Shaken Baby Syndrome: A Genuine Battle of the Scientific (And Non-Scientific) Experts

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SHAKEN BABY SYNDROME: A GENUINE BATTLE OF THE SCIENTIFIC (AND NON-SCIENTIFIC) EXPERTS

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“[T]he conclusions that are . . . reached [about shaken baby syndrome]. . . are for the most part anecdotal.”

Dr. Travis Hindman, a prosecution witness in *People v. Lind*¹

“Shaken baby syndrome [does] not exist. [It is] ‘the medical scandal of the last 20 years.’”

Dr. John Plunkett, defense witness in *In re J.M.*²

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The numbers dramatize the importance of the issue of shaken baby syndrome. 1,500 incidents of alleged shaken baby syndrome are reported nationwide every year. Some commentators estimate that each year forcible shaking harms 50,000 children in the United States. There were 84 published judicial opinions on the subject in 2002, and 104 in 2006. The annual number of prosecutions based on shaken baby syndrome has been steadily increasing. It seems clear that during the past two decades, prosecution expert testimony about shaken baby syndrome has contributed to thousands of convictions.

Of course, the advent of shaken baby syndrome evidence is only one of the ways in which the national campaign against child abuse has changed the face of American Evidence law. The campaign has led to changes in the procedures for cross-examining children. In some cases, children are permitted to testify via closed circuit television; and when children do appear in person in court, during their testimony they are sometimes allowed to have support persons sitting next to them. Several states have abolished competency requirements for child witnesses in abuse prosecutions. Numerous state legislatures have fashioned special hearsay exceptions for

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3 Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 706.

4 Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1112. However, the author cautions that such estimates may be “wildly inflated.” Id.

5 Note, supra note 4, at 1113.

6 Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 706. See also Deborah Tuerkheimer, The Next Innocence Project: Shaken Baby Syndrome and the Criminal Courts, 87 Wash.U.L.Rev. 1 (forthcoming 2009)(“Beginning in 1990, . . . the number of appeals grew dramatically. In five-year increments, published appellate decisions increased from 74 (Jan. 1, 1990-Dec. 31, 1994), to 160 (January 1, 1995-December 31, 1999), to 315 (January 1, 2000-December 31, 2004). The numbers from the first half of the current five-year period suggest that this trend toward rising SBS appeals is continuing: from January 1, 2005 to June 30, 2008, 259 written opinions in this category were issued”).

7 Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 708.

8 Comment, supra note 7, at 704-05.


11 Imwinkelried, Giannelli, Gilligan & Lederer, supra note 10, at § 206.
such prosecutions.12 Virtually all the states have carved out exceptions to the medical privileges and required physicians and therapists to report suspected incidents of child abuse.13 A number of jurisdictions have gone farther and imposed a similar reporting duty on attorneys14 and clergy.15 The campaign has also impacted the law governing the admissibility of expert testimony. Prosecutors trying child abuse cases have proffered novel types of expert evidence such as battered child syndrome,16 child sexual abuse accommodation syndrome,17 and repressed or recovered memory syndrome.18

To be sure, all of these innovations are well-intentioned.19 These innovations have been championed by committed advocates for children.20 However, the question is whether in some instances, these advocates have been overly zealous.21 The protection of vulnerable infants is unquestionably a laudable objective;22 but these prosecutions are “highly charged” and pose the danger that emotions will “run roughshod over logic, science, and the law.”23 For example, there

12 Imwinkelried, Giannelli, Gilligan & Lederer, supra note 10, at § 1305.
16 2 Paul C. Giannelli & Edward J. Imwinkelried, Scientific Evidence § 19.05[a], at 177-81 (4th ed. 2007).
18 See notes 24-25, infra.
20 Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 725.
21 Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1126 n. 132 (quoting Dr. Cyril Wecht). See also Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby or Shaken Impact Syndrome, 188 Mil.L.Rev. 1, 1 (2006)(“over enthusiasm”).
22 Ramsey, supra note 21, at 30.
23 Ramsey, supra note 21, at 1-2.
are grave doubts about the reliability of the recovered memory syndrome\textsuperscript{24} which the government has sometimes relied to justify the prosecution of incidents which occurred years before.\textsuperscript{25} The question here is whether shaken baby syndrome evidence is “junk” science presenting an intolerable risk of a wrongful conviction or a valid theory that can help establish the guilt of perpetrators of heinous offenses against defenseless babies. The thesis of this article is that this subject is one of the expert topics on which, given the current state of the empirical data, there is a genuine battle of the experts; both sides should be permitted to present their theories to the trier of fact. The first part of this article is descriptive. It traces the scientific and legal history of the syndrome. The second part of the article reviews the relevant empirical data. After surveying the supportive research and the criticisms of that research, this part details the contrary research and the criticisms of that body of research. The third and final part of the article is a critical evaluation of the admissibility of testimony on the subject of shaken baby syndrome. This part concludes that the attacks on the syndrome are based on adequate scientific methodology and admissible for the defense under Federal Rule of Evidence 702 and \textit{Daubert}, the Supreme Court’s seminal 1993 decision on expert testimony.\textsuperscript{26} However, the part also concludes that the support for the theory qualifies as admissible non-scientific expertise under Rule 702 and \textit{Kumho}, a 1999 decision by the Court’s 1999.\textsuperscript{27} When \textit{Daubert} was litigated in 1992-93, one of the briefs predicted that if the Court adopted a new empirical validity test, there would be cases of genuine battles of the experts–instances in which both the proponents and the opponents of an expert theory could point to enough, methodologically sound research to justify the admission of their testimony.\textsuperscript{28} The battle over shaken baby syndrome is one of those cases.

I. A BRIEF DESCRIPTION OF THE SCIENTIFIC AND LEGAL HISTORY OF SHAKEN BABY SYNDROME

A. An Overview of the Syndrome

Simply stated, the theory is that if an adult violently shakes an infant for four or five\textsuperscript{29} oscillations\textsuperscript{30} during a period of three to 10 seconds,\textsuperscript{31} the rapid acceleration and deceleration of

\textsuperscript{24} Trear v. Sills, 69 Cal.App.4th 1341, 1346, 82 Cal.Rptr.2d 281 (1999); Ramona v. Los Angeles Superior Court, 57 Cal.App.4th 107, 66 Cal.Rptr.2d 766 (1997).

\textsuperscript{25} Franklin v. Duncan, 884 F. Supp. 1435 (N.D. Cal.), aff’d, 70 F.3d 75 (9th Cir. 1995).


\textsuperscript{27} Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999).

\textsuperscript{28} See note 257, infra.


\textsuperscript{30} United States v. Gaskell, 985 F.2d 1056, 1241 (11th Cir. 1993).

\textsuperscript{31} State v. Leibhart, 266 Neb. 133, 139, 662 N.W.2d 618, 624 (2003).
the infant’s brain within the skull\textsuperscript{32} can cause the infant’s death. An infant has a heavy head\textsuperscript{33} but relatively undeveloped neck muscles,\textsuperscript{34} permitting the shaking to produce tremendous acceleration and deceleration forces.\textsuperscript{35} The alternating to-and-fro shaking causes the infant’s chin to strike the anterior chest wall (the sternum) and then causes the occiput on the rear of the child’s head to hit the backbone\textsuperscript{36} (the upper thoracic spine).\textsuperscript{37} The rotational\textsuperscript{38} movement of the brain within the cranial cavity generates shearing forces which tear the bridging veins in the brain. In turn, the tearing can cause bleeding, brain swelling, and death.

The syndrome has two “classic” symptoms.\textsuperscript{39} The most consistent finding is the presence of a subdural hematoma.\textsuperscript{40} Such hematomas are present in 90 to 98\% of the autopsies in cases classified as shaken baby syndrome.\textsuperscript{41} The brain is protected by three membranes: the dura, the arachnoid, and the pia.\textsuperscript{42} Blood found between the dura and the arachnoid is referred to as a subdural hematoma.\textsuperscript{43} The presence of the hematoma causes increased intracranial pressure. The

\begin{itemize}
\item \textsuperscript{32} State v. Adams, 280 Kan. 494, 497, 124 P.3d 19, 24 (2005).
\item \textsuperscript{34} Caffey, supra note 33, at 166; United States v. Gaskell, 985 F.2d 1056, 1059 (11\textsuperscript{th} Cir. 1993).
\item \textsuperscript{36} State v. Sayles, 662 N.W.2d 1, 8 (Iowa 2003).
\item \textsuperscript{38} In rotational movement, the head moves in an arc with respect to the body. In contrast, translational motion tends to be linear. Case, infra note 41, at 114.
\item \textsuperscript{39} Allen G. Breed, Shaken-Baby Syndrome Is Questioned, Los Angeles Times, May 20, 2007, at A-14 (stating the position of the National Institute of Neurological Disorders and Stroke).
\item \textsuperscript{41} Mary E. Case, Michael A. Graham, Tracey Corey Handy, Jeffrey M. Jentzen & James A. Monteleone, Position Paper on Fatal Abusive Head Injuries in Infants and Young Children, 22 Am.J. Forensic Med. & Path. 112, 115 (2001)(hereinafter cited as Case).
\item \textsuperscript{42} Smith v. Mitchell, 453 F.3d 1203, 1205 n. 2 (9\textsuperscript{th} Cir. 2006).
\item \textsuperscript{43} Smith v. Mitchell, supra note 42, at 1205 n. 2.
\end{itemize}
other symptom of the syndrome is the occurrence of retinal hemorrhages.\textsuperscript{44} These flame-shaped\textsuperscript{45} hemorrhages occur in the back or posterior of the inside surface of the eyes.\textsuperscript{46} The shaking of the infant’s head “enables blood to rush into the facial region, . . . increasing the volume of fluid in the venous channels of the eye. When venous outflow is blocked by pressure on the thorax from the abuser’s hands, distention of the optic nerve sheaths” can lead to retinal hemorrhages.\textsuperscript{47} These hemorrhages are present in 70 to 85\% of the autopsies in cases categorized as shaken baby syndrome deaths.\textsuperscript{48}

Although the presence of these symptoms supposedly points to shaken baby syndrome,\textsuperscript{49} other symptoms are surprisingly not required. Thus, there is no requirement to find fractures of either the skull or ribs. At first blush, a layperson might think that violent shaking would cause such injuries. However, the proponents of shaken baby syndrome explain that an infant’s bones are flexible\textsuperscript{50} and malleable.\textsuperscript{51} Since the bones have not fully calcified,\textsuperscript{52} they tend to bend rather than break.\textsuperscript{53} While such fractures would tend to be present if the infant’s death were caused by an impact, their absence is supposedly explicable when the cause of death is violent shaking.

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44 Case, supra note 41, at 116-17.  
46 Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1109.  
48 Case, supra note 41, at 116; Brandon M. Togioka, Meghan A. Arnold, Melinda A. Bathurst, Susan M. Ziegfeld, Rosemary Nabaweesi, Paul M. Colombani, David C. Chang & Fizan Abdullah, Retinal Hemorrhages and Shaken Baby Syndrome: An Evidence-Based Review, 37 J. Emerg. Med. 98 (2009) (“Child abuse should be highly suspect in children with RH,” that is, retinal hemorrhage); Victor M. Elner, Ocular Manifestations of Child Abuse, 126 Arch. Ophthalmol. 1141 (2008) (“retinal hemorrhages are the most consistent ocular manifestation of NAHT,” that is, nonaccidental head trauma). See also Smith v. Mitchell, 437 F.3d 884, 887 (9th Cir.) (“in 80\% or more of the cases of Shaken Baby Syndrome”), reh’g denied, 453 F.3d 1203 (9th Cir. 2006); Lindo v. State, 278 Ga.App. 228, 232, 628 S.E.2d 665, 670 (2006) (“In 90 percent of shaken baby syndrome cases”).  
On reflection, the theory underlying shaken baby syndrome is reducible to three propositions. First, infants can suffer a fatal brain injury characterized by the symptomatology of subdural hematoma and retinal hemorrhages but without fractures suggesting an impact. The second is that a certain amount of force is required to produce this type of brain injury.\(^{54}\) As we shall see, there have been experimental efforts to quantify that amount of force. The third and final proposition is that shaking by an adult is enough to cause an infant’s brain to experience that amount of force. As we shall see in the ensuing sections, the first proposition is well accepted, there is some consensus on the second, but modernly the third proposition is the subject of a sharp, ongoing controversy.\(^{55}\)

B. The History of the Emergence of the Syndrome

A number of scientific publications played a pivotal role in the emergence and eventual


acceptance of shaken baby syndrome.\textsuperscript{56}

In 1962, C. Henry Kempe released the landmark paper, “The Battered-Child Syndrome.”\textsuperscript{57} In the article, Kempe listed a constellation of childhood symptoms which he asserted were more likely caused by abuse than accident. The list included outward indicia of abuse such as fractures. However, the list was not limited to such symptoms; the list also included internal indicia such as subdural hematoma.\textsuperscript{58} Indeed, Kempe described the presence of a subdural hematoma as “an extremely frequent finding.”\textsuperscript{59}

Later in the same decade Ayub Ommaya, Fred Faas, and Philip Yarnell released the results of an experiment\textsuperscript{60} that is frequently cited by proponents of shaken baby syndrome.\textsuperscript{61} The empirical data in the Ommaya study has come to be regarded as a “cornerstone” of the justification for the syndrome.\textsuperscript{62} Oddly enough, on its face the experiment has nothing to do with childhood brain injury. Rather, the stated purpose of the study was to investigate the validity of claims of whiplash injury allegedly caused by rear-end automobile collisions.\textsuperscript{63} The researchers wanted to determine whether such injuries could occur “without direct impact to the head.”\textsuperscript{64} The researchers used animals, primarily rhesus monkeys, as test subjects.\textsuperscript{65}

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\textsuperscript{58} Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1119.


\textsuperscript{61} Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby Syndrome or Shaken Impact Syndrome, 188 Mil.L.Rev. 1, 25 (2006).

\textsuperscript{62} Ramsey, supra note 61, at 25.

\textsuperscript{63} Ommaya, supra note 60, at 285.

\textsuperscript{64} Ommaya, supra note 60, at 285-86.

\textsuperscript{65} Ommaya, supra note 60, at 285.
The monkeys were given a barbiturate anesthesia. To mimic a rear-end collision, the monkeys were seated on a fiberglass chair mounted on a rigid carriage. The apparatus moved freely on roller-skate wheels over a 20-foot long track. An air-compression device was attached at one end of the track to deliver impacts at various force levels to the carriage. Different monkeys were subjected to different force levels. All the tests were filmed to ensure that although the back of the chair stopped the rear of the monkey’s head, the monkeys had not sustained significant direct head impacts.

After the tests, the researchers killed the monkeys and autopsied their bodies, including their brains. The researchers identified the monkeys who had suffered subdural hematomas to determine the force level at which that type of brain damage occurred in 50% of the monkeys. The researchers then speculated about the extrapolation from the results in monkeys to human beings. They pointed out that “because it is easier to injure the much larger brain of man—as compared to that of the monkey, it is suggested that the levels of . . . acceleration required to produce . . . brain injury in man will be much lower . . . .” than the levels indicated for monkeys. However, after describing their assumption, the researchers added the caveat that “[w]e do not contend that our experiments prove that whiplash injury in man can produce lesions similar to what we have demonstrated in monkeys.” They conceded that in order to extrapolate, an analyst would need a validated scaling method to convert the monkey’s injury thresholds to comparable thresholds for human beings. They frankly conceded that their research did not yield such a scaling method.

Although Kempe referred to “battered child syndrome,” it was John Caffey who coined the expression “whiplash shaken baby syndrome.” In the early 1970s Caffey developed the modern theory of shaken baby syndrome. In 1972, he released “On the Theory and Practice of Shaking Infants: Its Potential Residual Effects of Permanent Brain Damage and Mental

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66 Ommaya, supra note 60, at 286.
67 Ommaya, supra note 60, at 286.
68 Ommaya, supra note 60, at 286.
69 Ommaya, supra note 60, at 286.
70 Ommaya, supra note 60, at 286.
71 Ommaya, supra note 60, at 287.
72 Ommaya, supra note 60, at 287-88.
73 Ommaya, supra note 60, at 288.
74 Ommaya, supra note 60, at 288.
75 Ommaya, supra note 60, at 288.
Retardation.” 77 He cited Kempe’s original article. 78 In this article, Caffey collected 27 instances of what he deemed “convincing recorded examples” 79 of shaken baby syndrome. In all these cases, the custodian of an infant either admitted shaking the child, or there was a convincing eyewitness accounts of shaking; but there was no evidence that the child’s head had suffered direct impact. 80 Even absent impact, these cases displayed such whiplash injuries as hematoma. 81

In 1974, Caffey revisited the topic. 82 In his later article, Caffey cited Ommaya’s research. 83 Once again, he relied on “admitted” cases of shaking. 84 Although he conceded that the empirical data was “manifestly incomplete” 85 and the number of such cases “meager,” 86 he asserted that the evidence was nonetheless “reliable.” 87 In these cases, autopsies found intracranial bleeding (subdural hematoma) as well as intraocular bleeding (retinal hemorrhage). Yet, external signs of trauma were conspicuously absent. 88 His 1972 article had suggested that an infant could suffer the fatal set of symptoms without experiencing impact. In this article he made it clear that he doubted whether the presence of external signs of trauma was a necessary symptom for the diagnosis. 89 Near the end of the article, he stated that “it seems reasonable to hypothecate that habitual whiplash shakings are pathogenic to some degree in many such

77 Caffey, supra note 33, at 161.
78 Caffey, supra note 33, at 169 n. 9.
79 Caffey, supra note 33, at 163. See also Caffey, supra note 33, at 164 (“recorded” cases).
80 Caffey, supra note 33, at 161, 162, 168, 169.
81 Caffey, supra note 33, at 162.
82 Caffey 1974, supra note 37.
83 Caffey 1974, supra note 37, at 403 nn. 24-26.
84 Caffey 1974, supra note 37, at 396-398, 400, 402.
85 Caffey 1974, supra note 37, at 399. See also Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1119.
86 Caffey 1974, supra note 37, at 397.
87 Caffey 1974, supra note 37, at 397.
88 Caffey 1974, supra note 37, at 396-400, 402.
89 Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby or Shaken Impact Syndrome, 188 Mil.L.Rev. 1, 6 (2006); Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1119.
cases.”\textsuperscript{90} In carefully qualified language, he added that “whiplash shaking may be responsible” for the symptoms in these cases.\textsuperscript{91} However, those qualifications evaporated when Caffey reached his formal conclusion. There he asserted that “[o]ur evidence, both direct and circumstantial, indicates that manual whiplash shaking of infants is a common primary type of trauma in the so-called battered infant syndrome. It appears to be the major cause in these infants who suffer from subdural hematomas and intraocular bleedings.”\textsuperscript{92}

C. The Widespread Medical and Legal Acceptance of the Syndrome

In a relatively short time after Caffey’s enunciation of the theory, the theory became widely accepted in both medical and legal circles.\textsuperscript{93}

In one shaken baby syndrome case, a prosecution expert asserted that “most people in medicine” subscribe to the theory underlying the syndrome.\textsuperscript{94} In case after case, experts took the stand to vouch that the syndrome was “generally accepted”\textsuperscript{95} and “recognized”\textsuperscript{96} as a valid diagnosis.\textsuperscript{97}

The extensive legal acceptance of the syndrome paralleled its widespread medical acceptance. The Indiana legislature enacted a statute providing for the admissibility of testimony about shaken baby syndrome.\textsuperscript{98} The United States Department of Health and Human Services’

\begin{itemize}
  \item \textsuperscript{90} Caffey 1974, supra note 37, at 402.
  \item \textsuperscript{91} Caffey 1974, supra note 37, at 402.
  \item \textsuperscript{92} Caffey 1974, supra note 37, at 402.
  \item \textsuperscript{93} Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby and Shaken Impact Syndrome, 188 Mil.L.Rev. 1, 8 (2006).
  \item \textsuperscript{94} People v. Swart, 369 Ill.App.3d 614, 626, 860 N.E.2d 1142, 1153, 308 Ill.Dec. 60, 72 (2006).
  \item \textsuperscript{95} State v. McClary, 207 Conn. 233, 248, 541 A.2d 96, 103 (1988); Middleton v. State, 980 So.2d 351, 357 (Miss. 2008). But see State v. Humphries, 2008 WL 307712 (Ohio App. Feb. 4, 2008)(“Dr. Paul Byrne, a Physician Director of Neonatology at St. Charles Mercy Hospital in Oregon, Ohio, and the Director of the Department of Pediatrics, testified that shaken baby syndrome is not a medically accepted injury”).
  \item \textsuperscript{97} State v. Candela, 929 S.W.3d 852, 864 (Mo.App. 1996).
  \item \textsuperscript{98} Ind. Code § 16-41-40-2 (2002); Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1122-23.
manual on child abuse litigation for judges approvingly referred to the syndrome,\(^{99}\) and a National Center on Shaken Baby Syndrome was founded.\(^{100}\) Most importantly, although there are a few contrary decisions,\(^{101}\) the clear majority view favors the admissibility of testimony about the syndrome.\(^{102}\) The courts have “almost universally accepted” testimony based on the syndrome.\(^{103}\) In the published opinions, the testimony is “almost universally seen as proof . . . that the baby was deliberately harmed by a . . . malevolent caretaker.”\(^{104}\) There are tens of published opinions ruling the testimony admissible.\(^{105}\) The courts have repeatedly declared that the syndrome is no longer a novel theory\(^{106}\) and that the admissibility of testimony about the syndrome is now well settled.\(^{107}\)

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\(^{100}\) State v. Sayles, 662 N.W.2d 1, 7 (Iowa 2003).

\(^{101}\) E.g., Order, State v. Hyatt, No. 06MJ-CR00016-02 (Mo.Cir.Ct., Nov. 6, 2007)(unpublished); State v. Edmunds, 308 Wis.2d 374, 746 N.W.2d 590 (App. 2008).


\(^{103}\) Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1109.

\(^{104}\) Note, supra note 103, at 1122.


Perhaps even more importantly, the courts have not only admitted shaken baby syndrome testimony; they have also ascribed great significance to the testimony. For instance, after the prosecution expert testifies that the adult must shake the infant with great force to produce the symptoms of the syndrome, the courts typically permit the expert to take the next step and opine that the injury was intentional. The argument runs that any "reasonable person would know that such force would cause the death of an infant." Hence, the testimony is admissible to show the perpetrator’s mens rea as well as the occurrence of the actus reus. Furthermore, the expert often adds that the child will become unconscious and the symptoms will manifest themselves almost immediately after the violent shaking—within seconds, minutes, or at most a few hours. In effect, the testimony time stamps the injuries, powerfully incriminating the last adult in the child’s presence before the onset of the symptoms. The upshot is that the testimony tends to establish the accused’s identity as the perpetrator as well as proving mens rea and the actus reus. There are critics who claim that there can be a lengthy lucid interval before the infant

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108 E.g., Villegas v. State, 2008 WL 2515879, at 9 (Tex.App. Mar. 13, 2008); Martin v. State, 246 S.W.3d 246, 252 (Tex.Ct.App. 2007)(“intentionally inflicted,” “the perpetrator’s intent,” and “he was qualified as an expert in regard to whether the injuries presented were intentional and not accidental injuries”).


110 Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 705-06 (“intentional abuse”).


116 Case, supra note 41, at 118.
lapses into unconsciousness\textsuperscript{117} and that the real cause of the symptoms can be a spontaneous or innocently caused rebleed of a prior subdural hematoma.\textsuperscript{118} However, to date, despite these criticisms, most courts continue to both admit shaken baby syndrome testimony and assign it considerable probative weight.

\textsuperscript{117} J. Kelly, Sports Related Recurrent Brain Injuries: Second Impact Theory, 46 MMWR 224-27 (2000); M. Nahelsky & J. Dix, The Time Interval Between Lethal Infant Shaking and Onset of Symptoms: A Review of the Shaken Baby Syndrome Literature, 16 Am.J. Forensic Med. & Path. 154 (1995); John Plunkett, Fatal Pediatric Head Injuries Caused by Short-Distance Falls, 22 Am. J. Forensic Med. & Path. 1 (2001)(the researchers studied the Consumer Product Safety Commission’s database of playground equipment falls between January 1988 and June 1999; in the study involving 18 children who displayed the symptoms of retinal hemmorhaging and subdural hematoma caused by a fall, 12 experienced a lucid interval before expiring; the intervals varied from 5 minutes to 48 hours in length; thus, the symptoms were “clinically silent” and the child asymptomatic during the lucid interval); G. Reiber, Fatal Falls in Childhood, 14 Am.J.Forensic Med. & Path. 201 (2001)(of the three cases of death, two children had lucid intervals); W. Snoek, Delayed Deterioration Following Mild Head Injury in Children, 107 Brain 15 (1984); David Talbert, The Nature of Shaken Baby Syndrome Injuries and the Significance of a “Lucid Interval,” 71 Medical Hypotheses 117 (2008); Motion to File and Brief Amicus Curiae of Physicians and Bio-Scientists on Behalf of Appellant Medhi Belahbib, CO44224, People v. Belahbib, at 15-16 (Cal.Ct.App., Third App. Dist. (copy on file in Professor Imwinkelried’s office)(“Doctors specializing in sports medicine have coined the term ‘Second Impact Syndrome’ to describe athletes who incur a blow to the head but suffer little or no alteration in consciousness, until hours or days later when they unexpectedly lapse into unconsciousness or death”); “Pediatricians use the term ‘Talk and Deteriorate or Die’ or TADD to describe the lucid intervals that occur in individuals with epidural hematoma. TADD is the reason physicians and hospitals keep people under 24-hour observation after suffering a major head injury and the reason parents are advised to awaken their children periodically after such an event”); Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 710.

\textsuperscript{118} There is a substantial body of literature indicating that a prior subdural hematoma can rebleed spontaneously or with minimal new force. A.D. Parent, Pediatric Chronic Subdural Hematoma: A Retrospective Comparative Analysis, 18 Pediatric Neurosurgery 266 (1992); J. Piatt, A Pitfall in the Diagnosis of Child Abuse: External Hydrocephalus, Subdural Hematoma and Retinal Hemmorhages, 7 Neurosurgical Focus 1 (1999); Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby or Shaken Impact Syndrome, 118 Mil.L.Rev. 1, 28-29 (2006)(“a second, yet trivial, head injury” can cause the rebleed; “the amount of force required to initiate a re-bleed can be de minimis”); D. Sherwood, Chronic Subdural Hematoma in Infants, 39 Am.J.Dis.Child 980 (1930); R. Uscinski, Shaken Baby Syndrome: Fundamental Questions, 16 Brit.J. Neurosurgery 217, 218 (2002)(“The mechanism of membrane formation as a means of resorption of chronic subdural hematoma in infants has never been demonstrated to be different from that in adults . . . . Rebleeding in subdural hematoma may occur, with minimal or no trauma, owing to the nature of the membranes and the process of resorption . . . .”). When blood vessels are healing after the initial hematoma, they are delicate and fragile. Hence, during the healing process, the new blood vessels that are forming can be damaged with little or no trauma.
II. A REVIEW OF THE EMPIRICAL DATA SUPPORTING AND AT ODDS WITH THE SHAKEN BABY SYNDROME THEORY

The question that naturally arises is whether the empirical support for shaken baby syndrome justifies the significant probative value that the vast majority of courts have accorded it. Before critically evaluating that question in Part III of this article, we shall review the available data—the data at odds with the theory as well as the data supporting the theory.

A. The Data Supporting the Validity of the Syndrome

As Part I.A explained, the syndrome is reducible to three propositions: Infants can suffer fatal brain injury characterized by subdural hematoma and retinal hemorrhages; a certain level of force must be applied to the infant in order to produce those brain injuries; and the shaking of an infant by an adult is capable of generating that amount of force. As the Advisory Committee Note to Federal Rule of Evidence 702 points out, each essential step in an expert’s reasoning process must have adequate support.

Proposition #1: The Existence of a Certain Type of Fatal Brain Injury with a Particular Symptomatology

The proponents of the syndrome have ample evidence to substantiate this proposition. In his 1972 and 1974 articles, Caffey documented numerous autopsies of infants in which brain injury was identified as the cause of death. In many of these autopsies, the pathologist found the characteristic symptomatology of the syndrome: the presence of subdural hematoma and retinal hemorrhage without skull or rib fracture or external marks suggesting impact.

Proposition #2: The Amount of Force Required to Produce That Type of Brain Injury

In their testimony, to illustrate the amount of force required to produce this type of brain injury, prosecution experts frequently give analogies. The most common analogies are to the amount generated by high speed automobile accidents and a fall from a several-story


121 In re Saim S., 23 Misc.3d 1101, 881 N.Y.S.2d 366 (Fam.Ct. 2009)(Dr. Gave, the Associate Director of Trauma and Surgical Intensive Care and Director of Surgical Education at Staten Island University Hospital, “stated that there are frequently no external marks, bruises, or other indicia of physical abuse”).

The experts analogize to these “real-life accident scenarios” in order to give the trier of fact a sense of the “massive, violent” force required to produce this kind of brain injury. The basis of the analogies is that autopsies in such cases find injuries similar to those in shaken baby syndrome cases. However, without more, the mere similarity of the injuries in these types of cases does not support a logical inference that the amount of force in the typical high speed accident or several-story fall is the minimum force required to cause shaken baby syndrome. Although those accidents may result in similar injuries, the amount of force involved in those accidents might exceed the necessary minimum. In other words, while those kinds of accidents may be sufficient to cause such injuries, it is fallacious to conclude that the amount of force generated in those types of accidents is the necessary minimum quantum of force. Hence, the analogies may be helpful, but they do not establish proposition #2.

In their attempt to validate the second proposition, the proponents of the syndrome sometimes invoke Ommaya’s research. Ommaya tried to determine the amplitude of the force at which a large percentage of the monkeys involved in the experiment suffered concussion and brain damage. After reviewing Ommaya’s data, Caffey estimated that severe brain injuries such as subdural hematoma did not occur in the monkeys until the monkeys experienced approximately 155 gs of acceleration force. In addition, based on the different size and mass of the human brain, Ommaya attempted to extrapolate from monkeys to humans. However, he conceded that such extrapolation was unreliable until there is a validated scaling method for converting the injury threshold levels in monkeys to a corresponding level for humans. He

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125 People v. Martinez, 74 P.3d 316, 320 (Colo. 2003).
128 Ommaya, supra note 60, at 287.
130 The symbol g denotes g force or gee force, namely, the force of acceleration due to gravity at the earth’s surface. Ramsey, supra note 129, at 6 n. 25.
131 Ommaya, supra note 60, at 287.
132 Ommaya, supra note 60, at 288.
stated that “to date” the condition of the establishment of a valid scaling method has not “been satisfied.”

Common sense suggests that in order to produce the profound injuries characteristic of the syndrome, shaking would have to be “quite violent.” However, given the state of the data, at trial prosecution experts often concede that they cannot precisely quantify the minimum amount of force necessary to produce the injuries which are the characteristic symptoms of shaken baby syndrome.

Proposition #3: The Shaking of an Infant by an Adult Can Generate the Amount of Force Required to Cause That Type of Brain Injury

As support for this proposition, the proponents of the admissibility of the syndrome rely on two very different types of data. One type of data is generated by controlled experiments. Some of the subsequent shaken baby syndrome researchers point to Ommaya’s experiment with monkeys. However, that argument is strained. Ommaya’s experiment simulated a traffic accident and did not involve shaking. Ommaya made no attempt to determine whether the shaking of either a monkey or a human infant could generate enough force to trigger the characteristic injuries of the syndrome.

The second—and far more important—type of data is anecdotal. In his widely cited 1972 and 1974 articles Caffey relied primarily on confessions and admissions by caretakers.

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133 Ommaya, supra note 60, at 288.
135 People v. Dunaway, 88 P.3d 619, 631, 633 (Colo. 2004); People v. Martinez, 74 P.3d 316, 324 (Colo. 2003)(“the amount of force . . . is unknown . . . .”).
136 Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby and Shaken Impact Syndrome, 118 Mil.L.Rev. 1, 25 (2006)(four of the leading articles on the subject “refer to a single paper by Ommaya published in 1968 as the biomechanical justification for this concept”).
139 Case, supra note 41, at 114 (confessions and reports by eyewitnesses); Caffey, supra note 35, at 397.
141 Caffey 1974, supra note 37.
In the 1972 article, Caffey collected 27 cases\textsuperscript{142} that he considered “convincing recorded examples.”\textsuperscript{143} In these examples, the autopsy of the child revealed brain injuries characteristic of the syndrome without skull or rib fractures. Moreover, for the most part, in these examples the caretaker admitted\textsuperscript{144} shaking the child but did not report that the child’s head had sustained any impact. In his 1974 article, he described “some new examples of admitted” shaken baby syndrome.\textsuperscript{145} As in his 1972 article, he relied heavily on confessions and admissions by caregivers.\textsuperscript{146} As previously stated, in the 1974 article he conceded that the number of new examples was “meager”;\textsuperscript{147} but he insisted that as admissions, the caretaker’s statements were sufficiently “reliable.”\textsuperscript{148} Caffey does not stand alone; in its position statement on the syndrome, the Ad Hoc Committee of the National Association of Medical Examiners declares that “many forensic pathologists have experience based on confessions by perpetrators or witnesses of how these injuries were inflicted . . . .”\textsuperscript{149}

It is certainly understandable that the proponents of the syndrome cannot marshal controlled experiments involving infant human beings. The rules of medical ethics would obviously forbid exposing infants to the grave risks that such experiments would entail.\textsuperscript{150} However, there are two troublesome questions about the probative value of the anecdotal evidence presented by Caffey.

First, it is doubtful whether some of his examples involved the sort of forcible shaking that the syndrome presumes. As the preceding discussion of proposition #2 indicated, although the


\textsuperscript{143} Caffey, supra note 142, at 163.

\textsuperscript{144} Caffey, supra note 142, at 163 (“admitted”), 164 (“admitted”).

\textsuperscript{145} Caffey 1974, supra note 37, at 396.

\textsuperscript{146} Caffey 1974, supra note 37, at 396 (“admitted”), 397 (“admission by the parent-assailant”), 402 (“admitted”).

\textsuperscript{147} Caffey 1974, supra note 37, at 397.

\textsuperscript{148} Caffey 1974, supra note 37, at 397.

\textsuperscript{149} Case, supra note 41, at 114. See also Allen G. Breed, Shaken-Baby Syndrome Is Questioned, Los Angeles Times, May 20, 2007, at A-14 (“‘People confess to it. So it has to be possible,’” [says] Dr. Suzanne Starling, director of forensic pediatrics at Children’s Hospital of the King’s Daughters in Norfolk, Va. She and her colleagues analyzed 81 cases in which an adult confessed to shaking and/or battering a child. In cases where only shaking was admitted, the children were 2.39 times more likely to have retinal hemmorhages than victims of impact alone, they found, ‘suggesting that shaking is more likely to cause retinal hemorrhages than impact’”).

\textsuperscript{150} People v. Lind, 307 Ill.App.3d 727, 739, 718 N.E.2d 316, 324, 240 Ill.Dec. 835, 843 (1999)(in the words of Dr. Travis Hindman, “as you can readily understand, a controlled breaking of a child’s skull does not fit into what would be considered to be good, moral, ethical practices”).
data does not permit the precise quantification of the amount of force necessary to cause the severe brain injuries which are symptomatic of the syndrome, there is consensus that the amount of force must be considerable. However, one set of 15 cases cited in the 1972 article included some “burpings.” In another case, a mother said only that “she and her husband ‘might have shaken [the infant] when he cried at night.’” In still another case, a mother grabbed a child and yanked him upward to prevent his falling off a bassinet onto the floor. It is debatable whether such conduct should be characterized as the kind of major, violent shaking events that supposedly cause shaken baby syndrome.

Second, some of these examples may have involved impact in addition to shaking. In one of the examples cited in the 1972 article, the report included the fact that the child’s “head was banged against the crib.” Furthermore, even if the reports did not include such details, it is questionable to accept the reports at face value. As Caffey himself acknowledges in the same article, the caregiver could easily be traumatized by the event; and as a consequence, he or she might experience amnesia or “defensive forgetting” of any impact. A loving parent’s recollection of their child’s head accidentally striking an object or wall might be a painful memory that the parent would want to repress. On the alternative assumption that the caregiver acted in bad faith, in order to minimize his or her culpability the caregiver might deliberately withhold the detail that they struck the child’s head against an object or surface.

B. The Data at Odds with the Validity of the Syndrome

Although at one time most members of the medical community regarded shaken baby syndrome as a triusm, the research on the subject has been evolving. As we shall now see,

152 Caffey, supra note 151, at 163.
153 Caffey, supra note 151, at 163.
154 Caffey, supra note 151, at 163.
157 Case, supra note 41, at 114 (“Perpetrators may not remember, or later may not be willing, to fully describe their actions”).
158 Case, supra note 41, at 114.
research conducted since Caffey’s 1974 article has triggered a fierce debate, especially over the third proposition underlying the syndrome.

**Proposition #1**

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160 State v. Edmonds, 308 Wis.2d 374, 746 N.W.2d 590, 593, 595-96, 598-99 (App. 2008) (“the emergence of a debate,” “a shift has occurred,” “a significant debate,” “a significant and legitimate debate,” “a shift in mainstream medical opinion,” and “fierce debate”).

In the case of the initial proposition, the critics of the syndrome concede that infants can suffer fatal brain injuries without exhibiting typical signs of impact such as skull and rib fractures. However, they contend that it is a non sequitur for the syndrome’s proponents to infer from that the lack of such signs that there was no impact. As a position paper of the National Association of Medical Examiners’ Ad Hoc Committee on Shaken Baby Syndrome acknowledges, “[i]mpacts may not be reflected on the [infant’s] scalp if the striking surface is padded or if it is broad and firm.”\textsuperscript{162} That acknowledgement is due in part to research conducted by Dr. A. C. Duhaime and her colleagues. In a 1992 article, she described a research project finding that “if the [infant’s] head strikes a soft padded surface, contact forces will be dissipated over a broad area and external or focal injuries may be undetectable while intracranial rotational shear forces can be sufficient to result in subdural hemorrhage and severe brain injury.”\textsuperscript{163} Again, in a 1998 article, Duhaime and her co-investigators discovered that “[w]hen the surface [impacted] is soft, the force of the impact is widely dissipated and may not be associated with visible signs of surface trauma . . . “\textsuperscript{164}

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\textbf{Proposition #2}

Just as the critics concur with the syndrome’s proponents that infants can suffer the brain injuries characteristic of the symptom without exhibiting the typical external signs of impact, they tend to agree with prosecution experts on several points related to the second proposition.

Initially, they agree with the prosecution witnesses who have testified that in general, the amount of force required must be quite substantial.\textsuperscript{165}

Next, they are in agreement with the government witnesses who frankly concede that the available empirical data does not permit the identification of the precise minimum amount of force needed to cause the injuries that characterize the syndrome in human infants.

Lastly, they concur that Ommaya’s data are relevant to the discussion of proposition #2. As previously stated, Ommaya released the results of his experiments with monkeys in 1968.\textsuperscript{166} He identified the amount of force which produced significant brain injuries in over 50% of the monkeys.\textsuperscript{167} He found that “levels of rotational acceleration of the monkey head exceeding 40,000 radians per second squared\textsuperscript{168} could produce” such injuries in the monkeys.\textsuperscript{169} Based on

\textsuperscript{162} Case, supra note 41, at 114.


\textsuperscript{166} Ommaya, supra note 60.

\textsuperscript{167} Ommaya, supra note 60, at 285, 287.

\textsuperscript{168} See note 174, infra.
the differences in size and mass between the money and human brains, he then extrapolated from
that data to brain injury thresholds for humans.\textsuperscript{170} He admitted that his experiment did not
validate a scaling method for converting monkey injury thresholds to human thresholds.\textsuperscript{171}
Nevertheless, he conjectured that a “level[] of angular acceleration . . . in the order of 6,000 to
7,000 radians per second squared” would suffice to produce comparable injuries in the human
brain.\textsuperscript{172} To be sure, other figures, such as 155 g forces, are sometimes mentioned in the
literature.\textsuperscript{173} However, for the most part, they derive from Ommaya’s research and restate his
findings in different terms, that is, g forces rather than radians per second squared.\textsuperscript{174} Ommaya’s

\textsuperscript{169} Ommaya, supra note 60, at 285.
\textsuperscript{170} Ommaya, supra note 60, at 287-88.
\textsuperscript{171} Ommaya, supra note 60, at 288.
\textsuperscript{172} Ommaya, supra note 60, at 288. See also R. Uscinski, Shaken Baby Syndrome:
rotational acceleration exceeding 40,000 radians/s squared was sufficient to produce experimental
concussion [in the monkeys], without impact to the head. Ommaya postulated from these data
that the levels of angular acceleration required to produce cerebral concussion and brain injury in
man without impact should be in the order of 6000-7000 radians/s squared, a figure he revised
downward later to 4000 radians/s squared”).
\textsuperscript{173} Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby and
Basuta, DO34429, at 42-43 n. 24 (Cal.Ct.App.) (copy on file with Professor Imwinkelried)
collected a sample of the figures mentioned in various publications: 150-200 g, 200-250 g, 200 g,
and 200 g).
\textsuperscript{174} Unfortunately, as far as this author can tell, none of the published articles on shaken baby
syndrome explains how to convert from force estimates, based on radians, to g forces.
Consequently, the author contacted Professor David Hewitt, the former chair of the Forensic
Science Graduate Group at the University of California, Davis. Professor Hewitt was kind
enough to provide the following explanation. Email from David G. Howitt to Edward J.
Imwinkelried, dated August 17, 2009 (copy in Professor Imwinkelried’s office).
“The units of 40,000 radians per second per second is the acceleration of the head in
angular terms. [What] we are talking about is a whiplash, since that is what you do when you
shake a baby. [Y]ou can solve for the force using

\[
\text{Force} = (\text{weight of the head in kilograms}) \times (\text{length of the neck in meters}) \times (\text{angular}
\text{acceleration in radians per second squared}).
\]

This amount of force is stated “in units of Newtons. A G force is this force divided by the force
of gravity which is 9.81 Newtons.”

Using this analysis, Professor Hewitt provided the following example:

“Angular acceleration 40,000 radians per second squared
Length of the neck 0.04 meters
paper does not even purport to identify the precise minimum level of requisite force for humans, but the data are undeniably relevant and serve as a starting point for any discussion of the second proposition.

Proposition #3

Although there is a good deal of agreement between the proponents and critics of the syndrome on the first two propositions, the third proposition is the battleground. The critics cite two experiments as proof that shaking alone cannot produce enough force to satisfy the thresholds for the injuries which characterize shaken baby syndrome.\textsuperscript{175}

<table>
<thead>
<tr>
<th>Mass of the head</th>
<th>0.8 kilograms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force in Newtons</td>
<td>1,280</td>
</tr>
<tr>
<td>Force in G units</td>
<td>130.4791</td>
</tr>
</tbody>
</table>

As previously stated, Ommaya found that an acceleration of 40,000 radians per second squared could produce serious brain injury in monkeys. He speculated that an acceleration as small as 6,000 radians per second squared could cause similar injuries in the human brain. 6,000 is 15% of 40,000. Assuming \textit{arguendo} that Ommaya’s speculation was correct, if 130 G units of force would be necessary to cause serious brain injury in monkeys, 18.5 G units would be required to produce comparable injuries in the human brain. Research reveals no published experiment finding that without more, shaking can produce that quantum of G force. But see Allen G. Breed, Shaken-Baby Syndrome Is Questioned, Los Angeles Times, May 20, 2007, at A-14 (“But still-to-be-published research using a more advanced infant dummy simulated far greater brain damage than the previous dummies, says Dr. Carole Jenny, a Brown University Medical School professor and chairwoman of the American Academy of Pediatrics’ committee on child abuse and neglect”).

\textsuperscript{175} E.g., Grant v. Warden, 2008 WL 2447272, at *8 (Conn.Super. June 4, 2008)(a defense witness, Chris Van Ee, a biomechanical engineer, cited Dr. Duhaime’s 1987 study).
One was conducted by Dr. Duhaime and published in 1987. Rather than employing animal surrogates, Dr. Duhaime and her colleagues used anthropomorphic models of one-month-old infants. The researchers appreciated that the features of the models would have a major impact on the outcome of the experiment. The problem they faced is that “the mechanical properties of the infant neck have not been studied.” Nevertheless, the researchers attempted to devise a model that was realistic in the sense that it had a relatively large head and a weak neck. Given the lack of information about the infant neck’s mechanical properties, the researchers used three different models with different neck structures. Two of the models had rubber necks. The model’s head was somewhat heavier than that of an infant with a similarly sized head. However, the head dimensions—circumference, width, and diameter—“were comparable to human infants.”

The models were subjected to shaking as well as impact episodes. In the former, the models were “subjected to repetitive violent shaking” by both adult male and female experimenters. In the latter, the model’s head “was impacted against either a metal bar or a padded surface.” In the shaking episodes, the “[m]ean peak tangential acceleration . . . was 9.29 G.” In sharp contrast, the “mean tangential peak acceleration for . . . impacts was 428.18 G.” On average, the force of the impact accelerations exceeded that of the shake accelerations “by a factor of nearly 50 times.” In the words of one critic of the syndrome,

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177 Duhaime, supra note 176, at 411.

178 Duhaime, supra note 176, at 411.

179 Duhaime, supra note 176, at 411.

180 Duhaime, supra note 176, at 411.

181 Duhaime, supra note 176, at 412.

182 Duhaime, supra note 176, at 411.

183 Duhaime, supra note 176, at 411.

184 Duhaime, supra note 176, at 413.

185 Duhaime, supra note 176, at 413.

186 Duhaime, supra note 176, at 413.

187 Duhaime, supra note 176, at 413.

188 Duhaime, supra note 176, at 413.

189 Duhaime, supra note 176, at 413.
“Using Dr. Ommaya’s 155 gs as the threshold . . ., . . . . shaking alone produced at most only 9.3 gs of force, a mere fraction of the force . . . required to cause subdural hematomas [or] retinal hemorrhages . . . .”

A second experiment was conducted by Dr. Michael Jones of the University of Wales Cardiff Department of Engineering. Dr. Jones has a Ph.D. in bioengineering. Dr. Jones described the experiment in his testimony in *People v. Basuta*. Dr. Jones conducted a controlled [biomechanical] experiment by having young adult women shake a 34.25 pound infant model that was 29.5 inches in length . . . . This replicated the [1987] study by Duhaime . . . on the shaken baby syndrome. The test was purposely biased in favor of creating more acceleration and injury because the neck model used was that of a one-month old child. Volunteers were asked to shake the model as violently as possible while walking twenty feet. Dr. Jones concluded . . . that shaking a healthy 13 month old child would not generate sufficient force to cause a subdural hematoma.

In his experiment, Dr. Jones used a metal headform with mass, size, and shape specifications complying with recommendations by the British Standards Institution and the American Society for Testing Materials. He stated that this headform is widely used in head injury simulations. He added that:

- for simulation purposes in this case the metal headform gives a worst case scenario as it is solid and inflexible unlike the head of an infant which is flexible due to scalp compression and flexible cranial cartilage which is not fully ossified (developed into bone) in an infant.

According to Jones, for that reason, a human head would absorb more of the force.

Like the studies supporting shaken baby syndrome, these studies have been attacked. The general thrust of the attacks is that the anthropomorphic dummies used in the studies

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190 Matthew D. Ramsey, A Nuts and Bolt Approach to Litigating Shaken Baby and Shaken Impact Syndrome, 118 Mil.L.Rev. 1, 9 (2006). See also Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1120 (Dr. Duhaime’s 1987 data “showed that shaking alone (the method postulated by Caffey) produced less than one quarter of the force necessary to produce the SBS markers of subdural hematoma and retinal hemorrhaging in primate[s] . . . .”).


194 Appellant’s Reply Brief, supra note 193.

“respond differently from” human infants. In a 2008 article on the subject, three Canadian experts assert that “most authors believe that this model was faulty . . . .” In its position statement, the Ad Hoc Committee on Shaken Baby Syndrome of the National Association of Medical Examiners states that the features of the models do not “necessarily truly resemble[] the immature human infant skull and brain.” Thus, critics find fault with the simulated heads and necks of the dummies, since it is unknown how well those simulated features correspond to those of infants.

III. A CRITICAL EVALUATION OF THE QUESTION OF THE ADMISSIBILITY OF EXPERT TESTIMONY SUPPORTING AND ATTACKING SHAKEN BABY SYNDROME

As Part II pointed out, there is relative consensus on the first two propositions underlying the syndrome. Experts on both sides of the debate acknowledge that an infant can suffer fatal brain injuries characterized by subdural hematoma and retinal hemorrhages without skull fractures, rib fractures, or any other external indicia of impact. On the second proposition, experts on both sides concur that while the available data does not permit the identification of the precise force threshold for causing such injuries in humans, the force has to be considerable. Further, both sides treat Dr. Ommaya’s research as relevant evidence.

By process of elimination, the debate between the two sides centers on the third proposition. For their part, the syndrome’s proponents point to the anecdotal data collected by Dr. Caffey. In response, the syndrome’s opponents rely primarily on the controlled experiments conducted by Dr. Duhaime. This state of the empirical record poses several questions: Based on Dr. Duhaime’s experiments, would expert testimony that the syndrome does not exist qualify as


197 Sauvageau, supra note 196, at 480. However, there have been criticisms of the analysis set out in this article. Waney Squier, Commentary, 53 J. Forensic Sci. 1244 (2008)(“scanty information”); John Galaznik, id. at 1246 (“In light of this new research, the American Academy of Ophthalmology (AAO) could no longer sustain its previously held positions on eye findings and allegations of SBS, and in June of 2007, the AAO took down its Shaken Baby Resource Website for extensive revisions. I fail to see how Sauvageau can continue to argue that the Shaking Baby Syndrome . . . . [is] a valid primary cause of the entire triad or even a valid primary cause for any single feature of the triad in a previously normal infant. I suspect Sauvageau et al. may be the vocal representatives of a dwindling minority of physicians willing to testify that pure shaking is a valid primary cause . . . .”); Lawrence E. Thibault & Kirk L. Thibault, Commentary, id. at 1249 (“their case study does nothing more than undermine the exclusivity of the ‘classic triad’ by demonstrating that it can occur from a relatively ‘minor’ impact event”).

198 Case, supra note 41, at 114. See also Tim Jaspan, Current Controversies in the Interpretation of Non-Accidental Head Injury, 38 Pediatr. Radiol. (Suppl. 3) S378, S385 (2008)(“the models employed are not sufficiently biofidelic and the results derived are open to dispute and contrary analysis”).
admissible scientific evidence under Federal Rule of Evidence 702 and *Daubert*\textsuperscript{199}? Based on Dr. Caffey’s data, would expert testimony that the syndrome exists otherwise qualify as admissible non-scientific evidence under Rule 702 and *Kumho*\textsuperscript{200}? And finally, assuming that both questions are answered in the affirmative, is expert testimony as to the syndrome’s existence nevertheless inadmissible because scientific evidence automatically trumps contrary non-scientific expertise?

**A. The Admissibility of Expert Testimony that the Syndrome Does Not Exist as Scientific Evidence**

Prior to 1993, the prevailing view in the United States was that to qualify as admissible scientific evidence, expert testimony had to be based on a generally accepted theory.\textsuperscript{201} That standard was traceable to a 1923 case law decision by the District of Columbia Court of Appeals.\textsuperscript{202} That view dominated in federal as well as state court.\textsuperscript{203} However, in 1993 in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* the United States Supreme Court ruled that the general acceptance test no longer governed in federal practice. In his majority opinion, Justice Blackmun pointed out that Federal Rule of Evidence 402 provides that “[a]ll relevant evidence is admissible except as otherwise provided . . . ” under the Constitution, Act of Congress, the other provisions of the Rules of Evidence, or other rules promulgated by the Court pursuant to statutory authority such as the Federal Rules of Civil and Criminal Procedure.\textsuperscript{204} The justice noted that Rule 402 makes no mention of case or decisional law. The justice added that the statutory text of the Federal Rules contained no language which could reasonably bear the interpretation that it codified the general acceptance standard. The Court therefore concluded that the enactment of the Rules impliedly overturned the common-law general acceptance test. After holding that the general acceptance test was no longer good law in federal court, the Court derived a new validation test from the text of Federal Rule of Evidence 702. That statute refers in the alternative to “scientific, technical or other specialized knowledge.”\textsuperscript{205} In Justice Blackmun’s mind, the key question was the definition of “scientific . . . knowledge.” The Court decided against equating that expression with a set of substantive propositions in disciplines such


\textsuperscript{201} 1 Paul C. Giannelli & E. Imwinkelried, *Scientific Evidence* Ch. 1 (4\textsuperscript{th} ed. 2007). Most courts followed the general acceptance test announced in *Frye v. United States*, 293 F. 1013 (D.C.Cir. 1923).

\textsuperscript{202} Giannelli & Imwinkelried, supra note 201, at Ch. 1.

\textsuperscript{203} Recent Developments, 64 Cornell L.Rev. 875, 878-79 (1979); Note, 40 Ohio St.L.J. 757, 769 (1979).


\textsuperscript{205} Fed.R.Evid. 702, 28 U.S.C.A.
as physics, chemistry, and biology. Rather, drawing on several amicus briefs filed by scientific organization and individual scientists, the Court adopted an essentially methodological definition of the expression. Justice Blackmun elaborated; he stated that the trial judge must make a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue. Ordinarily, a key question . . . will be whether [the theory or technique] can be (and has been) tested. “Scientific knowledge . . . is based on generating hypotheses and testing to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquiry.” The focus . . . must be solely on principles and methodology, not on the conclusions they generate.

If the expert’s methodology is sufficiently reliable, the expert’s testimony is admissible. To assist trial judges in evaluating the soundness of the expert’s underlying methodology, Justice Blackmun listed a number of relevant factors: whether the theory is testable empirically, whether it in fact has been tested, whether the theory has been subjected to peer review and publication, whether the theory has a known or ascertainable error rate, and whether the theory is generally accepted. The justice made it clear that the experiments validating a theory need not be perfect. The justice emphasized that the Federal Rules have a “liberal thrust” and “a permissive backdrop.” Near the end of the opinion, he stated that proffered scientific evidence can be “shaky” yet admissible. Justice Blackmun explained that even when the underlying research is “shaky,” the opponent can use cross-examination, the presentation of contrary evidence, and judicial instructions to expose the weaknesses and help the jury intelligently assess the weight of the evidence.

The critical question is whether under Rule 702, based in part on Dr. Duhaime’s experimental data, an expert should be allowed to opine that the shaking of an infant by an adult cannot generate sufficient force to cause the brain injuries which are symptomatic of the syndrome. How do the Daubert factors apply here? Dr. Duhaime subjected that hypothesis to empirical testing, and on several occasions—in 1987, 1992, and 1998—published her data

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207 509 U.S. at 592-93.

208 509 U.S. 579, 593-94 (1993). Even though general acceptance is no longer the litmus test, it remains a pertinent consideration. If a theory has gained general acceptance, presumably several other experts have examined the underlying research and found it to be methodologically sound.


213 Duhaime 1987, supra at note 176.
and reasoning in peer-reviewed professional journals. Admittedly, her experiments were imperfect. Her test subjects were anthropomorphic dummies rather than infants, but the rules of medical ethics would preclude testing with vulnerable infants. Dr. Duhaime and her co-researchers went into great detail describing the features of the dummies to permit other scientists to review and critique her experiment. In many respects, the researchers obviously made a bona fide effort to simulate an infant’s physiology. For example, they made certain that the circumference, diameter, and height of the model head were "comparable to human infants." To compensate for the fact that “the mechanical properties of the infant neck have not been studied,” the researchers utilized three different neck designs in the dummies.

Opponents of the introduction of this testimony may argue that the general acceptance factor cuts against the admission of this testimony. Many of the proponents of the syndrome find Dr. Duhaime’s research unpersuasive. There is currently a “significant,” “fierce” debate over the question of whether the syndrome exists. In particular, the position statement of the National Association of Medical Examiners’ Ad Hoc Committee on Shaken Baby Syndrome questions whether the model of dummy used in the experiment “necessarily truly resembles the immature human infant skull and brain.” However, even this “opposition” to the testimony is rather weak. The Ad Hoc Committee does not assert that the features of the dummies definitely do not resemble those of a human infant. Rather, the committee states only that the features do not “necessarily resemble[]” those of human babies. That statement could be made about virtually any biomechanical experiment in which models are substituted for human subjects.

214 Duhaime 1992, supra at note 163.


218 Duhaime 1987, supra note 176, at 411.

219 Duhaime 1987, supra note 176, at 411.

220 Duhaime 1987, supra note 176, at 411-12.

221 State v. Edmunds, 308 Wis.2d 374, 746 N.W.2d 590, 596 (App. 2008).

222 State v. Edmonds, 308 Wis.2d 374, 746 N.W.2d 590, 599 (App. 2008).


224 Case, supra note 41, at 114.
The bottomline is that Dr. Duhaime’s line of research evidenced relatively sound scientific methodology; the research consists of carefully designed experiments that remain one of the few serious empirical investigations into the question of how much force shaking by an adult can apply to an infant’s brain. In his experiment, Dr. Jones used a headform complying with specifications recommended by the British Standard Institution and the American Society for Testing Materials. As the Ad Hoc Committee noted, there are doubts about whether important features of the models used in these experiments correspond to those of human infants. However, in large part those doubts exist because, as Dr. Duhaime noted in her 1987 article, little is known about the mechanical properties of various parts of the infant’s body such as the neck.  

Moreover, the differences between an infant’s head and neck and those of the models are obvious and can easily be explored by cross-examination and contrary expert testimony, the techniques Justice Blackmun mentioned in Daubert. That exploration may shake the trier of fact’s faith in testimony that the syndrome does not exist; but as Justice Blackmun stated in Daubert, even if the scientific underpinning of an expert theory is “shaky,” testimony can be admissible. If a jury is asked to decide whether an adult accused killed an infant by violently shaking the infant, it is difficult to argue that this experimental data would not be of genuine assistance to the trier. In short, it should be held admissible under the Daubert standard for purportedly scientific expertise.

B. The Admissibility of Testimony That the Syndrome Does Exist as Non-Scientific Expertise

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Federal Rule of Evidence 702

In Daubert, the Court dealt with purportedly scientific expertise. In footnote, the Court cautioned that its discussion was “limited to the scientific context because that is the nature of the expertise offered here.” The statute, Rule 702, though, is worded in the alternative: “scientific, technical or other specialized knowledge.” The question arose whether Daubert’s reliability test and the same Daubert factors control the admissibility of non-scientific expertise. The Court reached that question in 1999 in Kumho.

On the one hand, the Court ruled that whether the witness’s expertise is characterized as scientific or non-scientific, the proponent must make a showing that the testimony is reliable. The Court reiterated the comment that it had made in 1997 in General Electric v. Joiner that

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226 509 U.S. at 590 n. 8.


the expert’s opinion must rest on more than his or her ipse dixit. The Kumho Court explained that the statutory source of the reliability requirement is Rule 702's reference to “knowledge.” The three adjectives, scientific, technical, and specialized, all modify that noun. The statute mandates that however the expertise is characterized, it must amount to reliable “knowledge,” not mere subjective belief.230

On the other hand, while the basic Daubert reliability requirement applies across the board, Justice Breyer stated that the factors listed in Daubert might not govern the evaluation of non-scientific expertise. He wrote that the types of expertise are so varied that in some cases, it would be inappropriate to rely on the factors listed in Daubert. Not only might some of those factors be inappropriate; the justice added that the trial judge has discretion to identify and apply other factors as “reasonable measures” of the reliability of the testimony.231

Suppose that based on Caffey’s collection of anecdotal data, an expert offers to testify that shaken baby syndrome exists. Would that testimony pass muster under Rule 702 and Kumho? It is submitted that the answer is Yes. That body of data certainly represents more than ipse dixit by Dr. Caffey and the other proponents of the syndrome. Like Dr. Duhaime’s experiments, in some respects Dr. Caffey’s reasoning is “shaky.” As previously stated, in some of the cases Caffey mentions the shaking may have been minor, in at least one case there was an impact, and there are good reasons to suspect that some of the other reports are incomplete. A custodian could have been so traumatized by seeing the infant’s head impact an object or surface that the custodian repressed the memory, or a custodian might intentionally suppress that fact to minimize his or her culpability. Nevertheless, in his 1972 and 1974 articles Dr. Caffey collected more than 30 documented cases in which there was no evidence of an impact but either the custodian admitted or an eyewitness observed shaking. There are doubts about the reliability of both confessions232 and eyewitness testimony,233 but common sense suggests that in at least a significant percentage of these cases the reports were likely true— even absent impact the post-shaking autopsies yielded findings of the subdural hematoma and retinal hemorrhages characteristic of the syndrome. Further, as the Ad Hoc Committee stressed, “many forensic pathologists” subscribe to the syndrome because they have heard “confessions by perpetrators or [reports by] witnesses” indicating that there was shaking without impact.234

230 526 U.S. at 147.

231 526 U.S. at 152-53.


234 Case, supra note 41, at 114.
Kumho teaches that in evaluating the admissibility of non-scientific expertise such as opinions based on anecdotal data, trial judges should adopt a broad rationalist perspective, not a narrow scientific viewpoint. Any objective analyst would say that cumulatively, this anecdotal data supports a logical inference that even without impact, shaking by an adult can cause fatal brain injuries in infants. On cross-examination an opposing attorney can force the expert to concede that it is possible that the confessing custodians repressed the memory of the impact or deliberately suppressed that detail. In addition, on the assumption that testimony based on Dr. Duhaime’s research is admissible, the opponent can present the sort of contrary expert testimony that Justice Blackmun mentioned in Daubert. Expert testimony based on Dr. Caffey’s data may be assailable on several grounds; but from a rationalist perspective, it certainly would be of help to a jury attempting to decide whether the syndrome exists. It therefore satisfies Rule 702's requirement that the proffered expert testimony “assist the trier of fact . . . to determine a fact in issue.”

Federal Rule of Evidence 403

Of course, Rule 702 is not the only hurdle to the admission of expert testimony. Federal Rule 403 authorizes a trial judge to exclude otherwise admissible evidence when the judge concludes that the attendant probative dangers substantially outweigh the probative value of the evidence. As Justice Blackmun noted in Daubert, the trial judge may invoke Rule 403 when he or she believes that there is a grave danger that the jury will assign undue weight to the testimony. However, today there is less reason to fear that jurors will overvalue syndrome testimony because, in many cases, the facts of the case will permit the defense to propose an innocent, alternative explanation for the supposedly characteristic symptoms of the syndrome. Consider, for example, the presence of a subdural hematoma. Subdurals can have natural causes such as a ruptured berry aneurism, congenital bleeding problems, or the rebleed of a pre-existing older hematoma. In addition, a review of Consumer Product Safety Commission data


on playground equipment injuries by Dr. John Plunkett indicated that even short falls by infants can produce hematoma if the manner of the fall generates adequate rotational force. Dr. Plunkett studied 18 deaths which occurred between January 1988 and June 1999 and found that falls of between two and 10 feet had produced hematoma and death. Dr. Plunkett’s conclusion has been sharply disputed but the availability of Dr. Plunkett’s study significantly reduces the risk that the jury will automatically leap from a finding of subdural hematoma to the conclusion that the infant in question was shaken to death.

Now consider the other classic symptom of the syndrome, namely, retinal hemorrhages. The position statement of the Ad Hoc Committee on Shaken Baby Syndrome states that such hemorrhages are “not specific” to the syndrome. Retinal hemorrhages can be occur during

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240 John Plunkett, Fatal Pediatric Head Injuries Caused by Short Distance Falls, 22 Amer.J. Forensic Med. & Path. 1 (2001). See also Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 711-12.

241 People v. Smith, 2008 WL 607577, at *5 (Cal.App. Mar. 6, 2008)(“Dr. Persaud conceded that some studies existed in reputable publications concluding . . . that short falls can cause this type of injuries. Dr. Persaud expressed her certainty that the injuries in this case could not have been caused by that kind of short fall”); Caban v. State, 9 So.3d 50, 52 (Fla.Dist.Ct.App. 2009)(“Dr. John Tilelli testified that Dr. Plunkett’s opinion was not supported or substantiated by his data and that Dr. Plunkett’s interpretation of his data is incorrect”).

242 Case, supra note 41, at 117. See also Timothy J. David, Non-Accidental Head Injury–The Evidence, 38 Pediatr. Radiol. (Suppl.) S370, S374 (2008)(listing 56 possible causes of retinal hemorrhage); Jakob Matschke, Klaus Puschel & Markus Glatzel, Ocular Pathology in Shaken Baby Syndrome and Other Forms of Infantile Non-Accidental Head Injury, 123 Int’l J. Legal Med. 189, 193 (2009)(“There are substantial numbers of cases reporting RH in infants due to apparently innocent causes, or in the context of a variety of medical diseases . . . .”); D. G. Talbert, Shaken Baby Syndrome: Does It Exist?, 72 Med. Hypotheses 131, 133 (2009)(“Reinopathy occurs for many reasons . . . . The condition described is consistent with intracranial venous hypertension resulting from feed aspiration, such as violent coughing, or high intrathoracic pressures necessary in attempted cardio-pulmonary resuscitation following apnea”); Johnny Tang, Sheldon M. Buzney, Kameron Lashkari & John J. Weiter, Shaken Baby Syndrome: A Review and Update on Ophthalmologic Manifestations, 48 Int’l Ophth. Clinics 237 (2008)(“these hemorrhages can result from other mechanisms as well. [T]here are many causes for retinal hemorrhages in infants. Other causes of retinal hemorrhage in infants include birth (traumatic and otherwise), coagulopathy, severe accidental trauma, central nervous system infection, Purtcher syndrome, Terson syndrome from other causes, cardiopulmonary resuscitation, seizures, near drowning, Valsalva, and ocular and central nervous system surgery”); Day v. Quarterman, 566 F.3d 527, 531 (5th Cir. 2009)(a prosecution witness, Dr. Joel Leffler, a pediatric ophthalmologist, testified that “retinal hemorrhaging in infants ha[s] several causes . . . .”). But see V. Sturm, P. B. Knecht, K. Landau & M. N. Menke, Rare Retinal Haemorrhages in Translational Accidental Head Trauma in Children, 23 Eye 1535 (2009)(there
vaginal childbirth. In addition, they can be caused by the administration of Hepatitis B vaccine or extensive CPR, especially when it is administered by untrained personnel. If parents placed a 911 call after finding their infant unconscious and the responding EMT personnel administered CPR too vigorously, the defense might propose that the CPR accounted for the infant’s retinal hemmorhages.

To be sure, some prosecution experts “believe” that the combination of symptoms “only results from SBS.” However, that defense can challenge the belief that the combination is “evidence that there are strong differences between the ocular involvement in accidental translational trauma and those in victims of non-accidental trauma”); Robert M. V. Superior Court, 2008 WL 3844740 (Cal.App. Aug. 19, 2008)(a prosecution witness, Dr. Tawasny “had a clinical and research interest in retinal hemmorhages and its etiology, including shaking baby syndrome, and how to distinguish retinal hemmorhages caused by shaken baby syndrome from retinal hemmorhages which derived from one of numerous other etiologies”).


Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 707. See also Manof V. Parulekar & John S. Elston, Letter to the Editor, 50 Developmental Med. & Child Neurology 793 (2008)(“it provides a skewed perspective on the subject [to] focus[] on subdural haemmorhages in isolation. It ignores another important finding—the presence of retinal haemmorhages . . . .”); Note, Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept, 2003 Utah L.Rev. 1109, 1123 n. 106, citing Johnson v. Sec’y of Health & Human Services 1997 WL 368375, at *5 (Fed.Cl. Apr. 29, 1997)(“To summarize, this evidence indicates that when an infant has the particular combination of injuries that Devin had (i.e. subdural hematoma, brain swelling, and retinal hemmorhages) such injuries are very likely to have been caused by physical trauma”).
pathognomic or unique to shaken baby syndrome. If the prosecution offers testimony to that effect the defense can retort that aside from anecdotal evidence, there are no published experiments or systematic studies substantiating that belief. The upshot is that in a significant percentage of cases, the defense will be able to suggest to the jury that there is a benign explanation for the brain injuries which are supposedly symptomatic of shaken baby syndrome. The availability of those arguments to the defense reduces the risk of jury over-evaluation of syndrome testimony and renders the testimony less vulnerable to a Rule 403 objection.

C. If a Judge Concludes That Testimony the Syndrome Does Not Exist Is Admissible Scientific Expertise But Also Would Otherwise Conclude That Testimony as to the Syndrome’s Existence Is Admissible Non-Scientific Expertise, Does the Former Conclusion Require the Judge to Exclude Testimony that the Syndrome Exists?

In a 2008 case, Martin, the Court of Appeals of Kentucky confronted this question. In Martin, the prosecution relied on Ommaya’s and Caffey’s publications as support for its position that expert testimony about shaken baby syndrome is admissible. Predictably, the defense countered by citing Dr. Duhaime’s work. The trial judge ruled the prosecution evidence inadmissible. In the words of the appellate court, the judge “drew a distinction between the ‘scientific’ and ‘clinical’ communities . . . .” The trial judge reasoned that the defense testimony was full-fledged scientific evidence while as “clinical” evidence the prosecution testimony was inferior.

The appellate court held that the trial judge erred in excluding the prosecution testimony. The court faulted the trial judge for “giving greater weight to ‘scientific’ as opposed to ‘clinical’ studies.” The court found that in doing so, the judge had exceeded his legitimate gatekeeping role and “assess[ed] the weight of the testimony” rather than making a limited admissibility ruling. The court cited Daubert as precedent that when proffered expert testimony satisfies the basic reliability standard announced in Daubert, the trial judge ought to admit the testimony but permit the opponent to attack its weight through cross-examination and “presentation of

247 Laura Dupaix, Linda Jones & Christina Jepson Schmutz, Interpreting Rules and Constitutional Provisions, Utah Bar J. 29, 31 (Mar./Apr. 2008)(“Within the past couple of years, studies have demonstrated that the symptoms Dr. Walker identified for shaken baby syndrome are indicative of other nonviolent events”).


249 2008 WL 2388382, at *2.

250 2008 WL 2388382, at *2.

251 2008 WL 2388382, at *2.


contrary evidence.”  In Martin, the trial judge in effect resolved the battle of the experts by holding that scientific expertise trumps non-scientific clinical expertise. The appellate court rejected that holding. The court believed that the jury was “fully capable of understanding and evaluating” the weaknesses in the two types of studies. The trial judge should have permitted the jury to resolve the battle between the “dueling, but well-qualified’ experts . . . ”

The Martin court reached the right result. As Justice Blackmun emphasized in Daubert and the Advisory Committee Note accompanying the 2000 amendment to Rule 702 reaffirmed, when qualified experts propose testifying to conflicting theories at trial, the judge’s task is not to decide which theory or conclusion is correct. Rather, the judge’s province is to examine the foundational testimony supporting each theory and inquire whether that testimony includes sufficient, methodologically sound reasoning to validate the theory. The judge’s limited authority is to scrutinize the expert’s methodology rather than his or her conclusion.

In rare cases, it is conceivable that one side’s foundational testimony is so overwhelming that it dictates the conclusion that the opposing expert’s methodology is flawed. On its facts,

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254 2008 WL 2388382, at *8.
257 2008 WL 2388382, at *8. See also Edward J. Imwinkelried, The Judge as Daubert Gatekeeper: Adapting Old Maps to the Unfamiliar Terrain of the “Brave New World,” in Proceedings of the National Conference on Science and the Law 46, 64 (2000) (“In its [opening] brief in Daubert, Merrell Dow Pharmaceuticals argued for the exclusion of the plaintiffs’ testimony about the epidemiological reanalysis. However, Merrell Dow conceded that, if the courts abandoned Frye and shifted to an empirical validation standard, there would be times when it would be appropriate for the trial judge to submit the ‘battle of the experts’ to the jury. Merrell Dow acknowledged that there might be ‘several competing . . . [scientific] claims’ which satisfied a validation standard. In the words of Merrell Dow’s brief, the state of the research record might be such that there could be a ‘genuine debate in the scientific community’”).
258 509 U.S. at 595.
260 Edward J. Imwinkelried, The Judge as Daubert Gatekeeper: Adapting Old Maps to the Unfamiliar Terrain of the “Brave New World,” in Proceedings of the 1999 National Conference on Science and the Law 46, 65-66 (2000) (“The fact pattern in Daubert itself can be used to illustrate [this] stage. As Professor Faigman and his colleagues have quite correctly pointed out, Daubert was a unique fact situation. In a Bendectin case preceding Daubert, Ealy v. Richardson-Merrell, Inc., [879 F.2d 1159 (D.C.Cir. 1990), cert.denied, 510 U.S. 1193 (1994)], Judge Abner Mikva emphasized that the question was not so much the validity of the plaintiff’s epidemiological reanalysis considered in isolation. Rather, the real hurdle for the plaintiffs was that their evidence was arrayed against a ‘massive’ ‘wealth’ of contrary, published epidemiological studies reaching a contrary conclusion. Judge Mikva characterized the defense evidence as an ‘overwhelming body of contradictory epidemiological evidence.’ He
Daubert approached qualifying as such a case. In Daubert, both sides presented epidemiological evidence on the question of whether a mother’s ingestion of Bendectin during the first trimester can cause limb defects in the mother’s child. The defense submitted 30 published epidemiological studies, uniformly finding that there was no statistically significant relationship between a mother’s use of Bendectin and the incidence of limb defects. The plaintiffs responded by presenting evidence of an unpublished metanalysis—a plaintiffs’ expert had pooled the data from the published epidemiological studies, renalyzed it, and was prepared to testify that he had teased a statistically significant relationship from the data. As several courts have commented, the state of the empirical data on Bendectin was unique.261 One side presented a huge number of well-designed epidemiological studies which had been published and which consistently found no statistically significant relationship. The other side had to rely on a single unpublished epidemiological study which seemed to come to a contrary conclusion. The corpus of data favoring the defense’s position was so much larger than the body of data favoring the plaintiff’s position that it could naturally lead a dispassionate analyst to suspect that there must have been a methodological flaw in the plaintiffs’ expert’s reasoning.262

The state of the record on shaken baby syndrome is readily distinguishable from the record on Bendectin. To begin with, the quantities of evidence on the two sides of the syndrome dispute are much more equally balanced. Prosecution experts can point to two anecdotal collections by Caffey and the experience of “many forensic pathologists”263 who have investigated cases in which custodians reported shaking without impact. For their part, defense experts can cite the experiments conducted by Dr. Duhaime and her colleagues as well as the research Dr. Jones described in Basuto. This record is markedly different than the lopsided record in Daubert where a single unpublished study was pitted against 30 published studies.

Moreover, in Daubert it would be much easier to infer that the methodology of the unpublished study must have been flawed. All the studies—the 30 published ones and the single unpublished study—were drawn from the same discipline, epidemiology. In contrast, here experimental scientific data is matched against non-experimental anecdotal data. When the two sides rely on different types of studies, the fact that the two kinds of studies yield conflicting findings does not dictate the conclusion that the methodology of either type of study was unsound. If the judge intervenes in this situation and altogether bars testimony about one type of study, the judge is not merely passing on the studies’ methodology; rather, the judge is almost inevitably deciding which expert’s conclusion is correct—the very determination that Daubert forbids the judge from making.264

distinguished the Bendectin litigation from ‘a classic battle of the experts,’ where the state of the research supporting the competing claim is more evenly balanced. In Daubert, Justice Blackmun noted that several courts of appeal had found that there was a ‘massive weight’ of epidemiological research rebutting the plaintiff’s expert’s theory.” 509 U.S. at 482-83 (1993)).

261 See note 260, supra.

262 See note 260, supra.

263 Case, supra note 41, at 114.

In that light, if the judge is going to exclude otherwise admissible prosecution testimony about shaken baby syndrome based on non-scientific expertise, the judge must take the same approach as the trial judge in *Martin*: At least implicitly the judge must reason that a conclusion adequately supported by scientific expertise necessarily trumps a conclusion adequately based on non-scientific expertise.

As a matter of statutory construction and epistemology, that approach is indefensible. Rule 702 is worded in the alternative, “scientific, technical or other specialized knowledge.” The statute indicates that a proponent is entitled to introduce expert testimony if the proponent lays a sufficient foundation qualifying the testimony as “scientific, technical . . . or . . . specialized” knowledge. The statute neither states nor implies that the proponent must qualify his or her proffered testimony as “scientific” expertise simply because the opposing litigant has chosen to present that precise type of expertise. Neither the original Advisory Committee Note to Rule 702 nor the new Note accompanying the 2000 amendment to 702 contains that suggestion.

The approach is equally unacceptable from the perspective of epistemology. There should not be a rigid bias in favor of scientific evidence. One of the authorities cited by the Daubert Court was John Ziman, the author of *Reliable Knowledge: An Exploration of the Grounds for Belief in Science*. In that very text, Ziman remarked that it is “naive” to think “that all science is necessarily true and that all true knowledge is necessarily scientific . . . .” When a scientific analysis leads to a different conclusion than an otherwise sound rational, non-scientific analysis, it is doctrinaire to assume that the latter conclusion is necessarily false. Again and again, propositions regarded as scientific truths have been discredited by later research. It would be silly for the courts to embrace the dogmatic view that scientific expertise must always prevail in a clash with rationally developed non-scientific expertise.

IV. CONCLUSION

The one thing that all sides agree on is that further research is necessary. Some commentators have called for a comprehensive investigation by the National Academy of Science. The state of the data on the second proposition underlying shaken baby syndrome is incomplete; at present, we cannot define with any precision the amount of force required to produce the characteristic symptoms in human infants. Worse still, the data on the third essential proposition are conflicting. The experimental data developed by Drs. Duhaime and Jones indicate that shaking alone cannot generate the required amount of force while the anecdotal data compiled by Dr. Caffey point in the opposite direction. In the future, it may be possible to improve the head and neck components of the anthropomorphic dummies used in the

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biomechanical experiments to better approximate the properties of infants’ heads and necks. Additional animal experiments may shed further light on the truth of these propositions. There is a promising, ongoing line of research involving piglets. University of Pennsylvania researchers, including Dr. Susan Margulies, have released several articles based on this research during the past decade. There have already been some references to this research in the shaken baby syndrome litigation.

In the meantime, though, the crucial question is how should the courts treat syndrome evidence before more and better empirical data are available. The data furnished by Drs. Duhaime and Jones are prompting a more cautious approach to the syndrome. A new skepticism about the syndrome is evident in other countries, including Australia, Canada, Japan, and


272 Comment, Shaken Baby Syndrome: Medical Uncertainty Casts Doubt on Convictions, 2007 Wis.L.Rev. 701, 722.

the United Kingdom. In the United States, acquittals in shaken baby syndrome cases are more frequent today. Some American experts have changed their minds about the validity of the syndrome. At least two courts are rethinking their position on the admissibility of testimony about the existence of the syndrome. Furthermore, prosecution experts’ testimony on the subject is becoming more guarded; some now use the expression, “abusive head trauma,” rather than “shaken baby syndrome.”

However, the more circumspect wording of such trial testimony should not be permitted to gloss over the fact that there is presently a lively, legitimate debate in the relevant expert circles over the validity of the syndrome. The thesis of this article is that when both sides in such a debate can reason with sound expert methodology, based on logically adequate data, the trial judge should not usurp the jury’s role by endeavoring to decide which side’s conclusion is correct. As one federal District Court wrote in mid-2009,

*Daubert* does not require that a party who proffers expert testimony carry the burden of proving to the judge that the expert’s assessment of the situation is correct. As long as an expert’s scientific testimony rests upon “good grounds, based on what is known,” . . . it should be tested by the adversary process . . . rather than excluded from the jurors’

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277 Tuerkheimer, supra note 276.

278 See note 101, supra.

279 State v. Sayles, 662 N.W.2d 1, 5 (Iowa 2003); State v. Broyles, 272 Kan. 823, 826, 36 P.3d 259, 263 (2001); Taylor v. Commonwealth, 2009 WL 485034, at *3 (Ky.App. Feb. 27, 2009); State v. Candela, 929 S.W.2d 852, 860 (Mo. 1996). See also Allen G. Breed, Shaken-Baby Syndrome Is Questioned, Los Angeles Times, May 20, 2007, at A-14 (“Dr. Robert Reece, a Boston pediatrician, is on the international advisory board of the National Center on Shaken Baby Syndrome, but he avoids using the term in a courtroom. In testimony, he refers to ‘abusive head trauma’ or ‘inflicted traumatic brain injury,’ though he still believes shaking alone can cause it”); Cindy W. Christian, Robert Block & the Committee on Child Abuse and Neglect, Abusive Head Trauma in Infants and Children, 123 Pediatrics 1409, 1411 (2009)(the Committee on Child Abuse and Neglect of the American Academy of Pediatrics has recommended that “[p]ediatricians should use the term ‘abusive head trauma’ rather than a term that implies a single injury mechanism, such as shaken baby syndrome”).

scrutiny for fear that they will not grasp its complexities or satisfactorily weigh its inadequacies . . . In short, *Daubert* neither requires nor empowers trial courts to determine which of several competing . . . theories has the best provenance. It demands only that the expert’s conclusion has been arrived at in a scientifically sound and methodologically reliable fashion.\(^{281}\)

As Part III.B noted, the availability of alternative, innocent explanations for the supposed symptoms of the syndrome decreases the risk that the jury will overvalue the prosecution testimony about the syndrome. Yet, its availability also raises a fundamental, countervailing concern: Will the state of the empirical record put the jury in an impossible position and force the jury to arbitrarily guess in order to decide the case? That fear can easily be overstated. These alternative possibilities will raise doubts in reasonable jurors’ minds only if the facts of the particular case make it plausible to think that these other possibilities materialized in the case. Negatively, suppose that the testimony in the case indicates that: Eyewitnesses who observed the child for hours before the child lapsed into unconsciousness did not see the child fall or sustain any other impact, the child had not received a Hepatitis B vaccination, and the autopsy found no evidence of a ruptured berry aneurism or an older hematoma that rebled.\(^{282}\) Affirmatively, the record contains either the custodian’s admission or ample eyewitness testimony that the infant was strongly shaken. The negative testimony renders most of the possible innocent explanations inapplicable in the instant case. Conventional process of elimination reasoning would then come into play to greatly strengthen the inference that on the facts of this case, shaken baby syndrome is the best fit for the facts and the most likely cause of the child’s death.\(^{283}\) Given that record, the jury’s choice to draw that inference would be a perfectly sensible decision, not an arbitrary guess or conjecture. The choice would not be an inexorable one, but it would be reasonable.

In these cases, the jury’s task is to make a rational decision despite the uncertainty created by the empirical record on shaken baby syndrome. Shaken baby syndrome prosecutions are not the only cases that present the jury with that challenge. In truth, whenever a jury must decide whether to accept an expert’s opinion, it must decide whether the available data has


\(^{282}\) Although the age of a hematoma cannot be determined precisely, the color of the blood within the hematoma is a helpful clue to whether it is a new or old hematoma. Matthew D. Ramsey, A Nuts and Bolts Approach to Litigating the Shaken Baby Syndrome, 118 Mil.L.Rev. 1, 35 (2006)(“When the dura is cut and removed [during the autopsy], a subdural hematoma can be seen. This blood will appear bright red if it is ‘acute’ and the color of port wine or ‘crank case oil’ if it is older. ‘Chronic’ or older subdurals will be darker in color and may leave an iron stain on the dura the color of port wine, brown or yellow”). In addition, the older the hematoma, the more likely it is to adhere to the dura. People v. Swart, 369 Ill.App.3d 614, 625, 860 N.E.2d 1142, 1153, 308 Ill.Dec. 60, 71 (2006).

\(^{283}\) See generally Edward J. Imwinkelried, The Admissibility and Legal Sufficiency of Testimony About Differential Diagnosis (Etiology): Of Under- and Over-Estimations, 56 Baylor L.Rev. 391 (2004)(process of elimination reasoning is a valid logical technique; the courts often resort to this mode of reasoning in their opinions; in addition, the courts permit experts to rely on such reasoning in the form of differential diagnosis and differential etiology testimony).
reduced the uncertainty to a tolerable level to satisfy the applicable burden of proof. One of the most important passages in the *Daubert* decision was Justice Blackmun’s observation that “arguably, there are no certainties in science.”\(^{284}\) In making that observation, the justice drew heavily on several of the amicus briefs filed by scientific organizations. Those briefs attempted to educate the Court about the modern understanding of the limits of the scientific process.\(^{285}\) Scientific investigations often rely on inductive reasoning: If enough experimental outcomes bear out an hypothesized connection between \(A\) and \(B\), the researcher will generalize that there is indeed a connection between the two. However, no matter how many experiments have yielded the same outcome, another experiment is always conceivable; and consequently there is always a possibility of falsification of the hypothesis. In principle, inductive reasoning can never validate a proposition absolutely or conclusively. The scientific process cannot provide the jury or judge with an absolutely certain answer.

In some cases, the available empirical data are so scanty and the uncertainty is so extreme that the court should not permit any expert to proffer an opinion, based on the data, to the trier of fact.\(^{286}\) In other cases, though, the available data will be more complete but conflicting. The *Daubert* Court recognized this possibility. In one passage Justice Blackmun stated that the proponent’s testimony could be “shaky” but admissible.\(^{287}\) In another passage, the justice added that opponent could counter the proponent’s “shaky” testimony by presenting “contrary evidence”—a classic battle of the experts.

The controversy over shaken baby syndrome is illustrative. The proponents of the syndrome have marshaled persuasive anecdotal evidence. In the anecdotal cases, autopsies found fatal brain injury accompanied by subdural hematomas, retinal hemmorhages, and brain swelling while credible lay evidence in these cases established shaking without impact. For their part, the syndrome’s opponents have presented fairly well-designed experiments which raise serious doubts that shaking alone can generate the amount of force needed to cause these brain injuries in infants. Both sides’ evidence is assailable. The proponents’ is assailable due to the possibility that the anecdotal reports intentionally or unintentionally omitted mention of impacts. The opponents’ evidence is questionable because of doubts about the head and neck components of the dummies used in the leading experiments. This case is radically different than the *Daubert* record where one side’s evidence was overpowering. Here the conflict is much more evenly balanced. This is a genuine battle between scientific and non-scientific expertise.


\(^{286}\) Of course, although no scientific opinion is possible, a legal judgment will follow: The party assigned the burden of proof will lose.

\(^{287}\) 509 U.S. at 596.