and highly questionable dimensions of comparison in this area of violence research – first, from animal to human; second, from normal to pathological.

The absurdities that can flow from these extrapolations are evident in Mobb and Jones’ connection of aggression in cats with terrorism.<sup>203</sup> From their literature review showing that different activation patterns underlie “defensive rage” and “predatory aggression” in cats (and rats), they conclude that unique “neural topographies” might underlie specific human crimes – including whether a person becomes a “political terrorist.”<sup>204</sup> Even holding aside the problems of cross-species extrapolation, the related problem of meaning is obvious: Terrorism is an inherently political and social concept that has a plethora of definitions<sup>205</sup> and no independent biological reality.

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<sup>203</sup> See discussion, *supra*, at the text accompanying notes 140 - 147.

<sup>204</sup> Mobbs et al., *supra* note 16, at 695.

<sup>205</sup> The Second Circuit (among other bodies) has concluded that there is no generally-accepted definition of “terrorism”:

There simply is no way to extrapolate from activation patterns in animal brains to conclusions about (putative) biological bases of human terrorism – much less legal prescriptions for intervention in the same. Until researchers can show that, *e.g.*, rats view cats as “terrorists,” the notion that specific patterns of brain activation in lab animals may, if mirrored in humans, predispose people to behave as “political terrorists” (or any other socially constructed and historically contingent category) is particularly inflammatory and unsupportable.

### 3. *Problems with extrapolation from human brain injury cases*

If claims about the localization of violence based on animal experiments are suspect, what about evidence directly from human beings? Accidental brain injuries and brain diseases have produced a host of illuminating scientific curiosities, including the Phineas Gage story and its modern equivalents. Don’t these old canards show the relationship between frontal lobe damage and violence (or uncontrolled sexuality)? In

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We regrettably are no closer ... to an international consensus on the definition of terrorism or even its proscription; the mere existence of the phrase “state-sponsored terrorism” proves the absence of agreement on basic terms among a large number of States that terrorism violates public international law. Moreover, there continues to be strenuous disagreement among States about what actions do or do not constitute terrorism, nor have we shaken ourselves free of the cliché that “one man's terrorist is another man's freedom fighter.”

*United States v. Yousef*, 327 F.3d 56, 106-07 (2d Cir. 2003). *See also id.* at notes 41 & 42.

International treaties and domestic laws offer a plethora of conflicting and controversial definitions of “terrorism.” For but a small sampling, see, *e.g.*, Declaration on Principles of International Law Concerning Friendly Relations Among Co-operating States in Accordance with the Charter of the United Nations, Oct. 24, 1970, G.A. Res. 2625, 25 U.N. GAOR Supp. (No. 28) at 21, U.N. Doc. A/8028 (1971), reprinted in 9 I.L.M. 1292 (1970); European Convention on the Suppression of Terrorism, Nov. 10, 1976, Europ. T.S. No. 90; Arab Convention on the Suppression of Terrorism (Cairo, Apr. 22, 1998), reprinted in International Instruments Related to the Prevention and Suppression of International Terrorism, 152-73 (United Nations 2001); 18 U.S.C. § 2331 (defining terrorism by motive); 6 U.S.C. § 444(2)(B) (defining terrorism by its effect on United States interests); 8 U.S.C. § 1182(a)(3)(B)(ii) (excluding aliens based on participation in “terrorist activity” involving, *inter alia*, attacks on third parties to influence the policy of any government). Scholars have their own definitions as well. *See, e.g.*, ALEX P. SCHMID & ALBERT J. JONGMAN, POLITICAL TERRORISM 1-2 (1988) (“Terrorism is a method of combat in which ... symbolic victims serve as an instrumental target of violence.”).

fact not: although brain injuries can be catastrophic, there is no reliable relationship pfc damage and violent or impulsive behavior. While in some cases, “relatively large volumes of brain can be ‘disconnected’ without much obvious consequence,” in other cases extremely small traumas of a few millimeters can “have devastating effects.”<sup>206</sup> Brain injury continues to puzzle, and throws more caution than light on simplistic localization arguments about the functioning of intact brains.<sup>207</sup>

For these reasons, it is “surprising[.]” that “a few scientists” have started to use pfc activity levels “as a referent for moral feeling or judgment.”<sup>208</sup> While it is true that certain “[p]sychopaths who are shown an aggressive picture ... display less activation” in the pfc than neurotypical people, the reverse is not true: “Most adults with damage to, or compromise of, the orbitofrontal prefrontal cortex never commit a serious crime, whereas most who lie, cheat, and steal have perfectly intact brains.”<sup>209</sup> This is not to say that a brain trauma or disease, like a tumor, could not produce dramatic personality changes; it could. However, the nature of the deficit frequently will be idiosyncratic, and the presence of the deficit does not mean – reasoning in the other direction – that a person has a compromised brain. The questions of how the brain re-routes around injuries and compensates for its deficits, and how the brain continues to grow and change throughout a person’s life, merit extensive examination in their own right. The limited point here, on the localization of violence, is just this: Not only is there no linear relationship between

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<sup>206</sup> LEWONTIN, ET AL., NOT IN OUR GENES, *supra* note 167, at 190.

<sup>207</sup> Stephan L. Chorover, *Violence: A Localizable Problem?*, in BIOLOGY, CRIME, & ETHICS 255, 263 (Frank H. Marsh & Janet Katz, eds. 1985) [“Chorover, *Violence: A Localizable Problem?*”] (“Brain lesions, whether the results of operations or accidents in humans, or in controlled animal experiments, have continued to produce puzzles and paradoxes.”).

<sup>208</sup> KAGAN, *supra* note 89, at 130.

<sup>209</sup> *Id.*

degree of pfc functionality and degree of impulse control, there is no definite relationship at all.

4. *Differences between subjective experience & scan data*

If animal studies and accident victims are unreliable guides for the relationship between the activity in specific parts of the brain and violence, can we not look to self-reports of intact people? Again, the answer is: Not so fast. With advanced scanner technology, it now is possible to examine activity in a person's brain while he or she goes through an experience. One of the fascinating findings of direct studies is the surprising lack of correlation between whether specific parts of the brain show activity and what the person says she *feels* about what she experiences. Indeed, in some studies “there is *little or no relation* between verbal reports of the intensity of anxiety or fear to pictures of angry or fearful facial expressions and the amount of activity in the amygdala.”<sup>210</sup>

A classic example is the difference between physiological measures of women's response to pornography and their reported experience of arousal, or lack thereof.<sup>211</sup> Similarly, there is little or even no correlation between people's subjective reports of whether they are experiencing fear or anxiety and the amount of activity

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<sup>210</sup> *Id.* at 214 (citing T. Furmark, et al., *Amygdalar Activity during Emotional Perception and Experience in Subjects with Social Phobia*, 57 *BIOLOGICAL PSYCHIATRY* 169S (2005); A.E. Guyer, et al., *Developmental Differences in Attention Related to Amygdala Response to Emotional Facial Expression*, 57 *BIOLOGICAL PSYCHIATRY* 8S (2005)); see also *id.* at 208 (describing lack of correspondence between observed brain activity and self-reports of experience).

<sup>211</sup> See, e.g., A.H. Rellini, et al., *The Relationship between Women's Subjective and Physiological Sexual Arousal*, 42 *PSYCHOPHYSIOLOGY* 116 (2005).

detected in their amygdalae.<sup>212</sup> Which is a more accurate indicator of the person’s “state of mind” – what the brain scan shows or what the person experiences?

The divergence between brain scan data and reported subjective experience raises an important and troubling question about the detection and regulation of criminal violence. We might credit a woman’s self-report that she does not feel turned on by pornography, even if brain and physiological indicators show activity believed to be consistent with arousal – whether because we believe she has no incentive to deceive the researcher or because it accords with our cultural expectations about women’s sexuality (which, reciprocally, might condition the woman’s own experience of her sexuality). But what about differences in self-reporting versus scanning in, say, a male offender who is up for parole review? Would we credit that he claims not to have violent thoughts or impulses, even though a brain scan indicates reduced activation in the pfc or greater activation in the limbic system relative to standard ranges? This is a question with serious implications for some of the proposed uses of fMRI data in the criminal context: How, generally, could we assess a discrepancy between an fMRI and the self-reported mental state, given that: (1) there can be authentic discrepancies between feelings and scans, and (2) both the a subject and the interpreter of the scan might be influenced by a set of incentives and biases? Given the tendency to credit as objective any data that appears in the form of a picture and that is proffered by socially-respected sources,<sup>213</sup> we well might privilege scans over self-reports – and be mistaken in doing so.

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<sup>212</sup> See, e.g., Furmark, *et al.*, *supra* note 210; A.E. Guyer, *et al.*, *supra* note 210. See also KAGAN, *supra* note 89, at 214 (discussing same).

<sup>213</sup> See generally Jennifer L. Mnookin, *Fingerprint Evidence in an Age of DNA Profiling*, 67 BROOK. L. REV. 13 (2001) (discussing judicial and public acceptance of fingerprinting); Jennifer L. Mnookin, *Scripting Expertise: The History of Handwriting Identification Evidence and the Judicial Construction of*

#### IV. THE SEDUCTIONS OF REDUCTION

As different as the underlying science has been in each of the major criminal law and neuroscience movements, the same animating concerns and beliefs have been at play. As long as these beliefs animate the ways we look both at criminal violence and the mind, we are likely to make the same mistakes – and encode those mistakes into the criminal law. Thus, while the scientific challenges to localization presented in the prior Part are important to understanding today’s neuroreductionism, they are not a sufficient response either to the current neuro-everything craze nor to the general tendency of the criminal law to adopt a neuroreductionist perspective on the relationship between brain and violence. If the problems with the localization of violence were merely at the scientific or technical level, legal scholars and researchers might say in the future that, because *now* the science has evolved further, we finally really are equipped to deal with criminal violence on the biological level.

But this will no more be possible with some as-yet-to-be perfected future science than it is today. Three epistemological tenets unite the phrenological localizations of Gall, the psychosurgery craze of the 20<sup>th</sup> century, and the overbroad contemporary claims about the “neurobiology of violence”: (i) that complex and contextual actions are biologically determined by brain function, (ii) that socially disfavored actions, like “violence,” result from pathologies that can be traced to specific parts of the brain, and (iii) therefore, that the most relevant level on which to address “violence” (and other social issues) is at the level of the individual brain.

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*Reliability*, 87 VA. L. REV. 1723 (2001) (discussing judicial reception of handwriting identification as a form of scientific evidence).

Looking at individual brains takes the social out of the picture, including the important biological dimensions of the social. We go from the socio-political down to the individual, from the individual down to the brain, and from there down to a structure of the brain, and from there down to a certain group of neurons. While it would be surprising if the structures of, and patterns of activity in, the brain did *not* relate to human behavior, that is merely one level of explanation that interacts with, and, critically, is shaped by, the progressively greater levels at which individual and social phenomena may be understood.

A. *Localization Flows from Reductionism*

From the instinct to kill bump to the enlarged amygdala theory, the movements discussed above have construed violence as arising principally from a disordered brain state. Brain-behavior reductionism, or “neuropsychological reductionism,”<sup>214</sup> is fundamentally connected with ideas of localization – indeed, neuroreductionism is “an epistemological position from which behavior is seen as ... ‘traceable to’ particular or localizable brain states (or processes).”<sup>215</sup> The understanding of criminal violence as something entirely internal to the brain rests on the notion that all personal, social, and cultural phenomena – from an individual’s actions to the way markets function – not only can be explained *but are totally caused and determined by* the make-up of physical bodies.<sup>216</sup> This kind of “reductive materialism” not only aims to explain all higher-order phenomena completely in terms of their lower-level components

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<sup>214</sup> Chorover, *Violence: A Localizable Problem?*, *supra* note 207, at 266.

<sup>215</sup> *Id.*

<sup>216</sup> Calling this approach “reductive” is no slur – a majority of neuroscientists share a “commitment” to reductive materialism. Indeed, Michael Gazzaniga, a preeminent neuroscientist who coined the very phrase “cognitive neuroscience,” identifies reductionism (or reductive materialism) as the dominant mode of explanation and inquiry in his field. *See, e.g.,* Snead, *supra* note 17, at 1278 (quoting Gazzaniga).

but entails the belief that higher-level phenomena are completely caused by lower-level phenomena.<sup>217</sup> Under this view, all “human thought and behavior” are believed to be “*caused solely* by physical processes taking place inside the brain[.]”<sup>218</sup>

Describing with approval the mainstream view of neuroreductionism, Professor Jones writes that:

[A]ll choices emerge from the human nervous system. ... The [nervous] system is composed of molecules, in turn composed of atoms, and it is driven by chemical reactions and electrical circuits. The nervous system and its brain are therefore part of a material world in which present events are caused by prior events, *extending back to the beginning of time and matter.*<sup>219</sup>

Those who subscribe to the strong reductionist position believe, as Professor Jones implies, that the Big Bang contained within it all the information that has determined everything that has come after<sup>220</sup> – including whether a given person will commit criminal violence. This is because “all choices emerge” from a physical “system,” which is part of an unbroken chain of causation stretching back to “the

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<sup>217</sup> Snead, *supra* note 17, at 1278 (citing PATRICIA SMITH CHURCHLAND, BRAIN-WISE: STUDIES IN NEUROPHILOSOPHY 20-21 (2002) (“[A] reduction has been achieved when the causal powers of the macrophenomenon are explained as a function of the physical structure and causal powers of the microphenomenon.”)).

<sup>218</sup> For a fine comment exploring the implications of reductive materialism in criminal law, see Andrew E. Lelling, Comment, *Eliminative Materialism, Neuroscience and the Criminal Law*, 141 U. PA. L. REV. 1471 (1993). See also Snead, *supra* note 17, at 1278 (“Materialism” denotes the philosophical premise that only physical things truly exist and, thus, that all phenomena must be explained exclusively in terms of material causes. See, e.g., THE CAMBRIDGE DICTIONARY OF PHILOSOPHY 599-602 (1995) (defining and discussing materialism as philosophical concept). An alternative descriptor of the cognitive neuroscience premise is “biological mechanism,” which “broadly attempts to reduce all vital operations to the laws of physics and chemistry.” WILLIAM A. WALLACE, THE ELEMENTS OF PHILOSOPHY: A COMPENDIUM FOR PHILOSOPHERS AND THEOLOGIANS 213-14 (1977).)

<sup>219</sup> Owen D. Jones, *The Impact of Behavioral Genetics on Criminal Law*, 69-SPG LAW & CONTEMP. PROBS. 81, 93 (2006) (emphasis added).

<sup>220</sup> For a summary and critique of this view, see RICHARD C. LEWONTIN, BIOLOGY UNDER THE INFLUENCE: DIALECTICAL ESSAYS ON ECOLOGY, AGRICULTURE AND HEALTH 16 (2007) (“Not only was the entire history of the stars immanent in that millionth of a second when the universe began but the history of life as well. It is not simply that we have reached the end of history, there never was any history to begin with.”)

beginning of time.”<sup>221</sup> Professor Hank Greeley similarly argues in favor of the reductionist-determinist<sup>222</sup> relationship between brain and behavior.<sup>223</sup> While one’s “genetic variations” will only “sometimes influence” one’s later behavior,<sup>224</sup> the “architecture[] and patterns of neuronal activity” in one’s brain “should be much more strongly connected to that person’s behavior.”<sup>225</sup> Indeed, “[t]hey should ... determine it.”<sup>226</sup>

This approach to criminal violence, which restricts itself exclusively to the individual “nervous system,”<sup>227</sup> is profoundly deterministic and individualistic.<sup>228</sup> This individualism denies the relevance of context and of interaction in creating the individual; the individual brain is taken as the basic unit of analysis, and the brain is treated as having features and acting in ways that are fully explicable in isolation. As “psychosurgery and other forms of psychotechnology generally take the individual person as the main locus of intervention,”<sup>229</sup> a great deal falls away: The social,

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<sup>221</sup> Owen D. Jones, *The Impact of Behavioral Genetics on Criminal Law*, 69-SPG LAW & CONTEMP. PROBS. 81, 93 (2006).

<sup>222</sup> Reductionist/determinist reasoning from biology in law also permeates the literature on law and genetics and law and so-called evolutionary psychology. See, e.g., Owen D. Jones, *Law, Evolution and the Brain: Applications and Open Questions*. 359 PHILOS. TRANS. R. SOC. LOND. 1697 (2004); Owen D. Jones, *Sex, Culture, and the Biology of Rape: Toward Explanation and Prevention*, 87 CAL. L. REV. 827, 910-11 (1999); cf. Steven Goldberg, *Evolutionary Biology Meets Determinism: Learning from Philosophy, Freud, and Spinoza*, 53 FLA. L. REV. 893 (2001) (Dunwoody commentary on shortcomings of determinist uses of evolutionary psychology and behavioral biology in law).

<sup>223</sup> Henry T. Greeley, *Neuroethics and ELSI: Similarities and Differences*, 7 MINN. J.L. SCI. & TECH. 599, 609 (2006).

<sup>224</sup> *Id.*

<sup>225</sup> *Id.*

<sup>226</sup> *Id.*

<sup>227</sup> Owen D. Jones, *The Impact of Behavioral Genetics on Criminal Law*, 69-SPG LAW & CONTEMP. PROBS. 81, 93 (2006).

<sup>228</sup> Individualism is used here in the philosophical sense of taking the individual as ontologically prior to the social (“methodological individualism”), see LARS UDEHN, *METHODOLOGICAL INDIVIDUALISM: BACKGROUND, HISTORY, AND MEANING* 321 (2001), not the more general meaning of self-expression or “the assertion of one’s own will or personality,” *AMERICAN HERITAGE DICTIONARY* 656 (2d ed. 1991).

<sup>229</sup> Chorover, *Violence: A Localizable Problem?*, *supra* note 207, at 264.

historical, and economic have no role in this account of violence. Even psychological considerations about why people do what we do (including why some people break the law) would seem to vanish; rather, to the extent psychology is relevant at all, it merely is a kind of “reverse-engineering” to figure out what the “machine [of the brain] was designed to do.”<sup>230</sup>

*B. The Meaning of “Violence” Is Normative, Legal, and Contextual*

A problem fundamental to the localizability and “scientific” treatment of violence is the question of whether “violence” has any physical reality. Violence is both a social and legal construction and a psychological construct. Historically, biological approaches to violence in the criminal law have considered “violence” to be a single category, a reified behavior.<sup>231</sup> The acts of serial murderers, women’s retaliation against abusive partners, blacks’ riots in U.S. inner cities, cats’ attacks on rats, and acts of political terrorism have all been called “violence” (or “aggression”).<sup>232</sup> And yet, “violence” designates a huge range of individual, group, and even national behavior. It is an inherently contextual and transactional term, given meaning by the law, background social norms, and the particular context in which the violent acts take place.<sup>233</sup>

*1. Violence as a Legal Construct*

What the law recognizes as violence changes greatly over time. Perhaps the most significant example of this in the last half-century has been the revolution in the recognition of domestic violence. Prior to the latter quarter of the twentieth century, the

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<sup>230</sup> STEVEN PINKER, HOW THE MIND WORKS 21 (1997).

<sup>231</sup> LEWONTIN, ET AL., NOT IN OUR GENES, *supra* note 167, at 91. (This work does not discuss cat-on-rat aggression; this is a reference to the discussion of the same in the prior Part.)

<sup>232</sup> *Id.*

<sup>233</sup> ELIZABETH STANKO, THE MEANINGS OF VIOLENCE 2-3 (2003).

victims of domestic violence might have identified their abusers' conduct as "violent" – but the legal culture, reflecting patriarchal societal norms, did not. This raises the important point that what counts as violence depends in large part on who gets to define it. Until Pennsylvania passed its landmark Protection from Abuse Act in 1977, domestic violence was largely unrecognized and not separately legally actionable.<sup>234</sup> With the stroke of a legislator's pen, acts that previously did not rate the designation "violence" suddenly became legally recognized as such. Did anything change in the brains of domestic abusers between the day before and the day after such legislation was signed into law? Of course not. And yet, domestic abusers were acting within their marital rights one day and were perpetrators of criminal violence the next.

The marital rape exception tells the same story as to sexual violence. Until recently, state courts across the United States presumed that a husband had a legal right to sex at any time within marriage, regardless of the wife's consent.<sup>235</sup> After much legal and social contestation, the marital rape exception was eliminated; a husband who one day was exercising his law- and God-given rights became the perpetrator of criminal sexual violence the next. Today, in much of Asia and the Middle East, the marital rape exception endures;<sup>236</sup> thus, the same conduct that is "sexual violence" in one culture is not considered "violence" under the laws and mores of another. The historical

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<sup>234</sup> EVE S. BUZAWA & CARL G. BUZAWA, DOMESTIC VIOLENCE: THE CRIMINAL JUSTICE RESPONSE 109 (2003) (describing history of enactment of anti-domestic violence legislation in the United States).

<sup>235</sup> Rebecca M. Ryan, *The Sex Right: A Legal History of the Marital Rape Exception*, 20 LAW & SOC. INQUIRY 941 (1995) (providing a history of the challenges to, and defeat of, marital rape exceptions in the United States). For a comprehensive treatment of this subject, see DIANA E. H. RUSSELL, RAPE IN MARRIAGE (1990).

<sup>236</sup> AIHWA ONG, NEOLIBERALISM AS EXCEPTION: MUTATIONS IN CITIZENSHIP AND SOVEREIGNTY 49-50 (2006) (discussing the marital rape exception under Islamic law; noting that many Asian legal scholars view the marital rape exception as an unacceptable "Western import"; the views of Asian and Muslim wives, however, are not reported).

contingency of what rates as violence, and the role that power structures play in defining who or what is called violent, render absurd the notion that violence can be understood entirely internally to the brain.

Section I.B, above, discussed social unrest as an impetus in the 1960s for calls for wide-spread psychointervention. Drs. Mark and Ervin explicitly linked their localization theory of violence to neurobiological differences in race rioters; they claimed, that, because some African-Americans rioted and others did not, the only explanation must be the “brain proneness to violence” amongst those who did riot. Surely, the acts of rioters count as “violence” under any customary definition of “riot” or “violence.” However, Drs. Mark and Ervin failed to consider anywhere in any of their published work that racist injustices perpetrated on a mass scale against African-Americans also might constitute “violence.” Extensive research reveals no proposals by esteemed scientists or legal scholars during this period to, for example, conduct neurobiological assays of white supremacists or overly enthusiastic Jim Crow sheriffs to determine the brain disorders underlying their predispositions to violence. Nor were any proposals for “therapeutic lobotomy” or “sedative neurosurgery” advanced for dealing with the then-widespread phenomenon of white violence. Thus we see that *who* is described as “violent,” as well as *what* is described as “violence” is intensely normative and socially contingent.

But perhaps the practitioners of psychointervention and their contemporary counterparts use a more scientific definition of violence based on non-contextual factors traceable to specific brain pathologies. Lobotomy advocates and practitioners Drs. Mark and Ordia have defined violence as “abnormal aggressive

behavior” that is “unwarranted.”<sup>237</sup> Similarly, the drafters of the Aspen Statement, who in 2001 asserted that violence arises from dysfunction of the amygdala and pfc, have defined “violence” as “unwarranted physical aggression.”<sup>238</sup> Although the terms “aggression” and “physical” seem naturalizing, these definitions are as at least as normative and contextual as any other: It takes “a *normative* point of view to perceive a particular act (or set of acts) as *abnormal*,” and this “socially defined frame of reference” does not “exist independently of the observer’s point of view.”<sup>239</sup> The determination of what is “unwarranted” also requires an outside observer making normative and contextual judgments about what would be warranted under particular circumstances. That the people making judgments as to what is “unwarranted” are doctors and neuroscientists does not make their judgment scientific fact; rather, their judgment is situated squarely within a background of law and norms.

That the question of “what is violence” is a normative and legal determination shows that it is socio-culturally situated. For not only are types of conduct deemed “violence” in one place and time but not in another, but rates of violence change dramatically across time and place. Even the most zealous biological determinist would have difficulty arguing that the different rates of violence across different countries could be traced to neurogenetic or neurodevelopmental variation amongst populations. It is a

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<sup>237</sup> Chorover, *Violence: A Localizable Problem?*, *supra* note 207, at 258.

<sup>238</sup> Christopher M. Filley et al., *Toward an Understanding of Violence: Neurobiological Aspects of Unwarranted Physical Aggression: Aspen Neurobehavioral Conference Consensus Statement*, 14 NEUROPSYCHIATRY NEUROPSYCHOLOGY & BEHAV. NEUROLOGY 1, 1 (2001) (discussing conclusions of the Aspen Neurobehavioral Conference’s consensus statement on the relationship between mind, brain, and violence; see title for definition of violence as “unwarranted physical aggression”).

<sup>239</sup> Chorover, *Violence: A Localizable Problem?*, *supra* note 207, at 260.

banal observation, but violence correlates worldwide strongly with poverty.<sup>240</sup> A committed neuroreductionist might argue that poverty and violence correlate so strongly because the conditions of poverty cause brain-based changes that lead to violence. But, even if true, is the individual brain the most relevant level at which to examine the problem? This is not to say that brain deficits that might be related to poverty should not be examined. Rather, the relationship between the biological and the social ought to be examined together, as there are important ways in which they may co-create each other.<sup>241</sup> Focusing on the biology alone is misleadingly incomplete and therefore likely to be ineffective.

What violence is and why it happens are inseparable from the context in which it takes place. This leads back to the uses of animal data to support claims about human violence (discussed *infra*, in Part III). Only in a weirdly decontextualized world is it possible to group “a mouse that bit an intruder entering its territory ... with the boys who killed their classmates at Columbine High School.”<sup>242</sup> The point here is not that we have nothing to learn from animal models. Rather, the core “lesson to be learned from

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<sup>240</sup> See, e.g., ROBERT L. AYERS, CRIME AND VIOLENCE AS DEVELOPMENT ISSUES IN LATIN AMERICAN AND THE CARIBBEAN 11 (1998) (World Bank study describing the increase in urban crime rates along with the development of large urban slum areas in Latin American countries). The connection in social theory between poverty and violence is an old one. I do not purport to provide a comprehensive history of the idea, nor of examples of it, here. For a discussion of the Hegelian concept of the relationship between poverty and violence, see KENNETH KIPNIS & DIANA T. MEYERS, ECONOMIC JUSTICE: PRIVATE RIGHTS AND PUBLIC RESPONSIBILITIES 49-50 (1985).

<sup>241</sup> A great deal of creative work linking neurological development and social conditions has been done in the area of early childhood development. See, e.g., EDWARD F. ZIGLER ET AL., THE FIRST THREE YEARS & BEYOND: BRAIN DEVELOPMENT AND SOCIAL POLICY (2002) (see, for example, the discussion of the “moderate and more integrative” approach of many child development scholars on the question of the mutual influence of neurological development and social conditions, *id.* at 8); see also, e.g., JACK P. SHONKOFF & DEBORAH A. PHILLIOS, FROM NEURONS TO NEIGHBORHOODS: THE SCIENCE OF EARLY CHILDHOOD DEVELOPMENT (2000).

<sup>242</sup> KAGAN, *supra* note 89, at 94.

biology and history is to view every observation as an event in a context.”<sup>243</sup> Working in this contextual or “relational frame,” we can transcend the “localization of function” and put the emphasis both on, for example, all “the circuits activated by all tasks requiring working memory” as well as the *meanings* that the subject ascribes to the situation and inform his or her actions.<sup>244</sup>

## 2. *Violence as a Psychological Construct*

The relationship between psychological constructs, on the one hand, and physical reality on the other, goes to the heart of profound issues in fields ranging from cognitive psychology and neuroscience to linguistics and philosophy.<sup>245</sup> It would be impossible to do justice to this set of questions within a short Article section. However, any discussion of the barriers to localizing violence would be incomplete without flagging this set of issues.

A psychological construct “is a theoretical idea developed to explain and to organize some aspects of existing knowledge.... [It is] a work of informed scientific imagination ... understood from its network of relationships.”<sup>246</sup> Common psychological constructs describe general features observed across people, like “intelligence” or “memory,”<sup>247</sup> but also may be highly abstruse and specific – like “library anxiety.”<sup>248</sup>

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<sup>243</sup> *Id.*

<sup>244</sup> *Id.* at 92.

<sup>245</sup> See, for example, HILARY PUTNAM, REPRESENTATION AND REALITY 7 (1988) (challenging Noam Chomsky’s notion of mental modules). Putnam fires a shot over the bow at the notion that there is a correspondence between either mental states or psychological representations, and physical reality, stating that there is a “general tendency in the history of thought ... to think of concepts as scientifically describable (‘psychologically real’) entities in the mind or brain. And it is this entire tendency that, I shall argue, is misguided.” *Id.*

<sup>246</sup> American Psychological Association, Standards for Educational and Psychological Tests 29-30 (1974).

<sup>247</sup> James R. P. Ogloff & Kevin S. Douglas, *Psychological Assessment in Forensic Settings*, 346, 355, in HANDBOOK OF PSYCHOLOGY, VOL. 10 (John R. Graham & Jack A. Naglieri, eds. 2003).

Psychological constructs do not purport to describe an underlying physical reality; psychologists do not consider them to be “things” that can be measured in the same way as, *e.g.*, height.<sup>249</sup> For example, the construct of “attachment” between a parent and infant would not be capable of reduction to a physical state or a transformation in a physical place in the brain (although of course the brain enables all of the actions involved in attachment) because it occurs through interaction between subjects and takes place over a long period of time.<sup>250</sup> Like “attachment,” violence (or propensity to violence) may be transpersonal and not bounded in time or space.

History is littered with ridiculous taxonomies of mental properties that turned out to have no biological reality but rather only to reflect the view of the mind current in a particular socio-historical moment. Today, who would think to look for Freud’s Id or super ego in a defined location of the brain? With psychoanalytic terms, it is fairly transparent that they have no physical reality (although that bears no relationship to their theoretical or therapeutic validity); but it is less transparent that the terms of our contemporary “folk psychology” may be equally lacking in objective reality. This is not to say that such terms are without value, but instead that psychological constructs and biological structures may have no one-to-one relationship; indeed, psychological constructs may have no specific physical reality at all.<sup>251</sup>

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<sup>248</sup> ANTHONY J. ONWUEGBUZIE, QUN G. JIAO, SHARON L. BOSTICK, *LIBRARY ANXIETY: THEORY, RESEARCH, AND APPLICATIONS* 125 (2004) (describing library anxiety as “psychological construct”).

<sup>249</sup> Steven J. Osterlind, *Constructing Test Items: Multiple-Choice, Constructed Response, Performance, and Other Formats* 36 (1998). *See also* KAGAN, *supra* note 89, at 42 (psychological constructs “are theoretical inventions intended to explain behavior. They are not ‘things in the brain.’”).

<sup>250</sup> Susan Goldberg, *Introduction*, 1, 3, in *ATTACHMENT THEORY: SOCIAL, DEVELOPMENT, AND CLINICAL PERSPECTIVES* (SUSAN GOLDBERG ET AL., EDS. 2000) (describing attachment between care-giver and child, and its measurement).

<sup>251</sup> The definition of a “psychological representation” is itself the subject of extensive dispute in the fields of psychology, linguistics, and philosophy. *See, e.g.*, Gregory McCulloch, *Mental Representation and*

C. *The Neuroreductive Approach to Violence Is Seductive – But False*

The allure of localizing the problem of violence to parts of the individual brain is the seduction of reduction. Determinist, individualist, and acontextual, a purely brain-based approach to criminal violence is powerfully alluring but deceptive. If the localization of violence is so deeply flawed both scientifically and epistemologically, and keeps being disproved in different ages, why do we keep falling for it? What is the hold that it exerts over our collective legal imagination?

On the narrative level, the view of violence as a physically-determined, localized disorder offers a simple and appealing way of differentiating the good man and the bad man. This is the allure of “otherizing” the violent person – constructing him or her as not like us, and possibly even not fully human. The ways in which prior criminal-neuroscience movements have constructed the perpetrator of violence as “other” are clear: For Cesare Lombroso, the brain of the criminal resembled that of the “rat” or the “lower carnivore.”<sup>252</sup> Psychointerventionalists of the mid-twentieth century compared violence in people to the behaviors of the “raging bull” or the “predatory and vicious lynx” and “wolverine.”<sup>253</sup> The racial dimension of their work speaks to the notion of the violent person as the “other,” as well. Today, we have returned to comparisons to

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*Mental Presentation*, in LOGIC, THOUGHT & LANGUAGE 22, 22-23 (Anthony O’Hear ed., Cambridge University Press 2002) (describing definitions of a “psychological representation” across several intellectual disciplines). A full exegesis of the nature of psychological representations is both beyond the scope of this Article and not necessary to the subject.

<sup>252</sup> See discussion of Lombroso’s work *infra* at Section I.A.2.

<sup>253</sup> MARK & ERVIN, *supra* note 73, at 29. Sampling here just some of the work summarized and relied upon by Mark and Ervin, *id.* at 38-46: B.N. Brunnell, et al., *Septal Lesions and Aggressiveness in the Cotton Rat, Sigmodon Hispidus*, 6 PSYCHONEUROLOGICAL SCI. 443 (1966); M.D. Egger & J.P. Flynn, *Effects of Electrical Stimulation of the Amygdala on Hypothalamically Elicited Attack Behavior in Cats*, 26 J. NEUROPHYSIOL. 705 (1963); H. Ursin & B. Kaada, *Functional Localization within the Amygdaloid Complex in the Cat*, 12 EEG CLIN. NEUROPHYSIOL. 1 (1960); L. Weiskrantz, *Behavioral Changes Associated with Ablation of the Amygdaloid Complex in Monkeys*, 49 J. COMP. PHYSIOL. PSYCHOL. 381 (1956).

rats, and the ways in which people who engage in violent acts are like rats or cats that display “defensive rage” and “predatory aggression.”<sup>254</sup>

These analogies are as inapt as they provocative. On the biological level, these analogies are misleading because they falsely imply homology.<sup>255</sup> Accordingly, as discussed above, many experimental psychologists and neuroscientists openly criticize the work on the putative human neurobiology of violence that proceeds through extrapolation from cat and rat models. On a metaphorical level, these analogies are equally misleading because they fold back into and reinforce the mistaken notion that people who engage in violent acts are, as Lombroso contended, essentially both animal-like and a different kind of animal than the rest of us.

In constructing violence as the biological feature of the Other, modern and historical localization stories also offer a comforting answer to the problem of evil: There are no evil people, just dysfunctional brains. One of the most common reactions to acts of horrific violence is to ask how a person (or people) could do such a thing. Who could torture a child? Who could drag an innocent man to death behind a truck? (Not to mention how genocides and mass torture could occur throughout history.) Extreme acts of violence are, most of the time and to most people, incomprehensible. Such acts pose hard questions. Perhaps the only easy or comforting answer is that such acts are the product of real, literal sickness: “Crime is a disease.” “Crime is a ... pathology.”

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<sup>254</sup> See *infra* at Section II.A.1, discussing the work of Owen Jones and Dean Mobbs.

<sup>255</sup> That is, there are important ways that the brains of people and of rats, cats, and bulls are *not alike*. While researchers frequently extrapolate from animal models to human models, brain and behavior are areas where particular care must be taken with “transphyletic extrapolation.” One of the founders of comparative psychology, T.C. Schneirla, famously railed against (and was careful to avoid) “uncritical extrapolation” from animal behavioral models to human behaviors, particularly when the extrapolation ignored specific evolutionary features of the animal and its environmental adaptations that are not applicable to human beings. See, e.g., T.C. Schneirla *Behavioral Development and Comparative Psychology*, 41 QUARTERLY REV. OF BIOL. 283, 285 (1966).

Further, the notion of violence as a literal disease offers the promise of easy criminal justice solutions: If violence were a physical disorder, we might be able to address it with simple testing, and, ultimately, treatments. Certainly, a discourse would arise about privacy, self-incrimination, and where to set the balance between liberty and public safety. Such questions might be addressed within a framework not unlike that in use for other public health problems, utilizing tools like preventative monitoring and quarantine. Depending on one's normative and legal commitments, this vision<sup>256</sup> might seem either eminently sensible or highly dystopian, but there is little doubt that it would be much simpler.

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As an eminent scientist wrote a quarter century ago, with equal relevance for today, “Human nature is too big, too fascinating, and too important a subject for major thinkers to resist. It is also too complex to fit the manageable visions they construct.”<sup>257</sup> The brain is a physical manifestation of the interaction between biology and society, of the inability to separate and fix a biological nature apart from a social existence. A “more unified picture of brain-behavior relationships and [of] the nature of human problems” would integrate “the overlapping aspects of existence represented by the organization of the brain, the individual, and the society.”<sup>258</sup> The challenge in this time period, in this particular episode of the affair between criminal law and neuroscience, is to avoid the seductions of reduction – and to use neuroscience not to

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<sup>256</sup> If it even were possible; of course, it is the thesis of this Article that the scientific and epistemological predicates for such an approach are utterly lacking.

<sup>257</sup> Stephen Jay Gould, *Sociobiology and Human Nature: A Postpanglossian Vision*, 1 HUMAN NATURE, 1, 1 (1978).

<sup>258</sup> Chorover, *Violence: A Localizable Problem?*, *supra* note 207, at 265.

craft simplistic falsities but to shed a measure of light on complex and multi-faceted realities.