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Concocting Criminal Intent

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Concocting Criminal Intent

DEBORAH W. DENNO*

My empirical study, which examines neuroscience evidence in 800 criminal cases over the course of two decades, is the first to determine how, when, and why victim brain scan evidence is introduced and used in court. My study reveals that although courts commonly rely on brain scans to show the extent of a victim's injury, the actual application of this neuroscience evidence extends far beyond the purpose for which it is admitted. Indeed, victim brain scans are introduced primarily by prosecutors, and nearly half of these cases are based on medical expert testimony that the victims suffer from shaken baby syndrome, a medical diagnosis with controversial scientific underpinnings and distorted legal ramifications. The diagnosis often successfully serves as the sole foundation for a prosecutor's case, with no proof of the defendant's act or intent beyond the victim's brain scan and the accompanying medical expert testimony. Shaken baby syndrome cases thus portray a troubling phenomenon in which the key element of mens rea is either unclear or overlooked altogether and prosecutors are permitted to concoct intent out of brain scans that were admitted for the sole purpose of presenting the victim's injury. My study further reveals that shaken baby syndrome cases are merely the more transparent examples of the criminal justice system's failure to deal adequately with the surging influx of neuroscience evidence into the courtroom. Shaken baby cases thus represent a microcosm of prosecutorial misuse of victim neuroscience evidence more generally, particularly when the evidence is employed to determine a defendant's mental state.

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INTRODUCTION

On June 21, 1999, Jacquelyn Swart was babysitting a fourteen-month-old girl named Alexandra (Alex) Pirkins.¹ Swart, a mother of two who had previously worked at a daycare facility, had been providing daycare for Alex in Swart's apartment for the past year.² Around 2:00 p.m. that day, Swart lifted Alex out of her playpen and noticed that the child was limp and motionless, with her head "flopped back."³ Swart immediately placed several calls to Alex's mother, who came to the apartment.⁴ The women called 911 and paramedics rushed Alex to the hospital.⁵

Dr. Jose Quinones, a physician who treated Alex at the hospital, observed that Alex was "very pale and unresponsive . . . but she presented no outward signs of injury."⁶ However, because Alex was having seizures, he ordered brain scans, which revealed internal bleeding and swelling in Alex's brain.⁷ Based on these neurological findings, along with Alex's clinical condition and the brain scan, Dr. Quinones diagnosed Alex with shaken baby syndrome (SBS)—a brain injury that is presumably caused by someone shaking an infant or toddler's head with such force that it can destroy brain cells and cause permanent brain damage or death.⁸ Swart, who had no criminal record, was arrested despite her insistence that she "had never handled Alex roughly, nor shaken her, nor . . . struck her in any way."⁹

At trial, the State called seven medical experts who testified that Alex's injuries were consistent with a diagnosis of SBS,¹⁰ as well as two rebuttal witnesses who testified that Alex's death was caused by "an abusive head injury" and not by pre-existing injury.¹¹ In contrast, the defense never rebutted the SBS diagnosis. Rather, the defense argued that Alex died from accidental injuries that occurred in the weeks and days prior to her hospitalization and called four experts in support of that theory.¹² Swart was nonetheless convicted of first-degree murder and sentenced to thirty-five years in prison.¹³ On appeal, Swart argued that without any other evidence apart from SBS to prove her guilt beyond a reasonable doubt, expert testimony regarding SBS "was insuffi-

1. *People v. Swart*, 860 N.E.2d 1142, 1145, 1147–48 (Ill. App. Ct. 2006).

2. *Id.* at 1145.

3. *Id.* at 1149.

4. *Id.*

5. *Id.* at 1149–50.

6. *Id.* at 1150.

7. *Swart*, 860 N.E.2d at 1150. Dr. Quinones had ordered CT scans "because Alex exhibited cerebrate posturing, a reflexive movement of the spinal cord without any control from the upper central nervous system, manifested by the hyperextension of the feet, hands, and legs." *Id.*

8. *Id.* at 1150, 1153. For a fuller discussion of the definition of SBS and the complexity behind it, see *infra* notes 104–20 and accompanying text.

9. *Swart*, 860 N.E.2d at 1145–46.

10. *Id.* at 1151–54.

11. *Id.* at 1156.

12. *Id.* at 1154–56.

13. *Id.* at 1145.

cient.”¹⁴ In 2006, the appellate court rejected this argument.¹⁵ Swart remains incarcerated to this day.¹⁶

People v. Swart is representative of a typical SBS case.¹⁷ In typical cases, scientific evidence forms the only foundation for determining whether the child has been abused and by whom, as well as for proving the perpetrator’s intent (to abuse, harm, or kill) and guilt.¹⁸ Thus, brain scans and medical expert testimony carry immense weight at trial, as does the diagnosis of SBS itself.¹⁹ Yet the history of SBS reveals that such a diagnosis was never intended to be used in the courtroom at all, much less as a vehicle for determining a defendant’s level of intent.²⁰ Still, these and other cases that relied on evidence of a victim’s brain injury essentially enable the prosecution to concoct the defendant’s level of intent from a complex and convoluted science in which the victim has no (or limited) external signs of injury.²¹ This science is widely acknowledged to be controversial and problematic;²² nonetheless, physicians throughout the world rely on SBS as an established medical diagnosis for assessing the health and status of potentially injured infants.²³ When an SBS diagnosis enters the courtroom, however, it triggers legal ramifications that extend beyond what physicians might anticipate.²⁴

The rising acceptance of neuroscience evidence such as brain scans has fueled a heated debate in the criminal justice system.²⁵ As “the branch of the life sciences that studies the brain and nervous system,”²⁶ neuroscience can reveal a

14. *Id.* at 1156.

15. *Swart*, 860 N.E.2d at 1160.

16. See *Internet Inmate Status, R76046–Swart, Jacquelyn*, ILL. DEP’T OF CORR., https://www.idoc.state.il.us/subsections/search/inms_print.asp?idoc=R76046 [<https://perma.cc/M8T6-3QT6>].

17. *Swart*, 860 N.E.2d 1142.

18. See *infra* Part III.

19. See *infra* Part III.

20. See *infra* Part II.

21. See *infra* Parts III, IV.

22. Compare Christopher Spencer Greeley, “Shaken Baby Syndrome” and Forensic Pathology, 10 FORENSIC SCI., MED., & PATHOLOGY 253, 254 (2014) (“Uncertainties remain regarding aspects of AHT [abusive head trauma or SBS], for example the frequency and duration of lucidity after a fatal injury in infants, the role of neck injury in suspected AHT patients, or the differences between single and repeated episodes of brain injury.”), with Daniel M. Albert et al., *Ensuring Appropriate Expert Testimony for Cases Involving the “Shaken Baby,”* 308 JAMA 39, 39 (2012) (discussing “evidence-based, peer-reviewed medical literature with 40 years of contributions by pediatricians, neuroradiologists, clinical and forensic pathologists, ophthalmologists, and physiologists clearly supporting the construct of a medical diagnosis for AHT”).

23. See Sandeep K. Narang et al., *A Daubert Analysis of Abusive Head Trauma/Shaken Baby Syndrome*, 11 HOUS. J. HEALTH L. & POL’Y 505, 574–76 (2011) (providing verifiable references to fifteen national and international medical societies that have publicly endorsed the validity of SBS as a medical diagnosis).

24. See *infra* Parts III, IV.

25. See generally Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANSACTIONS ROYAL SOC’Y B: BIOLOGICAL SCI. 1775 (2004) (discussing key debates regarding the criminal law and neuroscience).

26. NEUROSCIENCE AND THE LAW: BRAIN, MIND, AND THE SCALES OF JUSTICE 206 (Brent Garland ed., 2004); see also OWEN D. JONES ET AL., *LAW AND NEUROSCIENCE* 762 (2014) (defining neuroscience as

reservoir of information about how the human brain works while healthy and while injured, thereby going to the core of key concerns pertaining to the criminal law.²⁷ Yet the criminal justice system's over-reliance on neuroscience can be severely misleading, potentially prompting unjustified presumptions regarding a defendant's level of intentionality.²⁸

In most cases, a crime must have two key components: the *mens rea* (literally, a "guilty mind"), which refers to the defendant's mental state at the time he or she commits the crime; and the *actus reus*, which refers to the defendant's voluntary act that causes the social harm.²⁹ In essence, a defendant's guilt is based on the "fundamental predicate"³⁰ that "an evil-meaning mind" must accompany "an evil-doing hand" in order to fairly gauge a defendant's culpability and ensure that punishments are proportionate to mental blameworthiness.³¹ Although the meaning of *mens rea* has fluctuated across twelve centuries,³² by the twentieth century the concept had become a "universal" requirement of modern legal systems.³³

This legal mandate for *mens rea* has been continuously reinforced, both by the U.S. Supreme Court³⁴ and by proposals considered by Congress recommending "*mens rea* reform."³⁵ There has been a growing concern, for example, that *mens rea* requirements are not always sufficiently specified in state and federal

"[t]he scientific study of the structure and function of the nervous system; includes experimental and clinical studies of animals and humans").

27. JONES ET AL., *supra* note 26, at 762; Deborah W. Denno, *The Myth of the Double-Edged Sword: An Empirical Study of Neuroscience Evidence in Criminal Cases*, 56 B.C. L. REV. 493, 504–05 (2015).

28. See *infra* Part III.

29. See JOSHUA DRESSLER, UNDERSTANDING CRIMINAL LAW § 10.01 (7th ed. 2015).

30. MODEL PENAL CODE § 2.01 explanatory note (AM. LAW INST., Official Draft and Explanatory Notes 1985).

31. *Morissette v. United States*, 342 U.S. 246, 251–52 (1952) (emphasizing the central thought that a defendant must be "blameworthy in mind" in order to be criminal); see also Deborah W. Denno, *Criminal Law in a Post-Freudian World*, 2005 U. ILL. L. REV. 601, 609–13 (discussing the historical development of the requirements for culpability and blameworthiness).

32. For a broad overview of the history and purpose of *mens rea*, see generally GUYORA BINDER, CRIMINAL LAW ch. 5 (2016); Gerhard O.W. Mueller, *On Common Law Mens Rea*, 42 MINN. L. REV. 1043 (1958); Francis Bowes Sayre, *Mens Rea*, 45 HARV. L. REV. 974 (1932); J.W.C. Turner, *The Mental Element in Crimes at Common Law*, 6 CAMBRIDGE L.J. 31 (1936).

33. *Morissette*, 342 U.S. at 250.

34. See, e.g., *Elonis v. United States*, 135 S. Ct. 2001 (2015) (emphasizing the importance of *mens rea* in criminal statutes); see also *infra* notes 61–65 and accompanying text (discussing *Elonis*).

35. Alex Sarch, *How to Solve the Biggest Issue Holding Up Criminal Justice Reform*, POLITICO.COM (May 16, 2016, 5:25 AM), <http://www.politico.com/agenda/story/2016/05/criminal-justice-reform-mens-rea-middle-ground-000120> [https://perma.cc/FD2S-4RK5] (noting that although Congress intended to pass legislation in 2016 to improve the criminal justice system, there were vast disagreements between both parties concerning how to reform *mens rea*, "a very real problem"); see also Mike Debonis, *The Issue That Could Keep Congress From Passing Criminal Justice Reform*, WASH. POST (Jan. 20, 2016), https://www.washingtonpost.com/news/powerpost/wp/2016/01/20/the-issue-that-could-keep-congress-from-passing-criminal-justice-reform/?utm_term=.f12204dfd4da [https://perma.cc/NJX7-T8FH] (discussing "a narrow but crucial issue that has emerged as the main political obstacle to a criminal justice reform bill: to what degree prosecutors must prove a defendant's criminal intent in order to win convictions for certain federal crimes"); *infra* note 68 and accompanying text.

statutes.³⁶ Neuroscience evidence further highlights the significance of *mens rea* by providing more refined and detailed information about how the human mind operates.³⁷

To prove a mental state such as intent, the criminal justice system theoretically relies on both direct and indirect (that is, circumstantial) evidence.³⁸ If police find a victim dead from a gunshot wound in the victim's home, for example, there would be direct evidence available if a witness said that she saw the defendant shoot the victim. However, without such a witness, only circumstantial evidence would be available if the defendant was the only person home when the victim died from a gunshot wound.³⁹ Thus, when juries rely on circumstantial evidence, they "must make a leap of logic and infer the existence of a fact at issue, connecting a circumstantial fact to a directly incriminating fact."⁴⁰ Relative to direct evidence, these kinds of assessments can be more prone to manipulation because jurors have more evidentiary gaps to fill.⁴¹

Prosecutors often must attempt to prove a defendant's intent through circumstantial evidence.⁴² Yet because these intent determinations provide prosecutors

36. See Sarch, *supra* note 35 (explaining that "[m]ens rea reform is meant to solve a very real problem: the dangers of criminal statutes that include no intent requirement at all").

37. Deborah W. Denno, *The Place for Neuroscience in Criminal Law*, in *PHILOSOPHICAL FOUNDATIONS OF LAW AND NEUROSCIENCE* 69, 77–80 (Dennis Patterson & Michael S. Pardo eds., 2016); Joseph R. Simpson, *Introduction to Neuroimaging in Forensic Psychiatry: From the Clinic to the Courtroom* xv, xv–xvii (Joseph R. Simpson ed., 2012).

38. See Julie Schmidt Chauvin, Comment, "*For It Must Seem Their Guilt*": *Diluting Reasonable Doubt by Rejecting the Reasonable Hypothesis of Innocence Standard*, 53 *LOY. L. REV.* 217, 221–22 (2007). For a discussion on the differences, advantages, and weaknesses inherent in direct and circumstantial evidence, see 29A *AM. JUR. 2D EVIDENCE* § 1390 (2015); BARBARA E. BERGMAN ET AL., *WHARTON'S CRIMINAL EVIDENCE* § 1:8 (15th ed. 1997). Courts usually recognize that equal weight should be attributed to both circumstantial and direct evidence. See *Holland v. United States*, 348 U.S. 121, 140 (1954) (noting that "[c]ircumstantial evidence . . . is intrinsically no different from testimonial evidence" and that although "circumstantial evidence may in some cases point to a wholly incorrect result . . . this is equally true of testimonial evidence"); Francis Paul Greene, Comment, *I Ain't Got No Body: The Moral Uncertainty of Bodiless Murder Jurisprudence In New York After People v. Bierenbaum*, 71 *FORDHAM L. REV.* 2863, 2875 (2003) (emphasizing that although "New York courts have long recognized that a unique danger inheres in criminal cases built entirely on circumstantial evidence . . . [they] agree that circumstantial evidence is often more probative than direct evidence").

39. See Chauvin, *supra* note 38, at 222–23 (noting that jurors are more apt to rely on their own personal experiences with circumstantial evidence without considering contrary evidence).

40. Greene, *supra* note 38, at 2876.

41. See *id.*

42. Courts view circumstantial evidence as particularly important when proof of "intent" or some other mental state is required for conviction because such mental states can rarely be proven through direct evidence. See, e.g., 29A *AM. JUR. 2D EVIDENCE* § 1392 (2015); see also *United States v. Sullivan*, 522 F.3d 967, 978 (9th Cir. 2008) ("Intent may be established through circumstantial evidence."). Further, in many cases, proving intent or some other mental state requires the use of circumstantial evidence, given that direct evidence of the defendant's mental state is rarely available. See, e.g., CHARLES ALAN WRIGHT & PETER J. HENNING, 2A *FEDERAL PRACTICE AND PROCEDURE* § 411 (4th ed. 2009) (describing the use of circumstantial evidence in certain kinds of cases, including those requiring proof of criminal intent, as "indispensable"); see also *United States v. Stoker*, 706 F.3d 643, 646 (5th Cir. 2013) ("Intent may, and generally must, be proven circumstantially." (quoting *United States v. Maggitt*, 784 F.2d 590, 593 (5th Cir. 1986))); *United States v. Smith*, 508 F.3d 861, 867 (8th Cir. 2007) (stating

with more opportunities to distort the facts, the line between acceptable and unacceptable uses of circumstantial evidence begins to blur. Prosecutors have the freedom to somewhat “concoct” the defendant’s level of intent and push the boundaries of inference in all types of cases. The vague construction of *mens rea*, and specifically of criminal intent, further fosters this practice.⁴³ For example, my study of SBS cases revealed that the diagnosis of SBS alone often successfully serves as the sole foundation for a prosecutor’s case, with no proof of the defendant’s act or intent beyond the victim’s brain scan and accompanying medical expert testimony.⁴⁴ At the same time, a substantial portion of the public does not realize that shaking a baby can be harmful (assuming there was any shaking at all).⁴⁵ SBS cases therefore present a troubling circumstance in which prosecutors seem to be afforded free rein, by both the court and the defense, to manufacture intent from neuroscience evidence admitted solely for medical purposes to present the victim’s injury.⁴⁶

Large-scale research studies of criminal cases can better reveal how and why these legal strategies exist. This Article reports the results of my unprecedented study (the “Neuroscience Study”) of all criminal cases (totaling 800) that addressed neuroscience evidence from 1992 to 2012.⁴⁷ The discussion focuses on cases that use neuroscientific evidence relating to the victim and particularly on how neuroscience evidence explicates the degree of a victim’s injury and what bearing that injury has on efforts to assess a defendant’s *mens rea*. One of the Neuroscience Study’s most compelling findings is that prosecutors most commonly rely on SBS to explain the source of victims’ injuries.⁴⁸ My initial results also show that when prosecutors use victim neuroscience evidence, they are often attempting to establish a defendant’s mental state based on the type and extent of brain injury suffered by the victim, with SBS cases constituting a high proportion of these cases.⁴⁹

The medical diagnosis of SBS seems to become inextricably linked to the requisite legal elements of a crime, such that the mere existence of the syndrome suggests the defendant’s wrongful intent. In addition, courts seem to ignore evidence that 25% to 50% of the general public is “unaware of the

that a jury “rarely has direct evidence of a defendant’s knowledge, [and] it is generally established through circumstantial evidence” (quoting *United States v. Ojeda*, 23 F.3d 1473, 1476 (8th Cir. 1994)). Thus, the uses for circumstantial evidence in showing intent and other mental states are numerous and widely accepted. *See, e.g.*, *United States v. Wright*, 739 F.3d 1160, 1169 (8th Cir. 2014) (“A large quantity of narcotics alone provides sufficient circumstantial evidence for a jury to infer an intent to distribute it.”).

43. *See* Sanford H. Kadish, *The Decline of Innocence*, 26 CAMBRIDGE L.J. 273, 273 (1968).

44. *See infra* Sections III.A, III.B.

45. *See infra* note 50 and accompanying text.

46. *See infra* Parts III, IV.

47. *See infra* Section I.B (discussing in more detail the Neuroscience Study’s methodology and choice of years).

48. *See infra* note 95 and accompanying text.

49. *See infra* Parts III, IV.

dangers” and risks associated with shaking a baby.⁵⁰ SBS cases thus illustrate the worst type of union between law and medicine. In this Article, I will argue that cases involving SBS also represent a microcosm of prosecutorial misuse of victim neuroscience evidence, and I will demonstrate how such cases contribute to a “perfect storm” of the legal and scientific factors that can lead to such misuse.⁵¹ In essence, SBS cases are one of the more transparent examples of the criminal justice system’s failure to deal adequately with the surging influx of neuroscience evidence into the courtroom, particularly when it involves determining a defendant’s mental state.

Part I of this Article discusses the importance of *mens rea* in criminal law. It also examines the results of my Neuroscience Study, noting that prosecutors commonly explain the source of infant victims’ injuries by relying upon a theory of SBS. Such a strategy helps to construct both a defendant’s *mens rea* and *actus reus*, particularly because most cases have little or no direct or circumstantial evidence.

Part II examines the history of SBS from its inception in 1971 to the present. The discussion also focuses on the factors that have contributed to the syndrome’s perfect storm of distortion and misuse. By the time the syndrome was first introduced in a criminal case in 1984, the ties between SBS and the requisite elements of an offense—particularly the act of “shaking” and the perpetrator’s intent—had become firmly established within the medical community.⁵² Yet the SBS link to criminal intent has no basis of support in medicine.⁵³

Part III analyzes individual SBS case studies selected from my Neuroscience Study to demonstrate how heavily the State relies in court on the troubling science of SBS, as well as on medical experts to explain that science. Problems arise when a diagnosis such as SBS, created for the purpose of medical care and

50. Michelle G.K. Ward et al., *Prevention of Shaken Baby Syndrome: Never Shake a Baby*, 9 PAEDIATRICS & CHILD HEALTH 319, 320–21 (2004); see also *infra* Section II.D (discussing the unintentional caretaker).

51. See *infra* Parts III, IV.

52. See *infra* Section II.B.

53. See *infra* Sections II.C, D. The link between a diagnosis of SBS and intent is not supported in medicine because (1) SBS is not necessarily caused by shaking, despite what prosecutors want the jury to believe, and (2) even if a case of SBS was caused by shaking, this finding alone does not establish the requisite *mens rea*. For example, even if a parent or caretaker does admit to having intended to shake the baby and actually did shake the baby, this act does not necessarily mean the caretaker intended to kill or harm the baby. It may seem obvious to some that shaking a baby is dangerous or risky given the fragility of babies’ brains, necks, and bodies, but a substantial portion of individuals are not aware of these dangers and risks. See *supra* note 50 and accompanying text. With shaking, it is important to point out that some parents commonly shake their babies to get them to stop crying but not to kill them or hurt them. In those instances, wrongdoing is not conscious to the criminal. See *infra* Section II.D; see also Jacy Showers, *Preventing Shaken Baby Syndrome*, in THE SHAKEN BABY SYNDROME: A MULTIDISCIPLINARY APPROACH 349, 353 (Stephen Lazoritz & Vincent J. Palusci eds., 2001) (noting that “caretakers of children ‘may be unaware of the specific injuries they may cause by shaking’ and may perceive shaking as less abusive or less culpable than other forms of child ‘discipline’” and that “there has been some speculation that subservience to an adult’s wishes is a more primary goal than injury to the child” (citations omitted)).

prevention, is hijacked by the legal system for the purpose of criminal prosecution. The case studies, which are exemplary, share three characteristics: (1) the prosecution depends nearly entirely on an SBS diagnosis for its theory and argument, without which there would be no case or a case with a substantially lesser charge; (2) the prosecution focuses on proving that the defendant intended the shaking actions, as opposed to proving more accurate levels of *mens rea* such as recklessness or negligence or bringing no charge at all; and (3) the prosecution stresses a causal connection between the defendant's *mens rea* and *actus reus* even though such a connection is not warranted by either law or science.

Part IV demonstrates the extent of such prosecutorial deference to victim neuroscience evidence. My Neuroscience Study shows that when attorneys use victim neuroscience evidence at the trial level, the prosecution dominates its introduction and subsequent application. Thus, SBS evidence is virtually always used to the benefit of the prosecution and commonly for the purpose of proving the defendant's intent.

Part V analyzes some of the Neuroscience Study's adult-victim cases for two reasons: (1) to demonstrate that prosecutors' opportunities to concoct intent are widespread, extending beyond the SBS cases, and (2) to provide a balanced perspective on how prosecutors use victim neuroscience evidence within the starkly different context of adult victims. Although adult-victim cases are more factually and scientifically varied, prosecutors still employ neuroscience evidence in nearly one-fifth of these cases to reinforce a determination of the defendant's mental state.⁵⁴ The adult-victim cases therefore illustrate the benefits and drawbacks of victim neuroscience evidence when it comes to intent determinations.

The criminal justice system needs neuroscience to help clarify the vague and murky territory of establishing a defendant's *mens rea*. Yet that science can also be problematic. Each time science seemingly brings criminal law forward in terms of a more sophisticated understanding of a defendant's mental state or a victim's injury, it can set the criminal law back if that science is wrongly applied. The broader problem of concocting intent, then, extends far beyond SBS cases.

I. WHY INTENT MATTERS

A. THE MODERNIZATION OF *MENS REA*

The idea that individuals possess mental states indicative of their culpability has a long history developed throughout at least twelve centuries and swayed in large part by changing social, cultural, and political ideology.⁵⁵ By the nine-

54. See *infra* note 380 and accompanying text.

55. See *supra* note 32.

teenth century, the legal requirement of *mens rea* pervaded the law,⁵⁶ but there was extraordinary variation among state criminal statutes concerning how to define these gradated mental states.⁵⁷ In response to this confusion, in 1962 the American Law Institute published the Model Penal Code (MPC), a groundbreaking advance in modernizing the criminal law that reduced the numerous existing mental-state terms to four categories.⁵⁸ Under the MPC, a defendant can act with purpose (synonymous with intent), knowledge, recklessness, or negligence when engaged in a particular *actus reus*.⁵⁹ The MPC's emphasis on requiring a *mens rea* term for every element of an offense corresponded with the established doctrine that "wrongdoing must be conscious to be criminal."⁶⁰

In *Elonis v. United States*, one of the Supreme Court's most recent pronouncements on the importance of *mens rea*, the Court incorporated the MPC's four *mens rea* standards when explaining its outcome and reasoning.⁶¹ In the Court's view, purpose or knowledge was a sufficient standard for the *mens rea*-silent statute before them, but negligence was not.⁶² The Court took no position on whether reckless disregard would suffice for a conviction because the issue was not raised,⁶³ to the frustration of some Justices. As Justice Samuel Alito noted in his concurrence, "[a]ttorneys and judges are left to guess."⁶⁴ Justice Clarence Thomas seemingly agreed in his dissent: "Given the majority's ostensible concern for protecting innocent actors, one would have expected it to announce a clear rule—any clear rule. Its failure to do so reveals the fractured foundation upon which today's decision rests."⁶⁵

Many states have adopted the MPC's definitions of *mens rea*;⁶⁶ yet, as *Elonis* shows, they continue to be plagued by vagueness, confusion, manipulation, and politics.⁶⁷ Indeed, Congress reviewed a proposal that would have mandated the use of *mens rea* in many more cases, recognizing that *mens rea* terms have been discarded or sidelined over the years, perhaps in an effort to bypass this quagmire.⁶⁸ Because modern neuroscience deals so much with the workings of the human brain and therefore how individuals think and behave, it can offer

56. See Sayre, *supra* note 32, at 994–1004.

57. See Sanford H. Kadish, *Fifty Years of Criminal Law: An Opinionated Review*, 87 CALIF. L. REV. 943, 947 (1999).

58. See MODEL PENAL CODE § 2.02 explanatory note (AM. LAW. INST., Official Draft and Explanatory Notes 1985); see also Sanford H. Kadish, *Codifiers of the Criminal Law: Wechsler's Predecessors*, 78 COLUM. L. REV. 1098, 1140 (1978) (noting that the MPC was "stunningly successful in accomplishing the comprehensive rethinking of the criminal law").

59. MODEL PENAL CODE § 2.02 (AM. LAW. INST., Official Draft and Explanatory Notes 1985).

60. *Morrisette v. United States*, 342 U.S. 246, 252 (1952).

61. 135 S. Ct. 2001, 2009–12 (2015).

62. *Id.* at 2010–13.

63. *Id.* at 2012.

64. *Id.* at 2014 (Alito, J., concurring).

65. *Id.* at 2028 (Thomas, J., dissenting).

66. Kadish, *supra* note 58, at 1144.

67. See *supra* notes 61–65 and accompanying text.

68. See *supra* note 35 and accompanying text.

greater clarity and insight into interpreting such concepts as intent.⁶⁹ At the same time, as this Article discusses, there can be dangers in the way criminal justice actors use certain types of neuroscience if the legal system does not provide sufficient safeguards. There may be circumstances, for example, in which prosecutors use victims' injuries to "prove," however dubiously, a defendant's intent when there is no other kind of circumstantial evidence available.⁷⁰ The next Section discusses my study of neuroscience evidence and criminal cases to reveal more thoroughly how brain science can distort the construction of *mens rea*.

B. THE NEUROSCIENCE STUDY

Much has been written about the growing impact of neuroscience evidence on the criminal justice system but, until my Neuroscience Study, there was little systematic information available about it.⁷¹ Of course, courts have relied on nonimaging neuroscience tests for decades,⁷² and brain imaging by way of a computed tomography (CT) X-ray scan was used as early as the 1982 trial of John Hinckley Jr., President Ronald Reagan's attempted assassin.⁷³ Yet over the next decade, defense lawyers slowly started to adopt and prefer the positron emission tomography (PET) scan,⁷⁴ and their use of that test started to have an impact. *People v. Weinstein*, for example, is believed to be the first case in which a court admitted testimony concerning the results of PET scans to determine a defendant's insanity.⁷⁵ Weinstein had been charged with the second-degree murder of his wife.⁷⁶ The PET scan suggested he suffered from organic

69. See generally NEUROIMAGING IN FORENSIC PSYCHIATRY, *supra* note 37.

70. See *infra* Part III.

71. See Denno, *supra* note 27, at 500–05 (explaining the unique range of the Neuroscience Study). Other wide-scale empirical research has been recently completed in Canada, England, the Netherlands, the United States, and Wales. See generally Paul Catley & Lisa Claydon, *The Use of Neuroscientific Evidence in the Courtroom by Those Accused of Criminal Offenses in England and Wales*, 2 J.L. & BIOSCIENCES 510 (2015) (researching England and Wales); Jennifer A. Chandler, *The Use of Neuroscientific Evidence in Canadian Criminal Proceedings*, 2 J.L. & BIOSCIENCES 550 (2015) (researching Canada); C.H. de Kogel & E.J.M.C. Westgeest, *Neuroscientific and Behavioral Genetic Information in Criminal Cases in the Netherlands*, 2 J.L. & BIOSCIENCES 580 (2015) (researching the Netherlands); Nita A. Farahany, *Neuroscience and Behavioral Genetics in US Criminal Law: An Empirical Analysis*, 2 J.L. & BIOSCIENCES 485 (2016) (researching the United States); Lyn M. Gaudet & Gary E. Marchant, *Under the Radar: Neuroimaging Evidence in the Criminal Courtroom*, 64 DRAKE L. REV. 577 (2016) (researching the United States).

72. See generally Deborah W. Denno, *Human Biology and Criminal Responsibility: Free Will or Free Ride?*, 137 U. PA. L. REV. 615 (1988) (discussing the types and applications of early nonimaging tests).

73. See Virginia Hughes, *Head Case*, 464 NATURE 340, 341 (2010).

74. *Id.*

75. See 591 N.Y.S.2d 715, 720, 724 (N.Y. Sup. Ct. 1992); see also Cerisse Anderson, *Brain Scan Deemed Admissible at Trial: Guilty Plea Follows Insanity Defense Ruling*, N.Y.L.J., Oct. 20, 1992, at 3. But see Zachary Weiss, *The Legal Admissibility of Positron Emission Tomography Scans in Criminal Cases: People v. Spyder Cystkopf*, 1 SEMINARS IN CLINICAL NEUROPSYCHIATRY 202, 206 (1996) (stating that in California courts, PET scans had been admitted in at least eleven previous murder cases).

76. *Weinstein*, 591 N.Y.S.2d at 717.

cerebral defects that impaired his judgment during periods of stress, which Weinstein said included the argument he and his wife were having at the time he killed her.⁷⁷ Ultimately, because of the potential impact of the tests on a jury, the district attorney offered Weinstein a plea bargain and, in 1992, he pled guilty to first-degree manslaughter.⁷⁸

The *Weinstein* case “is important historically” because it came about “well before” the surge of scholarship examining the connection between law and neuroscience.⁷⁹ Thus, the case marks a point in time at which the influx of more advanced neuroscience techniques was just beginning and is therefore a neuroscience moment worth measuring. For this reason, the Neuroscience Study’s collection of cases starts at 1992 and the Study’s universe of 800 cases consists of every criminal law case that addressed neuroscience evidence from January 1, 1992 to December 1, 2012.⁸⁰ The end point of 2012 enables a two-decade perspective on the role of neuroscience, with the goal that more data will be collected and updated in the future.⁸¹ For the Study, I used information from criminal law cases derived from the Westlaw and LexisNexis legal databases to code and analyze over 150 key factors relevant to how courts and attorneys apply and interpret neuroscience evidence to reach legal conclusions about defendants and victims.⁸²

The 800 cases fall into two categories: 286 cases (35.75%) concern neuroscience evidence as it pertains to the victim, primarily to prove the extent of a victim’s brain injury; and 514 cases (64.25%) concern neuroscience evidence as it pertains to the defendant, similarly to prove the extent of a defendant’s brain injury.⁸³ The first category, what I call “victim neuroscience cases,” was particularly valuable. Until the Neuroscience Study, no other researcher had gathered

77. *Id.* at 725 n.6; Anderson, *supra* note 75, at 3.

78. Daniel A. Martell, *Causal Relation Between Brain Damage and Homicide: The Prosecution*, 1 SEMINARS IN CLINICAL NEUROPSYCHIATRY 184, 192–93 (1996). For further discussion of the *Weinstein* case and its role in capturing the attention of the neuroscience community, see Deborah W. Denno, *Crime and Consciousness: Science and Involuntary Acts*, 87 MINN. L. REV. 269, 377–81 (2002).

79. JONES ET AL., *supra* note 26, at 41.

80. All cases and case distributions discussed in this Article are available from the Author in an extensive appendix. See Neuroscience Study App. (on file with Author) [hereinafter “App.”]. The case selection and coding techniques employed for the Neuroscience Study have been described in depth elsewhere. See Denno, *supra* note 27, at 500–01; see also DEBORAH W. DENNO, CHANGING LAW’S MIND: HOW NEUROSCIENCE CAN HELP US PUNISH CRIMINALS MORE FAIRLY AND EFFECTIVELY (forthcoming 2018).

81. Practically speaking, the collection, coding, and cleaning of these cases is time-consuming and expensive. It is important to examine what the data are showing first, before moving on to more data collection and updating.

82. See Denno, *supra* note 27, at 500–01; see also DENNO, *supra* note 80 (describing the Neuroscience Study and some of the shortcomings of this method of case selection).

83. See App., *supra* note 80, at I. Altogether, 39 cases (4.88%) concern neuroscience evidence as it pertains to both the defendant and the victim because the brains of one or more individuals in both the “victim” and “defendant” categories were examined. *Id.* at III. Of the 286 victim neuroscience cases, then, 247 of the cases (86.36%) contained only victim neuroscience evidence, while 39 of these cases (13.64%) contained both victim neuroscience evidence and defendant neuroscience evidence. See *id.* at I–III. In other articles in which I have analyzed the Neuroscience Study’s data, I have combined the thirty-nine cases concerning both the defendant and the victim with the defendant-only neuroscience

enough data to discover these distinctions among neuroscience cases and to reveal the prevalence and importance of the victim cases. The victim neuroscience cases stand out because they are dominated by the prosecution and a focus on conviction, whereas defendant neuroscience cases are dominated by the defense and a focus on mitigation.⁸⁴ Such disparate goals reveal substantial differences in how the prosecution and the defense handle neuroscience evidence.⁸⁵

In the Neuroscience Study, victim neuroscience evidence usually consists of CT (computerized tomography) scans⁸⁶ (238 cases or 83.22%), autopsies of the brain (136 cases or 47.55%), and, to a lesser extent, MRI (magnetic resonance imaging) scans⁸⁷ (33 cases or 11.54%).⁸⁸ A key focus of the Neuroscience Study was to examine what role victim neuroscience evidence played in court. Surprisingly, of the 310 victims present in the Study (some cases have more than one victim), the great majority (216 victims or 69.68%) were under age eighteen.⁸⁹

cases to reach a total of 553 cases pertaining to defendants. *See Denno, supra* note 27, at 501 (reaching a total of 553 cases to analyze).

84. *See* Deborah W. Denno, *How Prosecutors and Defense Attorneys Differ in Their Use of Neuroscience Evidence*, 85 *FORDHAM L. REV.* 453, 456–61 (2016) (discussing the different ways the prosecution and defense approach introducing neuroscience evidence into court).

85. *Id.*

86. *See* JONES ET AL., *supra* note 26, at 757 (describing a CT scan as “[a] neuroimaging technique in which X-rays of the head are obtained from all angles and mathematically combined to yield a three-dimensional image of the skull and brain”).

87. *See id.* (describing an MRI as “[a] neuroimaging technique that provides images of interior brain structure through systematic variation of the magnetic properties of atoms in gray and white matter”).

88. App., *supra* note 80, at IV.A–C. Other tests were used to a substantially lesser extent: electroencephalograms (EEGs) appeared in thirteen cases (4.55%); single-photon emission computerized cosmography (SPECT) scans appeared in two cases (.70%); magnetic resonance angiography (MRA) scans appeared in one case (.35%); and angiograms appeared in one case (.35%). *Id.* at IV.D, IV.F, & IV.I. There were also seven cases (2.45%) that used “nonimaging” tests, which included neuropsychological assessments (2 cases or .70%), and neurological assessments (1 case or .35%), as well as the Glasgow Coma Scale (4 cases or 1.40%). *Id.* at IV.E, IV.G, & IV.H. The Glasgow Coma Scale is “an objective standard for measuring brain function along a continuum which begins at [level] three, indicating no brain function, and ends at [level] fifteen, indicating normal brain function.” *See State v. Brown*, 311 S.W.3d 422, 427 (Tenn. 2010). For a complete list of the types of victim neuroscience evidence used by the Neuroscience Study victim cases, see App., *supra* note 80, at IV.

89. *See* App., *supra* note 80, at VI.A–F. The full age breakdown of the 310 victims is as follows:

0 to less than 1 year: 95 (30.65%)
 1 to less than 2 years: 44 (14.19%)
 2 to less than 5 years: 45 (14.52%)
 5 to less than 10 years: 14 (4.52%)
 10 to less than 18 years: 4 (1.29%)
 Minor Victim but Age Unknown: 14 (4.52%)
 18 to less than 30 years: 4 (1.29%)
 30 to less than 40 years: 2 (.65%)
 40 to less than 50 years: 0 (0%)
 50 to less than 60 years: 2 (.65%)
 60 to less than 70 years: 2 (.65%)
 70+ years: 2 (.65%)
 Adult Victim but Age Unknown: 82 (26.45%)
 Total: 310 cases or 100%
Id. at VI.

Yet such evidence is used overwhelmingly in cases where the victim is a child, with close to half of the 310 victims (139 victims or 44.83%) under the age of two at the time of injury.⁹⁰ In addition, the majority of the victims (178 victims or 57.42%) died as a result of their injuries.⁹¹ These findings suggest that victim neuroscience evidence may carry more weight in cases where the victim does not remember the attack due to infancy or is unavailable to testify due to death or brain damage. In addition, the most commonly charged offenses against defendants in these cases reflect the victim profile. In 162 cases (56.64%), the defendant was charged with a homicide offense,⁹² and in 122 cases (42.66%), the defendant was charged with a specific offense against a child.⁹³

Victims' injuries were attributed to a number of causes, such as assault and battery or, more often, specific offenses against children.⁹⁴ Given the young age of most victims, the frequency of child abuse or neglect charges is to be expected. Yet within this category, one startling finding emerged: When prosecutors sought to explain the source of victims' injuries, they most commonly relied upon a theory of SBS. Indeed, in the sample of 286 victim neuroscience

90. *See id.* at VI.A–B.

91. *See id.* at VI.N. Of the 132 victims who survived, 75 of them (56.82%) suffered a significant brain injury and/or long term effects from their brain injury. *See id.* at VI.O (the 132 victims who lived) & VI.P (the 75 victims who lived with traumatic and long-term brain injuries).

92. *Id.* at VII.A. Such homicide offenses include First-Degree Murder, Second-Degree Murder, Felony Murder, Manslaughter, or Criminally Negligent Homicide. *See id.* (citing cases). The full breakdown of defendant sentences is as follows:

Probation: 2 (.70%) cases

0–10 years: 77 (26.92%) cases

11–30 years: 76 (26.57%) cases

31–50 years: 26 (9.09%) cases

More than 50 years: 15 (5.24%) cases

Potential Life Sentences (for example, 15 years to life): 16 (5.59%) cases

Life Sentences: 48 (16.78%) cases

Death Penalty: 26 (9.09%) cases

Id. at VIII.

93. *See App.*, *supra* note 80, at VII.B. These specific offenses include Child Abuse, Child Endangerment, or Cruelty to Children. *See id.* (citing cases). Additionally, there were 91 cases (31.82%) where the defendant was charged with an assault or battery type offense and 15 cases (5.24%) where the defendant was charged with a sexual offense. *Id.* at VII.C–D. For a complete list regarding the most commonly charged offenses against defendants, see *id.* at VII. Defendants were convicted of at least one crime in all of the cases. This result is due in large part to the nature of the Neuroscience Study's cases, which consisted almost entirely of appeals. The dispositions of the 286 cases were as follows: 199 (69.58%) convictions affirmed completely, 39 (13.64%) convictions reversed, 17 (5.94%) convictions affirmed with their sentences modified or vacated, 15 (5.24%) convictions reversed in part and affirmed in part, 10 (3.50%) convictions reinstated after they had been reversed by an intermediary appellate court, and 6 cases (2.10%) without an appeal of a conviction. *Id.* at IX. In 280 cases, either the defendant was appealing his or her conviction (through a direct appeal, a petition for the writ of habeas corpus, or a motion for postconviction relief) or the State was appealing a decision overturning the defendant's conviction. *Id.* at IX.A–E. Of the remaining 6 cases (2.10%), 1 case involved a motion to exclude evidence and the other 5 cases were appeals regarding something other than the defendant's conviction. *See App.*, *supra* note 80, at IX.F. However, a subsequent review revealed that all defendants in these 6 cases were eventually convicted of at least one crime. *Id.*

94. *See supra* note 93 and accompanying text.

cases, 115 cases (40.21%) involved a diagnosis of SBS.⁹⁵ Given the prevalence of SBS cases within the sample of victim neuroscience cases, issues related to SBS become intertwined with any discussion regarding the use of victim neuroscience evidence, particularly because prosecutors rely on the evidence so heavily to prove a defendant's intent.

There are more findings from my Neuroscience Study that I will discuss throughout this Article. For now, Part II will examine the origins of, and controversy surrounding, SBS and how it contributes to a perfect storm for concocting *mens rea*.

II. SHAKEN BABY SYNDROME AND THE START OF A PERFECT STORM

This Part reviews the history of SBS, beginning with its inception in 1971 by its creator Norman Guthkelch.⁹⁶ By the 1990s, Guthkelch and others argued that the legal system was misusing the syndrome, a concern that persists to the present time.⁹⁷ A combination of events contributed to a perfect storm of exploitation and distortion, ranging from the growing reliance on brain scans in courtrooms to the requirement that doctors report all cases that they suspect may potentially involve child abuse.⁹⁸ Most important was the increasingly adopted presumption that SBS is intentionally caused.⁹⁹

A. ORIGINS AND MEASUREMENT

In 1971, Norman Guthkelch, a British pediatric surgeon, published the research that would lay the original foundation for SBS.¹⁰⁰ After examining

95. See App., *supra* note 80, at X.A. There were 82 cases (28.67%) involving a form of child abuse or neglect other than SBS and 81 cases (28.32%) involving assault/battery against adult victims or teenage minors. *Id.* at X.B–C.

96. See generally A. N. Guthkelch, *Infantile Subdural Haematoma and Its Relationship to Whiplash Injuries*, 2 BRIT. MED. J. 430 (1971).

97. See *infra* notes 129–31 and accompanying text. A prime example of current litigation concerns the Texas case of Robert Roberson who, in June 2016, was granted a stay of execution following his conviction for shaking his young daughter to death. See *Ex Parte* Roberson, No. WR–63,081–03, 2016 WL 3543332, at *1 (Tex. Crim. App. June 16, 2016); see also *infra* note 292 (referencing the Roberson case). Before granting the stay, the Texas Court of Criminal Appeals was “aware of a sea change in the medical consensus since [Roberson’s] trial commenced in September 2002 regarding the phenomenon known as ‘Shaken Baby Syndrome’ (SBS) aka ‘Abusive Head Trauma’ (AHT).” Motion for Stay of Execution at 3, *Ex Parte* Roberson, No. WR–63,081–03, 2016 WL 3543332 (Tex. Crim. App. June 16, 2016). Although Roberson suffers from brain damage as well, his defense team claimed that the injuries inflicted on his two-year-old daughter were not consistent with SBS and that the case was based on “junk science.” See Johnathan Silver, *Court Halts Texas Man’s Execution in “Shaken Baby” Case*, TEX. TRIB. (June 17, 2016), <https://www.texastribune.org/2016/06/17/appeals-court-halts-east-texas-mans-execution/> [<https://perma.cc/M9B3-MAV2>]. The case is ongoing, as are other recent cases. See, e.g., *People v. Bailey*, WL 6644372 (N.Y. App. Div. Nov. 10, 2016) (granting defendant’s motion for vacatur of judgment of conviction for second-degree murder based on SBS due to newly discovered evidence concerning scientific and medical advances that suggest short distance falls could cause substantial injury or death to a toddler).

98. See *infra* Section II.B.

99. See *infra* Section II.B.

100. See Guthkelch, *supra* note 96, at 430–31.

thirteen cases in which infants evidenced bleeding in the brain (subdural hematomas), Guthkelch proposed that such injuries could occur by manually shaking the infant, without the infant's head hitting any other surface area.¹⁰¹ Three years later, John Caffey, an American pediatric radiologist, hypothesized that the rapid acceleration–deceleration forces applied during the shaking sheared the veins inside the brain, thus causing subdural hematomas, a phenomenon he called “whiplash shaken infant syndrome.”¹⁰² It would take another decade for the term “shaken baby syndrome” to be mentioned in a publication for the first time¹⁰³ and more time still for SBS to be systematically defined by the presence of three classic symptoms, or “triad”: (1) subdural hematoma, (2) bleeding in the retina (retinal hemorrhages), and (3) brain swelling (cerebral edema).¹⁰⁴ These symptoms can result in a significant brain injury that may cause permanent brain damage or death,¹⁰⁵ especially in young children.¹⁰⁶ Although SBS children range in age from birth to five years, SBS occurs most frequently in babies less than one year old and particularly in those who are newborn to six months old, when infant crying is at its peak.¹⁰⁷ Crying is a frequent trigger for caregivers who engage in behavior that may lead to a diagnosis of SBS.¹⁰⁸

Proper evaluation of SBS can be conducted in several ways: (1) CT scan, which can measure injuries that need immediate attention; (2) MRI, which provides a magnetic field and radio waves to show finer images of a child's brain; (3) skeletal survey, which entails administering a range of skeletal X-rays of all the bones (such as extremities, ribs, skull, pelvis, and spine) so examiners can determine the severity and type of fractures, as well as whether there have been prior fractures; (4) eye exam, which assesses the presence of bleeding or other eye injuries; and (5) blood tests, which determine if there are any genetic, metabolic, or other disorders that look similar to SBS but may provide alterna-

101. *See id.*

102. John Caffey, *The Whiplash Shaken Infant Syndrome: Manual Shaking by the Extremities with Whiplash-Induced Intracranial and Intraocular Bleedings, Linked with Residual Permanent Brain Damage and Mental Retardation*, 54 *PEDIATRICS* 396, 401 (1974). Two of Caffey's earlier articles built up to this conclusion. *See* John Caffey, *The Parent-Infant Traumatic Stress Syndrome*, 114 *AM. J. ROENTGENOLOGY, RADIUM THERAPY & NUCLEAR MED.* 217 (1972); John Caffey, *On the Theory and Practice of Shaking Infants*, 124 *AM. J. DISEASES IN CHILDREN* 161 (1972).

103. *See* Stephen Ludwig & Matt Warman, *Shaken Baby Syndrome: A Review of 20 Cases*, 13 *ANNALS OF EMERGENCY MED.* 104, 104 (1984); *see also* Cindy W. Christian et al., *Abusive Head Trauma in Infants and Children*, 123 *PEDIATRICS* 1409, 1409 (2009) (noting that “Ludwig and Warman first published the term ‘shaken baby syndrome’” in their 1984 article).

104. *See* David L. Chadwick et al., *Shaken Baby Syndrome—A Forensic Pediatric Response*, 101 *PEDIATRICS* 321, 321 (1998).

105. *See* Christian et al., *supra* note 103, at 1410; Showers, *supra* note 53, at 353.

106. *See infra* notes 107–08 and accompanying text.

107. *See* Suzanne Franklin Carbaugh, *Understanding Shaken Baby Syndrome*, 4 *ADVANCES IN NEONATAL CARE* 105, 106, 108 (2004); *Preventing Abusive Head Trauma in Children*, *CTRS. FOR DISEASE CONTROL & PREVENTION*, <http://www.cdc.gov/violenceprevention/childmaltreatment/abusive-head-trauma.html> [<https://perma.cc/MU5Y-3JK2>].

108. *See infra* notes 173–75 and accompanying text.

tive explanations for a child's injuries.¹⁰⁹

Most experts suggest that a child be evaluated with both a CT scan and an MRI because each device serves a separate purpose.¹¹⁰ There are also other factors that influence when and why medical professionals use these techniques. CT scans are faster and easier to administer than MRIs, especially in emergency situations,¹¹¹ and they are typically performed first, when an infant is admitted to the hospital.¹¹² CT scans do not require the infant to be still, as MRIs do;¹¹³ therefore, an MRI is most useful when performed a day or so after the alleged injury.¹¹⁴ According to an expert panel of pediatricians specializing in child abuse, a CT scan is a required procedure during evaluation for brain bleeding whereas an MRI is only recommended.¹¹⁵ Yet because MRIs can detect abnormalities and information that are not well defined by CT scans, infants may present with normal CT scans but abnormal MRIs.¹¹⁶

109. Patrick D. Barnes & Michael Krasnokutsky, *Imaging of the Central Nervous System in Suspected or Alleged Nonaccidental Injury, Including the Mimics*, 18 TOPICS IN MAGNETIC RESONANCE IMAGING 53, 56, 62–65 (2007); see also I. Blumenthal, *Shaken Baby Syndrome*, 78 POSTGRADUATE MED. J. 732, 732–34 (2002) (reviewing the skeletal and eye exams that are administered); Thomas D. Lyon et al., *Medical Evidence of Physical Abuse in Infants and Young Children*, 28 PAC. L. J. 93, 102–27, 143, 148–55 (1996) (discussing skeletal X-rays and tests, eye exams, and blood tests); Alexandra R. Paul & Matthew A. Adamo, *Non-Accidental Trauma in Pediatric Patients: A Review of Epidemiology, Pathophysiology, Diagnosis and Treatment*, 3 TRANSLATIONAL PEDIATRICS 195, 199–202 (2014) (noting the skeletal survey and tests for bleeding disorders and “ocular manifestations” necessary to diagnose nonaccidental head trauma); Elizabeth E. Gilles, *Abusive Head Injury*, CHILD NEUROLOGY FOUND., <http://www.childneurologyfoundation.org/disorders/abusive-head-injury/> [<https://perma.cc/2PQB-MFAX>] (describing testing); Healthwise Staff, *Shaken Baby Syndrome*, EmedicineHEALTH (Feb. 20, 2013), http://www.emedicinehealth.com/shaken_baby_syndrome-health/article_em.htm [<https://perma.cc/AM4W-XJKP>] (describing testing). For examples of other injuries that mimic SBS, see *infra* Section II.D.

110. See Barnes & Krasnokutsky, *supra* note 109, at 56.

111. Brigitte Chabrol et al., *The Role of Cranial MRI in Identifying Patients Suffering from Child Abuse and Presenting with Unexplained Neurological Findings*, 23 CHILD ABUSE & NEGLECT 217, 225 (1999).

112. See K.M. Barlow et al., *Magnetic Resonance Imaging in Acute Non-Accidental Head Injury*, 88 ACTA PAEDIATRICA 734, 739 (1999).

113. Erica Beecher-Monas & Edgar Garcia-Rill, *Overselling Images: fMRI and the Search for Truth*, 48 J. MARSHALL L. REV. 651, 657 (2015) (explaining that one of the limitations of an MRI relative to other imaging tests is that “the MRI can secure an image only if the subject being scanned lies completely still, as any movement can introduce alterations in the image and decrease resolution”); *Comparing Different Types of Imaging*, NPS MEDICINEWISE (April 22, 2015), <http://www.nps.org.au/medical-tests/medical-imaging/for-individuals/imaging-compared> [<https://perma.cc/R99H-HM5W>] (noting as a disadvantage of the MRI that “[s]light movement can ruin the image, requiring retesting” and that “[s]edation or anaesthesia may be required for young children or others who can’t remain still”); see also *Imaging Choices for Children*, NPS MEDICINEWISE (May 23, 2013), <http://www.nps.org.au/medical-tests/medical-imaging/for-individuals/imaging-and-children/imaging-choices-for-children> [<https://perma.cc/83RK-R9EY>] (“MRI does have some disadvantages [relative to a CT]. For example, your child may need to be sedated or undergo anaesthesia during an MRI, as the procedure can be lengthy and noisy and your child must remain motionless throughout.”).

114. See Chabrol et al., *supra* note 111, at 227.

115. Kristine A. Campbell et al., *Critical Elements in the Medical Evaluation of Suspected Child Physical Abuse*, 136 PEDIATRICS 35, 41 tbl.2 (2015).

116. Barlow et al., *supra* note 112, at 739.

MRIs are able to show more detail regarding the pattern, extent, and timing of brain injuries,¹¹⁷ and they can better detect and differentiate bleeding of different ages, which is particularly useful in identifying patterns of abuse.¹¹⁸ For example, SBS cases that present with bleeding of different ages may suggest multiple shaking incidents, which may conflict with a caretaker's account of a single incident resulting in head trauma. However, bleeding of different ages may also be a result of an ongoing natural disease and is not necessarily indicative of abuse.¹¹⁹ Therefore, MRIs are increasingly included as part of the routine investigation when infants present with head trauma.¹²⁰

B. LINK TO CRIMINALITY

Soon after Guthkelch and Caffey's research was published, SBS was widely adopted in the medical community as a clinical diagnosis for head injury inflicted on infants.¹²¹ Caffey also emphasized a medical need to recognize and curtail the devastating cultural beliefs of the day that led to SBS: the "ordinary, casual, habitual, customary, repeated shaking of infants" and "[t]he wide practice of habitual whiplash-shaking for trivial reasons" that justified "a massive nationwide educational campaign" to inform caretakers of the repercussions to infant welfare.¹²² Two decades would pass, however, before that campaign occurred.¹²³ Meanwhile, SBS research continued but primarily remained within the confines of medical circles.¹²⁴

117. Patrick D. Barnes, *Ethical Issues in Imaging Nonaccidental Injury: Child Abuse*, 13 TOPICS MAGNETIC RESONANCE IMAGING 85, 89 (2002); Waney Squier, *Retino-Dural Hemorrhage of Infancy*, in WILEY ENCYCLOPEDIA OF FORENSIC SCIENCE 2339 (Allan Jamieson & Andre Moenssens eds., 2013).

118. Chabrol et al., *supra* note 111, at 225. Additionally, injury from shaking most frequently results in bleeding in the subtemporal region of the brain, which is an area of the brain that is difficult to image with a CT. See Barlow et al., *supra* note 112, at 739. An MRI can also be used during autopsy procedures to precisely direct brain cutting to focal areas of injury to better illuminate the extent of injury. *Id.*

119. See Barnes & Krasnokutsky, *supra* note 109, at 64, 67.

120. See Barlow et al., *supra* note 112, at 734, 739. Indeed, "MRI has become the standard for such evaluation in these matters." Barnes & Krasnokutsky, *supra* note 109, at 64. Magnetic resonance spectroscopy imaging (MRSI), an application of the MRI that measures the presence of metabolites that are broken down in the brain, has also proven to be a useful tool in predicting patient outcomes. See Gregory S. Aaen et al., *Magnetic Resonance Spectroscopy Predicts Outcomes for Children with Nonaccidental Trauma*, 125 PEDIATRICS 295, 296, 300, 302 (2010).

121. Ronald Uscinski, *The Shaken Baby Syndrome*, 9 J. AM. PHYSICIANS & SURGEONS 76, 76 (2004).

122. Caffey, *On the Theory and Practice of Shaking Infants*, *supra* note 102, at 168–69; see also Keith A. Findley et al., *Shaken Baby Syndrome, Abusive Head Trauma, and Actual Innocence: Getting It Right*, 12 HOUS. J. HEALTH L. & POL'Y 209, 223 (2012) (noting that "shaking was at that time viewed as benign"); *supra* note 50 and accompanying text (revealing that about 25%–50% of the population is not aware of the dangers associated with shaking a baby).

123. See DEBORAH TUERKHEIMER, *FLAWED CONVICTIONS: "SHAKEN BABY SYNDROME" AND THE INERTIA OF INJUSTICE 2* (2014). In her book, Deborah Tuerkheimer discusses the social, medical, and legal problems associated with SBS. Although her book is a groundbreaking introduction and analysis of the SBS problem, her selection of legal cases is neither systematic nor methodological (per her admission). See *id.* at xiii–xiv. Moreover, the great majority of the thirty-or-so cases Professor Tuerkheimer discusses are not published, see *id.*, and therefore do not provide official precedent for other cases.

124. *Id.* at 2.

The link between SBS and criminality developed gradually. The first SBS case, that of John Schneider, took place in 1984,¹²⁵ but it would be one of only fifteen such appellate cases decided before 1990.¹²⁶ In sharp contrast, there would be hundreds more cases in the early 1990s and beyond.¹²⁷ Indeed, by the late 1990s, in the legal community, SBS had garnered a substantial level of “acceptance and enormously widespread popularity, with no real investigation or even question as to its scientific validity.”¹²⁸ A constellation of factors contributed to this status, ranging from the establishment of mandatory-reporting laws for health care and other professionals¹²⁹ to the increased use of clinical medicine in legal cases to a growing presumption that any child’s unexplained injury was likely to have been inflicted by a culpable adult.¹³⁰

125. *State v. Schneider*, No. L-84-214, 1984 WL 3719 (Ohio Ct. App. Dec. 21, 1984).

126. TUERKHEIMER, *supra* note 123, at 2.

127. *Id.*

128. Ronald H. Uscinski, *Shaken Baby Syndrome: An Odyssey*, 46 *NEUROLOGIA MEDICO-CHIRURGICA* 57, 58 (2006); *see also* Waney Squier, *The “Shaken Baby” Syndrome: Pathology and Mechanisms*, 122 *ACTA NEUROPATHOLOGICA* 519, 521 (2011) (discussing how “nobody has yet marshaled a coherent and comprehensive argument in support of shaking as a causal mechanism for abusive head injury” and that “the consistent and repeated observation that confessed shaking results in stereotypical injuries that are so frequently encountered in AHT—and which are so extraordinarily rare following accidental/impact injuries—IS the evidentiary base for shaking” (quoting Mark S. Dias, *The Case for Shaking*, in *CHILD ABUSE AND NEGLECT: DIAGNOSIS, TREATMENT AND EVIDENCE* 364, 364, 370 (Carole Jenny ed., 2011))).

129. All states have a reporting statute requiring certain individuals to report suspected cases of child abuse to local child protection officials. *See* Thomas L. Hafemeister, *Castles Made of Sand? Rediscovering Child Abuse and Society’s Response*, 36 *OHIO N.U. L. REV.* 819, 851 (2010). Currently, medical personnel, teachers, school officials, and social workers are required to report in all fifty states and the District of Columbia; forty-nine states and the District of Columbia also require reporting by law enforcement officers. *Id.* Eighteen states require all citizens to report. *Id.* at 853–54. Twenty-three states require reporting to a state’s Department of Social Services (DSS) or a related child protection agency, twenty-six states and the District of Columbia allow reporting to either the state’s DSS or a law enforcement agency, and New York requires reporting to a central registry, which forwards the reports to a local child protection service. *Id.* at 858. Most states use a “reasonable cause” standard, requiring reporting when “a reasonable person under similar circumstances” would suspect child abuse. *Id.* at 854. Model statutory language was developed to encourage individuals to report abuse when they suspect it, rather than waiting until they believe abuse has occurred, thereby potentially inflating the number of erroneous reports by lowering the threshold. *Id.* at 855. Most states’ reporting statutes also include an immunity provision to protect those who report in “good faith.” Caroline T. Trost, *Chilling Child Abuse Reporting: Rethinking the CAPTA Amendments*, 51 *VAND. L. REV.* 183, 196 (1998). Courts have interpreted these good-faith provisions to allow immunity for negligent reporting, consistent with the purpose of encouraging those who are in positions to detect child abuse to “freely report it to authorities without fear of liability.” *See id.* at 198 (citation omitted). Seventeen states include a presumption of good faith in their immunity provisions, but immunity is usually granted whether the statute indicates a presumption of good faith or not. *Id.* at 199 & n.94. Upon receiving a report of suspected abuse, a state’s child protection agency must investigate to determine whether there is reasonable or probable cause to believe the child has been abused. *Id.* at 202. Agency workers typically rely on physicians’ reports because of their expertise in dealing with injuries and their objectivity regarding the possible perpetrator. *Id.* If the agency finds that abuse has occurred, the agency will work with parents to improve their parenting skills. *Id.* In cases of severe abuse, the agency may petition the court for custody of the child. Trost, *supra*, at 202. Law enforcement agents and the criminal justice system are usually only consulted in cases involving death, serious injury, or sexual abuse. *Id.*

130. Uscinski, *supra* note 128, at 57–58.

Also by this time, the ties between SBS and the requisite elements of a crime had become firmly entrenched: shaking was the act that caused harm to the infant; the force with which the baby was shaken indicated the perpetrator's mental state, especially intent; and finally, the caretaker who was last with the conscious baby was the defendant.¹³¹ The very term "shaken baby syndrome" fuels the causal perception of these associations, with its suggestion that there is a singular origin of the act—"shaking"—and its implication of intent because shaking a baby is only rarely accidental.¹³² In other words, the caretaker presumably fulfills both the *actus reus* requirement and the *mens rea* requirement. It is highly unusual for a medical syndrome to be identified using terms that so readily connote wrongdoing; the vast majority of syndromes are named either by the person who discovered them or by their medical characteristics.¹³³ By 2012, even Guthkelch, the creator of SBS, published an article severely deriding how the syndrome had been misapplied over the years, particularly as a vehicle for connoting a caretaker's intent to harm.¹³⁴

The initial SBS research proposed that shaking was merely a possible method by which the triad symptoms could occur and that it was often considered an acceptable response to a crying infant.¹³⁵ However, influential medical organizations took the causal suggestion one step further. In 1992, the National Center on Child Abuse and Neglect supported a groundbreaking nationwide strategy to promote awareness of SBS.¹³⁶ As a result, prosecutors throughout the country were instructed about the SBS triad symptoms in order to pursue cases.¹³⁷ A year later, the American Academy of Pediatrics, the leading U.S. organization of pediatricians, made statements suggesting that evidence of the triad symptoms supported a medical presumption of abuse, thereby prompting both doctors and prosecutors to equate those symptoms with shaking.¹³⁸

Likewise, in 1998, a number of leading pediatricians who specialized in child abuse endorsed a published letter to the editor of the journal *Pediatrics* insisting that SBS "is now a well-characterized clinical and pathological entity."¹³⁹ The group questioned "those who would challenge the specificity of [the SBS]

131. See TUERKHEIMER, *supra* note 123, at 5. Because the onset of symptoms would have been immediate following shaking, the last person with the conscious baby could be identified as the abuser. See Comm. on Child Abuse & Neglect, Am. Acad. of Pediatrics, *Shaken Baby Syndrome: Rotational Cranial Injuries—Technical Report*, 108 PEDIATRICS 206, 207 (2001) [hereinafter *Rotational Cranial Injuries*].

132. See A.N. Guthkelch, *Problems of Infant Retino-Dural Hemorrhage with Minimal External Injury*, 12 Hous. J. HEALTH L. & POL'Y 201, 202 (2012).

133. *Id.*

134. *Id.* at 201–08.

135. Caffey, *On the Theory and Practice of Shaking Infants*, *supra* note 102, at 165; see also *infra* Section II.D.

136. See Showers, *supra* note 53, at 358.

137. TUERKHEIMER, *supra* note 123, at 4.

138. See Comm. on Child Abuse & Neglect, Am. Acad. of Pediatrics, *Shaken Baby Syndrome: Inflicted Cerebral Trauma*, 92 PEDIATRICS 872, 872 (1993).

139. Chadwick, *supra* note 104, at 321.

diagnostic features” in court by way of suggesting other causes for an infant’s injury.¹⁴⁰ Therefore, by reinforcing the presumption of abuse, the medical community created a scenario in which presumption of abuse could be treated as intentionality in the legal context.¹⁴¹ Recent findings and investigation into the original research, however, have seriously questioned both the scientific and legal underpinnings of SBS.

C. DOUBTS ABOUT THE SCIENCE

There is a debate in much of the modern literature on SBS concerning whether the science behind the diagnosis is problematic.¹⁴² For example, despite many reported cases of shaken infants, there has not been a single documented instance in which someone has witnessed shaking alone cause brain injury in an infant, nor has such damage been replicated in a controlled laboratory setting.¹⁴³ Furthermore, no study has shown that human beings are capable of creating the necessary rotational acceleration through manual shaking to cause brain injuries in infants without impact.¹⁴⁴ These and other findings conflict with Guthkelch’s original hypothesis that manual shaking alone can manifest in triad symptoms.¹⁴⁵

140. *Id.*

141. *See* Guthkelch, *supra* note 132, at 202.

142. *Compare* TUERKHEIMER, *supra* note 123, at 5 (criticizing the science) and Findley et al., *supra* note 122, at 213 (criticizing the science), with Narang, *supra* note 23, at 578 (explaining that SBS (abusive head trauma or AHT) “is the most peer reviewed and well-published topic in child abuse pediatrics”) and Joëlle A. Moreno & Brian Holmgren, *Dissent Into Confusion: The Supreme Court, Denialism, and the False “Scientific” Controversy over Shaken Baby Syndrome*, 1 UTAH L. REV. 153, 154–55 (2013) (discussing SBS as “a diagnosis that has been recognized as clinically valid and evidence-based by an overwhelming majority of pediatric medical specialists for almost half a century, substantiated by the bulk of the medical research in a range of scientific disciplines, recognized and defined by the Centers for Disease Control and Prevention, and widely accepted by courts in the United States and numerous foreign countries”).

143. *See* Uscinski, *supra* note 121, at 76–77 (collecting research and relying heavily on research published by A.K. Ommaya); Waney Squier & Lucy B. Rorke-Adams, *The Triad of Retinal Haemorrhage, Subdural Haemorrhage and Encephalopathy in an Infant Unassociated with Evidence of Physical Injury is Not the Result of Shaking, But is Most Likely to Have Been Caused by a Natural Disease*, 3 J. PRIMARY HEALTH CARE 159, 159 (2011) (noting that “in nearly 40 years, no one has ever witnessed shaking to cause the collapse of a well baby”).

144. *See* Uscinski, *supra* note 121, at 77; *see also* Ann-Christine Duhaim et al., *The Shaken Baby Syndrome: A Clinical, Pathological, and Biomechanical Study*, 66 J. NEUROSURGERY 409, 414 (1987); Michael Thomas Prange et al., *Anthropomorphic Simulations of Falls, Shakes, and Inflicted Impacts in Infants*, 99 J. NEUROSURGERY 143, 149 (2003).

145. *See* Guthkelch, *supra* note 96, at 430–31. *But see* Christopher Spencer Greeley, *Abusive Head Trauma: A Review of the Evidence Base*, 204 AM. J. ROENTGENOLOGY 967, 970–71 (2015) (discussing various methods of testing the SBS hypothesis and the merits of each, including animal and biofidelic research and computer models); Sandeep K. Narang et al., *A Daubert Analysis of Abusive Head Trauma/Shaken Baby Syndrome—Part II: An Examination of the Differential Diagnosis*, 13 HOUS. J. HEALTH L. & POL’Y 203, 252 (2013) (noting that “the biomechanical literature does not offer a definitive ‘yes’ or ‘no’ answer to the widely debated question of whether shaking alone can cause SDHs [subdural hematomas]. . . . It is clear, however, that continued assertion of the principle—that bio-

Guthkelch has acknowledged the veracity of this lack of replication, stressing, however, that the particular anatomical vulnerabilities and complexities of the infant brain are virtually impossible to document and replicate in a laboratory setting.¹⁴⁶ He suggests that additional research is necessary before any conclusive statements can be made about the exact cause and mechanism of subdural hemorrhaging in infants.¹⁴⁷ That said, he has also reacted strongly to how SBS research has been distorted to implicate defendants in the criminal justice system. For example, he emphasizes that it is erroneous to infer that shaking or abuse caused an infant's retino-dural hemorrhage and explicitly laments "the danger of assuming criminal intent" in the criminal SBS cases.¹⁴⁸ As he explains, "both medical science and the law have gone too far in hypothesizing and criminalizing alleged acts of violence in which the only evidence has been the presence of the classic triad or even just one or two of its elements."¹⁴⁹ Likewise, because of the presumed certainty of the syndrome, some physicians may fail to sufficiently inquire into other causes of the triad, even when medical reports suggest that the infant may have a significant history of abnormalities and illnesses.¹⁵⁰

Beginning in the mid-1970s, examiners started to use CT scans to help diagnose SBS.¹⁵¹ By the 1980s, the introduction of MRIs enhanced researchers' abilities to better detect and define certain kinds and patterns of brain injuries, as well as the time in which they occurred.¹⁵² Although the CT and MRI are complementary,¹⁵³ the growing application of MRI has also revealed that the SBS-triad symptoms could result from accidental injury and medical disorders, contrary to previous assumptions that the triad symptoms could only be caused by shaking.¹⁵⁴ Consequently, recent research has questioned the physiological mechanism of rapid acceleration–deceleration forces applying shearing strain to the bridging veins in the brain.

mechanics clearly demonstrates that [subdural hematomas] and/or serious brain injury cannot result from shaking—is disingenuous and scientifically irresponsible.”).

146. Guthkelch, *supra* note 132, at 202–03.

147. *Id.* at 208.

148. *Id.* at 203.

149. *Id.* at 203–04.

150. TUERKHEIMER, *supra* note 123, at 26. *But see* Albert et al., *supra* note 22, at 39 (explaining how “[p]hysicians treating and studying the pathology of children with these other disorders and diseases that mimic AHT agree that these disorders and diseases can be diagnosed or ruled out on the basis of routine diagnostic evaluation and ancillary studies”).

151. *Rotational Cranial Injuries*, *supra* note 131, at 206.

152. *Id.* at 206–08; Barnes & Krasnokutsky, *supra* note 109, at 56; Squier, *supra* note 128, at 520–21.

153. *Rotational Cranial Injuries*, *supra* note 131, at 207; Barnes & Krasnokutsky, *supra* note 109, at 56; Kent P. Hymel et al., *Intracranial Hemorrhage and Rebleeding in Suspected Victims of Abusive Head Trauma: Addressing the Forensic Controversies*, 7 *CHILD MALTREATMENT* 329, 344 (2002).

154. *See* Barnes, *supra* note 117, at 91; Squier, *supra* note 128.

Academic challenges to the SBS diagnosis first emerged in 2001 with the publication of two articles by Jennian Geddes, a British neuropathologist.¹⁵⁵ According to Geddes, bleeding in the brain was more likely to be hypoxic-ischaemic, meaning due to a shortage of oxygenated blood rather than the result of physical damage.¹⁵⁶ Because a lack of oxygen could occur for many reasons unrelated to abuse, the premise behind the triad would “require fresh examination.”¹⁵⁷ Thus, Geddes contended that SBS could no longer be used as an accurate indicator of abuse nor could it be relied on to identify the perpetrator, as infants may remain conscious for periods of time prior to collapse.¹⁵⁸ Additional research in 2001 revealed that short-distance falls of less than three to four feet could cause triad symptoms, further weakening the link between triad symptoms and abuse.¹⁵⁹ By 2002, the National Institutes of Health held a conference to discuss such critical findings.¹⁶⁰ Although the conference was confined to SBS supporters, much discussion concerned the dearth of evidentiary support for the diagnosis,¹⁶¹ as a preface to the conference proceedings made clear: “Because there is very little scientific experimental or descriptive work [on SBS], the pathophysiology remains obscure, and the relationship to mechanics even cloudier. . . . What we need is science—research and evidence that just isn’t there right now.”¹⁶²

The controversy surrounding SBS in no way invalidates the horrifying fact that some caregivers do inflict injury or death upon children. Child abuse and SBS are devastating issues for families and society, and there is no question that nonaccidental brain trauma in babies is medically diagnosable within the confines of medical practice in a hospital. Yet there is a growing recognition of the legal problems raised by SBS. The doctors who make and corroborate such diagnoses are not trained in the forensics of child abuse. Their sole concern is to immediately treat their patients and to protect them from future harm. Therefore, these doctors are not capable of determining whether the patient was in fact criminally abused, let alone whether the alleged abuser intended to cause

155. See J. F. Geddes et al., *Neuropathology of Inflicted Head Injury in Children, I. Patterns of Brain Damage*, 124 *BRAIN* 1290 (2001) [hereinafter Geddes, *Patterns of Brain Damage*]; J. F. Geddes et al., *Neuropathology of Inflicted Head Injury in Children, II. Microscopic Brain Injury in Infants*, 124 *BRAIN* 1299 (2001) [hereinafter Geddes, *Microscopic Brain Injury in Infants*]. For an in-depth critique of Geddes’s alternative hypothesis, see Narang, *supra* note 145, at 264–78; Narang, *supra* note 23, at 562–68.

156. Geddes, *Patterns of Brain Damage*, *supra* note 155, at 1295, 1297–98; Geddes, *Microscopic Brain Injury in Infants*, *supra* note 155, at 1303–05.

157. Geddes, *Microscopic Brain Injury in Infants*, *supra* note 155, at 1305.

158. TUERKHEIMER, *supra* note 123, at 24.

159. John Plunkett, *Fatal Pediatric Head Injuries Caused by Short-Distance Falls*, 22 *AM. J. FORENSIC MED. & PATHOLOGY* 1, 5, 10 (2001).

160. See *AM. ACAD. OF PEDIATRICS, INFLECTED CHILDHOOD NEUROTRAUMA* (Robert M. Reece & Carol E. Nicholson eds., 2003) (publishing the proceedings of the conference).

161. Findley et al., *supra* note 122, at 234.

162. See Carole E. Nicholson, *Preface* to *INFLECTED CHILDHOOD NEUROTRAUMA*, *supra* note 160, at ix.

such harm.¹⁶³ As one neurosurgeon and expert noted, “[w]ith regard to treatment of cranio-cerebral trauma, the differentiation between accidental and inflicted injury is of limited practical importance: injuries are injuries. For social purposes, however, the distinction is critical.”¹⁶⁴

D. THE UNINTENTIONAL CARETAKER

As the science around SBS becomes more controversial, using the diagnosis to show criminal intent becomes even more problematic. In fact, the literature overwhelmingly converges on a similar theme: given the number of natural diseases, short falls, and slight impacts that can mimic SBS symptoms, it is erroneous for doctors, medical experts, and subsequently courtrooms to infer that a defendant intentionally abused an infant based on the presence of symptoms.¹⁶⁵

Reflecting these developments, in 2009 the American Academy of Pediatrics recommended that pediatricians drop the term SBS, which “implies a single injury mechanism,” and instead use the term “abusive head trauma,” which reflects a broader and more varied constellation of head and brain injury.¹⁶⁶ Although shaking remains one of the acknowledged causes of “abusive head trauma,” the Academy now recognizes that the former SBS diagnosis implied an unrealistic level of certainty and a presumption of abuse.¹⁶⁷ As Guthkelch notes, however, “abusive head trauma” is an imperfect name as well: “abusive” presupposes intent, and “trauma” presupposes causation.¹⁶⁸ To jump to the conclusion that an infant has been abused, without a more thorough investigation into the infant’s medical history and possible alternative causes, is to infer intent prematurely.¹⁶⁹

Recognizing such connotations, many physicians now call such a diagnosis “nonaccidental injury” or “nonaccidental trauma,” terms that presumably discard the intent-laden names of “shaken baby” and “abusive head trauma.”¹⁷⁰ Nonetheless, the term “nonaccidental trauma” still suggests wrongdoing because the possibility that the child’s injury was due to an accident is, by definition, no longer a viable explanation. It seems this type of harm cannot avoid a pejorative label. Regardless, this Article continues to refer to “shaken baby syndrome” because that is the term currently used in most criminal court

163. Findley et al., *supra* note 122. That said, although doctors are not specifically trained to determine if a child was criminally abused, they are legally required to report a case even if they only slightly suspect that there was abuse. *See supra* note 129 and accompanying text (discussing some of the reporting statutes and requirements for doctors).

164. Uscinski, *supra* note 121, at 77.

165. *See* TUERKHEIMER, *supra* note 123, at 22; *see also* Albert et al., *supra* note 22, at 39–40 (discussing the problems associated with experts testifying about SBS in court).

166. Christian et al., *supra* note 103, at 1411.

167. *Id.* at 1410.

168. Guthkelch, *supra* note 132, at 202.

169. *Id.* at 202.

170. Barnes & Krasnokutsky, *supra* note 109, at 53.

cases.¹⁷¹

Indeed, much of the SBS literature emphasizes the same message: “[C]aretakers . . . ‘may be unaware of the specific injuries they may cause by shaking’”¹⁷² and “frustration with a child’s crying is the number one reason a person shakes a baby.”¹⁷³ This frustration is often exacerbated by contributing factors such as a caregiver’s depression, anxiety, and fatigue¹⁷⁴ as well as the “‘developmental curve’ of increased crying” that peaks in babies at ages two or three months.¹⁷⁵ Indeed, many caretakers simply want the baby to comply with their wishes.¹⁷⁶ Likewise, infant abusive head injuries frequently occur when the caretaker is inexperienced around children.¹⁷⁷ Some shakers claim that shaking successfully stopped a child’s cries in the past without any visible repercussions.¹⁷⁸ In these cases, the shaking may be a repeated occurrence rather than a single, isolated event¹⁷⁹ as research on confessed shaking offenders has

171. See, e.g., *supra* note 97 and *infra* note 292 (discussing the ongoing “shaken baby syndrome” case of Robert Roberson and illustrating the continuing use of the terminology).

172. Showers, *supra* note 53, at 353 (citations omitted).

173. *Shaken Baby Syndrome (SBS)*, NAT’L CTR. ON SHAKEN BABY SYNDROME, <http://purplecrying.info/sub-pages/protecting/shaken-baby-syndrome-sbs.php> [<https://perma.cc/Q9PZ-QRSN>]; see also Ronald G. Barr et al., *Maternal Frustration, Emotional and Behavioural Responses to Prolonged Infant Crying*, 37 *INFANT BEHAV. & DEV.* 652, 652 (2014) (emphasizing that “[p]rolonged inconsolable crying bouts in the first months of life are frustrating to parents and may lead to abuse”).

174. E-mail from Ronald G. Barr, Emeritus Professor of Pediatrics, Univ. of B.C., to Marisa McPeck-Stringham, Info. and Research Specialist, Nat’l Ctr. on Shaken Baby Syndrome (Feb. 10, 2016, 5:45 PM) (on file with author) [hereinafter Barr E-mail].

175. *Id.* (“In brief, there is a ‘positive feedback’ cycle that occurs *only* with shaking as a response, and not with other responses. This contributes to the repeated shaking phenomenon.”).

176. Showers, *supra* note 53, at 353. This situation is especially problematic when doctors, prosecutors, juries, and others infer *mens rea* from victims’ injuries, thereby adding to the perfect storm.

177. Mary E. Case et al., Nat’l Ass’n of Med. Examiners Ad Hoc Comm. on Shaken Baby Syndrome, *Position Paper on Fatal Abusive Head Injuries in Infants and Young Children*, 22 *AM. J. FORENSIC MED. & PATHOLOGY* 112, 113 (2001). For research on the risk factors associated with abusive head trauma (SBS), see Greeley, *supra* note 145, at 968 (“Maternal characteristics associated with increased risk of perpetrating AHT include age younger than 21 years and being unmarried. Children living in households with unrelated adults, compared with a home with two biologic parents, are at 50-fold increased risk of dying of inflicted injuries. Maternal undereducation (<12 years), maternal age younger than 15 years, and lack of prenatal care have been identified as risk factors for infant homicide, battering being the most common cause. A survey of parents in The Netherlands showed that 5.6% of parents indicated that they smothered, slapped, or shook their infants because of their crying. A survey in North and South Carolina showed that 2.6% of parents reported shaking their children younger than 2 years as a method of discipline. Perpetrators of AHT are more than twice as often men. Fathers are the most common perpetrators of AHT overall, followed by mothers’ boyfriends and female babysitters.”).

178. Greeley, *supra* note 145, at 968.

179. Barr E-mail, *supra* note 174; see also Catherine Adamsbaum et al., *Abusive Head Trauma: Judicial Admissions Highlight Violent and Repetitive Shaking*, 126 *PEDIATRICS* 546 (2010). Catherine Adamsbaum, M.D. and her colleagues conducted perhaps the seminal study on the caregiver–infant interaction that results in violent and repetitive shaking. The objective of the study was to “correlate legal statements by [confessed SBS] perpetrators with medical documentation [brain scans] to offer insights into the mechanism of injury.” *Id.* at 546. In twenty-nine of the cases examined in the study, detailed confessions were given, which is a rarity in these types of crimes. *Id.* at 547–48.

shown.¹⁸⁰ Educating parents about the dangers of shaking has been a highly effective strategy in curtailing such abuse.¹⁸¹

Guthkelch himself further complicated the problems by inferring criminal intent. In his original research, he wrongly attributed SBS symptoms in two infants: one who had been gently shaken by his mother during a coughing fit when she feared he was going to choke and one whose “mother admitted she and her husband ‘might have’ shaken the baby when he cried at night.”¹⁸² He notes too that Caffey had presented a case in which a mother jerked her child in the process of grabbing his arm to prevent him from falling off of a table.¹⁸³ Although the circumstances in these three cases seemingly produced a subdural hemorrhage or further hemorrhaging, none of them involved any kind of violent shaking or “any apparent malicious intent.”¹⁸⁴ Therefore, it is incorrect for courts to infer intent from the mere presence of triad symptoms, as it is evident that triad symptoms can occur without violent shaking.¹⁸⁵ As one article emphasizes in the context of more modern measurements of infant brain trauma, “[t]he medical and imaging findings cannot diagnose intentional injury.”¹⁸⁶ Wrong diagnoses not only create disastrous consequences for the accused, but they may also thwart an infant’s chances of receiving necessary medical attention if medical professionals overlook natural disease causes in favor of the presumption of abuse.¹⁸⁷

Researchers now recognize that numerous conditions can mimic SBS, including congenital malformations, metabolic or genetic disorders, hematological disorders, infectious diseases, autoimmune conditions, aneurysms, strokes, and chain reactions to cardiorespiratory arrest, hypoxia, resuscitation, and seizures.¹⁸⁸ As radiological imaging improves, even more infants are found to have subdural hemorrhages following birth that are not associated with any abuse whatsoever.¹⁸⁹ Guthkelch points to one study that reported 46% of asymptomatic infants had subdural hemorrhages following a normal birth; for symptomatic infants with difficult births or congenital diseases, the percentage is likely

180. Adamsbaum et al., *supra* note 179, at 546. According to Adamsbaum’s study, in over 50% of the reviewed SBS cases, the shaking in response to crying was recurrent. *Id.* at 550, 553.

181. *See* Showers, *supra* note 53, at 349, 356–59 (detailing successful prevention programs).

182. Guthkelch, *supra* note 132, at 205–06.

183. *Id.* at 205.

184. *Id.* at 205–06.

185. *See id.*

186. Barnes & Krasnokutsky, *supra* note 109, at 71.

187. *See* Guthkelch, *supra* note 132, at 206.

188. Barnes & Krasnokutsky, *supra* note 109, at 53–71; Hymel et al., *supra* note 153, at 332; Katherine Judson, *What Child Welfare Attorneys Need to Know About Shaken Baby Syndrome*, 17 CHILD. RTS. LITIG. 9, 10 (2015); Narang, *supra* note 145, at 229 (opining that “[b]leeding disorders may be proposed as the underlying cause for clinical findings in cases of suspected abusive head trauma”); Andrew P. Sirotiak, *Medical Disorders That Mimic Abusive Head Trauma*, in ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN: A MEDICAL, LEGAL, AND FORENSIC REFERENCE 191, 193–214 (Lori D. Frasier et al. eds., 2006).

189. Guthkelch, *supra* note 132, at 206.

significantly higher.¹⁹⁰ Although most subdural bleeds resolve themselves, infants who do not improve are more likely to have a pre-existing condition that may result in more brain hemorrhaging.¹⁹¹ Research on the causes and mechanisms of subdural hemorrhaging is still developing, but much of what previously had been accepted as fact is now being called into question.¹⁹² It is increasingly difficult to justify deciphering the state of mind of an alleged abuser on the basis of such controversial research.

Nonetheless, my Neuroscience Study reveals that this approach is astonishingly successful. Courts are surprisingly receptive to the prosecution's efforts, notwithstanding weaknesses in the underlying science. SBS cases illustrate a disturbing phenomenon in which the crucial element of *mens rea* is either muddled or missing altogether in the crime that has been charged, yet prosecutors are effectively—and without objection from the defense—concocting intent out of victim neuroscience evidence that is admitted for solely medical purposes. My Study shows prosecutorial exploitation of victim neuroscience evidence, with SBS cases representing a perfect storm of the legal and scientific factors that lead to such a strategy.

III. SHAKEN BABY SYNDROME AS A MICROCOSM OF SCIENTIFIC MISUSE

This Part discusses individual case studies derived from my Neuroscience Study to illustrate how the victim neuroscience cases follow a paradigm in which the State relies heavily—if not entirely—on two key pieces of evidence: the science of SBS and the testimony of medical expert witnesses explaining that science.¹⁹³ This reliance is all the more troubling in light of Part II's overview of the scientific weaknesses of SBS. In addition, much of the medical and legal literature agrees that SBS should not be introduced in the courtroom in the ways this Part's case studies demonstrate, most particularly as evidence of the defendant's *mens rea* at the time of a crime. Problems arise when a diagnosis such as “nonaccidental trauma,” made for the purpose of medical care and treatment, is transformed in a courtroom to a diagnosis of “shaken baby syndrome” or “abusive head trauma” and introduced for the purpose of criminal prosecution.¹⁹⁴

Three key interrelated factors distinguish this Part's cases from other kinds of criminal cases: (1) the prosecution depends almost entirely on the medical

190. *Id.*; V.J. Rooks et al., *Prevalence and Evolution of Intracranial Hemorrhage in Asymptomatic Term Infants*, 29 AM. J. NEURORADIOLOGY 1082, 1083, 1085 (2008); see also Narang, *supra* note 145, at 231 (“There are many . . . congenital bleeding disorders, and significant variability exists in the prevalence and presenting symptoms of each of the bleeding disorders, such that each disorder must be considered individually.”).

191. Guthkelch, *supra* note 132, at 206.

192. Rooks et al., *supra* note 190, at 1085–86.

193. See TUEKHEIMER, *supra* note 123, at 5 (describing a similar type of prosecutorial paradigm).

194. Albert et al., *supra* note 22, at 39 (noting that “some cases may have an unexpected outcome that contradicts what an objective view of the science and facts would otherwise dictate”).

diagnosis of SBS for its theory and argument, without which there would most likely be no case or, at most, a case involving a substantially lesser charge; (2) the prosecution focuses on proving, however dubiously, that the defendant intended his or her actions, as opposed to a lower level of *mens rea* such as recklessness, despite no direct evidence of intentionality; and (3) the prosecution emphasizes a causal connection between the defendant's *mens rea* and *actus reus*, which suggests that the defendant was aware that the actions he or she engaged in would cause the victim's harm. As a result, for many cases involving SBS, courts convict defendants for the most serious offenses, and those defendants receive the harshest punishments.

A. INTENT IS "IN THE AIR"¹⁹⁵

This Section examines, from the Neuroscience Study's pool of 286 victim-neuroscience evidence cases,¹⁹⁶ a select number of case studies focusing in particular on the three interrelated factors mentioned above. These case studies are exemplary in the sense that they demonstrate the problems with SBS in a variety of scenarios particularly well.

In *State v. Rodriguez*, for example, the defendant was convicted of first-degree felony murder in the death of his 5-month-old son, Louie.¹⁹⁷ At trial, the prosecution introduced a CT scan of Louie's brain, which "revealed significant blood around the surface of [his] brain and extreme swelling of the brain itself."¹⁹⁸ The prosecution also offered testimony from three physicians who had treated Louie and whose testimony substantially swayed the appellate court. One doctor testified that she believed "vigorous shaking had caused Louie's injuries, which were consistent with 'nonaccidental trauma.'"¹⁹⁹ The second doctor concluded that the "massively swollen" nature of Louie's brain was "the result of 'intentionally inflicted head trauma.'"²⁰⁰ The third doctor determined that Louie's injuries were "consistent with 'shaken baby nonaccidental trauma.'"²⁰¹

The defense called only one expert, a pathologist and toxicologist who concluded that Louie's death was caused by whooping cough based on his review of Louie's medical history and hospital records.²⁰² On appeal, the defendant's principal argument was that the district court erred by failing to instruct the jury on several lesser included charges, including reckless second-

195. This subtitle is a play on words from a famous quote, "negligence [is] in the air." See *Palsgraf v. Long Island R.R. Co.*, 162 N.E. 99, 99 (N.Y. 1928).

196. See *supra* note 83 and accompanying text (describing the breakdown between defendant neuroscience cases and victim neuroscience cases).

197. 289 P.3d 85, 89 (Kan. 2012).

198. *Id.*

199. *Id.* at 90.

200. *Id.*

201. *Id.*

202. *Id.* at 90.

degree murder and reckless involuntary manslaughter.²⁰³ The court rejected this argument, reasoning that not only was the father Louie's sole caretaker at the time Louie became injured, but also that the three examining physicians "were united in their opinions that [Louie's] injuries were intentionally inflicted."²⁰⁴

The court concluded that "[t]he evidence was not that Louie's injuries were simply the result of trauma, perhaps recklessly inflicted, but rather that the injuries were the result of intentionally inflicted trauma."²⁰⁵ Yet *Rodriguez* is a case in which medical testimony about Louie's ill health was substantial—not only was Louie sickly throughout much of his short life, but the father-caretaker called 911 immediately when there was a problem, and there was no indication that he had inflicted any other kind of injury.²⁰⁶ Without the medical testimony of nonaccidental trauma, it is unclear what charge, if any, the father would have faced.

Rodriguez illustrates the propensity for courts to accept a prosecution's pervasive reliance on expert testimony and brain scans in interpretations of a defendant's mental state. Likewise, in *Roark v. State*, the defendant was convicted of injury to a child, B.D., and sentenced to thirty-five years in prison.²⁰⁷ At trial, the prosecution introduced a CT scan of B.D.'s brain and medical testimony interpreting the scan. Dr. Kathleen Murphy, a pediatric intensivist, testified that B.D.'s CT scan revealed "a subdural hemorrhage, which involves bleeding around the brain in the space between the brain and the cranium."²⁰⁸ Dr. Murphy believed this brain damage was caused by a "closed head injury," which was likely nonaccidental.²⁰⁹ She further opined that "the type of force needed to cause an injury like B.D.'s would be comparable to a motor vehicle accident, a high-speed bicycle accident without a helmet . . . or a non-accidental trauma where the child is shaken or hit against a wall or some object."²¹⁰

Similarly, Dr. Nancy Rollins, a pediatric neuroradiologist, testified that B.D.'s CT scan revealed neurological abnormalities, such as "brain swelling, [and] blood over the brain."²¹¹ She concluded that B.D. "had undergone non-accidental trauma, child abuse" and that B.D.'s injuries "were consistent with

203. *Rodriguez*, 289 P.3d at 91.

204. *Id.* at 92.

205. *Id.*

206. *Id.* at 89–90.

207. No. 05-00-00584-CR, 2001 WL 1173916, at *1 (Tex. Crim. App. Oct. 5, 2001).

208. *Id.* at *3.

209. *Id.* A "closed head injury" is defined as "a trauma in which the brain is injured as a result of a blow to the head, or a sudden, violent motion that causes the brain to knock against the skull." *Closed Head Injury*, BRAINANDSPINALCORD.ORG, <http://www.brainandspinalcord.org/traumatic-brain-injury-types/closed-brain-injury/index.html> [https://perma.cc/X3WZ-LERL]. Such an injury is different than "an open head injury, in that no object actually penetrates the brain." *Id.* Closed head injuries have the potential to be "diffuse," in the sense "that they affect cells and tissues throughout the brain; or focal, meaning that the damage occurs in one area." *Id.*

210. *Roark*, 2001 WL 1173916, at *3.

211. *Id.* at *4.

the type of violent injury known as [SBS].”²¹²

On appeal, the defendant’s primary argument was that the evidence at trial was legally insufficient to support his conviction for injury to a child because the State did not prove that the defendant “(1) knowingly or intentionally caused serious bodily injury to B.D., (2) caused the injuries to B.D., or (3) shook or struck B.D. against an object as alleged in the indictment.”²¹³ The appellate court rejected these arguments because of the victim neuroscience evidence in the record that supported conviction. Based on the expert testimony and testing, the court determined that a rational jury “could infer appellant knowingly or intentionally caused serious bodily injury by shaking B.D.” and thereby “conclude[d] the evidence [was] legally sufficient to support [Roark’s] conviction for injury to a child.”²¹⁴ Similar to *Rodriguez*, the prosecution’s arguments in *Roark* rested heavily on its experts’ characterization of SBS as well as the defense’s decision not to introduce experts to criticize the SBS diagnosis.

B. THE CAUSAL DISCONNECT BETWEEN *MENS REA* AND *ACTUS REUS*

In *State v. Hales*, the court’s focus on the defendant’s level of intent was even more pronounced, particularly as it applied to the defendant’s acts. In *Hales*, the defendant was convicted of murder and sentenced to five years to life in prison.²¹⁵ The facts are unusual because the defendant was alleged to have fatally injured the victim, Luther, on December 5, 1985, when Luther was five months old; however, Luther did not die until he was twelve years old (from complications attributed to severe brain injuries that he experienced at five months).²¹⁶ At the preliminary hearing and at trial, the prosecution presented several CT scans of Luther’s brain taken across a span of three years, illustrating a progressive worsening of its condition.²¹⁷

Based on the CT scans and other medical evidence regarding retinal hemorrhaging, Dr. Marion Walker, a pediatric neurosurgeon, testified that the injury to Luther must have been nonaccidental and caused by SBS.²¹⁸ Dr. Walker explained that “the ‘constellation of injuries’ clinically associated with [SBS] is

212. *Id.*

213. *Id.* at *1.

214. *Id.* at *4.

215. 152 P.3d 321, 329 (Utah 2007).

216. *Id.* at 324–25.

217. *See id.* at 339 (“[T]he first CT scan, which was taken on December 5, 1985, showed initial signs of edema and bleeding over the surface and between the hemispheres of the brain (or ‘subarachnoid hemorrhaging’); the CT scans taken on December 8, 1985, and December 11, 1985, showed ‘black brain,’ evidencing global injury caused by something like lack of blood flow and oxygen (or ‘hypoxia-ischemia’), which injured the brain throughout; the CT scan from December 8, 1985, showed that the degree of injury to the front and the back of the brain differed, indicating that arteries had been occluded by swelling; and finally, a CT scan taken three years later, on December 13, 1988, showed a shrunken brain evidencing severe loss of functions.”).

218. *Id.* at 329, 340.

indicated by ‘a brain scan that actually looks quite similar to what we’ve seen here today.’”²¹⁹ Dr. Walker added that “the force required to cause these injuries to a baby’s brain from shaking would be violent force” and that the injuries “would have caused immediate unconsciousness with no possibility of a ‘lucid interval.’”²²⁰

The defense called a forensic pathologist at trial, Dr. John Plunkett, who testified that shaking can injure the neck but not the brain, and thus “the most likely cause of [Luther’s] injuries was . . . impact from [an earlier] near-miss car accident that caused the bruising followed by a lengthy ‘lucid interval.’”²²¹ In addition, there were no other signs of injury apart from the bruise; the SBS diagnosis was the only kind of circumstantial evidence available.²²²

On appeal, the defendant argued that the evidence did not show he possessed the mental state necessary for a murder conviction,²²³ an argument the court rejected. As the court explained, Luther’s injuries comprised “the key circumstantial evidence as to [defendant’s] mental state.”²²⁴ Based on the CT scans, for example, Dr. Walker had testified that Luther’s “massive brain injury” was “caused by shaken baby syndrome” and “by ‘violent force.’”²²⁵ In addition, testimony by Luther’s mother indicated that Luther “was fine” when she put him in his bed for the night but must have been injured during the twenty to thirty minutes that the defendant was with him.²²⁶ Therefore, altogether, the jury could infer through “logic and reasonable human experience” that the defendant’s act of “violently shaking” Luther “created a grave risk of death to Luther and . . . resulted in Luther’s death” and that the defendant “knew his conduct presented a grave risk of death to Luther, and that the circumstances evidenced depraved indifference to human life.”²²⁷

Such a conclusion did not rest on the defendant’s level of awareness of SBS; rather, the court assumed that “reasonable human experience indicates that an adult would know that violently shaking a five-month-old baby with less-developed neck control presents a grave risk of death to the baby.”²²⁸ As this Article’s discussion in Part II indicates, however, the court has little to no basis for linking together such a causal connection between the defendant’s *mens rea* and *actus reus*. First and foremost, there is no direct evidence that the defendant

219. *Id.* at 340.

220. *Id.* at 329.

221. *Hales*, 152 P.3d at 329.

222. *See id.* at 326.

223. *Id.* at 336.

224. *Id.* at 336–37. The defendant’s conviction was overturned on other grounds. Specifically, the court held that “Hales’s trial attorneys failed to provide effective assistance of counsel because they did not hire a qualified expert to give an independent interpretation of the CT scans of Luther’s brain injuries” and that “Hales was prejudiced by this failure.” *Id.* at 344.

225. *Id.* at 337.

226. *Hales*, 152 P.3d at 337.

227. *Id.*

228. *Id.*

ever injured Luther.²²⁹ But, even if the defendant did commit the act, there is no basis for the court's presumption that the defendant would be aware of Luther's particular vulnerability or that the shaking would cause such an injury. Indeed, the overwhelming literature suggests just the opposite.²³⁰

In *People v. Wade*, the court similarly presumed that the defendant would understand the extent of the victim's physical vulnerability if in fact the defendant had inflicted an injury.²³¹ In *Wade*, the defendant was convicted of involuntary manslaughter and "assault on a child under eight years of age by means of force that to a reasonable person would be likely to cause great bodily injury and that did cause death."²³² At trial, the prosecution introduced CT scans of the eighteen-month-old victim's (Koby) brain and the testimony of nine medical experts who interpreted the scans and conducted medical examinations.²³³ Dr. Mark Wagner, an emergency room physician, testified that a CT scan of Koby's brain revealed "'massive bleeding about the right frontal parietal' portion of the head from the forehead to the back of the head."²³⁴ He added that "Koby's brain was swollen, especially on the right side, and his brain 'was shifting from the right to the left' due to the '[s]welling, blood, and edema.'"²³⁵ He opined that Koby's injuries were "consistent with 'shaken baby syndrome,'" which "occurs when a young child is 'shaken back and forth vigorously over and over.'"²³⁶

Similarly, Dr. Hosam Moustafa, a pediatric radiologist, reviewed the CT scan and "noted a large subdural hemorrhage in the right cerebral hemisphere, brain edema (bleeding), 'midline shift,' and areas of brain contusions (bruising)."²³⁷ According to Dr. Moustafa, Koby's "hemorrhage was 'acute,' meaning it had happened within two or three days of the CAT scan"²³⁸ and his injuries were "'high impact,'" suggesting that "they could have been caused by [SBS] or similar trauma such as a car accident."²³⁹ Additionally, Dr. Robert Clark, a pediatric ophthalmologist, testified that "Koby's injuries were too severe to have been caused by a fall or other 'everyday' type of accident."²⁴⁰

The defendant, however, was at a severe disadvantage. Although the appellate court noted he introduced "significant medical evidence in his defense case challenging the prosecution's medical evidence," the court did not address the

229. *See id.* at 326.

230. *See supra* Section II.D (discussing the unintentional caretaker).

231. No. B227026, 2011 WL 5997023, at *6 (Cal. Ct. App. Nov. 29, 2011).

232. *Id.* at *1.

233. *Id.* at *1–6.

234. *Id.* at *2.

235. *Id.*

236. *Id.* at *3.

237. *Wade*, 2011 WL 5997023, at *4.

238. *Id.*

239. *Id.*

240. *Id.*

specifics of this evidence for procedural reasons.²⁴¹ The court explained that “the substantial evidence standard of review requires us to examine the evidence in a light favoring the jury’s verdict” and thus “the defense’s medical evidence is of secondary importance for purposes of the substantial evidence test.”²⁴² Of course, such a dismissal of defendant’s medical evidence challenging the prosecution’s theory was highly detrimental, especially in a case involving SBS.

On appeal, the defendant argued that his assault conviction must be reversed because it was not supported by substantial evidence. Specifically, he argued that “the record d[id] not disclose sufficient evidence supporting the jury’s [required] finding that a reasonable person would have understood that the physical force he used on Koby would be likely to cause great bodily injury.”²⁴³ The court rejected this argument, finding that the evidence established that the victim died from SBS and that “a reasonable trier of fact could have found, as it did, that a reasonable person in [the defendant’s] position would understand that the physical force he used on Koby was likely to cause great bodily injury.”²⁴⁴

These case studies provide examples of some of the prosecution’s arguments and themes in the Neuroscience Study’s victim-case database. Yet the case studies also demonstrate how inadequately defense attorneys represent their SBS clients. My Neuroscience Study reveals, for example, that of the 280 cases where the prosecutor introduced victim neuroscience evidence, there was not a single case in which the defendant argued on appeal that the trial court should have excluded that evidence.²⁴⁵ It seems that this evidence is uniformly admitted by the courts without any objection from the defense.²⁴⁶ This is an extraordinary finding for two reasons: (1) brain scans and accompanying expert testimony wield enormous influence in cases involving SBS, especially when it comes to proving a defendant’s intent;²⁴⁷ and (2) over time, the diagnosis of SBS has become mired in heated debate.²⁴⁸

C. THE GROWING PUSH FOR THE “JUST AND RIGHT RESULT”

The deficiencies in the SBS strategy are becoming increasingly apparent. In its groundbreaking report on neuroscience and the law, The Royal Society included as one of its “key legal issues” a discussion of SBS, noting that SBS has “immediate relevance” due to the controversy surrounding the science and disagreement among the medical expert witnesses who explain SBS to juries.²⁴⁹

241. *Id.* at *2 n.2.

242. *Id.*

243. *Wade*, 2011 WL 5997023, at *2.

244. *Id.* at *6.

245. *See App.*, *supra* note 80, at XIII.A.

246. *See infra* Part IV.

247. *See supra* Section II.A (noting that brain scans and accompanying expert testimony are commonly the only types of evidence available in modern diagnoses of SBS).

248. *See supra* Part II.

249. *See ROYAL SOC’Y, BRAIN WAVES MODULE 4: NEUROSCIENCE AND THE LAW* 19, 30–32 (2011).

The report concluded with a call for more research in this area so that a greater consensus could be achieved, thus enabling courts to finally reach “the right and just result” in SBS cases.²⁵⁰ This Part concludes with a discussion of two such cases.

1. The U.S. Supreme Court’s Push

In 2011, three Supreme Court Justices recognized the shaky science behind SBS in *Cavazos v. Smith*, the only Supreme Court case among the Neuroscience Study’s 286 victim neuroscience cases.²⁵¹ In *Cavazos*, the defendant was convicted of assault on a child resulting in death and was sentenced to fifteen years to life in prison.²⁵² The conviction stemmed from an incident on November 29, 1996, in which the defendant was alleged to have vigorously shaken her grandson, seven-week-old Etzel Glass, resulting in his death.²⁵³ At trial, each of the prosecution’s three experts testified that Etzel died from SBS.²⁵⁴ In contrast, one of the defendant’s experts contended that Etzel died from Sudden Infant Death Syndrome (SIDS), while the other stated he died from brain trauma that was not the result of SBS.²⁵⁵ On appeal, the defendant contended that there was insufficient evidence to support her conviction,²⁵⁶ an argument that the California Court of Appeals rejected. According to the court, the jury was appropriately tasked with resolving any conflicts between expert witnesses and there was “substantial and sufficient” evidence to support its conclusions.²⁵⁷

The defendant filed a petition for a writ of habeas corpus with the United States District Court for the Central District of California in which she claimed yet again that there was not sufficient evidence to link Etzel’s death to SBS.²⁵⁸ The district court denied the petition, but the Ninth Circuit reversed,²⁵⁹ determining that there was “no evidence to permit an expert conclusion one way or the other” on the cause of Etzel’s death; the Ninth Circuit stressed that there was “no physical evidence of . . . tearing or shearing, and no other evidence supporting death by violent shaking.”²⁶⁰ Instead, the State’s experts “reached [their] conclusion because *there was no evidence in the brain itself of the cause of*

250. *Id.* at 31–32.

251. *See* 132 S. Ct. 2, 8 (2011).

252. *Id.* at 4–5.

253. *Id.* at 4.

254. *Id.*

255. *Id.* at 5. SIDS is “the sudden death of an infant less than 1 year of age that cannot be explained after a thorough investigation is conducted, including a complete autopsy, examination of the death scene, and a review of the clinical history.” *About SUID and SIDS*, CTRS. FOR DISEASE CONTROL & PREVENTION, <http://www.cdc.gov/sids/aboutsuidandsids.htm> [<https://perma.cc/Q55W-Y76Z>]. It is also “the leading cause of death in infants 1 to 12 months old.” *Id.*

256. *Cavazos*, 132 S. Ct. at 5.

257. *Id.* at 5–6.

258. *Id.* at 6.

259. *Id.*

260. *Id.*

death.”²⁶¹ Because “[a]bsence of evidence cannot constitute proof beyond a reasonable doubt,” the Ninth Circuit determined that the California Court of Appeal had “unreasonably applied” the Supreme Court’s opinion in *Jackson v. Virginia*²⁶² when it upheld Smith’s conviction.²⁶³

The Supreme Court reversed the Ninth Circuit’s decision, holding that the California Court of Appeals did not unreasonably apply *Jackson* when it found that the evidence was sufficient to support the jury’s conclusion that Etzel died from SBS.²⁶⁴ Yet it is the dissent, written by Justice Ruth Bader Ginsburg and joined by Justices Stephen Breyer and Sonia Sotomayor, that is particularly notable because it highlights the controversy surrounding SBS.²⁶⁵ Justice Ginsburg explained that in the years following the defendant’s 1997 trial, there has been growing cause to question medical testimony regarding SBS.²⁶⁶ Specifically, Justice Ginsburg emphasized the medical community’s concerns about “whether infants can be fatally injured through shaking alone,” noting that “it is unlikely that the prosecution’s experts [in *Cavazos*] would today testify as adamantly as they did in 1997” because “[r]ecent scientific opinion undermines [much of their] testimony.”²⁶⁷ This new research was “worthy of considerable weight in the discretionary decision whether to take up this tragic case.”²⁶⁸ Although Justice Ginsburg’s assertions are compelling, especially in light of the weak science behind SBS, it is also crucial to note that some scholars have roundly criticized her conclusions.²⁶⁹

Cavazos highlights the problems with overturning an SBS conviction based on a sufficiency of the evidence claim. At the time of trial, the scientific underpinnings of SBS were not in question, whereas at the time of appellate review they were hotly contested.²⁷⁰ It is beyond the scope of this Article to delve into these problems further, which of course also apply to other types of

261. *Id.* (emphasis added).

262. 443 U.S. 307, 324 (1979) (“We hold that in a challenge to a state criminal conviction brought under 28 U.S.C. § 2254—if the settled procedural prerequisites for such a claim have otherwise been satisfied—the applicant is entitled to habeas corpus relief if it is found that upon the record evidence adduced at the trial no rational trier of fact could have found proof of guilt beyond a reasonable doubt.”).

263. *Cavazos*, 132 S. Ct. at 6.

264. *Id.* at 6–7.

265. *Id.* at 10–11 (Ginsburg, J., dissenting).

266. *Id.* at 10.

267. *Id.* at 10–11.

268. *Id.* at 11.

269. See Moreno & Holmgren, *supra* note 142, at 156, 162 (“Ignoring the overwhelming medical evidence, the [minority] [J]ustices support their opinion with single-sentence quotations from seven cherry-picked [methodologically flawed] sources. . . . [T]he *Smith* dissent reveals how courts carelessly or inadvertently rely on pseudoscientific information resoundingly rejected within multiple scientific fields.”).

270. *Id.* at 162.

neuroscience evidence.²⁷¹ Nonetheless, such challenges point to the special evidentiary frailties concerning changes in scientific opinion over time.

2. The Evidentiary Push

Cavazos may also provide an impetus for lower courts to begin closer scrutiny of SBS evidence. Indeed, my Neuroscience Study research suggests that SBS evidence remains a controversial form of victim neuroscience evidence among the lower courts.²⁷² Of the eleven cases (3.85%) in my Neuroscience Study involving challenges to the reliability of victim neuroscience evidence²⁷³ under either *Daubert v. Merrell Dow Pharmaceuticals, Inc.*²⁷⁴ or *Frye v. United States*,²⁷⁵ nine cases (81.82%) focused on SBS evidence,²⁷⁶ with the earliest of those nine occurring in 2003.²⁷⁷ Yet challenges to SBS evidence are consistently resolved in the prosecution's favor.²⁷⁸ It seems that appellate courts still reject the notion that medical opinions regarding SBS are not generally accepted in the medical community or that they are not based on reliable scientific methods.²⁷⁹

Cases in the Neuroscience Study's database are illustrative. In *Commonwealth v. Martin*, for example, a Kentucky trial court held that expert medical

271. See Denno, *supra* note 37, at 69–71 (discussing the problems with interpreting brain scan evidence that is a decade or two old in long-running death penalty appeals).

272. See *supra* Section III.A.

273. See App., *supra* note 80, at XII.A (dividing 11 by 286).

274. 509 U.S. 579, 597 (1993) (“‘General acceptance’ [the adopted standard under *Frye*] is not a necessary precondition to the admissibility of scientific evidence under the Federal Rules of Evidence, but the Rules of Evidence—especially Rule 702—do assign to the trial judge the task of ensuring that an expert’s testimony both rests on a reliable foundation and is relevant to the task at hand. Pertinent evidence based on scientifically valid principles will satisfy those demands.”).

275. 293 F. 1013, 1014 (D.C. Cir. 1923) (“Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.”); see also *Frye Standard*, LEGAL INFO. INST., https://www.law.cornell.edu/wex/frye_standard [<https://perma.cc/N8TC-3MGJ>] (“A court applying the *Frye* standard must determine whether or not the method by which that evidence was obtained was generally accepted by experts in the particular field in which it belongs.”).

276. See App., *supra* note 80, at XII.B (dividing 9 by 11). Ten of these cases involved a defendant’s appeal, and one case involved a State’s appeal. See *id.* at XII.A and cases cited therein.

277. *Id.* at XII.B.

278. See *id.* As Tuerkheimer also points out, “defense motions to exclude the prosecution’s expert testimony” regarding SBS almost uniformly fail. TUERKHEIMER, *supra* note 123, at 202. “In cases involving triad symptoms alone, courts continue to reject arguments that the proffered [medical] opinions are not generally accepted in the medical community, or that they are not based on reliable scientific methods.” *Id.*

279. See App., *supra* note 80, at XII.B. Tuerkheimer makes this observation as well. See TUERKHEIMER, *supra* note 123, at 202. For a general discussion of this issue, see Mary Sue Henifin et al., *Reference Guide on Medical Testimony*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 439, 441 (Fed. Judicial Ctr. ed., 2d ed. 2000) (“Testimony by physicians is one of the most common forms of expert testimony in the courtroom today. Medical testimony is routinely offered in both civil and criminal cases . . .”).

testimony regarding SBS was unreliable and therefore inadmissible under *Daubert*.²⁸⁰ The court observed that “the most damning studies supporting SBS are the ones that failed to follow the scientific method,” while studies that “utilize a more scientific methodology . . . appear to support the conclusion that the subdural hematoma and bilateral ocular bleeding are not caused by shaking alone, but require blunt force impact.”²⁸¹ The court further noted that “[t]o allow a physician to diagnose SBS with only the two classical markers, and no other evidence of manifest injuries, is to allow a physician to diagnose a legal conclusion.”²⁸² The *Martin* trial court therefore recognized the core concern with SBS. On the other hand, it also held that additional information could tip the balance toward acceptability: “If the physician has the two classical markers (subdural hematoma and bilateral ocular bleeding) coupled with other manifest injuries, then the diagnosis arises to more than a legal conclusion—it becomes a medical opinion.”²⁸³ Overall, the court concluded that “the clinical medical and scientific research communities are in disagreement as to whether it is possible to determine if a given head injury is due to an accident or abuse.”²⁸⁴

Regardless of such an astute analysis, however, the trial court in *Martin* was overruled on appeal.²⁸⁵ According to the appellate court, *Daubert* does not give courts the power to usurp a jury’s witness credibility determinations.²⁸⁶ Simply because two qualified experts disagree or propose conflicting opinions based on the same information or data does not suggest that, under *Daubert*, a trial court could strike one expert’s opinion over the other.²⁸⁷ This is not the role of the judge’s “gatekeeping function”²⁸⁸ and taking such an approach would assume the jury’s responsibility.²⁸⁹ As the court explained, “[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admis-

280. 290 S.W.3d 59, 64 (Ky. Ct. App. 2008). *Martin* is the only case in the Neuroscience Study in which the prosecution appealed a trial court’s decision to exclude prosecution victim neuroscience evidence. This outcome is likely due to the nature of the Neuroscience Study’s cases. Indeed, there are only seventeen cases (5.94%) in the Study involving any type of appeal by a state or the federal government. See App., *supra* note 80, at XIV. In most of these cases, the prosecution was appealing an intermediary court’s decision to reverse the defendant’s conviction or to modify the defendant’s sentence. See *id.* *Martin* was the only case where the State appealed an evidentiary ruling made by a trial court. See 290 S.W.3d at 59. However, if trial courts were routinely excluding prosecution victim neuroscience evidence, one would expect to find many cases where the prosecution appealed these decisions. That only one such case exists is another strong indication that trial courts admit prosecution victim neuroscience evidence routinely and without controversy from defense counsel. See App., *supra* note 80, at XII.B.

281. *Martin*, 290 S.W.3d at 64.

282. *Id.*

283. *Id.*

284. *Id.*

285. *Id.* at 69.

286. *Id.* at 67–68.

287. *Martin*, 290 S.W.3d at 67–68.

288. *Id.* at 68.

289. *Id.*

sible evidence.”²⁹⁰

Despite the availability of these opportunities in theory, however, my Neuroscience Study shows that defendants are rarely successful in challenging the admissibility of the prosecution’s victim neuroscience evidence.²⁹¹ In Part IV, I discuss the role prosecutorial deference plays in this process. Indeed, my Study reveals that the prosecution has seemingly unfettered capability to present neuroscience evidence, beyond even SBS cases, without challenge from the defense. Unfortunately, this circumstance often comes at the expense of contravening established frameworks of criminal law doctrine, and ultimately, criminal justice for the accused.

IV. THE DANGERS OF PROSECUTORIAL DEFERENCE

The criminal justice system appears to have embraced, with limited controversy, the use of prosecution victim neuroscience evidence in criminal trials.²⁹² At the same time, the role of SBS as both a medical and legal construct serves as due warning that the growing acceptance of neuroscience evidence provides opportunity for both innovation and abuse.

Of the 280 cases in the Neuroscience Study where the prosecutor introduced victim neuroscience evidence, the defendant challenged the prosecution expert’s testimony interpreting that victim neuroscience evidence in thirty cases (10.71%).²⁹³ In these cases, the defendant typically argued that the trial court should have excluded the expert testimony for one of the following four reasons: (1) the expert’s testimony was unreliable under *Daubert/Frye* standards; (2) the witness should not have been allowed to give an expert opinion on a particular topic or should not have been qualified as an expert in a given field; (3) the expert impermissibly relied on hearsay evidence; or (4) the expert’s testimony constituted impermissible rebuttal evidence.²⁹⁴ In twenty-eight of these cases (93.33%), the court resolved the legal issue in the prosecution’s favor on appeal.²⁹⁵

These findings are notable. When the prosecution introduces victim neuroscience evidence, this evidence is admitted without objection by the defense or skepticism from the court. Even on the rare occasions when defendants challenge the admissibility of expert testimony interpreting victim neuroscience

290. *Id.* (quoting *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 596 (1993)).

291. *See App.*, *supra* note 80, at XIII.B.

292. *But see Ex Parte* Roberson, No. WR–63,081–03, 2016 WL 3543332, at *1 (Tex. Crim. App. June 16, 2016) (stay of execution based on questions concerning SBS evidence); *People v. Bailey*, WL 6644372 (N.Y. App. Div. Nov. 10, 2016) (vacating a second-degree murder based on shaken baby syndrome because of medical advances questioning prior assumptions regarding SBS).

293. *See App.*, *supra* note 80, at XIII.B (dividing 30 by 280). Because the Neuroscience Study cases consist of appeals, cases were coded where the defendant challenged the admissibility of the prosecution’s victim neuroscience evidence on appeal, including the specific legal arguments the defendant made. *See id.* at XIII.

294. *See id.*

295. *See id.* (dividing 28 by 30).

evidence, the issue is almost always resolved in the prosecution's favor on appeal.²⁹⁶

A. CHALLENGES TO VICTIM NEUROSCIENCE EVIDENCE AT TRIAL

When attorneys use victim neuroscience evidence at the trial level, the prosecution indisputably dominates its introduction and subsequent application. The Neuroscience Study indicated that prosecutors introduced victim neuroscience evidence in 280 of the 286 victim cases (97.90%),²⁹⁷ as compared to the defense's use of such evidence in less than one-third of the cases (84 cases or 29.37%).²⁹⁸ When the evidence is introduced for reasons related to the mental state element of the crime (as it is about half of the time—156 cases or 54.55%),²⁹⁹ this application often occurs during the trial, at the prosecutor's request, for the purpose of establishing the defendant's mental state (122 cases or 78.21%).³⁰⁰ After introducing victim neuroscience evidence, prosecutors are also far more likely than the defense to call medical expert witnesses to explain the evidence. Indeed, expert witness testimony was incorporated into nearly all of the victim neuroscience cases (277 cases out of 286 total cases, or 96.85%).³⁰¹ Yet, whereas prosecutors called on experts in 272 cases (95.10%),³⁰² the defense used such testimony in only 83 cases (29.02%).³⁰³

It is unsurprising that medical experts play a key role in victim neuroscience cases. As Part I mentioned, victim neuroscience evidence usually consists of CT scans (238 cases or 83.22%), autopsies of the brain (136 cases or 47.55%), and MRIs (33 cases or 11.54%), all of which would require an expert's translation in order to make sense to a judge or jury.³⁰⁴ It is worth noting, though, that in

296. *See id.* at XI.I–L & XIII.

297. *See id.* at XIII.A.

298. *See App., supra* note 80, at XV.

299. *See id.* at XI.A. For a full breakdown of cases involving victim neuroscience evidence and mental state, *see id.* at XI.

300. *See id.* at XI.B. One case offers an interesting illustration of how victim neuroscience evidence is used at the trial court level to prove or refute the mental state element of the crime. *See Wegner v. State*, 14 P.3d 25 (Nev. 2000), *overruled by Rosas v. State*, 147 P.3d 1101 (Nev. 2006). In *Wegner*, the defendant was charged with first-degree murder in connection with the death of a fourteen-month-old child who was left in her care. *Id.* at 26. At trial, the prosecution called nine expert witnesses who testified that the victim's CT scans and medical records indicated she died from nonaccidental trauma to the head which caused a head fracture and hemorrhaging around the brain. *Id.* at 27–29. In contrast, the defense's three experts testified that the victim's CT scans, and reports from the Mayo Clinic and the Armed Forces Institute of Pathology, indicated she suffered an extensive brain injury at an earlier date. *Id.* at 27. Consequently, these experts believed the victim's death could have been caused by a spontaneous rebleed of this original injury, or by minor accidental trauma, that reagravated the original injury. *Id.* at 27, 29. Ultimately, the jury found the prosecution's experts to be more persuasive and convicted *Wegner* of first-degree murder. *Id.* at 26.

301. *See App., supra* note 80, at V.A. This distribution includes 194 cases (67.83%) where only the prosecution used expert testimony, 5 cases (1.75%) where only the defense used expert testimony, and 77 cases (27.27%) where both the prosecution and defense used expert testimony. *Id.* at V.D–F.

302. *Id.* at V.B.

303. *Id.* at V.C.

304. *See supra* note 86–88 and accompanying text.

every case where victim neuroscience evidence was used to establish the defendant's mental state, the prosecutor relied on medical experts to interpret the victim's medical records.³⁰⁵ Moreover, when the defense did use victim neuroscience evidence to refute a defendant's mental state at trial, they too consistently relied on medical expert witness testimony to interpret the victim's medical records.³⁰⁶ In this way, medical experts wield a great deal of influence in trials involving victim neuroscience evidence.

Most of the time, both prosecution³⁰⁷ and defense³⁰⁸ experts testified to the defendant's mental state in a general sense (for example, whether the victim's injuries were accidental, inflicted, the result of child abuse, or the result of homicide).³⁰⁹ However, in a handful of cases, prosecution experts testified to the defendant's specific mental state (for example, purpose, knowledge, or intent).³¹⁰

In eleven of the thirty cases (36.67%) in the Neuroscience Study where the defendant challenged prosecution expert testimony on appeal, the defendant argued that the prosecution expert witness was not qualified to offer an opinion on a particular topic or should not have been qualified in a particular field.³¹¹ In ten of these eleven cases (90.91%), the appellate court resolved the legal issue in the prosecution's favor.³¹² For example, in *State v. D'Alessio*, the defendant argued on appeal that the prosecution's expert, a medical examiner, was not qualified to offer an expert opinion that the cause of the victim's death was SBS because she was "not a specialist" in neuropathology and had "limited experience" with SBS.³¹³ The court rejected this argument, finding that although the defendant was "not an expert in the field, [she] testified that she studied and understood neuropathology" and "explained that a neuropathologist's opinion

305. See App., *supra* note 80, at XI.D, XI.E.

306. See *id.* at XI.F.

307. See *id.* at XI.D.

308. See *id.* at XI.F. For example, in *State v. Merwin*, the defense expert testified that the victim's brain injuries "could have been caused by a fall from a bed." 962 P.2d 1026, 1028 (Idaho 1998). In one of the twenty cases where defense experts testified to the defendant's mental state generally, the defense's use of victim neuroscience evidence backfired as the defense expert agreed with the prosecution that the victim's injuries were nonaccidental. See *Richards v. State*, 54 S.W.3d 348, 350 (Tex. Ct. App. 2001); App., *supra* note 80, at XI.F. Additionally, there were three hearings, such as a postconviction hearing or an evidentiary hearing, where the defendant presented expert testimony regarding victim neuroscience evidence that tended to refute the mental state element of the crime. See *State v. Kuehn*, 728 N.W.2d 589 (Neb. 2007); *Maze v. State*, No. M2008-01837-CCA-R3-PC, 2010 WL 4324377 (Tenn. Crim. App. Nov. 2, 2010); *State v. Barber*, 206 P.3d 1223 (Utah Ct. App. 2009).

309. See App., *supra* note 80, at XI.D, XI.F. In one case, for example, the prosecution's expert testified that the victim's CT scan showed that the victim suffered significant brain injuries due to violent shaking and that "[t]he intensity of such shaking would preclude an accidental shaking." See *Collado v. Commonwealth*, 533 S.E.2d 625, 629 (Va. Ct. App. 2000).

310. See App., *supra* note 80, at XI.E.

311. See *id.* at XIII.E.

312. See *id.*

313. 848 A.2d 1118, 1122 (R.I. 2004).

was not necessary to make her diagnosis.”³¹⁴

In *United States v. Iron Hawk*, the prosecution presented the testimony at trial of Dr. Edward Mailloux, a general pediatrician.³¹⁵ Dr. Mailloux testified that he reviewed the victim’s CT scans, which indicated the victim suffered permanent brain injuries.³¹⁶ On appeal, the defendant argued that the trial court abused its discretion because “there was no foundation to admit Dr. Mailloux’s testimony as an expert opinion.”³¹⁷ However, the appellate court rejected this argument, citing Dr. Mailloux’s employment, training, experience, and familiarity with the victim’s medical records.³¹⁸

In eight of the thirty cases (26.67%) in the Neuroscience Study where the defendant challenged prosecution expert testimony on appeal, the defendant challenged the prosecution expert testimony on grounds that the expert impermissibly relied on hearsay evidence.³¹⁹ In five cases, the defense argued that this reliance violated the defendant’s right to confrontation under the Sixth Amendment.³²⁰ In the other three cases, the defendant argued that the reliance was itself grounds for excluding the testimony.³²¹ In all eight cases (100%), the appellate court ruled in favor of the prosecution.³²²

Finally, in two of the thirty cases (6.67%) in the Neuroscience Study where the defendant challenged prosecution expert testimony on appeal, the defendant argued that the prosecution expert testimony constituted impermissible rebuttal evidence.³²³ The appellate court resolved the expert admissibility issue in favor of the defense in one of these two cases, *Beauchamp v. State*.³²⁴ Yet *Beauchamp* involved an unusual fact pattern. The substance of the prosecution expert’s testimony was not challenged; rather, it was alleged that the State had violated certain procedural rules when its expert testimony at trial differed from that at a deposition.³²⁵ The court accepted this argument.³²⁶ In another type of case in which the defense was successful, *Commonwealth v. Frangipane*, the defense’s claim was that the expert was not qualified in a particular field. In *Frangipane*, a social worker testified to the victim’s psychological problems after an attack.³²⁷ The social worker explained how a trauma victim stores and retrieves traumatic memories and how PET scans aid our understanding of this process.³²⁸ It seems

314. *Id.* at 1124.

315. 612 F.3d 1031, 1035 (8th Cir. 2010).

316. *Id.* at 1038.

317. *Id.*

318. *Id.* at 1038–39.

319. *See App.*, *supra* note 80, at XIII.F.

320. *See id.*

321. *See id.*

322. *See id.*

323. *See id.* at XIII.G.

324. *See id.*

325. 788 N.E.2d 881, 894 (Ind. Ct. App. 2003).

326. *Id.*

327. 744 N.E.2d 25, 28–29 (Mass. 2001).

328. *Id.*

understandable that a social worker would not possess the requisite expertise to give such technical testimony, and the court held as such.³²⁹

Overall, then, *Beauchamp* and *Frangipane* do not represent successful appellate challenges to the typical fact pattern involving prosecution neuroscience evidence. The typical pattern occurs when the prosecution calls a medical expert to testify to the victim's physical brain injuries based on a CT scan or a similar type of victim neuroscience evidence. Rather, *Beauchamp* and *Frangipane* illustrate unusual situations in which it is not surprising that courts supported the defendants' arguments.

B. CHALLENGES TO VICTIM NEUROSCIENCE EVIDENCE ON APPEAL

The Neuroscience Study shows that the defendant's mental state is a predominant focus in cases involving victim neuroscience evidence. In the Study, from the total sample of 286 cases,³³⁰ victim neuroscience evidence was considered for reasons related to the mental state element of a crime approximately half the time (156 cases or 54.55%).³³¹ Within those occasions, it was cited on appeal in eighty-three cases (53.21%) to help establish or refute the defendant's mental state.³³² In twenty of these cases, the appellate court's resolution of a contested legal issue was based at least in part on its finding that the victim neuroscience evidence presented at trial helped to establish the defendant's mental state in a general sense (for example, expert testimony regarding the victim's medical records established that the victim's injuries were nonaccidental, inflicted, the result of child abuse, or the result of homicide).³³³ More strikingly, in sixty-three cases, the appellate court's resolution of a contested legal issue was based at least in part on its finding that the victim neuroscience evidence presented at trial helped to establish the defendant's specific mental state (for example, that the defendant knowingly or intentionally caused the victim's injuries).³³⁴

The primary challenge raised by SBS defendants on appeal is sufficiency of the evidence.³³⁵ Indeed, the Neuroscience Study indicates that a considerable

329. *Id.* at 31–32.

330. App., *supra* note 80, at I.

331. *See id.* at XI.A.

332. *Id.* at XI.C. There is often a strong relationship between how victim neuroscience evidence is used to show mental state at the trial level and how this same evidence is used on appeal. For example, in *State v. Hales*, the prosecution's expert testified at trial that “[b]ased on the CT scans and the other medical evidence . . . the injury to Luther must have been nonaccidental and caused by shaken baby syndrome.” 152 P.3d 321, 340 (Utah 2007). On appeal, the appellate court held that “the jury was presented with evidence of nonaccidental injuries caused by violent force—evidence from which the jury could have reasonably inferred that the perpetrator knew that his conduct would create a grave risk of death and that he acted under circumstances evidencing depraved indifference to human life.” *Id.* at 337. Thus, the neuroscience evidence presented at trial to establish or refute the defendant's mental state is generally used on appeal to resolve a contested legal issue that also involves the defendant's mental state.

333. *See* App., *supra* note 80, at XI.G.

334. *Id.* at XI.H.

335. *See id.* at XI.I.

number of the victim neuroscience cases on appeal involved sufficiency of the evidence claims (69 cases or 83.13%).³³⁶ In these cases, the defendant argued that his or her conviction should be overturned due to insufficient evidence in the record to support the conviction.³³⁷ Yet, as Deborah Tuerkheimer points out, judicial review is a “woefully inadequate” mechanism for overturning doubtful SBS convictions³³⁸ for two key reasons: (1) SBS cases are based primarily on expert testimony, and the jury determines the credibility of this testimony,³³⁹ and (2) insufficiency claims on appeal require that “the evidence must be viewed in the light most favorable to the prosecution.”³⁴⁰

The Supreme Court has held that the jury determines what can be deduced from the evidence it hears at trial.³⁴¹ Consequently, “[a] reviewing court may set aside the jury’s verdict on the ground of insufficient evidence only if no rational trier of fact could have agreed with the jury.”³⁴² Returning to the case of *People v. Swart*, there the prosecution’s whole case centered on medical experts’ testimony that the child died from SBS, whereas the defense offered its own medical experts who argued that the child died from an earlier accidental injury.³⁴³ On appeal, the defendant challenged the sufficiency of the evidence adduced at trial.³⁴⁴ The court rejected this argument, finding that the case came down to conflicting expert testimony and “[t]he jury was free to credit the State’s experts and discredit defendant’s experts, and the verdict reflects that the jury did so.”³⁴⁵ The appellate court “in essence” is required to “credit[] the testimony of the prosecution experts—regardless of whether defense experts presented an entirely different account—and affirm[] the verdict if the cumulative evidence, however contested, could reasonably support it.”³⁴⁶

336. *See id.* (69 divided by 83).

337. *See id.* For example, in *People v. Belknap*, the defendant argued that “the evidence was insufficient to prove him guilty beyond a reasonable doubt of endangering the life or health of a child,” but the appellate court concluded that “the evidence was sufficient.” 918 N.E.2d 1233, 1252 (Ill. App. Ct. 2009). In another case, *Richards v. State*, the defendant argued that the evidence was insufficient to establish his intent to cause serious bodily injury to the complainant. 54 S.W.3d 348, 350 (Tex. App. 2001). However, the appellate court found that “medical evidence of the nature presented in this case, coupled with the evidence that complainant was in appellant’s sole care when he began exhibiting symptoms of his injuries, is sufficient for the jury to infer appellant’s intent to cause complainant serious bodily injury.” *Id.*

338. *See* TUERKHEIMER, *supra* note 123, at xiv.

339. *See id.* at 175.

340. *Id.*

341. *Cavazos v. Smith*, 132 S. Ct. 2, 3–4 (2011) (citing *Jackson v. Virginia*, 443 U.S. 307 (1979)).

342. *Id.* at 4.

343. 860 N.E.2d 1142, 1151–56 (Ill. App. Ct. 2006); *see also supra* notes 1–15 and accompanying text (discussing *Swart*).

344. *Swart*, 860 N.E.2d at 1156.

345. *Id.* at 1160.

346. TUERKHEIMER, *supra* note 123, at 175.

Meanwhile, in the case of *State v. Fero*, the court similarly emphasized its deference to the prosecution given the medical testimony.³⁴⁷ According to the court, the State offered the testimony of “several doctors” who had evaluated the victim following her injury; they “portrayed the injuries as non-accidental, consistent with the ‘shaken baby syndrome,’ and impossible . . . to have caused [herself].”³⁴⁸ Consequently, viewing the evidence “in the light most favorable to the State, and leaving credibility determinations to the jury,” the court determined that there was sufficient evidence to affirm Fero’s conviction.³⁴⁹

Given the consistency of this deference, it is unsurprising that appellate courts almost always resolve defendants’ mental state issues in favor of the prosecution (77 cases out of 83 cases or 92.77%).³⁵⁰ Of the victim neuroscience cases on appeal that involved sufficiency of the evidence claims, the prosecution almost always prevailed (66 cases out of 69 cases or 95.65%).³⁵¹ Prosecutors were similarly successful in cases in which other legal issues involving victim neuroscience evidence and the defendant’s mental state were appealed. Out of the ten cases claiming improperly rejected jury instructions,³⁵² prosecutors prevailed in eight of the cases (80%).³⁵³ Out of three cases claiming harmless or plain error analysis, prosecutors prevailed in two (66.67%) of the cases.³⁵⁴ Prosecutors also prevailed in the single case involving an actual

347. 104 P.3d 49, 55 (Wash. Ct. App. 2005), *review granted in part, cause remanded by* 119 P.3d 852 (Wash. Ct. App. 2005).

348. *Id.*

349. *Id.*

350. *See App.*, *supra* note 80, at XI.C.

351. *See id.* at XI.I. For example, in *State v. Parker*, the court found “there is not sufficient proof in the record to establish that Defendant ‘knowingly’ killed the victim.” 350 S.W.3d 883, 905 (Tenn. 2011). This conclusion was based partly on the testimony of Dr. Darinka Mileusnic-Polchan, who explained that, ordinarily, the fall the victim suffered after being struck by the defendant “would not produce the type of subdural hemorrhage that killed the victim.” *Id.*

352. *See App.*, *supra* note 80, at XI.J. Eight of these cases involved requests for a jury instruction regarding a lesser included offense. *Id.* For example, in *State v. Altum*, the defendant argued he was entitled to a jury instruction on the lesser included offenses of second-degree murder and involuntary manslaughter. 941 P.2d 1348, 1352 (Kan. 1997). However, the court rejected this argument because “the medical evidence indicated that the child had been severely beaten and shaken. The type and extent of his injuries did not permit a reasonable conclusion that the injuries were accidentally inflicted.” *Id.* Additionally, one case involved a rejected request for a jury instruction regarding the defense of accident. *See State v. Brooks*, 120 Wash. App. 1041, at *12–14 (Wash. Ct. App. 2004). Another case involved a rejected request for a jury instruction on intervening cause. *See State v. Hanna*, 767 N.E.2d 678, 692 (Ohio 2002).

353. *See App.*, *supra* note 80, at XI.J. In one case, the court found the defendant was entitled to a jury instruction regarding the lesser included offense of involuntary manslaughter based on facts that indicated a reduced level of *mens rea*. *See Wegner v. State*, 14 P.3d 25, 26, 31 (Nev. 2000), *overruled by Rosas v. State*, 147 P.3d 1101 (Nev. 2006).

354. *See App.*, *supra* note 80, at XI.K. There were three cases on appeal (3.61%) where victim neuroscience evidence regarding the defendant’s mental state was used as part of the appellate court’s harmless error or plain error analysis. *Id.* For example, in *State v. Belonga*, the court found that although evidence was improperly admitted, this error was harmless because the jury had before it overwhelming evidence that the defendant recklessly caused the victim’s death. 42 A.3d 764, 781 (N.H. 2012). This evidence included the testimony of many medical experts who agreed that the victim’s

innocence claim.³⁵⁵

The appellate court's deferential standards, however, may not be the only explanation for these prosecutorial triumphs. As the previous Section discussed, prosecutors are more likely than defendants to introduce victim neuroscience evidence at trial. Thus, when an appellate court looks to the trial court record to resolve a contested legal issue involving the defendant's mental state, the available victim neuroscience evidence will strongly favor the prosecution.³⁵⁶

There were only three cases where the defendant appealed a trial court's decision to exclude victim neuroscience evidence introduced by the defense; yet all three cases attacked the expert testimony rather than the victim neuroscience evidence itself.³⁵⁷ That there were only three cases on appeal where the defendant argued that the trial court improperly excluded victim neuroscience evidence again suggests that victim neuroscience evidence is routinely admitted into criminal trials without controversy. If trial courts were regularly excluding victim neuroscience evidence introduced by the defense, presumably one would expect to find many more cases where the defendant challenged these decisions on appeal. This finding also suggests that there is seemingly no disparate treatment against defendants in the context of victim neuroscience evidence: courts admit such evidence regardless of whether it is introduced by the prosecution or the defense. At the same time, it is clear that the prosecution is far more likely to introduce this evidence than the defense.

C. DAUBERT/FRYE CHALLENGES

Defendants challenged the reliability of prosecution expert testimony under *Daubert/Frye* standards in ten of the thirty cases (33.33%) where the defendant challenged prosecution expert testimony on appeal.³⁵⁸ SBS cases provided the most common context for this type of challenge in eight of the cases (80%).³⁵⁹ In these SBS cases, the defendant claimed that the SBS diagnosis is not

injuries were nonaccidental and that they likely occurred while the victim was in the custody of the defendant. *Id.* at 781–83. Yet, in *State v. Mascarenas*, the appellate court found the trial court erred in its definition of criminal negligence and that this error was not harmless because the extent of how severely and how often the victim was shaken was a disputed issue at trial. 4 P.3d 1221, 1225–26 (N.M. 2000). The jury could have concluded the defendant acted with mere carelessness as opposed to reckless disregard for the victim's health and safety. *Id.* at 1226.

355. See App., *supra* note 80, at XI.L. There was one (1.43%) case where the defendant appealed the denial of his habeas corpus petition alleging "actual innocence" due to newly discovered evidence. In *Rozzelle v. Secretary, Florida Department of Corrections*, the defendant argued that "if the 'new' evidence were introduced, no reasonable juror would have found that he acted with a 'depraved mind' and convicted him of second-degree murder." 672 F.3d 1000, 1008 (11th Cir. 2012). However, the court rejected this argument, noting that "[t]he extreme trauma Rozzelle so rapidly inflicted on Leier is itself compelling evidence of Rozzelle's depraved mind." *Id.* at 1021.

356. See *supra* Section IV.A.

357. See App., *supra* note 80, at XI.K.

358. See *id.* at XIII.C.

359. See *id.* at XIII.D. It should be noted there was one other case involving a *Daubert/Frye* challenge. However, for this case, the State appealed a lower court's decision to exclude evidence on *Daubert* grounds. See *Commonwealth v. Martin*, 290 S.W.3d 59, 64–65 (Ky. Ct. App. 2008).

generally accepted in the scientific community and is not based on reliable scientific methods.³⁶⁰ In the two non-SBS cases, the defendant challenged respectively the reliability of expert testimony regarding the victim's mental state and the reliability of expert testimony regarding the timing of the victim's injuries.³⁶¹ In all ten cases (100%), the appellate court resolved the *Daubert/Frye* challenge in the prosecution's favor.³⁶²

In one SBS case, *State v. Leibhart*, the appellate court noted that the trial court had conducted a *Daubert* hearing to assess the admissibility of the SBS evidence and had found it to be admissible.³⁶³ Specifically, the trial court concluded that SBS had been "peer reviewed, it ha[d] been clinically tested as the best it can and it has [a] small error rate."³⁶⁴ The court also explained that there was "considerable literature put out by professional scientific organizations that substantiate the findings" and that SBS "is generally accepted within the scientific medical community of pediatrics."³⁶⁵ The trial court found that the prosecution expert testimony concerning SBS was "scientifically reliable" and "would assist the jury in understanding the evidence and in determining specific issues that arose within the case."³⁶⁶ The appellate court affirmed the trial court's findings, explaining that the expert testimony concerning SBS was relevant to the facts at issue in *Leibhart* "because such injuries were similar to the injury sustained by [the victim] and causes other than shaken baby syndrome could be excluded."³⁶⁷

Similarly, in *People v. Armstrong*, the defendant was convicted of involuntary manslaughter and sentenced to seven years in prison.³⁶⁸ At trial, the defendant requested a *Frye* hearing to assess the admissibility of expert testimony concerning SBS evidence;³⁶⁹ yet the trial court determined that a *Frye* hearing was unnecessary because the SBS diagnosis "is generally accepted in the medical and legal communities and Illinois courts have applied it universally."³⁷⁰ The trial court also rendered "that any controversy surrounding the syndrome goes to the weight of the evidence, to be tested during cross-examination and by any contrary evidence at trial."³⁷¹ The defendant filed a motion for reconsideration,

360. See App., *supra* note 80, at XIII.D.

361. See *State v. Kuehn*, 728 N.W.2d 589, 598–99 (Neb. 2007); *State v. Barrow*, 718 S.E.2d 673, 677 (N.C. Ct. App. 2011), *aff'd in part, review dismissed in part*, 727 S.E.2d 546 (N.C. 2012); App., *supra* note 80, at XIII.C.

362. See App., *supra* note 80, at XIII.C; see also Joëlle Anne Moreno, *What Happens When Dirty Harry Becomes an (Expert) Witness for the Prosecution?*, 79 TUL. L. REV. 1, 3 (2004) (discussing the extent to which the prosecution survives challenges to expert testimony relative to the defense).

363. 662 N.W.2d 618, 627–28 (Neb. 2003).

364. *Id.* at 627.

365. *Id.*

366. *Id.* at 627–28.

367. *Id.* at 628.

368. 919 N.E.2d 57, 60 (Ill. App. Ct. 2009).

369. *Id.* at 67.

370. *Id.*

371. *Id.*

attaching as support a broad range of medical journal articles criticizing the soundness of the SBS diagnosis along with court cases from other jurisdictions rejecting the admissibility of SBS; yet the trial court found the articles “inapposite” and denied the motion.³⁷²

The defendant persisted, arguing on appeal that “the trial court erred in taking judicial notice that the ‘highly controversial’ diagnosis of [SBS] is generally accepted without first holding a hearing under *Frye*.”³⁷³ The appellate court first noted that “[t]he ‘general acceptance’ test set forth in *Frye* provides that scientific evidence is admissible at trial only if the methodology or scientific principle upon which the opinion is based is ‘sufficiently established to have gained general acceptance in the particular field in which it belongs.’”³⁷⁴ Unfortunately, however, *Armstrong* would not be the case to address such a key matter concerning the use and admissibility of SBS in criminal cases.³⁷⁵ As the *Armstrong* court noted, a retrial without the SBS testimony would not have changed the verdict.³⁷⁶ Yet the *Armstrong* court acknowledged the importance of these questions and that they may be up to another court to decide.³⁷⁷

Overall then, although SBS remains firmly planted in the criminal justice system for now, it is virtually always used to the benefit of the prosecution in victim neuroscience cases and commonly employed for the purposes of proving a defendant’s intent. The dominance of SBS is especially pronounced in cases in which little to no other circumstantial evidence is available. Part V suggests that the troublesome role of SBS is the canary in the mineshaft: SBS is simply a more transparent example of other legal strategies that are increasingly turning to neuroscience for help in determining a defendant’s mental state, for better or for worse.

V. THE BROADER PICTURE OF CONCOCTING INTENT

This Article has discussed the perfect storm aspect of SBS diagnoses in creating intent in criminal cases. But SBS cases are simply a microcosm of a larger picture of problems with assessing *mens rea*. This Part analyzes some of the Neuroscience Study’s adult-victim cases to provide context and to demonstrate how they were handled relative to the SBS cases.

In the Neuroscience Study, adult-victim cases were far more factually and scientifically varied than the cases involving children and SBS. In addition, the adult-victim cases had substantially more circumstantial evidence for courts to

372. *Id.*

373. *Id.* at 73.

374. *Armstrong*, 919 N.E.2d at 73.

375. *Id.* at 75.

376. *See id.*

377. *Id.*; *see also* Narang, *supra* note 145, at 247, 249 (noting that “biochemical and metabolic responses to brain injury are significantly different in the young infant compared to the older child or adult” and highlighting the “[m]ultiple differences—in tissue composition, brain and skull properties, and brain vulnerability—between adults and children”).

use to decipher the defendant's level of intent, far beyond simply the neuroscience evidence. For example, no adult-victim case relied solely on the victim neuroscience evidence, but they included other types of evidence that courts typically consider, such as the relationship between the defendant and the victim, eyewitness testimony, and additional injury testimony.³⁷⁸

A. THE NEUROSCIENCE STUDY'S ADULT CASES

In total, adult victims constituted slightly less than one-third of all the victims in the Neuroscience Study—ninety-four adults or 30.32% of all victims.³⁷⁹ Of that number, nearly one-fifth—sixteen individuals or 17.02%—were victims in cases in which prosecutors used the neuroscientific evidence to reinforce a determination of the defendant's mental state.³⁸⁰ This Part focuses on those sixteen cases.

Each case within the collection of sixteen features a victim who sustained serious head injuries, usually fatal, with common characteristics such as severe trauma, subdural hemorrhaging, and eventual brain death.³⁸¹ Reflecting the severity of the injuries and the usually fatal results, six of the sixteen cases involved defendants facing a death sentence,³⁸² with the remaining defendants facing a life sentence³⁸³ or a closely equivalent sentence.³⁸⁴ The severity of the victims' injuries typically resulted in medical screening and emergency action by medical professionals; therefore, the neuroscience evidence in these cases commonly included CT scans and X-rays, as well as autopsy evidence and accompanying experts who testified in court.³⁸⁵

378. See App., *supra* note 80, at VI.G–M.

379. See *id.*

380. See *id.* at XVII. The sixteen cases are: *Rozzelle v. Sec'y, Florida Dep't of Corr.*, 672 F.3d 1000, 1002–06, 1018–21 (11th Cir. 2012); *Johnson v. Upton*, 615 F.3d 1318, 1321–26, 1333–35 (11th Cir. 2010); *Carter v. Mitchell*, 443 F.3d 517, 520–23 (6th Cir. 2006); *State v. Dorans*, 806 A.2d 1033, 1037–39, 1045–46 (Conn. 2002); *Taylor v. State*, 87 So. 3d 749, 755 (Fla. 2012); *People v. Nelson*, 922 N.E.2d 1056, 1062–64, 1071–72 (Ill. 2009); *People v. Pertz*, 610 N.E.2d 1321, 1337, 1351 (Ill. App. Ct. 1993); *Norris v. State*, 943 N.E.2d 362, 364–65, 370 (Ind. Ct. App. 2011); *State v. George*, 19 So. 3d 614, 617–20 (La. Ct. App. 2009); *State v. Clifton*, 701 N.W.2d 793, 796, 801 (Minn. 2005); *State v. Rothacher*, 901 P.2d 82, 83–89 (Mont. 1995); *State v. Vandeweaaghe*, 799 A.2d 1, 4–5 (N.J. Super. Ct. App. Div. 2002), *aff'd*, 827 A.2d 1028 (N.J. 2003); *State v. Watson*, 618 A.2d 367, 368–69 (N.J. Super. Ct. App. Div. 1992); *State v. Hanna*, 767 N.E.2d 678, 685–87 (Ohio 2002); *State v. Parker*, 350 S.W.3d 883, 888–92, 904–05 (Tenn. 2011); *Felder v. State*, 848 S.W.2d 85, 87–90 (Tex. Crim. App. 1992).

381. See, e.g., *Carter*, 443 F.3d at 520–23; *Norris*, 943 N.E.2d at 364–65; *Vandeweaaghe*, 799 A.2d at 4–5. Not all the head injuries neatly fit this pattern. See, e.g., *Johnson*, 615 F.3d at 1324, 1333–35 (hitting of officer in the head with butt of a gun may or may not have contributed to officer's fatal stroke months later); *Hanna*, 767 N.E.2d at 685–87 (stabbing of cellmate in eye caused object to penetrate brain stem, leading to infection and death).

382. See *Johnson*, 615 F.3d at 1321; *Carter*, 443 F.3d at 520, 523; *Taylor*, 87 So. 3d at 753; *Nelson*, 922 N.E.2d at 1059; *Hanna*, 767 N.E.2d at 685–86; *Felder*, 848 S.W.2d at 87–88.

383. See *Clifton*, 701 N.W.2d at 796; *Vandeweaaghe*, 799 A.2d at 3; *Watson*, 618 A.2d at 368.

384. See, e.g., *Pertz*, 610 N.E.2d at 1325 (involving a sentence of forty-five years).

385. See, e.g., *Dorans*, 806 A.2d at 1038–39, 1045–46 (upholding the trial court's finding that the defendant was guilty of manslaughter and that the evidence supported the necessary element of recklessness, based on in part the following circumstances: that defendant hit his coworker in the head

Most importantly, these cases used neuroscience evidence for similar purposes. In all cases, the neuroscience evidence not only served the narrative purpose of describing the defendants' serious crimes, but it often also provided critical proof of the defendants' acts.³⁸⁶ In several of the cases, neuroscience evidence admitted at trial was used to directly show, at least in part, the requisite mental element.³⁸⁷ In addition, the cases were not limited to a determination of intent, but also included a showing of various states of mental culpability.³⁸⁸ For example, in *State v. Clifton*, medical evidence was employed in part to prove that the defendant was the killer and that he had the necessary premeditation.³⁸⁹ Neuroscience testimony has been applied elsewhere to show that a defendant's actions were in fact the cause of death.³⁹⁰

B. THE PLIABILITY OF INTENT

The Neuroscience Study's sixteen defendant cases also reflect the pliability of how courts viewed intent, knowledge, or recklessness and how they used neuroscience evidence to assess these *mens rea* levels.³⁹¹ As would be expected, a number of the adult-victim cases involved injuries in which the intent could be determined in ways consistent with traditional criminal law doctrine and expectations. For example, two cases concerned a prison inmate brutally attacking another inmate, inflicting injuries so severe that a court's finding of the defendant's intent was not surprising.³⁹² Other cases involved defendants inflicting

during an argument, a CT scan that showed that "the victim was suffering from life threatening intracranial pressure," and a CT scan and autopsy evidence that confirmed the injury was due to blunt-force trauma despite other findings of a brain condition that could have been a contributing factor).

386. See App., *supra* note 80, at VI.G–M. All cases consisted of appellate opinions, and the issue of the defendant's mental culpability in committing the offense consistently arose in a "sufficiency" claim where the defendant argued on appeal that there was insufficient evidence supporting the necessary *mens rea*. See *id.*

387. See *id.* This goal is not as definitive as one might think. In a number of cases, the court held that there was sufficient proof the defendant acted with the requisite mental state but, because the court also relied on other evidence, it could not be determined whether the medical evidence contributed to that finding as a significant factor, a minor factor, or no factor at all. See *supra* notes 388–89 and accompanying text (examining cases linking behavior with mental state and culpability).

388. See, e.g., *Rozzelle v. Sec'y, Florida Dep't of Corr.*, 672 F.3d 1000, 1002–06 (11th Cir. 2012) (finding of a killing with a "depraved mind"); *Dorans*, 806 A.2d at 1037–39, 1045–46 (noting that a CT scan contributed to the finding that the defendant possessed the required mental state of "recklessness"); *Pertz*, 610 N.E.2d at 1325, 1325 (determining that medical testimony concerning the size of a wound on the victim's head helped establish that the defendant acted "with the intent to kill her and with the knowledge that such acts created a strong probability of death to her"); *State v. Parker*, 350 S.W.3d 883, 904–05, 910 (Tenn. 2011) (concluding that medical evidence was insufficient to support "knowing" murder, but did establish "reckless" murder).

389. 701 N.W.2d 793, 796, 801 (Minn. 2005).

390. See *State v. Rothacher*, 901 P.2d 82, 84 (Mont. 1995).

391. See App., *supra* note 80, at XVII.

392. *Carter v. Mitchell*, 443 F.3d 517, 520–23 (6th Cir. 2006) (defendant stomping on decedent's head); *State v. Hanna*, 767 N.E.2d 678, 685–86 (Ohio 2002) (defendant plunging a paintbrush into decedent's eye).

direct and transparent injuries to particularly helpless adult victims, such as one defendant who stabbed to death a quadriplegic during a robbery³⁹³ or another defendant who bludgeoned and burned an entire family.³⁹⁴

In other cases, however, the level of the defendant's intentionality and causation was far less clear, particularly in circumstances involving potentially intervening causes or alternative explanations. In *Norris v. State*, for example, the appellate court upheld the trial court's finding that the defendant was guilty of the murder—rather than the involuntary manslaughter—of his live-in girlfriend.³⁹⁵ The court focused on the defendant's motive (sexual jealousy), a confession that he slapped his girlfriend and caused her to fall and hit her head, as well as his failure to seek medical care for her after the slap or even when he found his girlfriend unresponsive the next morning.³⁹⁶ According to the defendant, although he intended to slap his girlfriend, he did not intend for her to fall and hit her head on the side of the dresser and the wall, which ultimately killed her.³⁹⁷ Yet the judge rejected the defendant's request for jury instructions at trial regarding involuntary manslaughter as a lesser included offense of murder.³⁹⁸ The court relied heavily on the medical and neuroscience evidence, including the victim's autopsy results and a neurologist's interpretation of a CT scan indicating that the victim's brain injury was caused by "significant trauma" to show that the defendant intended to kill.³⁹⁹ Yet the source of the trauma (the slap or the fall) remained unclear.⁴⁰⁰ Another court could therefore question whether there was sufficient evidence to prove the defendant's intent and leave it to the jury to decide with an instruction for manslaughter.

The questionable nature of such causality determinations based on victim neuroscience evidence is even more pronounced in *State v. Rothacher*.⁴⁰¹ In *Rothacher*, the defendant was charged with deliberate homicide in connection with the death of the victim with whom he had fought outside of a bar.⁴⁰² Following a jury trial, the defendant was convicted of mitigated deliberate homicide, and he appealed.⁴⁰³ Although the Montana Supreme Court found error in a jury instruction concerning the defendant's intent to cause the harm, it held this error harmless, finding sufficient evidence to support the conviction, and affirmed.⁴⁰⁴

The nature of the "intent to cause" error is troubling in this case. The facts

393. *Felder v. State*, 848 S.W.2d 85, 87–90 (Tex. Crim. App. 1992).

394. *People v. Nelson*, 922 N.E.2d 1056, 1059–65, 1071–72 (Ill. 2009).

395. 943 N.E.2d 362, 363–64 (Ind. Ct. App. 2011).

396. *Id.* at 365–66, 370–71.

397. *Id.*

398. *Id.* at 366–67.

399. *Id.* at 364–65, 370.

400. *See id.*

401. 901 P.2d 82 (Mont. 1995).

402. *Id.* at 83.

403. *Id.* at 84.

404. *Id.* at 87–89.

show that the defendant struck the victim in the head two times, at which point the victim “fell on his back and hit his head hard on the ice.”⁴⁰⁵ The defendant then kicked the victim in the head.⁴⁰⁶ The victim was taken to the hospital where a neurosurgeon administered a CT scan that “revealed extensive bruising on [the victim’s] brain.”⁴⁰⁷ Although surgery was performed to relieve pressure on the brain, the extent of the victim’s injuries was so great that the procedure proved unsuccessful.⁴⁰⁸ In testimony, the neurosurgeon concluded that it was the defendant’s kick to the victim’s head after his fall that caused the fatal injury.⁴⁰⁹ The defendant was sentenced to sixteen years in prison.⁴¹⁰

The main issue before the court concerned the jury instruction that the appellate court later determined to be erroneous but also harmless.⁴¹¹ That jury instruction indicates how jury instructions regarding intent can be convoluted. As the instruction stated:

In order to convict the defendant of Deliberate Homicide, it is not necessary . . . to prove that the defendant intended to cause [the] death of [the] victim. Death may not be the intended result, *but, if the act which causes the death is done purposely*, . . . deliberate homicide is committed unless the result is too remote or accidental to have a bearing on the offender[’]s liability or on the gravity of the offense.⁴¹²

In essence, if the defendant did not intend the victim’s death, but did intend the act preceding it, the court could convict the defendant of deliberate homicide.

Although the appellate court recognized the causal disconnect between the defendant’s act and his intent in the jury instruction,⁴¹³ it avoided the error in other equally problematic ways. In the court’s view, “[a] defendant can properly be convicted of deliberate homicide even though he may not have intended that the death result from the act where he contemplated the same kind of harm or injury to the victim.”⁴¹⁴ The defendant’s admission that he hit and kicked the victim, coupled with the medical testimony, led the court to hold that there was still sufficient evidence to show that the defendant had “knowingly caused” the victim’s death.⁴¹⁵ Thus, because “knowingly” was still a sufficient *mens rea* for deliberate homicide, the jury instruction was considered harmless despite the highly troublesome and expanded definition of “knowingly” in the instruction.

405. *Id.* at 83.

406. *Id.*

407. *See Rothacher*, 901 P.2d at 83–84.

408. *Id.* at 84.

409. *Id.*

410. *Id.*

411. *Id.* at 84–88.

412. *Id.* at 84 (alterations and emphasis in original).

413. *See Rothacher*, 901 P.2d at 84–87.

414. *Id.* at 85 (quoting *State v. Van Dyken*, 791 P.2d 1350, 1362 (Mont. 1990)).

415. *Id.* at 89.

C. AN ADULT VICTIM WITH SHAKEN BABY SYNDROME SYMPTOMS

The pliable nature of intent is perhaps most pronounced when close comparisons can be made between SBS cases involving infants and those involving physically fragile adults. One of my Neuroscience Study cases, *State v. Parker*, allows such a comparison.⁴¹⁶

In *Parker*, the defendant sexually assaulted the victim in her bedroom, whereupon she escaped to her neighbor's apartment wearing only a shirt.⁴¹⁷ The neighbor called 911, and the police and the ambulance soon arrived.⁴¹⁸ A nurse who evaluated the victim at the hospital later testified that the victim reported to her that "a friend of her son had tried to rape her with his hand and had choked her" as well as "put her to the ground and then bent her legs up over her head."⁴¹⁹ The victim also complained of a headache, remarking that this was common when she was stressed, and the nurse gave her some Tylenol.⁴²⁰ The victim later stated that her headache was better, and the hospital released her about four hours after she was first admitted.⁴²¹

The following day, the victim was found dead in her home.⁴²² An autopsy revealed that there was no evidence of sexual penetration, but there was a subdural hemorrhage "between the hard covering of the brain and the brain itself."⁴²³ The doctor who performed the autopsy determined that the cause of death was blunt trauma to the victim's head.⁴²⁴ She made three additional conclusions: (1) the victim had died on the morning after the attack; (2) the injury that created the hemorrhage was inflicted near the time of the attack and not after the victim's release from the hospital; and (3) "[t]he main symptom from this type of trauma would be a headache."⁴²⁵

At trial, the victim was described as "slender and small,' weighing less than one hundred pounds."⁴²⁶ The doctor who testified that the cause of death was subdural hemorrhage resulting from trauma further elaborated on the meaning of her diagnosis: "It could be a blow, it could be a fall and could be also any mechanism that is going to her head to perform like a sudden deceleration"⁴²⁷ The doctor explained further that "elderly people do take a little bit less trauma than younger people . . . however, it has to be enough severe trauma to cause it. It cannot be just any household fall for that matter."⁴²⁸ On cross-

416. 350 S.W.3d 883 (Tenn. 2011).

417. *Id.* at 889.

418. *Id.*

419. *Id.* at 891.

420. *Id.*

421. *Id.*

422. *Parker*, 350 S.W.3d at 891.

423. *Id.*

424. *Id.*

425. *Id.* at 892.

426. *Id.* at 891.

427. *Id.*

428. *Parker*, 350 S.W.3d at 892.

examination, the doctor acknowledged that “the autopsy revealed no external injuries to the top or side of the victim’s head,” nor was there a skull fracture.⁴²⁹ Similarly, on cross-examination, the examining nurse acknowledged that “she had not observed on the victim ‘any bumps, bruises, cuts, abrasions to [the] head, scalp, face, ears, neck, shoulders, back, legs, [or] knees.’”⁴³⁰ However, the doctor described the victim’s injury as “‘a classic deceleration injury,’ an example of which is ‘the head being violently either going forward or backward fast and then stopping suddenly, the brain continuing to move, bouncing against the inside of the skull.’”⁴³¹ Although diagnosed in an adult, this kind of injury comes close to descriptions of diagnoses attributable to SBS.⁴³²

The defendant went to trial for first-degree felony murder and attempted rape.⁴³³ At the close of trial, the judge informed counsel that “he planned to instruct the jury on the charged offense of first-degree felony murder; second-degree murder; reckless homicide; and criminally negligent homicide.”⁴³⁴ In contrast to some SBS cases discussed in this Article, the trial court allowed the jury to pick among a range of different mental states represented by different degrees of criminal homicide. The jury found the defendant guilty of second-degree murder and attempted rape.⁴³⁵

The primary issue on appeal concerned the defendant’s conviction for second-degree murder, which the court vacated due to a lack of proof.⁴³⁶ However, the court did find sufficient evidence to support convicting the defendant of reckless homicide and remanded the case for amendment of the judgment to reflect a conviction for that offense and a sentencing hearing.⁴³⁷

The court first noted that the statutory definition of second-degree murder, defined as “[a] knowing killing of another,” required the State to prove beyond a reasonable doubt the following two factors: (1) the *actus reus*, in that the defendant committed the act of killing the victim, and (2) the *mens rea*, in that the defendant killed the victim with “a ‘knowing’ state of mind.”⁴³⁸ With respect to the defendant’s *actus reus*, the testimony of the attending doctor and

429. *Id.*

430. *Id.* at 891 (alteration in original).

431. *Id.* at 892.

432. Shaken Adult Syndrome does exist. See Amir A. Azari et al., *Shaken Adult Syndrome: Report of 2 Cases*, 131 JAMA OPHTHALMOLOGY 1468, 1468 (2013) (noting that “[t]he intracranial and ophthalmologic findings that are characteristic of abusive head trauma—subdural hemorrhages, optic nerve sheath hemorrhages, and retinal hemorrhages—are generally thought to be limited to young children and infants” but that adults can also suffer from such abuse and that medical investigation should be made if shaking is suspected); see also Derrick J. Pounder, *Shaken Adult Syndrome*, 18 AM. J. FORENSIC MED. & PATHOLOGY 321, 322–23 (discussing “the first reported instance of fatal ‘shaken adult syndrome’” presumably caused by “violent shaking” even though the deceased’s visible injuries “were remarkably few”).

433. *Parker*, 350 S.W.3d at 889 n.1.

434. *Id.* at 895.

435. *Id.*

436. *Id.* at 888.

437. *Id.* at 911.

438. *Id.* at 903–04.

examining nurse was sufficient to show that the defendant had caused the victim's death.⁴³⁹ With respect to the defendant's *mens rea*, however, the court found there was insufficient evidence.⁴⁴⁰ A "knowing" state of mind necessary for second-degree murder requires that the defendant is "aware that [his] conduct is reasonably certain to cause the result."⁴⁴¹ Yet the court found no proof that the defendant was aware that his treatment of the victim was "reasonably certain" to cause her death.⁴⁴² It cited, by way of example, the lack of exterior wounds to the victim, which would be expected if defendant had "deliberately slammed [the victim's] head onto a hard surface."⁴⁴³ In addition, the court emphasized that there was "no proof in the record that simply pushing someone to the floor . . . is reasonably certain to cause their death."⁴⁴⁴

With these conclusions stated, the court noted that the lower appellate court had agreed that there was insufficient proof of the "knowing" *mens rea* element.⁴⁴⁵ The defendant had only been convicted of second-degree murder (originally a part of the indictment but dismissed by the State prior to trial) "because it was charged to the jury by the trial court as a lesser-included offense of first degree felony murder."⁴⁴⁶ The main legal issue in dispute was whether the conviction could "nevertheless be affirmed because there was sufficient evidence to support the greater offense of felony murder."⁴⁴⁷ The court discussed past precedent suggesting that such a conviction could stand, ultimately holding that the second-degree murder conviction must be vacated but finding sufficient proof to support "reckless" homicide.⁴⁴⁸

Parker offers a sharp contrast to the mental state determinations for defendants in SBS cases. Even though the defendant intentionally and brutally assaulted the victim and there was unquestionable evidence that the assault took place, the court found "no proof" that the defendant was aware that such actions would cause the victim's death.⁴⁴⁹ Indeed, as support for that conclusion, the court pointed to the victim's lack of exterior wounds.⁴⁵⁰ Although the court found sufficient proof to convict the defendant of reckless homicide, it found no evidence that he acted either intentionally or knowingly.⁴⁵¹ Yet in SBS cases, courts have convicted defendants of first-degree murder based upon little more

439. *Parker*, 350 S.W.3d at 904.

440. *Id.*

441. *Id.*

442. *Id.* at 904–05.

443. *Id.* at 905.

444. *Id.*

445. *Parker*, 350 S.W.3d at 904.

446. *Id.* at 905.

447. *Id.*

448. *Id.* at 905–10.

449. *Id.* at 904–05.

450. *Id.* at 905.

451. *Parker*, 350 S.W.3d at 904–05.

than one or more medical experts' determinations of SBS.⁴⁵² These convictions stand regardless of questionable evidence that the defendant inflicted any injury on the child victim, much less possessed the intent to kill.⁴⁵³ Even though the *Parker* court recognized the particular fragility of the elderly victim's size and age, the court still found no evidence that the defendant had been aware that he was "reasonably certain" to cause her death.⁴⁵⁴ Yet in SBS cases, courts feel free to draw such connections between a defendant's *mens rea* and *actus reus* concerning the particular fragility of infants⁴⁵⁵—despite an overwhelming body of research and testimony indicating that defendants are often unaware their acts can cause such damage.⁴⁵⁶

The adult-victim cases therefore demonstrate the pros and cons of victim neuroscience evidence when it comes to manufacturing intent. As the *Parker* case illustrates, for example, courts can rely on neuroscience evidence to suggest a lower level of *mens rea* for a defendant—recklessness rather than knowledge or intent.⁴⁵⁷ On the other hand, *Norris* and *Rothacher* illustrate how courts can contrive a defendant's mental state with no more causal proof than what was before the *Parker* court.⁴⁵⁸ SBS cases operate at the extreme end of the continuum, where courts equate a syndrome with fulfilling both a defendant's *mens rea* and *actus reus* irrespective of any other evidence.

The criminal justice system will increasingly rely on neuroscience for a range of reasons, including to assess a defendant's mental state. Such reliance brings the hope of greater clarity and insight into criminal cases, but also the risk of pronounced abuse. The challenges concerning the manufacturing of criminal intent, then, extend past SBS and child-victim cases to a more overarching perspective on *mens rea*. Whichever direction that inquiry leads depends on large-scale research that can regularly monitor the reality of how science and law intersect.

CONCLUSION

A defendant's *mens rea*, specifically criminal intent, is the most critical element in the criminal law, yet it is an amorphous concept. The history of *mens rea* illustrates how courts have long struggled to define intent, with efforts at clarification often leading to greater confusion. As a result, prosecutors attempt

452. See, e.g., *People v. Swart*, 860 N.E.2d 1142 (Ill. App. Ct. 2006). In the Neuroscience Study of 286 cases, there were 60 cases in which the defendant was convicted of first-degree murder. See App., *supra* note 80, at XVIII. Of those 60 cases, 18 (30 percent) involved SBS. *Id.* at XVIII.A. In addition, there were 14 SBS cases where the court failed to instruct the jury on an offense requiring a lesser mental state than the offense for which the defendant had been charged. *Id.* at XVIII.B.

453. See, e.g., *id.*

454. *Parker*, 350 S.W.3d at 905.

455. See, e.g., *Norris v. State*, 943 N.E.2d 362, 364–65, 370 (Ind. Ct. App. 2011); *State v. Rothacher*, 901 P.2d 82, 83–89 (Mont. 1995).

456. See *supra* Part II.D.

457. *Parker*, 350 S.W.3d at 910–11.

458. *Norris*, 943 N.E.2d at 364–65, 370; *Rothacher*, 901 P.2d at 83–89.

to prove *mens rea* through the use of circumstantial evidence and frequently must “concoct” the defendant’s level of intent to some degree. With the emergence of neuroscience evidence, it seems that prosecutors have found the ultimate tool to do so. Yet inappropriate reliance on scans of a victim’s brain injuries leads to a level of speculation and impact that defies both the purposes of the science as well as its appropriate role within the criminal justice system.

Nonetheless, my research indicates that this approach is surprisingly effective for prosecutors. Courts defer to prosecutors’ efforts to manufacture intent out of victim brain scans that were taken and admitted solely for medical purposes. In my Neuroscience Study, nearly half of the cases involving victim neuroscience evidence are based on a theory of SBS, a medical diagnosis for which the scientific underpinnings have become increasingly controversial. The syndrome is unique in its legal ramifications: a diagnosis of SBS often successfully serves as the sole basis for a prosecutor’s case, with no proof of a defendant’s act or intent beyond the victim’s brain scan and the accompanying medical expert testimony. Although reliance on circumstantial evidence is nothing new, these cases are unusual in the extent to which prosecutors must go to construct *mens rea*. Moreover, the syndrome’s history indicates that it was never intended to be used in this way; indeed, this practice has been disparaged in recent years by numerous scientists, including the syndrome’s creator.

SBS cases, however, are simply one part of a broader problem with the role and development of *mens rea* in a criminal justice system that is increasingly turning to neuroscience for rescue. Although the criminal law needs neuroscience to help elucidate and refine outmoded conceptions of mental state, such innovations can come with the baggage of misuse. Large-scale research projects such as this Article’s Neuroscience Study can detect existing or potential misapplications of neuroscience with an eye toward amelioration.