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The Supreme Court Screws Up the Science: There Is No Abusive Head Trauma/Shaken Baby Syndrome "Scientific" Controversy

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I. INTRODUCTION

A. Litigation-Driven Science and Manufactured Controversies

Even if it is *not* true that law school is the consolation prize for those whose freshman biology grades make medical school impossible, judges, law professors, and lawyers are not (as a general rule) scientists. But they increasingly shape our understanding of scientific ideas by determining how law interprets and applies scientific information and by ensuring that bad science does not create bad law.[1] As law becomes more science-dependent and expert witnesses play a greater role in a wide range of criminal and civil cases, there has been a concomitant increase in the need

> to ensure that the expert testimony admitted [at trial] is not just flimsy or interested speculation, but reliable enough to be more helpful than misleading; and one factor that courts have sometimes taken as indicating that proffered scientific testimony may *not* be reliable is that it is based on "litigation-driven" science.[2]

 Professor of Law, Associate Dean for Faculty Research & Development, Florida International University College of Law. For K.L.M. Twenty years later, not much in here that seems appropriate for an anniversary, but for my money Mark Knopfler and Emmylous Harris got it just about right.

 Assistant District Attorney General and Child Abuse Team Leader, Davidson County District Attorney's Office, Nashville, Tennessee. For Wendy, Lauren and Andrew, my sanctuary.

[1] Susan Haack, *What's Wrong with Litigation-Driven Science? An Essay in Legal Epistemology*, 38 SETON HALL L. REV. 1053, 1054 (2008) ("Because the factual truths at issue in a case often go beyond what the average juror can be expected to know, courts have come increasingly to rely on expert witnesses, among them scientists testifying on just about every subject imaginable: experts on blood, bullets, bite marks, battered wives; on PCBs, paternity, poisons, posttraumatic stress; on radon, recovered memories, rape trauma syndrome, random match probabilities; on psychosis, asbestosis, silicosis (and for all I know, on psittacosis!).").

[2] *Id.* (emphasis added); *see also* Ronald J. Allen & Esfand Nafisi, Daubert *and Its Discontents*, 76 BROOK. L. REV. 131, 138 (2010) ("The concern, expressed in a roundabout way, is that scientists conducting litigation-driven science are more likely to succumb to biases, leading them to commit fraud or to fudge the data."); D. Michael Risinger & Michael J. Saks, *Rationality, Research and Leviathan: Law Enforcement-Sponsored*

Litigation-driven science compromises the judicial system's overarching goals of pursuing accurate and just results. As Professor Susan Haack has explained, research "undertaken for the purpose of finding evidence favoring one side in litigation, and explaining away or otherwise playing down evidence favoring the other side [is] . . . advocacy research . . . inherently in danger of bias."[3] Moreover, litigation-driven science creates critical problems in the full range of science-dependent legal contexts because it invariably "tends toward the predetermined conclusion irrespective of where the evidence points; the results it produces don't depend on where the evidence really leads."[4]

Litigation-driven science, like the policy-driven science that motivates so-called scientific debates over evolution and climate change, may be difficult for nonscientist judges and jurors to accurately identify and assess.[5] Misunderstandings are also more likely to increase than to abate, given the general public's troubling lack of basic scientific knowledge illustrated by the fact that 53% of adults do not know how long it takes for the earth to revolve around the sun, 41% believe that the earliest humans and dinosaurs lived at the same time, and 47% cannot even roughly approximate how much of the earth's surface is covered with water.[6] Moreover, for better or worse, the jury selection process virtually guarantees the exclusion of prospective jurors who have subject matter knowledge in the areas that are the focus of the litigation.[7] Under these circumstances,

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Research and the Criminal Process, 2003 MICH. ST. L. REV. 1023, 1036 (2003) ("Unlike the law, the culture of science as a general proposition is specifically and fully committed to rationality in the process of inquiry and conclusion. Of course, science does not completely achieve this unattainable goal, and it sometimes falls shorter than we would like to believe, but nevertheless its paramount goal is unambiguous.").

[3] Haack, *supra* note 1, at 1075; *see also* William L. Anderson et al., Daubert*'s Backwash: Litigation-Generated Science*, 34 U. MICH. J.L. REFORM 619, 622 (2001) ("The scientific and legal communities need to recognize the peculiar risks posed by litigation science, ensure disclosure of its source, and require thorough peer review and independent guarantees of its reliability before letting it into either the scientific realm or the courtroom."); Michelle S. Simon & William Pentland, *Reliable Science: Overcoming Public Doubts in the Climate Change Debate*, 37 WM. & MARY ENVTL. L. & POL'Y REV. 219, 261 (2012) (explaining that *Daubert* reflected the Supreme Court's concern with litigation-driven science and describing the overlapping problems with litigation-driven and policy-driven science).

[4] Haack, *supra* note 1, at 1077.

[5] *See generally* SUSAN JACOBY, THE AGE OF AMERICAN UNREASON 210–41 (2008) (explaining that "junk thought," which creates confusion by using the language of science to promote irrationality and unreason, has gained increased social respectability over the past half century and is rooted in a suspicion of legitimate experts and unaffected by scientific research).

[6] *American Adults Flunk Basic Science*, SCI. DAILY (Mar. 13, 2009), http://www.sciencedaily.com/releases/2009/03/090312115133.htm.

[7] *See generally* PAUL STERN, PREPARING AND PRESENTING EXPERT TESTIMONY IN CHILD ABUSE LITIGATION: A GUIDE FOR EXPERT WITNESSES AND ATTORNEYS 2–5 (1997)

nonscientist legal fact-finders need all the help they can get to distinguish legitimate science from its counterfeits.[8]

These systemic problems are exacerbated by the instant accessibility of all sorts of scientific-sounding information, which has "dramatically reshaped our relationship to the world of knowledge."[9] For example, Internet research on climate change, evolution, or childhood vaccine safety yields a range of information from specious speculation to sound science. Easy access to misinformation complicates lay analysis of scientific questions creating a "hyper-democratization of data"[10] that "unmoor[s] information from the context required to understand it."[11]

It has been two decades since the Supreme Court decided *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,[12] which was intended to force federal judges to enhance the quality of the scientific evidence used to decide legal cases. Most

(explaining the jury selection process); Brian Holmgren, *The Expert Witness*, 36 NEW ENG. L. REV. 593, 593–94 (2002) (same).

[8] Robert Camp, *Turn Out the Lights, the "Teach the Controversy" Party's Over*, SKEPTICAL ENQUIRER (Feb. 25, 2006), *available at* http://www.csicop.org/specialarticles/show/turn_out_the_lights_the_teach_the_controversy_partys_over (noting that the existence of a "scientific controversy" involving evolution has been perpetuated by the requirement that schools "'[t]each the controversy' [which] has been employed throughout the breadth and depth of the [intelligent design] movement both as an attack upon the 'academic unfairness' of an evolutionary monopoly on origins instruction, and as a call to arms for those slighted by such perceived persecution").

[9] SETH MNOOKIN, THE PANIC VIRUS 8 (2011) (describing the promulgation of the increasingly popular and dangerous myth that MMR vaccines cause autism).

[10] *Id.*

[11] *Id.* This concern is dramatically evidenced in the child abuse arena with hundreds of websites containing a panoply of medical literature ranging from the excellent to the absurd. *Compare* NAT'L CENTER ON SHAKEN BABY SYNDROME, http://www.dontshake.org (last visited Nov. 20, 2013), *and* SHAKEN BABY PREVENTION, INC., http://www.sbspreventi on.com (last visited Nov. 20, 2013), *with* AM. ACAD. PEDIATRICS' SHAKEN BABY SYNDROME FRAUD, http://www.medicalveritas.org/MedicalVeritas/Shaken_Baby_Syndro me_Fraud.html (last visited Nov. 20, 2013), *and* MED. MISDIAGNOSIS RES., http://medical misdiagnosisresearch.wordpress.com (last visited Nov. 20, 2013), *and The Baby Syndrome More Horrific than Falling Three Stories*, MERCOLA.COM (Mar. 26, 2011), http://articles.m ercola.com/sites/articles/archive/2011/03/26/dr-yazbak-on-the-shaken-baby-case.aspx, *and* Viera Scheibner, *Shaken Baby Syndrome: The Vaccination Link*, BIBLIOTECA PLEYADES, http://www.bibliotecapleyades.net/salud/esp_ salud33d.htm (last visited Nov. 20, 2013). The contentious nature of the subject matter encourages blogs espousing myriad purported medical/scientific viewpoints, including hundreds devoted to "innocence claims," written by accused and convicted perpetrators, their family members and friends, attorneys representing the accused, and other defense advocates. While some of these sites provide important and accurate information and offer valuable resources, the vast majority promote false claims of a "medical controversy" unsupported by the professional medical/scientific literature and the general consensus on the subject.

[12] 509 U.S. 579 (1993).

states have now adopted similar pretrial screening procedures.[13] But litigation-driven science continues to create trial problems for the civil[14] and criminal courts.[15] In the criminal arena, these problems also continue to arise post-trial as scientific-sounding information of dubious validity is increasingly offered to support postconviction claims.[16] Because the standards for the admission and

[13] *See* Robert Ambrogi, *Two More States Adopt* Daubert, *Bringing Total to 32*, BULLSEYE (Oct. 7, 2010), http://www.ims-expertservices.com/blog/2011/two-more-states-adopt-daubert-bringing-total-to-32; *see also* MARTIN S. KAUFMAN, ATL. LEGAL FOUND., THE STATUS OF DAUBERT IN STATE COURTS (2006), *available at* http://www.atlanticlegal.org/daubertreport.pdf (detailing the thirty states that had adopted the *Daubert* standard as of March 2006). Since 2006, Wisconsin and Arizona have joined the list.

[14] *See, e.g.*, Elizabeth Laposata et al., *Tobacco Industry Influence on the American Law Institute's Restatement of Torts and Implications for Its Conflict of Interest Policies*, 98 IOWA L. REV. 1, 65 (2012) (describing how litigation-driven pseudoscience has been proffered by cigarette companies to create doubt about the validity of EPA findings on the danger of secondhand smoke); *see also* Robin Stryker et al., *Employment Discrimination Law and Industrial Psychology: Social Science as Social Authority and the Co-Production of Law and Science*, 37 L. & SOC. INQUIRY 777, 779 (2012) (explaining the importance of rejecting specious sociolegal expert evidence proffered in Title VII cases); Douglas A. Kysar, *What Climate Change Can Do About Tort Law*, 41 ENVTL. L. REV. 1, 64–65 (2011) (explaining that, in the environmental law context, "[j]udicial concern about 'junk science'—usually focused on experts hired by plaintiffs' lawyers in advance of litigation—instead may shift to scientists and spokespeople hired by greenhouse gas emitters").

[15] *See, e.g.*, Joëlle Anne Moreno, *Einstein on the Bench?: Exposing What Judges Do Not Know About Child Abuse Cases to Improve How Courts Evaluate Scientific Evidence*, 64 OHIO ST. L. REV. 531 (2003) (exploring the unscientific and medically unsubstantiated diagnosis of "temporary brittle bone disease" offered by defense witnesses to explain fracture injuries in children and noting a large percentage of acquittals resulting from this testimony); *see also* Robert W. Block, *Child Abuse—Controversies and Impostors*, 29 CURRENT PROBS. PEDIATRICS 253, 253–72 (1999) (discussing a number of litigation driven alternative causation theories involving abusive head trauma which he describes as "courtroom diagnosis" rather than a "medical diagnosis"); Sandeep Narang et al., *A* Daubert *Analysis of Abusive Head Trauma/Shaken Baby Syndrome—Part II: An Examination of the Differential Diagnosis*, 13 HOUS. J. HEALTH & POL'Y 203 (2013).

[16] As discussed below, see *infra* Part II, this is a recurring and pervasive problem in child homicide and abuse cases involving diagnoses of abusive head trauma. *See* Day v. Quarterman, 566 F.3d 527 (5th Cir. 2009) (denial of habeas alleging ineffective assistance of counsel for failure to challenge prosecution testimony involving shaken baby syndrome and failure to obtain defense expert); *In re* Brooks, 138 Wash. App. 1005 (2007) (unpublished table decision) (denial of restraint petition alleging newly discovered evidence involving medical research allegedly supporting alternative theories for head injuries); State v. Louis, 798 N.W.2d 319 (Wis. Ct. App. 2011) (granting new trial based on inaccurate defense representations of shifts in science and newly discovered evidence); State v. Edmunds, 746 N.W.2d 590 (Wis. Ct. App. 2008) (granting relief on unsupported claims of newly discovered scientific evidence and scientific thought and consensus); Grant v. Warden, No. TSRCV030004233S, 2008 Conn. Super. LEXIS 1402, at *2 n.1,

reliability of scientific evidence in postconviction proceedings are murky, courts may mistake purported (but nonexistent or insignificant) scientific developments for an actual controversy meeting the applicable legal standards (e.g., factual innocence, newly discovered evidence, or ineffective assistance of counsel). Ironically, beginning in the mid-1980s, the Innocence Project paved the way for actual innocence claims using new evidence based on real developments in the legitimate science of DNA testing.[17] But trial and appellate courts should not be equally receptive to claims supported by the Innocence Project or others based on litigation-driven science or evidence of dubious empirical validity. These postconviction problems are especially likely to occur when judges rely on articles or opinions from "experts" who raise concerns about their scientific bona fides by boldly challenging the scientific "orthodoxy," proposing alternative outlier causation theories, or announcing the discovery of a scientific "paradigm shift."[18]

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*35–36 (Conn. Super. Ct. June 4, 2008) (denying postconviction claims of newly discovered evidence and ineffective assistance of counsel and concluding that "[t]he *Edmunds* case presents a potential quagmire of epic proportions: the strong likelihood of constant renewed prosecution and relitigation of criminal charges as expert opinion changes and/or evolves over time" and that "the strong interest in the finality of judgments is significantly undermined by reasoning employed by the *Edmunds* court").

[17] Simon Cole, *Forensic Science and Wrongful Convictions: From Exposer to Contributor to Corrector*, 46 NEW ENG. L. REV. 711, 714 (2012) ("[F]orensic DNA profiling during the 1980s caused people to begin associating forensic science with miscarriages of justice. . . . Realizing the potential of post-conviction DNA testing to expose miscarriages of justice, in 1992, American attorneys Peter Neufeld and Barry Scheck founded the Innocence Project at Cardozo Law School as a legal clinic dedicated to such testing. Over the next two decades, the Innocence Project and other independent efforts exposed more than 250 wrongful convictions in the United States through post-conviction DNA testing. This set of wrongful convictions has taken on a degree of significance beyond the parties involved in the underlying cases themselves. . . . [T]heir significance derives from their ability to . . . achieve supposed 'scientific certainty' or 'epistemological closure.'") (citations omitted); *see also* Caroline Livett, *28 U.S.C. § 2254(jj): Freestanding Innocence as a Ground for Habeas Relief: Time for Congress to Answer the Court's Embarrassing Question*, 14 LEWIS & CLARK L. REV. 1649, 1674 (2010) (noting that most states now allow postconviction DNA testing).

[18] *See, e.g.*, *Edmunds*, 746 N.W.2d at 598–99 (accepting, erroneously, defense witness claims "that there had been a shift in mainstream medical opinion" involving shaken baby syndrome since the time of the defendant's trial); *see also infra* notes 39–42 and accompanying text (referencing dissenting opinion in *Cavazos v. Smith*, 132 S. Ct. 2 (2011), that there had been a shift in medical opinions). *See generally* MICHAEL SPECTOR, DENIALISM: HOW IRRATIONAL THINKING HINDERS SCIENTIFIC PROGRESS, HARMS THE PLANET, AND THREATENS OUR LIVES (2009) (discussing how rejection of scientifically sound information in favor of truth claims that cannot be empirically supported has been increasingly referred to as "denialism"); Martin McKee & Pascal Diethelm, *How the Growth of Denialism Undermines Public Health*, 341 BMJ 1309, 1311 (2010) (noting that "denialism" in the medical arena is characterized by several features including (a) identification of conspiracies, (b) use of fake experts, (c) selectivity of citation, (d) creation

B. Manufactured Controversies

One person working to provide nonscientists with concrete tools to better understand scientific questions and controversies is Professor Leah Ceccarelli. In her work identifying and critiquing false "manufactured" scientific controversies, Professor Ceccarelli helpfully suggests that proponents of manufactured controversies typically "exploit a popular conception that science advances only when heroic dissidents push the frontiers of normal science to initiate a paradigm change"[19] and "orient themselves as critics of the world-defining hegemony of scientific discourse"[20] in the hope of "bringing the scientific establishment down a notch or two."[21]

Manufactured controversies, which may arise in a range of scientific contexts, also often share the following attributes: (1) the use of mercenary scientists, (2) reliance on cherry-picked data and manipulation of statistical methods, (3) the manufacture and promotion of doubt and uncertainty, and (4) the use of rhetoric to create doubt and manufacture controversy.[22] Thus, in Professor Ceccarelli's view, we should presume scientific illegitimacy whenever "an arguer announces that there is an ongoing scientific debate . . . about a matter for which there is actually overwhelming scientific consensus."[23]

C. Litigation-Driven Science and Manufactured Controversies in Child Homicide and Abuse Cases

This Article focuses on the convergence of two science-law problems—litigation-driven science and the manufacture of false "scientific" controversies—in the specific context of child homicide and abuse cases involving a medical diagnosis of abusive head trauma (AHT). Child abuse cases provide a model that elucidates how courts should evaluate complex scientific evidence, including novel theories, "newly discovered" scientific evidence claims, and purported "scientific controversies." More generally, such cases illuminate how future judges and jurors can learn to better recognize litigation-driven science and manufactured controversies.

Child abuse cases also enable us to focus explicitly on what Professor Ronald J. Allen has referred to as the "real" question: "how expert testimony fits into the

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of impossible expectations of research, (e) misrepresentation and logical fallacies, and (f) manufacture of doubt).

[19] Leah Ceccarelli, *Manufactured Scientific Controversy: Science, Rhetoric, and Public Debate*, 14 RHETORIC & PUB. AFF. 195, 209 (2011).

[20] *Id.* at 199.

[21] *Id.*

[22] *See id.* at 197.

[23] *Id.* at 196.

administration of justice more generally."[24] There is a powerful social and moral imperative to ensure judicial accuracy in child abuse cases because if we improve judicial accuracy in future criminal and civil cases, we can save and improve children's lives. Child abuse transcends all social, political, and economic boundaries. In the United States, more than 675,000 children are abused, neglected, or both every year.[25] More than 1,500 of these children die from abuse and neglect.[26] Many of these deaths may be preventable. Mistakes in criminal and civil child abuse cases are devastating, costly and potentially fatal.[27] Both the medical and legal professions have a vested interest in ensuring accuracy in the diagnostic and adjudicatory processing of child abuse cases. This interest includes avoiding both false positives (erroneously diagnosing injuries or death as abuse and prosecuting and convicting innocent caregivers) and false negatives (erroneously failing to medically detect or diagnose abuse, exculpating guilty perpetrators, and returning child victims to abusive caregivers).[28]

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[24] Ronald J. Allen, *Expertise and the Supreme Court: What is the Problem?*, 34 SETON HALL L. REV. 1, 2–3 (2003).

[25] U.S. DEP'T OF HEALTH & HUMAN SERVS., CHILD MALTREATMENT, at ix (2011), *available at* http://www.acf.hhs.gov/sites/default/files/cb/cm11.pdf. Of these there were 118,825 substantiated cases of physical abuse during 2011. *Id.* at 22.

[26] *See* EVERY CHILD MATTERS EDUC. FUND, WE CAN DO BETTER—CHILD ABUSE AND NEGLECT DEATHS IN AMERICA 1 (2012) (reporting that 15,510 children died from abuse between 2001–2010); Sharyn Parks et al., *Characteristics of Non-Fatal Abusive Head Trauma Among Children in the USA, 2003–2008: Application of the CDC Operational Case Definition to National Hospital Inpatient Data*, 18 INJ. PREVENTION 392, 392 (2012) (finding that 30 out of 100,000 children under the age of one suffer AHT each year and over 10,500 hospitalizations from AHT occurred over a six-year period); *see also* Sharyn E. Parks et al., *Characteristics of Fatal Abusive Head Trauma Among Children in the USA, 2003–2007: Application of the CDC Operational Case Definition to National Vital Statistics Data*, 18 INJ. PREVENTION 193, 195 (2012) (finding at least 138 deaths annually from AHT over a five-year period).

[27] In 2011, 1,037 children who were returned to their homes following official abuse inquiries were later beaten to death. *See* U.S. DEP'T OF HEALTH & HUMAN SERVS., *supra* note 25, at 66 tbl.4-4; Carole Jenny et al., *Analysis of Missed Cases of Abusive Head Trauma*, 282 JAMA 621, 622–24 (1999) (finding in a study of 173 children that physicians missed AHT in 31% of the cases, with 15 of these children (25%) experiencing further abuse after the diagnosis was missed and the child was returned home, 40% experienced medical complications from the delayed recognition, and concluding that 4 of 5 fatal incidents might have been prevented by earlier identification of the abuse).

[28] *See* Stephen C. Boos, *Abusive Head Trauma as a Medical Diagnosis*, *in* ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN: A MEDICAL, LEGAL, AND FORENSIC REFERENCE 49 (Lori D. Frasier et al. eds., 2006). Similar concerns have been articulated in cases involving child sexual abuse. Thomas D. Lyon, *False Allegations and False Denials in Child Sexual Abuse*, 1 PSYCHOL. PUB. POL'Y & L. 429, 430–36 (1995).

1. Cavazos v. Smith

In October 2011, the Supreme Court decided *Cavazos v. Smith*.[29] For the six Justices who joined in the Court's per curiam decision, *Smith* was a relatively easy case. The Court upheld Shirley Ree Smith's conviction for causing the death of her seven-week-old grandson, Etzel,[30] which was based on a jury finding that Etzel died from shaken baby syndrome (SBS), a type of infant AHT. The Court's conclusion that the jury's finding was "supported by the record"[31] was consistent with the relevant, extensive, and legitimate medical evidence that existed at the time of Smith's trial and has been verified by extensive medical research over the next fifteen years.[32]

AHT/SBS[33] is a diagnosis that has been recognized as clinically valid and evidence-based by an overwhelming majority of pediatric medical specialists for almost half a century.[34] This diagnosis has been substantiated by the bulk of the

[29] 132 S. Ct. 2 (2011).

[30] *Id.* at 6–8. The relevant statute states, "Any person who, having the care or custody of a child who is under eight years of age, assaults the child by means of force that to a reasonable person would be likely to produce great bodily injury, resulting in the child's death, shall be punished by imprisonment in the state prison for 25 years to life." CAL. PENAL CODE ANN. § 237ab (West 2008).

[31] *Cavazos*, 132 S. Ct. at 7.

[32] For a discussion of this evidence and the medical literature supporting the expert medical testimony admitted at Smith's trial, see Joëlle Anne Moreno & Brian Holmgren, *Dissent into Confusion: The Supreme Court, Denialism, and the False "Scientific" Controversy over Shaken Baby Syndrome*, 2013 UTAH L. REV. 153.

[33] We refer to AHT/SBS because the American Academy of Pediatrics (AAP) has recently revised its own position paper on SBS to be more inclusive of the multiple mechanisms by which AHT may be inflicted. *See* Cindy W. Christian et al., *Abusive Head Trauma in Infants and Children*, 123 PEDIATRICS 1409, 1409–11 (2009) ("Shaken baby syndrome is a subset of AHT. Injuries induced by shaking and those caused by blunt trauma have the potential to result in death or permanent neurologic disability . . . . The goal of this policy statement is not to detract from shaking as a mechanism of AHT but to broaden the terminology to account for the multitude of primary and secondary injuries that result from AHT . . . .").

[34] The original articles commenting on SBS were published in the early 1970s. *See, e.g.*, John Caffey, *On the Theory and Practice of Shaking Infants: Its Potential Residual Effects of Permanent Brain Damage and Mental Retardation*, 124 AM. J. DISEASES CHILDREN 161, 161–69 (1972) [hereinafter Caffey, *Theory and Practice*]; John Caffey, *The Whiplash Shaken Infant Syndrome: Manual Shaking by the Extremities with Whiplash-Induced Intracranial and Intraocular Bleedings, Linked with Residual Permanent Brain Damage and Mental Retardation*, 54 PEDIATRICS 396 (1974) [hereinafter Caffey, *Whiplash*]; A.N. Guthkelch, *Infantile Subdural Haematoma and Its Relationship to Whiplash Injuries*, 2 BMJ 430, 430–31 (1971). Over the past four decades, AHT/SBS has been well documented in the peer-reviewed medical literature. The research supporting this diagnosis includes: (1) two medical treatises, (2) at least fourteen chapters in medical treatises; (3) over seven hundred peer-reviewed clinical medical articles published by over

medical research in a range of scientific disciplines.[35] It has also been recognized and defined by the Centers for Disease Control and Prevention[36] and widely accepted by courts in the United States[37] and numerous foreign countries.[38]

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one thousand medical authors from at least twenty-eight countries, (4) at least eight systematic reviews of the medical literature, (5) at least fifteen controlled trials, (6) at least fifty comparative cohort studies or prospective case series, and (7) numerous well-designed retrospective case series/reports comprising thousands of cases. Sandeep Narang, *A* Daubert *Analysis of Abusive Head Trauma/Shaken Baby Syndrome*, 11 HOUS. J. HEALTH & POL'Y 505, 539–40 (2011).

[35] *See, e.g.*, ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN: A MEDICAL, LEGAL, AND FORENSIC REFERENCE, *supra* note 28; CHILD ABUSE: MEDICAL DIAGNOSIS & MANAGEMENT (Robert M. Reece & Cindy W. Christian eds., 3d ed. 2000); INFLICTED CHILDHOOD NEUROTRAUMA (Robert M. Reece & Carol E. Nicholson eds., 2003); JAMES A. MONTELEONE, CHILD MALTREATMENT: A CLINICAL GUIDE AND REFERENCE (2d ed. 1998); THE SHAKEN BABY SYNDROME: A MULTIDISCIPLINARY APPROACH (Stephen Lazoritz & Vincent J. Palusci eds., 2001); SHAKING AND OTHER NON-ACCIDENTAL HEAD INJURIES IN CHILDREN (Robert A. Minns & J. Keith Brown eds., 2005); Mark S. Dias, *The Case for Shaking*, *in* CHILD ABUSE AND NEGLECT: DIAGNOSIS, TREATMENT, AND EVIDENCE 364 (Carole Jenny ed., 2010).

[36] SHARYN E. PARKS ET AL., PEDIATRIC ABUSIVE HEAD TRAUMA: RECOMMENDED DEFINITIONS FOR PUBLIC HEALTH SURVEILLANCE AND RESEARCH (2012), *available at* http://www.cdc.gov/ViolencePrevention/pdf/PedHeadTrauma-a.pdf.

[37] *See, e.g.*, Mitchell v. State, No. CACR 07-472, 2008 WL 316166, at *6–8 (Ark. Ct. App. Feb. 6, 2008) (rejecting the defense's claim that a *Daubert* hearing was required before testimony on SBS may be admitted because this is a well-accepted diagnosis); Grant v. Warden, No. TSRCV030004233S, 2008 Conn. Super. LEXIS 1402, at *35–36 (Conn. Super. Ct. June 4, 2008) (noting that the Connecticut Supreme Court found that SBS satisfied the *Frye* standard in 1988, referencing *State v. McClary*, 541 A.2d 96, 102 (Conn. 1988) (which had also noted acceptance by six other states)); State v. Vandemark, No. CR.A. 04-01-0225, 2004 WL 2746157, at *2–3 (Del. Super. Ct. Nov. 19, 2004) (recognizing that the science behind SBS has been accepted in almost every jurisdiction and is generally accepted in pediatrics); Middleton v. State, 980 So. 2d 351, 356–57 (Miss. Ct. App. 2008) (rejecting defendant's claim that SBS is not generally accepted by the relevant medical community and noting the acceptance of this diagnosis by other courts); State v. Leibhart, 662 N.W.2d 618, 624–28 (Neb. 2003) (finding that SBS is reliable under *Daubert*); State v. Woodson, No. 85727, 2005 WL 2789082, at *12 (Ohio Ct. App. Oct. 27, 2005) (recognizing that case law establishes that SBS is within the medically accepted literature and has been admitted in courtrooms in the state and nationwide); State v. Lopez, 412 S.E.2d 390, 393 (S.C. 1991) (rejecting defendant's claim that SBS is not generally accepted by the relevant medical community and noting the acceptance of this diagnosis by other courts). *See generally* JOHN E.B. MYERS, MYERS ON EVIDENCE OF INTERPERSONAL VIOLENCE: CHILD MALTREATMENT, INTIMATE PARTNER VIOLENCE, RAPE, STALKING, AND ELDER ABUSE (5th ed. 2011) (discussing the issues surrounding expert medical testimony in this arena and citing numerous cases as examples).

[38] *See, e.g.*, R v. Harris, [2005] EWCA (Crim) 1980, [2006] 1 Crim. App. 5, [56]–[58] (appeal taken from Eng.), *available at* http://www.bailii.org/ew/cases/EWCA/Crim/2005/1980.html (commenting on treatment of AHT/SBS by courts in the United Kingdom); R v

Smith is not notable for the Court's per curiam decision, but instead because Justice Ginsburg, joined by Justices Breyer and Sotomayor, seized the opportunity to issue a lengthy and unusual dissent. In their view, the Court's summary adjudication of *Smith* was "untoward" because "doubt has increased in the medical community 'over whether infants can be fatally injured through shaking alone.'"[39] In Justice Ginsburg's opinion, "[w]hat is now known about SBS hypotheses seems to me worthy of considerable weight in the discretionary decision whether to take up this tragic case."[40] More importantly, the *Smith* dissenters concluded that "[w]hat is now known about . . . [SBS] casts grave doubt on the charge leveled against Smith"[41] and "[i]n light of current information, it is unlikely that the prosecution's experts would today testify as adamantly as they did in 1997."[42]

Because these Justices purport to describe a global shift in opinion among the "medical community" and to opine on our current understanding of the accuracy of the AHT/SBS diagnosis, the dissenters' conclusion might reasonably be mistaken for some sort of meta-analysis of the relevant medical literature. Nothing could be further from the truth. Instead the *Smith* dissenters based their scientific findings on two different, but interrelated, analytic mistakes. The first mistake, which has been fully addressed by the authors in a previous article,[43] was a thorough misconstruction of the medical and nonmedical evidence presented by the prosecution and defense at trial in *Smith*. The second, addressed herein, is that the dissenters, through their selection and reliance on a handful of outlier sources, endorsed an especially dangerous form of litigation-driven science and likely created unwarranted new support for a growing manufactured controversy. This second mistake is especially egregious because the papers selected by the dissenters, despite their manifest and easily ascertained shortcomings, continue to form the basis of increasingly popular child abuse defense arguments that infants cannot be seriously or critically injured through shaking.

Woodland, [2001] NSWSC 416 (unreported, May 25, 2001) (Austl.), *available at* http://www.lawlink.nsw.gov.au/scjudgments/2001nswsc.nsf/000000000000000000000000000000000/ec53c81ef75e2306ca256a540017c2bf?opendocument; Catherine Adamsbaum et al., *Abusive Head Trauma: Judicial Admissions Highlight Violent and Repetitive Shaking*, 126 PEDIATRICS 546, 547 (2010) (commenting on research into confessions from convictions in French tribunals); Jakob Matchske et al., *Nonaccidental Head Injury Is the Most Common Cause of Subdural Bleeding in Infants <1 Year of Age*, 124 PEDIATRICS 1587, 1590 (2009) (commenting on research into AHT/SBS cases that resulted in convictions in German courts).

[39] Cavazos v. Smith, 132 S. Ct. 2, 10 (Ginsburg, J., dissenting) (quoting State v. Edmunds, 746 N.W.2d 590, 596 (Wis. Ct. App. 2008)).

[40] *Id.* at 11.

[41] *Id.* at 9.

[42] *Id.* at 10.

[43] *See* Moreno & Holmgren, *supra* note 32.

2. Cavazos v. Smith *and Supreme Court Fact-Finding*

In her interesting new article on Supreme Court fact-finding, Professor Allison Orr Larsen provides insight that might explain how three Justices came to rely on shoddy scientific evidence despite the fact that they were attempting to address a long-standing, well-known, and well-researched medical question:

> Some may argue that we need not worry about judicial inexperience with science because it is just this inexperience that will steer a Justice toward reputable journals and away from dubious junk science. But this logic is not completely reassuring. . . . Justices cite authorities with a terrific range of prestige and reputation. Yes, they rely on articles in the New England Journal of Medicine, but they also cite to blog posts, sporting magazines, interest group websites, and (in lower courts) even to Wikipedia.
>
> Moreover, Justices—like all of us—have a tendency to engage in "motivated reasoning" and to look for facts that support the argument they are building, wherever those facts may come from and despite what other opposing authority is out there. This tendency may encourage the ad hoc and potentially mistaken evaluation of scientific findings—looking for what one wants to see—particularly if the studies to be used as authorities were never tested by the adversarial method or addressed by experts below. Couple this reality with the new, instant ability to find facts to support almost anything (thanks to Google), and confidence in judicial fact finding diminishes significantly.[44]

The *Smith* dissent provides a compelling example of the risks of independent Supreme Court fact-finding described by Professor Larsen. Here, the Justices' sweeping scientific-sounding conclusions are not based on any sort of legitimate attempt at a meta-analysis of the relevant data, but rely solely on a handful of single-sentence quotes excerpted from seven cherry-picked articles, all but one of which reflect the extreme outlier child abuse defense argument that AHT/SBS is diagnostically invalid.[45] These sources, selected without explanation from among the over seven hundred published research papers on AHT/SBS, fully substantiate

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[44] Allison Orr Larsen, *Confronting Supreme Court Fact Finding*, 98 VA. L. REV. 1255, 1300–01 (2012).

[45] This conclusion logically follows because no amicus briefs were filed in the Supreme Court and only one of the articles relied upon by the dissenters was cited in the defendant's brief, suggesting that the dissenters conducted an independent analysis of the extant medical literature. *See* Respondent's Brief in Opposition at 35, Cavazos v. Smith, 132 S. Ct. 2 (2011) (No. 10-1115) (citing Faris A. Bandak, *Shaken Baby Syndrome: A Biomechanics Analysis of Injury Mechanisms*, 151 FORENSIC SCI. INT'L 71, 78 (2005)); *see also infra* Part III.A (discussing Bandak's article); *infra* Part III.G (discussing the article by Dr. Minns which does not reflect an outlier view, but is misquoted by the *Smith* dissenters).

Professor Larsen's concern regarding Justices' "ad hoc and potentially mistaken evaluation of scientific findings" because these papers do not merely reflect unpopular conclusions, they are "actually so methodologically flawed, scientifically inaccurate, and involve the lowest level of evidence-based medical literature, that they would be reasonable examples of articles that are *not even good enough to be wrong*."[46]

More specifically, Justice Ginsburg's independent fact-finding in her *Smith* dissent led her to make several crucial mistakes regarding AHT/SBS. First, ignoring the vast quantity of legitimate scientific child abuse research, she relied instead on the opinions of a handful of medical professionals who regularly testify as defense-retained witnesses without recognizing that this bias could undermine their objectivity.[47] Second, the flaws in these papers should be readily apparent even to nonscientists. The articles contain little or no original research; reach conclusions based on cherry-picked data and manipulation of statistical methods;[48] rely on opinion and commentary, nonrandomized retrospective case reports

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[46] Narang et al., *supra* note 15, at 513 (citing Justice Stephen Breyer, *Introduction* to FEDERAL JUDICIAL CENTER, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 2–8 (2d ed. 2000), *available at* http://www.fjc.gov/public/pdf.nsf/lookup/sciman00.pdf/$file/sciman00.pdf ("A judge is not a scientist, and a courtroom is not a scientific laboratory. But consider the remark made by the physicist Wolfgang Pauli. After a colleague asked whether a certain scientific paper was wrong, Pauli replied, 'That *paper isn't even good enough to be wrong!*' Our objective is to avoid legal decisions that reflect that paper's so-called science." (emphasis added)).

[47] A recent article in the *Journal of the American Medical Association* described how legal cases involving AHT/SBS have been harmed by "physicians with variable credentials [who] have a willingness to disparage scientifically grounded and accepted testimony, use unique theories of causation, omit pertinent facts or knowledge, use unique or unusual interpretations of medical findings, make false statements, or engage in flagrant misquoting of medical journals." Daniel M. Albert et al., *Ensuring Appropriate Expert Testimony for Cases Involving the "Shaken Baby,"* 308 JAMA 39, 40 (2012). This is attributable to the fact that

> the pecuniary interest in providing expert testimony cannot be underestimated. It has posed and continues to pose a significant risk to the presentation of unbiased medical information. . . . [I]n addition to pecuniary interest, . . . personal prejudices can also affect scientific analysis. This can result in the adherence to disproven theories and the presentation of skewed information.

Narang, *supra* note 34, at 593–94. According to Dr. Daniel Lindberg, Brigham and Women's Hospital, the AHT/SBS "controversy" has been manufactured based "exclusively on the opinions and work of 'experts' who derive substantial income from lucrative court testimony on behalf of the accused perpetrators of child abuse" and "rarely, if ever, provide medical care for children." Carey Goldberg, *The Real Consensus on Shaken Baby Syndrome*, WBUR'S COMMONHEALTH REFORM & REALITY (Sept. 27, 2010, 5:12 PM), http://commonhealth.wbur.org/2010/09/shaken-baby/#comments.

[48] Ceccarelli, *supra* note 19, at 197.

(without comparative control groups), and scientifically unsubstantiated opinions of other "mercenary witnesses;" and mischaracterize and omit existing and easily ascertainable AHT/SBS research.[49] In fact, most of the papers, especially those reflecting commentary and opinion, could be characterized, not as medical research, but as advocacy for potential use in legal proceedings. Third, even where these defects were not patent, Justice Ginsburg selected papers that have been discredited by published and readily available pediatric expert medical research and peer-reviewed scientific publications in a wide range of fields.[50] Finally, after selecting skewed and unreliable sources, the *Smith* dissenters compounded the analytic shortcomings inherent to their source material by adopting a pseudoscientific judicial approach to a critical medical and public health problem by (1) misstating and misquoting the literature; (2) taking quotes out of context; (3) using portions of study findings, while ignoring the rest; (4) ignoring the full corpus of research by a particular author or group of researchers; (5) relying on papers that cite to personal experience, personal communications, or unpublished data; (6) ignoring easily accessible critiques of the data, methods, and conclusions of cited work; and (7) ignoring all opposing research findings.[51]

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[49] Almost all of the medical papers "'questioning' the validity of AHT (save two or three) are non-randomized, retrospective case series/reports, and without comparative control groups. In fact, many are single case reports." Narang, *supra* note 34, at 541. For an excellent article critiquing the "evidence base" of medical literature relied upon by defense witnesses in advancing alternative theories to SBS/AHT, and juxtaposing the substantial evidence base supporting this diagnosis, see Narang et al., *supra* note 15.

[50] *See infra* Part III.

[51] Selective citations and the promulgation of controverted data as unassailable scientific evidence are the hallmarks of irresponsible expert testimony and irresponsible scientific research and publication, not legitimate scientific analysis. *See, e.g.*, David L. Chadwick & Henry F. Krous, *Irresponsible Testimony by Medical Experts in Cases Involving the Physical Abuse and Neglect of Children*, 2 CHILD MALTREATMENT 313 (1997) (providing examples of experts misquoting the medical literature, making false statements, and deliberately omitting important facts leading to poor decisionmaking by judges and juries); Patrick Barnes, *Ethical Issues in Imaging Nonaccidental Injury: Child Abuse*, 13 TOPICS MAGNETIC RESONANCE IMAGING 85 (2002) (citing examples of unethical conduct including offering unique theories of causation not supported by the pertinent medical literature, misquoting well-known journals or texts, testifying contrary to one's own writings, omitting important facts or knowledge pertinent to opinions being offered, and misrepresenting facts, science, or literature); *see also* Austin v. Am. Ass'n of Neurological Surgeons, 253 F.3d 967, 970 (7th Cir. 2001). In *Austin*, Judge Posner noted that a neurosurgeon's expert testimony was irresponsible when he purported to express opinions that "the majority of neurosurgeons" would "concur" when he had not surveyed these professionals and where representations about medical literature he claimed supported his view were inaccurate. The court also noted that the Association's ethical code provided that experts must testify prudently, identify personal opinions not generally accepted by other neurosurgeons, and should provide the court with accurate and documentable opinions on the matters. *Id.* at 970–71; *see also* COUNCIL ON ETHICAL AND JUDICIAL AFFAIRS, AM. MED. ASS'N., CEJA OPINION E-9.07 (2004), *available at*

3. A New Evidence-Based Medical-Legal Approach

This Article returns the legal discussion of AHT/SBS to its appropriate medical and scientific context by adopting an evidence-based research methodology that critically examines each source relied upon by the *Smith* dissenters in the context of (1) the original work (including a careful examination of the underlying data, methods and conclusions), (2) the body of work by the cited author, (3) the body of relevant critical work by other medical experts, (4) the body of preexisting and contemporaneous relevant work on the same topic, and (5) the body of more recent relevant work. Additionally, this Article identifies readily accessible information pertinent to assessing the potential "bias" of the sources relied upon by the *Smith* dissenters. An evidence-based approach is of critical and ongoing importance because the sources cited by Justice Ginsburg continue to be cited as support for new challenges to the validity of the AHT/SBS diagnosis in the criminal and civil courts.

Correcting the *Smith* dissenters' mistakes serves three distinct and important jurisprudential goals. First, the Supreme Court and other courts have long recognized the goal of transparency to avoid the inherent potential for inaccurate legal determinations when the bases of expert testimony are concealed.[52] In fact,

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http://www.ama-assn.org/resources/doc/code-medical-ethics/907a.pdf (noting that a medical witness must testify honestly and should base all testimony on current scientific thought and standards of care); Brian K. Holmgren, *Ethical Issues in Forensic Testimony Involving Abusive Head Trauma*, 3 ACAD. FORENSIC PATHOLOGY 317 (2013) (summarizing various ethical standards and providing examples from cases).

[52] *See, e.g.*, Rocha v. Great Am. Ins. Co., 850 F.2d 1095, 1103 (6th Cir. 1988) ("The problem that arises . . . in this age where the 'forensic expert' populates the judicial landscape in ever increasing numbers, is that there is a plethora of experts who look good on paper and do not reveal their shortcomings until they start testifying. Although one would hope that the adversary system would be an adequate safeguard against misinformation, such is not always the case."); *In re* Gina D., 645 A.2d 61, 65 (N.H. 1994) ("An opinion that is impenetrable on cross-examination due to the unverifiable methodology of the expert witness in arriving at the conclusion is not helpful to the court in its search for the truth. If the court, as the trier of fact, cannot determine and assess the bases for the expert's opinion, it also cannot accord the proper weight, if any, to the testimony."); People v. Wernick, 674 N.E.2d 322, 323–26 (N.Y. 1996) (discussing the need for establishing scientific reliability of underlying technique upon which expert's opinion is based, otherwise the opinion should be excluded; noting defense could not skirt this requirement by having expert testify without identifying the syndrome or by having the expert rely on personal diagnostic experiences and those of other experts in support of the expert's opinion); *see also* Porter v. Whitehall Labs., Inc., 9 F.3d 607, 614 (7th Cir. 1993) ("If experts cannot tie their assessments of data to known scientific conclusions, based on research or studies, then there is no comparison for the jury to evaluate and the expert's testimony is not helpful to the jury.").

these concerns provided the impetus for Federal Rule of Evidence 703.[53] This same skepticism regarding potentially biased or incompetent experts led the Supreme Court to recommend the exclusion of expert evidence whenever it is based solely on the *ipse dixit* of the experts themselves.[54] Similar concerns have recently sparked a significant expansion of defendants' rights under the Confrontation Clause, especially the right to confront expert witnesses.[55] These well-recognized risks arise not only at trial,[56] but also, as *Smith*'s dissenting opinion illustrates, when pseudoscientific litigation-driven opinions are proposed or parroted from the bench during postconviction review. Second, state trial judges lack the time, scientific sophistication, and resources to undertake detailed independent critical analyses of complex scientific matters. Thus, they must rely on experts to accurately characterize, not just their own opinions, but also the state of knowledge within the field. Lower courts must also rely on higher courts that have the time and resources to explore these challenging questions in greater depth. Third, all cases and courts share the goal of fundamental fairness. By deviating from the trial record to engage in independent fact-finding, Justice Ginsburg modeled an opaque and fundamentally unfair judicial decisionmaking practice that yielded profoundly

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[53] FED. R. EVID. 703 ("An expert may base an opinion on facts or data in the case that the expert has been made aware of or personally observed. If experts in the particular field would reasonably rely on those kinds of facts or data in forming an opinion on the subject, they need not be admissible for the opinion to be admitted. But if the facts or data would otherwise be inadmissible, the proponent of the opinion may disclose them to the jury only if their probative value in helping the jury evaluate the opinion substantially outweighs their prejudicial effect.").

[54] *See* Kumho Tire Co. v. Carmichael, 526 U.S. 137, 157 (1999) ("[A]s we pointed out in *Joiner*, 'nothing in either *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert.'" (quoting General Electric Co. v. Joiner, 522 U.S. 136, 146 (1997))).

[55] *See* Bullcoming v. New Mexico, 131 S. Ct. 2705, 2717 (2011); Melendez-Diaz v. Massachusetts, 557 U.S. 305, 310 (2009). Logically, the need to expose irresponsible expert testimony should prompt courts to give not just defendants, but also the prosecution, wide latitude in challenging such witnesses through the "crucible of cross-examination." Similarly, courts should consider giving greater latitude to litigants through the discovery process and through pretrial *Daubert* hearings—procedures that might expose charlatan witnesses and their reliance on dubious science. This could include compelling production of materials that might expose the witness's bias including access to the witness's financial records to ascertain the amount of money garnered from court appearances. It could also include access to the prior reports of the witness in other cases to expose the number of times the witness has proposed controversial theories or relied on unreliable scientific evidence in other cases, even in cases that may not make it to court where a potential appellate record would be made. *See generally* Brian Holmgren, *The Legal System's Role in Facilitating Irresponsible Expert Testimony*, NAT'L INFO., SUPPORT & REFERRAL SERVS. ON SHAKEN BABY SYNDROME (Child Abuse Prevention Ctr. of Utah, Ogden, Utah), Summer 1999, at 4. Additionally courts should use a court-appointed expert pursuant to Federal Rule of Evidence 706 to evaluate questionable experts or scientific claims.

[56] *See supra* notes 7 and 52 and accompanying text.

distorted and inaccurate results.[57] Moreover, Professor Larsen's research indicates that the *Smith* case represents a trend because over the past fifteen years it has become increasingly common for Supreme Court Justices to make assertions of fact not mentioned in any of the briefs.[58] When judges rely on such materials, and especially when they refuse to disclose how or why these sources were selected, they conveniently relieve themselves of the burden of considering the conflicting data and deprive the opposing side from engaging in a response on the merits.

II. THE MEDICAL AUTHOR/EXPERT WITNESS PROBLEM

As described above, litigation-driven science tends towards a predetermined conclusion and frequently relies on the work of interested or mercenary "experts" whose work helps promulgate a manufactured controversy. Professor Ceccarelli explains how "experts" have been recruited to challenge mainstream scientific consensus regarding global warming in an effort "to create the public appearance of a scientific controversy in the face of 'the prevailing wisdom' of mainstream scientific thought."[59] She also explains that these efforts are facilitated by our nation's "commitment to *dissoui logoi* in our institutions of journalism, law, and politics," which "assume[s] that there are always two sides to a debate . . . and structure[s] our institutional discursive forums around this belief with balancing norms that ensure both sides are given equal representation and equal time."[60] The balanced argument approach, in the case of global warming, childhood vaccine safety, and AHT/SBS, is a gross mischaracterization of the scientific evidence.

"New science challenges old orthodoxy" is an increasingly prevalent theme in the context of recent legal and some medical AHT/SBS literature.[61] Child abuse

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[57] One of the dissenters, Justice Breyer, candidly admits to relying on the Internet to gather his own facts. Larsen, *supra* note 44, at 1260.

[58] *Id.* at 1261–62.

[59] Ceccarelli, *supra* note 19, at 205.

[60] *Id.*

[61] *See generally* Moreno & Holmgren, *supra* note 32. Similar "new science" challenges have been made in courtrooms for decades. Through its training, research and technical assistance programs, the National District Attorneys Association's National Center for Prosecution of Child Abuse ("NCPCA") has assisted prosecutors and other professionals seeking to assess the evidence base for a range of scientific-sounding AHT/SBS challenges. *See National Center for Prosecution of Child Abuse*, NAT'L DIST. ATTORNEYS ASS'N, http://www.ndaa.org/ncpca.html (last visited Jan. 31, 2014). More specifically, the NCPCA has addressed the use of defense experts and defense-oriented medical literature to support these challenges. The second author has contributed to this work as a senior attorney with the NCPCA from 1996–1999, and over the past fifteen years through ongoing consultation. *See, e.g.*, DERMOT GARRETT, NAT'L CTR. FOR PROSECUTION OF CHILD ABUSE, OVERCOMING DEFENSE EXPERT TESTIMONY IN ABUSIVE HEAD TRAUMA CASES (2013), http://www.ndaa.org/pdf/Abusive%20HeadTrauma_NDAA.pdf.

defense medical witnesses[62] and a small group of legal academics[63] have advanced the view that new science reveals a genuine scientific AHT/SBS "controversy." This assertion presupposes that credible medical (and biomechanical) literature supports the view that AHT/SBS does not exist—or is vastly over diagnosed. But this foundational presupposition is invariably sourced to a handful of medical authors, some of whom are cited by the *Smith* dissenters. Not all scientific-sounding evidence is of equal validity and not every medical publication is of equal quality; so it is no coincidence that the proponents of the AHT/SBS

[62] Virtually all of the medical journal articles challenging the science surrounding AHT/SBS are authored by physicians who also testify as defense witnesses in criminal and civil cases. *See, e.g.*, Steven C. Gabaeff, *Challenging the Pathophysiologic Connection Between Subdural Hematoma, Retinal Hemorrhage and Shaken Baby Syndrome*, 12 W.J. EMERGENCY MED. 144, 144 (2011); J.F. Geddes & J. Plunkett, *The Evidence Base for Shaken Baby Syndrome*, 328 BMJ 719, 719 (2004); Jan E. Leestma, *The So-Called "Shaken Baby" Syndrome: A Concept Unsupported by Science and the Facts*, IND. DEFENDER, Mar. 2006, at 1; Patrick D. Barnes, *Imaging of Nonaccidental Injury and the Mimics*, 49 RADIOLOGY CLINICS N. AM. 205, 210 (2011); *infra* note 73, and articles discussed *infra* Part III.A–F.

[63] Several law professors with varied degrees of professional and practical experience have authored articles critiquing AHT/SBS. *See* Symposium, *Examining Shaken Baby Syndrome Convictions in Light of New Medical Scientific Research*, 37 OKLA. CITY U. L. REV. 219 (2012); Keith A. Findley et al., *Shaken Baby Syndrome, Abusive Head Trauma, and Actual Innocence: Getting It Right*, 12 HOUS. J. HEALTH L. & PUB. POL'Y 209 (2012); Edward J. Imwinkelreid, *Shaken Baby Syndrome: A Genuine Battle of the Scientific (and Non-Scientific) Experts*, 46 CRIM. L. BULL. 156 (2010); Deborah Tuerkheimer, *The Next Innocence Project: Shaken Baby Syndrome and the Criminal Courts*, 87 WASH. U. L. REV. 1 (2009) [hereinafter Tuerkheimer, *The Next Innocence Project*]; Deborah Tuerkheimer, *Science-Dependent Prosecution and the Problem of Epistemic Contingency: A Study of Shaken Baby Syndrome*, 62 ALA. L. REV. 513 (2011) [hereinafter Tuerkheimer, *Science-Dependent Prosecution*]. Similarly, a number of law students have authored law review articles critiquing AHT/SBS despite having no practical experience or subject matter knowledge in the field. *See* Rachel Burg, Note, *Un-Convicting the Innocent: The Case for Shaken Baby Review Panels*, 45 U. MICH. J.L. REFORM 657 (2012); Molly Gena, Comment, *Shaken Baby Syndrome: Medical Uncertainty Casts Doubts on Convictions*, 2007 WIS. L. REV. 701 (2007); Genie Lyons, Note, *Shaken Baby Syndrome: A Questionable Scientific Syndrome and a Dangerous Legal Concept*, 2003 UTAH L. REV. 1109, 1132 (2003) (asserting that "for many years now, attorneys have been willing to prosecute, and juries have been willing to convict, people whose only clearly established mistake was caring for a baby that died"); Daniel Orenstein, Comment, *Shaken to the Core: Emerging Scientific Opinion and Post-Conviction Relief in Cases of Shaken Baby Syndrome*, 42 ARIZ. ST. L.J. 1305 (2011); Lauren Quint, Note, *Bridging the Gap: An Application of Social Frameworks Evidence to Shaken Baby Syndrome*, 62 HASTINGS L.J. 1839 (2011). A few defense practitioners have also authored articles critiquing AHT/SBS. *See* Matthew D. Ramsey, *A Nuts and Bolts Approach to Litigating the Shaken Baby or Shaken Impact Syndrome*, 188 MIL. L. REV. 1 (2006); Elizabeth A. Walker, *Shaken Baby Syndrome:* Daubert *and MRE 702's Failure to Exclude Unreliable Scientific Evidence and the Need for Reform*, 210 MIL. L. REV. 1 (2011).

"controversy" repeatedly cite to the same small group of articles to advance their views in court and in print. Nor is it a coincidence that the tiny chorus of regular child abuse defense witnesses routinely and cursorily ignores or dismisses critique and conflicting data. There may be two sides to some aspects of the medico-legal debate on AHT/SBS, but this does not mean that there is evidentiary parity. It also does not mean that trial courts in child homicide and abuse cases should blindly admit and thereby endorse alternative causation theories that cannot withstand legitimate *Daubert* or *Frye* scrutiny,[64] or that appellate courts should mistake specious scientific-sounding arguments for "shifted science" and "newly discovered evidence" during postconviction review.[65]

By choosing to cite outlier medical articles that, with one misleadingly quoted exception,[66] were written by authors who routinely testify as child abuse defense witnesses challenging the AHT/SBS diagnosis,[67] the *Smith* dissenters also ignore the fact that they have relied on a group of medical witnesses who hope to continue to receive substantial fees for their reports and testimony.[68] This naïve approach

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[64] *See* Brian K. Holmgren, *Prosecuting the Shaken Infant Case*, *in* THE SHAKEN BABY SYNDROME: A MULTIDISCIPLINARY APPROACH, *supra* note 35, at 275, 294 (noting the tendency of trial courts to permit rather than exclude defense witness testimonies and alternative theories rather than risk reversal for impeding the defendant's rights to present a defense); Holmgren, *supra* note 55 (same). Many of the defense claims that are daily paraded before judges and jurors, and the medical literature they are premised on, are examined in the next section. The readers can draw their own conclusions as to whether such claims meet *Frye* or *Daubert* standards for admissibility and reliability. *See* Narang et al., *supra* note 15 (applying the *Daubert* criteria to the purported scientific "evidence base" and alternative theories proposed by the defense and concluding that such evidence does not satisfy legal standards for reliability).

[65] *See, e.g.*, Flick v. Warren, 465 F. App'x 461 (6th Cir. 2012) (denial of habeas alleging ineffective assistance of counsel for failure to challenge prosecution testimony involving SBS and failure to obtain defense expert); *see also* cases cited *supra* note 16.

[66] *See infra* Part III.G (discussing the article by Dr. Minns).

[67] The six articles written by these defense witnesses contain no statements to this effect and make no disclosures of any conflicts of interest. *See, e.g.*, Kenneth Feldman, *Commentary on "Congenital Rickets" Article*, 39 PEDIATRIC RADIOLOGY 1127 (2009) (commenting that "it is a serious breach of conflict of interest to not disclose in their article that they profit personally from promoting the existence of congenital rickets as legitimate disease and as an explanation for multiple fractures in young adults" and that it is a serious breach of research bias for authors of medical literature to not disclose that the authors profit personally from promoting particular medical theories in the context of additional participation in legal proceedings where these theories are promoted); *see also infra* note 73 and accompanying text.

[68] *See, e.g.*, Bob Gardiner, *Costly Defense Tab in Conviction*, TIMES UNION (Dec. 17, 2009), http://blog.timesunion.com/crime/costly-defense-tab-in-conviction/3176/ (reporting that county spent more than $27,000 in defense expert fees in case involving Adrian Thomas, with Jan Leestma charging more than $6,500 and another defense expert who challenged Thomas's confession charging $12,782 but was not even permitted to testify); Deanne Johnson, *Expert Witness Ok'd for Shaken Baby Trial*, SALEM NEWS (Nov. 29,

ignores the increasingly well-recognized fact that "the pecuniary interest in providing expert testimony cannot be underestimated" because litigation-driven science "has posed and continues to pose a significant risk to the presentation of unbiased medical information."[69] The concern about author bias in AHT/SBS cases is not theoretical. Had the *Smith* dissenters researched their sources, they would have learned that these authors have been rebuked by courts[70] and by other medical experts from a range of pediatric subspecialties[71] for providing unscientific defense testimony and for writing papers designed specifically for use in legal proceedings.[72] Finally, the Justices ignored the fact that their sources are among a small group who repeatedly publicly self-identify as stakeholders in the so-called AHT/SBS controversy by arguing their "position" that AHT/SBS does not exist, is a flawed scientific concept, and that babies cannot be shaken and injured in the manner described by the overwhelming majority of medical professionals for over

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2011), http://www.salemnews.net/page/content.detail/id/548434.html (noting testimonial and reporting fees for Dr. Uscinski of $11,500); Motion for Instructed Verdict Testimony at 71–74, State v. Watson, Cause No. 50,524-E (Tex. Dist. Ct., Potter Cnty. Jan. 21, 2010) (testimony of Dr. Uscinski) (acknowledging that the previous year he made more than $200,000 from retained witness testimony and that he charged $750 an hour to review cases and $10,000 a day for trial testimony). Both Dr. Leestma and Dr. Uscinski are defense witnesses on whose articles the dissenters rely. The specific nature of these fees is often difficult to ascertain. Experts frequently charge separate fees for evaluation of the case and preparation of opinion reports, and then charge additional fees for trial testimony or testimony at other hearings. In this respect there is an incentive for experts to provide initial opinion reports favorable to the defense so additional fees can be generated at trial, not to mention in future cases. This fee structure enables witnesses to earn fees substantially greater than the fees that they ascribe to their time spent testifying in court. Moreover, payment of these fees is frequently supported by court funding sources, enabling defendants to retain for-hire expert witnesses and ensure payments. Failure to pursue such witnesses has resulted in a multitude of claims of ineffective assistance of counsel, providing further incentives for the promotion of litigation-driven experts. *See supra* notes 16 and 65.

[69] Narang, *supra* note 34, at 593.

[70] *See, e.g.*, Henderson v. R, [2010] EWCA (Crim) 1269, [2010] 2 Crim. App. 24, [51]–[63] (appeal taken from Eng.), *available at* http://www.bailii.org/ew/cases/EWCA/Crim/2010/1269.html (commenting that the willingness of Dr. Leestma to advance propositions which he subsequently had to withdraw in light of additional knowledge he acquired, coupled with his lack of up-to-date experience, severely damaged and undermined the effect of his evidence); *infra* notes 215–217 and accompanying text (commenting critically on Dr. Waney Squier's testimony in multiple cases).

[71] *See* David L. Chadwick et al., *Shaken Baby Syndrome—A Forensic Pediatric Response*, 101 PEDIATRICS 321, 321–23 (1998) (expressing critiques of more than seventy physicians to testimony by Dr. Uscinski and Dr. Leestma in the Louise Woodward case).

[72] Christopher Greeley, *Reviewer's Note*, 15 Q. UPDATE 13, 13–14 (2008) (reviewing Waney Squier, *Shaken Baby Syndrome: The Quest for Evidence*, 50 DEVELOPMENTAL MED. & CHILD NEUROLOGY 10 (2008)) (commenting that the Squier paper, discussed *infra* section III.D, was obviously written for legal proceedings).

four decades.[73] All of this vitally important background information was easily accessible to the Justices and their clerks.

Finally, the *Smith* dissent illustrates the significant risk that nonscientists will rely uncritically on a paper because it has been published in a scientific journal and (perhaps) subjected to some sort of peer review.[74] What nonscientists routinely fail to understand is that publication alone, even peer-reviewed publication, is not necessarily an imprimatur of validity. Arguably, some of the fault may lie with the *Daubert* Court, which described peer review and publication as factors that tend to enhance the validity of proffered scientific evidence. But *Daubert* reflects a very limited understanding of scientific literature. As a threshold matter, the quality of scientific journals varies dramatically so the mere fact of publication, even peer-reviewed publication, may communicate little about the quality of the underlying research or the validity of the conclusions. Moreover, even respected peer-reviewed journals will publish articles containing outlier views for the express purpose of exposing that view to criticism and critique from journal readers. This is especially true in fields distorted by manufactured controversies or litigation-driven science. Even those unfamiliar with this specific editorial practice should recognize these goals when journals also publish, often in the very same issue, critical responses to outlier articles written by others in the field.[75] However,

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[73] *See, e.g.*, John Plunkett, *Court of Appeal Issues Guidance on Shaken Baby Syndrome: Guidance for Shaken Baby Syndrome Testimony*, BMJ (June 28, 2010), http://www.bmj.com/rapid-response/2011/11/02/guidance-shaken-baby-syndrome-testimony#alternate (explaining that "SBS does not exist [and that there] is no scientifically acceptable evidence that shaking a child can cause subdural bleeding, retinal hemorrhage, or an encephalopathy"; Patrick Barnes, Marvin Miller, Ronald Uscinski, and numerous other frequent defense witnesses, signed onto this article); *see also* Waney Squier, *The "Shaken Baby" Syndrome: Pathology and Mechanisms*, 122 ACTA NEUROPATHOLOGICA 519, 521 (2011) ("[S]haking is no longer a credible mechanism for [non-accidental head injury] . . . ."); Jan E. Leestma, *Shaken Baby Syndrome: Putting Evidence Based Medicine to the Test*, SCI. ADVISORY BOARD, http://www.scienceboard.net/community/perspectives.24.html (last visited Nov. 23, 2013) (stating that biomechanical data has shown that "free shaking of a baby model cannot produce sufficient angular accelerations or G forces (about 10 G) that are apparently needed to produce subdural hematomas, brain injury and hemorrhage, retinal hemorrhages, axonal injury, etc. (100s of Gs);" but that "if impact occurs[,] the threshold for subdural hematoma and brain injury is easily reached[,] thus the conclusion is that pre-impact movements probably have nothing to do with the pathology observed and ascribed to shaking").

[74] *See* Sophia I. Gatowski et al., *Asking the Gatekeepers: A National Survey of Judges on Judging Expert Evidence in a Post*-Daubert *World*, 25 L. & HUM. BEHAV. 433, 447 (2001) (reporting on the results of a national survey of four hundred state court judges and concluding that judges lacked the scientific literacy necessary to evaluate expert witnesses). These results similarly suggest that judges may lack the "scientific literacy" necessary to critically evaluate medical research and literature.

[75] For a recent concrete example of an outlier theory published along with critical responses, see Kathy A. Keller & Patrick D. Barnes, *Rickets vs. Abuse: A National and*

confusion may increase in the future based on the recent and growing problem of journal editors who publish articles promoting such ideas but fail to engage in meaningful critical peer review or to redress problems identified in these works by other authors.[76]

The sections that follow critically examine the medical evidence relied upon by the *Smith* dissenters which continues to be routinely cited by defense witnesses in AHT/SBS cases and referenced by defense-oriented medical and legal commentary. This evidence-based approach illustrates how uncritical acceptance by courts of seemingly "scientific" publications creates significant potential for erroneous judicial decisions in the case at hand, and for all future cases relying on such decisions and similar evidence.

International Epidemic, 38 PEDIATRIC RADIOLOGY 1210, 1210–16 (2008) (proposing that "congenital rickets" could account for multiple fractures in several alleged child abuse cases). This article was published not as an accepted peer-reviewed article but instead as a "comment" along with invited critiques from numerous other doctors and the editors of the journal in which it was published. *See, e.g.*, Feldman, *supra* note 67; Carole Jenny, *Rickets or Abuse?*, 38 PEDIATRIC RADIOLOGY 1219, 1219 (2008) (criticizing the methodology used by Drs. Barnes and Keller and their selection bias based on their extensive experience as expert witnesses); Thomas L. Slovis & Stephen Chapman, *Evaluating the Data Concerning Vitamin D Insufficiency/Deficiency and Child Abuse*, 38 PEDIATRIC RADIOLOGY 1221 (2008) (providing the editor's comments revealing the lack of scientific support for the conclusions made by Drs. Keller and Barnes); Thomas L. Slovis & Stephen Chapman, *Vitamin D Insufficiency/Deficiency—A Conundrum*, 38 PEDIATRIC RADIOLOGY 1153, 1153 (2008).

[76] *See, e.g.*, Patrick D. Barnes et al., *Infant Acute Life-Threatening Event—Dysphagic Choking Versus Nonaccidental Injury*, 17 SEMINARS PEDIATRIC NEUROLOGY 7, 10–11 (2010) (proposing choking as an alternative causal mechanism for AHT); Christopher S. Greeley, *Letter to the Editor*, 17 SEMINARS PEDIATRIC NEUROLOGY 275, 275–78 (2010) (responding to Dr. Barnes's article, *Dysphagic Choking*, by documenting that the authors (1) omit salient abuse injuries to the child; (2) omit the fact that the case resulted in a prosecution on child abuse charges, that the defendant was convicted, and that the conviction was affirmed on appeal; and (3) fail to reveal that they were retained as defense witnesses at trial, or presented a fictitious vignette with strikingly similar characteristics to those in an abuse case in which they testified). It should also be noted that Barnes's *Dysphagic Choking* was published in a topical medical journal that does not include a peer-review process. *See About the Journal*, SEMINARS PEDIATRIC NEUROLOGY, http://www.se mpedneurjnl.com/aims (last visited Nov. 23, 2013). In a subsequent article, Dr. Barnes again promoted dysphagic choking as an alternative diagnosis or mimic to AHT findings. *See* Barnes, *supra* note 62. Curiously, rather than citing to his published article, *Dysphagic Choking*, which might lead readers to the critique by Dr. Greeley, Dr. Barnes instead cited as a reference a conference presentation on the topic that he and his co-authors had given. *Id*. at 228 n.167. These practices, both publication in a non-peer-reviewed journal of a single case report, and citation to unpublished conference workshops, are perplexing in light of Dr. Barnes's professed adherence to the principles of evidence-based medicine. *See infra* notes 159–160.

III. THE MEDICAL PAPERS SELECTED BY THE *SMITH* DISSENTERS

A. Faris A. Bandak, Ph.D., "Shaken Baby Syndrome: A Biomechanics Analysis of Injury Mechanisms"

Justice Ginsburg cited a 2005 article, *Shaken Baby Syndrome: A Biomechanics Analysis of Injury Mechanisms*,[77] written by Faris A. Bandak, Ph.D., quoting his conclusion that because "[h]ead acceleration and velocity levels commonly reported for SBS generate forces that are far too great for the infant neck to withstand without injury. . . . [A]n SBS diagnosis in an infant . . . without cervical spine or brain stem injury is questionable and other causes of the intracerebral injury must be considered."[78]

1. Dr. Bandak's Methods and Conclusions

Dr. Bandak purportedly used injury biomechanics to calculate forces exerted on the infant neck and spine caused by accelerations of the head during violent shaking episodes.[79] Based on these calculations, Dr. Bandak concluded that forces necessary to cause brain pathology typically ascribed to AHT/SBS (concussion, subdural hematoma, axonal damage) would also necessarily exceed injury tolerances for the neck and spine and therefore would be expected to cause infant decapitation, a broken neck, or spinal cord transection.[80] Because these specific types of neck and spinal injuries are not seen in infants diagnosed with AHT/SBS, Dr. Bandak asserted that his study should prompt reevaluation of the diagnostic criteria for AHT/SBS and that his work "merits serious attention for its implications on child protection."[81]

As should be clear from even a cursory review of this short article, Dr. Bandak did not base his findings about neck injury tolerances on original research,

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[77] Faris A. Bandak, *Shaken Baby Syndrome: A Biomechanics Analysis of Injury Mechanisms*, 151 FORENSIC SCI. INT'L 71, 71–79 (2005).

[78] Cavazos v. Smith, 132 S. Ct. 2, 10 (Ginsburg, J., dissenting).

[79] Bandak, *supra* note 77, at 75–76.

[80] *Id.* at 78.

[81] *Id.* at 79. He also suggests that a diagnosis of shaking as a mechanism for intracerebral injury in the absence of neck or spinal injury is "questionable and other causes of the cerebral injury must be considered" and the "rotational head acceleration mechanism for the intracerebral injuries of the SBS is inconsistent with the findings of this study." *Id.* at 78. In short, Bandak implies that his study discredits shaking as a mechanism of intracerebral injury unless neck injury is present, *see id.* at 78–79, a position he likewise asserts in courtroom testimony as a defense witness. *See* 3 Transcript of Proceedings - *Daubert*/*Taylor* Hearing, State v. Watts, CF-2001-43 (Okla. Dist. Ct., Woods Cnty., Mar. 28, 2003) (testimony of Faris Bandak) (on file with authors) (asserting that confessions to shaking are not plausible in the absence of neck injury based on biomechanical research that establishes adults cannot generate sufficient forces from shaking to cause injuries ascribed to SBS).

but on a review of neck injury thresholds previously described in earlier papers.[82] Several of the papers relied upon by Dr. Bandak involved experiments conducted on infant baboons[83] and one involved experiments conducted on infant goats.[84] Another paper, published in 1874, described a study where the primitive experimental methodology involved suspending weights sequentially around the necks of stillborn fetuses until their necks broke.[85]

More importantly, Dr. Bandak's conclusions rely on thresholds calculated for head injuries by Dr. Ann-Christine Duhaime during shaking experiments conducted on dummy surrogate models.[86] Dr. Duhaime's methodology, specifically the biofidelity of the models used and the brain injury tolerance calculations, has been extensively discussed, examined, and critiqued in the relevant and accessible AHT/SBS scientific literature by other experts.[87] A detailed evaluation of Dr. Duhaime's biomechanics research is beyond the scope of this Article. However, because Dr. Bandak relies on her work, which is also routinely cited by many other child abuse defense witnesses[88] and legal academics[89] seeking

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[82] Bandak, *supra* note 77, at 71.

[83] Randal P. Ching et al., *Tensile Mechanisms of the Developing Cervical Spine*, 45 STAPP CAR CRASH J. 329, 329 (2001); D.J. Nuckley et al., *Tensile Mechanisms of the Developing Baboon Cervical Spine*, 5 INJ. SCI. RES. 85, 85 (2000).

[84] Russell Mayer et al., *Pediatric Tensile Neck Strength Characteristics Using a Caprine Model*, 66 INJ. BIOMECHANIC RES. 87, 88 (1999).

[85] J. Matthews Duncan, *Laboratory Note: On the Tensile Strength of the Fresh Adult Fetus*, 2 BRIT. MED. J. 763, 763–64 (1874). Commentators have rightfully questioned whether such studies say anything about the vulnerability of infant necks during violent shaking. *See, e.g.*, Betty Spivack, *Reviewer's Note*, 13 Q. UPDATE 23, 24–25 (2006) (reviewing Bandak, *supra* note 77); *see also infra* notes 114–115 and accompanying text.

[86] Ann-Christine Duhaime et al., *The Shaken Baby Syndrome: A Clinical, Pathological and Biomechanical Study*, 66 J. NEUROSURGERY 409, 412 (1987).

[87] If brain injury thresholds are lower than those suggested by Dr. Bandak based on Dr. Duhaime's results, neck injuries would not be expected. Substantial research conducted since Dr. Duhaime's original 1987 paper and comments from other researchers addressing limitations in her methodology and results suggest that her conclusions regarding the forces needed to reach injury thresholds are not reliable. *See, e.g.*, C.Z. Cory & M.D. Jones, *Can Shaking Alone Cause Fatal Brain Injury? A Biomechanical Assessment of the Duhaime Shaken Baby Syndrome Model*, 43 MED. SCI. & L. 317, 322 (2003); R.A. Minns, *Shaken Baby Syndrome: Theoretical and Evidential Controversies*, 35 J. ROYAL C. PHYSICIANS EDINBURGH 5, 6 (2005); D.R. Wolfson et al., *Rigid Body Modeling of Shaken Baby Syndrome*, 219 J. ENGINEERING MED. 63, 63 (2005).

[88] *See infra* notes 179–187 and accompanying text.

[89] *See, e.g.*, Tuerkheimer, *Science-Dependent Prosecution*, *supra* note 63, at 517 (claiming that "many scientists now believe that shaking cannot possibly cause the triad" defined as subdural hemorrhage, retinal hemorrhage and cerebral edema, and referencing back to her earlier law review article); Tuerkheimer, *The Next Innocence Project*, *supra* note 63, at 19–20, 52 (suggesting that scientists point to Dr. Duhaime's study as support for the assertion that SBS cannot be caused by shaking); Lyons, *supra* note 63, at 1123 (opining that the Duhaime study proved that "shaking as a cause of injury had no

to refute or critique the validity of the AHT/SBS diagnoses, some clarification is warranted here.

(a) Dr. Duhaime's Biomechanics Research

Dr. Duhaime and her colleagues have made enormous contributions to the understanding of AHT/SBS and the role that impact trauma plays in the mechanisms of injury to infant brains.[90] Unfortunately, problems routinely arise when others, like Dr. Bandak, misstate her findings and conclusions in legal proceedings, medical articles, and legal academic articles. Most problematic is the fact that Dr. Duhaime's research has been miscited as support for the proposition that infants *cannot* sustain head injuries through shaking alone. To the authors' knowledge, Dr. Duhaime herself has never made this assertion. But because others have made this claim with increased frequency, some understanding of the scope and limits of Dr. Duhaime's research is essential. Thus, at the risk of oversimplifying Dr. Duhaime's extensive research, this section provides a brief explanation of her most frequently cited biomechanical experiment.

In 1987, Dr. Duhaime and her colleagues constructed a surrogate model of an infant, which they subjected to various experiments that involved shaking, shaking combined with an inflicted impact, and simulated falls onto various surfaces from different heights.[91] The neck of the surrogate model infant was constructed using a variety of materials (e.g., metal hinge, rubber tube) to provide different levels of resistance during the various experiments.[92] The surrogate was also outfitted with accelerometers placed on the head to measure peak accelerations during experimentation.[93]

Peak acceleration measurements from the model infant experiments were then compared with injury thresholds from previously reported experimental data that had been conducted using *adult primates*.[94] In these earlier adult primate experiments, the primates were subjected to a *single whiplash event* at various

theoretical basis"); Walker, *supra* note 63, at 3 (mischaracterizing Dr. Duhaime's 1987 paper as a study that "demonstrated the impossibility that a human being could create enough force by shaking alone to cause brain injuries in young infants and children"); Burg, *supra* note 63, at 666 (misquoting Duhaime by stating "[s]haking alone does not produce the shaken baby syndrome"); Symposium, *supra* note 63, at 226 (statement of Professor Keith Findley) (erroneously asserting that Dr. Duhaime's and Dr. Prange's two biomechanical research studies showed you could not shake an infant hard enough to cause brain injuries without first causing severe cervical-spinal injuries but impacts from short falls could cause these injuries).

[90] *See* Christian et al., *supra* note 33, at 1409.

[91] Duhaime et al., *supra* note 86, at 409.

[92] *Id.* at 411–12.

[93] *Id.* at 412–13.

[94] *Id.* at 414.

speeds, and then the "peak accelerations" were measured.[95] Following this single whiplash event, the primates were examined to determine which had sustained concussions, subdural hemorrhages, and axonal injuries.[96] From this data, injury thresholds were calculated based on the measured peak accelerations.[97]

Finally, Dr. Duhaime used the primate thresholds, scaled for application to infants based on her model infant experiments, and determined that pure shaking episodes and falls of short distances failed to achieve injury thresholds for concussion, subdural hemorrhage, and axonal injury.[98] Inflicted impacts, however, exceeded these injury thresholds.[99] From this data, Dr. Duhaime and her colleagues concluded, "[T]he shaken baby syndrome, at least in its most severe acute form, is not usually caused by shaking alone. Although shaking may, in fact, be part of the process, it is more likely that such infants suffer blunt impact."[100]

(b) Limitation of Dr. Duhaime's Biomechanics Research

In a follow-up biomechanics study published in 2003, Dr. Duhaime and her coauthors specifically acknowledge several limitations of their original 1987 research study.[101] Over the past two decades, other researchers have identified additional limitations of Dr. Duhaime's work, including (1) a lack of biofidelity in the model infants and the model infants' neck mechanisms; (2) the use of tests that did not involve strains on actual tissue samples and did not measure the effects of repetitive tissue strains; (3) force calculations and injury thresholds for human infants based on scaled findings from adult animal research (adult animals, like adult humans, have different anatomical properties as compared with immature infant brains); (4) the use of animal research involving only single whiplash events (as compared with the repetitive whiplash events routinely associated with AHT/SBS); (5) the failure to address retinal injuries or cranio-cervical junction injuries; (6) the failure to address the effect of head rotations in different directions and different mechanisms for shaking; and (7) the failure to address the fact that

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[95] *See* Thomas A. Gennarelli et al., *Diffuse Axonal Injury and Traumatic Coma in the Primate*, 12 ANNALS NEUROLOGY 564, 564 (1982).

[96] *Id.*

[97] *Id.* at 564–65.

[98] Duhaime et al., *supra* note 86, at 414.

[99] *Id.*

[100] *Id.*

[101] *See* Michael T. Prange, Brittany Coats, Ann-Christine Duhaime & Susan S. Margulies, *Anthropomorphic Simulations of Falls, Shakes, and Inflicted Impacts in Infants*, 99 J. NEUROSURGERY 143, 144 (2003); *see also* Ann-Christine Duhaime & Carter P. Dodge, *Closer But Not There Yet: Models in Child Injury Research*, 2 J. NEUROSURGERY: PEDIATRICS 320 (2008) (noting the shortcomings of using doll models and the need for future research to determine injury thresholds in specific tissue types).

injury thresholds for infants at different ages vary and have never been determined.[102]

These limitations raise significant doubt about the validity of basing a medical opinion on a 1987 biomechanical experiment that used surrogate infant models and injury thresholds determined by single whiplash events on adult primate subjects.[103] Defense arguments that infants cannot be injured by shaking without impact based on the Duhaime study are further undermined by (1) perpetrator confessions in AHT/SBS cases to shaking without impact,[104] (2) the absence of clinical evidence of impact injury in surviving and deceased AHT/SBS victims (including those described in Dr. Duhaime's own research findings),[105] and (3) by other biomechanical experimentation on animals.[106]

(c) Dr. Duhaime's Own AHT/SBS Conclusions

Finally, although Dr. Duhaime did opine that AHT/SBS in its most severe form, is not *usually* caused by shaking alone, she has notably *never* stated or suggested that findings of severe infant brain trauma (including subdural and subarachnoid hemorrhage, retinal hemorrhage, cerebral edema, and various neurologic sequelae) which she has consistently ascribed to abuse in her various studies, could be the result of a child abuse "mimic" (i.e., alternative medical conditions or accidental causes). Unfortunately, others have misused her research to argue that violent shaking cannot injure babies and produce these pathologies; thus, severe brain trauma must have been caused—not by child abuse—but by a mimic.[107] This argument ignores the corpus of Dr. Duhaime's research and

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[102] *See, e.g.*, Minns, *supra* note 87, at 7; Cory & Jones, *supra* note 87; Dias, *supra* note 35; Betty Spivack, *Biomechanics*, *in* ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN: A MEDICAL, LEGAL, AND FORENSIC REFERENCE, *supra* note 28, at 29; Narang et al., *supra* note 15, at 246–58 (noting that the biomechanical literature is conflicting and prone to multiple errors due to the difficulties of modeling complex biological systems within the infant brain and concluding that "continued assertion of the principle—that biomechanics clearly demonstrates that SDHs and/or serious brain injury cannot result from shaking—is disinegenuous and scientifically irresponsible").

[103] *See, e.g.*, Cory & Jones, *supra* note 87, at 317 (concluding that there exists sufficient doubt in Duhaime's original results to preclude reliance on this study in court proceedings); Wolfson et al., *supra* note 87, at 68–69 (noting that injury criteria used by Duhaime are scaled from studies examining single impact events in auto crashes, and by using these criteria, SBS is studied as a single-impact event and any effects of cumulative loading are ignored). "Although more suitable criteria based on cyclic loading are not available, it is inappropriate to apply current injury criteria, scaled or otherwise, to this syndrome." Wolfson et al., *supra* note 87, at 69.

[104] *See infra* Part III.E.

[105] *See infra* notes 108, 185–186 and accompanying text.

[106] *See infra* note 115.

[107] *See, e.g.*, Squier, *supra* note 73; Barnes, *supra* note 62.

opinions, including her original paper,[108] and (most egregiously) the fact that she has consistently opined that AHT/SBS injuries *are* the result of child abuse involving violent mechanisms including shaking.

> It is our conclusion that shaken baby syndrome, at least in its most severe acute form, is not usually caused by shaking alone. Although shaking may, in fact, be part of the process, it is more likely that such infants suffer blunt impact. The most common scenario may be a child who is shaken, then thrown into or against a crib or other surface, striking the back of the head and thus undergoing a large, brief deceleration. . . . Unless that child has predisposing factors . . . fatal cases of shaken baby syndrome are not likely to occur from the shaking that occurs during play, feeding or in a swing, or even from the most vigorous shaking given by a caretaker as a means of discipline.[109]

A decade later, Dr. Duhaime continued to express this view.

> The majority of abused infants in fact have clinical, radiologic, or autopsy evidence of blunt impact to the head. Thus, the term "shaking-impact syndrome" may reflect more accurately than "shaken-baby syndrome" the usual mechanism responsible for these injuries. Whether shaking alone can cause the constellation of findings associated with the syndrome is still debated, but most investigators agree that trivial forces, such as those involving routine play, infant swings, or falls from a low height are insufficient to cause the syndrome. Instead, these injuries appear to result from major rotational forces, which clearly exceed those encountered in normal child-care activities.[110]

Thus, arguments disputing the validity of the AHT/SBS diagnosis citing Dr. Duhaime as support for the view that "human adults simply cannot shake an infant hard enough to inflict the kinds of head injuries that we see in these cases"[111]

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[108] Although Dr. Duhaime's 1987 paper is most often cited for its conclusions regarding the biomechanical experiments that were conducted, what is most often overlooked are the results from the clinical portion of that paper which reported on the pathologies seen in forty-eight "suspected shake injury" patients of which there were thirteen fatalities. Of these, thirty-nine patients (81%) had retinal hemorrhages plus subdural or subarachnoid bleeding, which the authors ascribed to abusive causes. Thirty children (63%) had other evidence of blunt trauma to the head involving contusions, fractures, or both. Duhaime et al., *supra* note 86, at 410–11.

[109] *Id.* at 414.

[110] Ann-Christine Duhaime et al., *Current Concepts: Nonaccidental Head Injury in Infants—The "Shaken-Baby Syndrome,"* 338 NEW ENG. J. MED. 1822, 1822 (1998).

[111] Symposium, *supra* note 63, at 226 (statement of Professor Keith Findley) (citing Duhaime et al., *supra* note 86, at 414, as the sole support for this assertion). Findley also

patently mischaracterize her biomechanical research, clinical research, and extensive academic writings.

2. Scientific Critique of Dr. Bandak's Work

Dr. Bandak's selection of source articles that form the basis for his derivative work raises additional questions about the validity of his brain injury tolerance conclusions. To borrow from the *Daubert* criteria, these questions include whether the issue of infant neck injuries can be or has been accurately tested, whether adequate techniques and standards exist for these experiments, whether findings from studies involving surrogate nonbiofidelic models, baboons, and goats can validly be applied to shaking of infants, and whether there is a known or potential error rate for such comparisons. Although Dr. Bandak's article continues to be routinely cited as support for the argument that AHT/SBS does not exist,[112] the authors are unaware of any appellate or trial decision finding that this paper and its conclusions satisfy the *Daubert* criteria. In fact, in the only trial court decision assessing Dr. Bandak's opinion challenging the admissibility of AHT/SBS testimony, the trial judge soundly rejected Dr. Bandak's proffered testimony and conclusions.[113]

(a) Dr. Bandak's Problematic Selection of Medical Sources

More specifically, the four studies relied upon by Dr. Bandak are distinguishable from shaking episodes involving infants because each involved static or quasistatic loading conditions (a uniform force applied over a longer period of time). In contrast, shaking of infants involves dynamic loading (varying

states that "the peak rotational accelerations for a shake are less than those of a one-foot fall onto carpet . . . . To cause that level of trauma, you'd have to shake a child so hard that you'd inflict massive cervical-spinal injuries; the neck would fail before the brain would suffer the extensive injuries associated with SBS." *Id.* (citing Prange et al., *supra* note 101, at 148). Here again the medical evidence has been distorted because, in contrast to Professor Findley's assertion, Prange specifically acknowledged that "[a]t present, no detailed quantitative information is available to validate the biomechanical properties of the human infant neck." Prange et al., *supra* note 101, at 147.

[112] *See, e.g.*, Barnes, *supra* note 62, at 210 (citing Bandak, *supra* note 77; Patrick D. Barnes et al., *Traumatic Spinal Cord Injury: Accidental vs. Nonaccidental Injury*, 15 SEMINARS PEDIATRIC NEUROLOGY 178 (2008)) ("[S]haking alone cannot result in brain injury (i.e., the triad) unless there is concomitant injury to the neck, cervical spinal column, or cervical spinal cord . . . ."); Tuerkheimer, *The Next Innocence Project*, *supra* note 63, at 20 (citing Bandak, *supra* note 77, as sole support for the assertion that because "most infants diagnosed with SBS do not present this [damage to the neck and cervical spinal cord or column], they could not have been simply shaken").

[113] *See* State v. Watts, No. CF-2001-43 (Okla. Dist. Ct., Woods Cnty., Apr. 23, 2003) (finding SBS diagnosis satisfied *Daubert* requirements).

forces applied over short periods of time)[114] and may often involve repeated shaking incidents. Thus, Dr. Bandak's conclusions are premised on research (conducted by others) unrelated to the biomechanical mechanism he purports to describe. Furthermore, his conclusions are refuted by biomechanical research that he fails to acknowledge or address. For example, biomechanical research published prior to Dr. Bandak's paper, but not referenced by him, clearly demonstrates that repetitive shaking, as opposed to a single whiplash event, produces brain injuries at lower force thresholds.[115] It should also be noted that none of the four studies relied upon by Dr. Bandak, including the research involving suspending weights from stillborn infants until their necks broke which was conducted over 130 years ago, has ever been replicated—an essential element of scientific validation.

(b) Dr. Bandack's Mathematical Errors

Unsurprisingly, biomechanics experts have published articles critiquing Dr. Bandak's conclusions. In 2006, Dr. Susan Margulies of the University of Pennsylvania Department of Engineering, along with seven other biomechanical engineers, discovered that Dr. Bandak had made significant errors in his mathematical calculations which led her to express "grave[] concern[s] that the conclusions reached by Bandak may be invalid due to apparent numerical errors in

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[114] *See* Spivack, *supra* note 85, at 24 ("It is inappropriate to use thresholds derived from one sort of loading condition to infer injury under very different conditions."). Dr. Spivack describes additional significant errors in the paper including inaccurate citation references and misquoting of the medical literature and data. *See id.*

[115] *See, e.g.*, Ramesh Raghupathi et al., *Traumatic Axonal Injury Is Exacerbated Following Repetitive Closed Head Injury in the Neonatal Pig*, 21 J. NEUROTRAUMA 307, 314 (2004) (explaining data was indicative of a graded response of the immature brain to rotational load magnitude, which demonstrates vulnerability to repeated, mild, nonloading conditions); Ramesh Raghupathi & Susan S. Margulies, *Traumatic Axonal Injury After Closed Head Injury in the Neonatal Pig*, 19 J. NEUROTRAUMA 843, 843–44 (2002) (demonstrating that the rapid rotation of the piglet head subjected to rapid nonimpact rotation resulted in subarachnoid hematoma and traumatic axonal injury similar to that observed in children following severe head trauma); *see also* Phillip V. Bayly et al., *Deformation of the Human Brain Induced by Mild Acceleration*, 22 J. NEUROTRAUMA 845 (2005) (noting that because repetitive shaking involves dynamic loading conditions, it produces injuries at lower force levels); J.W. Finnie et al., *Neuropathological Changes in a Lamb Model of Non-Accidental Head Injury (The Shaken Baby Syndrome)*, J. CLINICAL NEUROSCIENCE (2012) (documenting shaking injuries to eyes and brains including fatal injuries in lambs without impact trauma and establishing injuries were caused by shaking mechanism and not from hypoxia, noting extensive axonal damage in the brainstems); B. Sandoz et al., *In Vivo Biomechanical Response of Ovine Heads to Shaken Baby Syndrome Events*, 15 (Supp. 1) COMPUTER METHODS IN BIOMECHANICS & BIOMEDICAL ENGINEERING 293 (2012) (reporting that experimental shaking of lambs produced neuronal and axonal injury to the brain and spinal cord of the lambs and shaking events involved impacts of the lamb's head with the back without a separate impact trauma independent of the shaking).

his estimation of forces."[116] When Dr. Margulies repeated Dr. Bandak's calculations, not only was she unable to replicate his findings, but she found "values of neck forces that are actually more than 10 times *lower* than those [calculated by Dr. Bandak]."[117] Because two of Dr. Margulies's coauthors were themselves favorably cited within Dr. Bandak's paper, this critique arguably has added weight.

Based on her research Dr. Margulies found that Dr. Bandak had used "flawed calculations" to "erroneously conclude[] that the neck forces in even the least severe shaking event far exceed the published injury tolerance of the infant neck."[118] According to Dr. Margulies, "when accurately calculated, the range of neck forces is considerably lower, and includes values that are far *below* the threshold for injury"[119] calculated by Bandak. The discovery of significant "numerical errors in Bandak's neck force estimations" significantly undermined Dr. Bandak's conclusions leading Dr. Margulies and her coauthors to "question the resolute tenor of Bandak's conclusions that neck injuries would occur in all shaking events . . . [and] propose that a more appropriate conclusion is that the possibility exists for neck injury to occur during a severe shaking event without impact."[120]

(c) Dr. Bandak's Failure to Respond to Scientific Critique

Dr. Bandak failed to adequately respond to the Margulies critique when it appeared shortly after his article was published and *in the same journal*.[121] The Margulies critique was followed by a second critical commentary, again published in the same journal, by a different set of biomechanics experts, to which Bandak also failed to adequately respond.[122] The second group of authors identified additional computational errors and critiqued Dr. Bandak's misuse of unpublished references from conference workshops.[123] Over the past eight years, Dr. Bandak has never clarified his methodology, corrected his calculations, or modified his

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[116] Susan Margulies et al., *Shaken Baby Syndrome: A Flawed Biomechanical Analysis*, 164 FORENSIC SCI. INT'L 278 (2006).

[117] *Id.* at 278.

[118] *Id.* at 279.

[119] *Id.*

[120] *Id.*

[121] *See* Faris A. Bandak, *Response to the Letter to the Editor*, 164 FORENSIC SCI. INT'L 282, 282–83 (2006).

[122] *See id.* at 282; N. Rangarajan & T. Shams, *Letter to the Editor*, 164 FORENSIC SCI. INT'L 280, 280–81 (2006).

[123] Narang et al., *supra* note 15, at 253–54; Rangarajan & Shams, *supra* note 122, at 281 (noting that the two of the studies involving non-human subjects were presented with the explicit condition that they were preliminary and not to be used as references).

conclusions.[124] Dr. Bandak has also failed to publish any follow-up research confirming or modifying his 2005 article.

(d) Dr. Bandak's Failure to Address Conflicting Data

Dr. Bandak's claim that forces necessary to produce brain injury by shaking would necessarily produce infant decapitation, a broken neck, or spinal cord transection injury to the neck and spine must also be contrasted with the extensive widely-available clinical evidence from multiple peer-reviewed studies indicating that neck and spinal cord injury may, but need not, be present in cases involving AHT/SBS.

In 2001, Dr. Jennian Geddes and her colleagues documented significant rates of cervical cord injury using β-amyloid precursor protein (βAPP) staining in children dying of fatal AHT/SBS.[125] These severe brain and spinal cord injuries occurred without damage to the spine itself. Based on these findings, Dr. Geddes, along with other researchers, concluded that trauma-induced apnea to the spinal column led to cerebral hypoxia and ischemia.[126] Notably, this is precisely the same cause of death described by the medical examiners and child abuse pediatrician in *Smith*.[127]

Dr. Bandak's claim that infant decapitation, a broken neck, or spinal cord transection must be present in AHT/SBS cases is further refuted by the work of Dr. Laura Brennan and her colleagues.[128] In 2009, these researchers confirmed that (1) shaking alone can cause severe infant injury or death and (2) neck and brainstem

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[124] One set of authors has noted that "when asked to produce a single 'worked example' demonstrating how the reported forces could be computed, Bandak failed to do so. Replication is a fundamental mechanism by which scientific validity is achieved. A work that cannot be replicated isn't bad science—it isn't science at all." Narang et al., *supra* note 15, at 254. According to these authors, this is especially notable because the methodology employed by Bandak, a purely analytic study, should be perfectly replicable. *Id.*

[125] *See, e.g.*, J.F. Geddes et al., *Neuropathology of Inflicted Head Injury in Children: I. Patterns of Brain Damage*, 124 BRAIN 1290 (2001) [hereinafter Geddes I]; J.F. Geddes et al., *Neuropathology of Inflicted Head Injury in Children: II. Microscopic Brain Injury in Infants*, 124 BRAIN 1299 (2001) [hereinafter Geddes II]; Mark N. Hadley et al., *The Infant Whiplash-Shake Injury Syndrome: A Clinical and Pathological Study*, 24 NEUROSURGERY 536 (1989) (documenting multiple cases with neck injuries); *see also* P. Shannon et al., *Axonal Injury and the Neuropathology of Shaken Baby Syndrome*, 95 ACTA NEUROPATHOLOGY 625, 625–30 (1998) (finding high rates of cervical cord injury without fracture).

[126] *See* Dennis L. Johnson et al., *Role of Apnea in Nonaccidental Head Injury*, 23 PEDIATRIC NEUROSURGEON 305, 306 (1995); A.M. Kemp et al., *Apnea and Brain Swelling in Non-Accidental Head Injury*, 88 ARCHIVES DISEASE CHILDHOOD 472, 472 (2003).

[127] *See* Moreno & Holmgren, *supra* note 32.

[128] *See* Laura K. Brennan et al., *Neck Injuries in Young Pediatric Homicide Victims*, 3 J. NEUROSURGERY PEDIATRICS 232, 238–39 (2009).

injuries are frequently present in fatal AHT/SBS cases, *but* that these neck and brainstem injuries do *not* involve the neck fractures and spinal cord transection injuries predicted by Dr. Bandak.[129] Dr. Brennan also established that careful dissection and examination of the brain stem, neck, and spinal column (using newer and more sophisticated techniques than those available at the time of Etzel's autopsy in *Smith*) provide additional clinical support for the diagnoses of trauma-induced apnea from injury to the spinal column leading to cerebral hypoxia and ischemia (also described by Dr. Brennan).[130] Although autopsy findings obviously cannot be documented in children who survive nonfatal AHT/SBS injuries, additional diagnostic support will likely be provided by MRI research capable of locating and imaging previously undetectable ligament injuries to the neck in AHT/SBS cases.[131]

(e) Despite Significant Methodological Flaws, Dr. Bandak's Work Continues to Be Cited by Legal Academics and Child Abuse Defense Witnesses

Given Dr. Bandak's bold conclusions, it is no coincidence that numerous recent legal articles ostensibly challenging the scientific foundation for AHT/SBS rely on the 2005 Bandak article.[132] However, these law professors and students

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[129] *Id.* at 238. Neck and spinal injuries are also documented in nonfatal AHT in a substantial, but not exclusive, number of circumstances. A study published in late 2011 documented that spinal subdural hematoma was prevalent (about 60%) in cases involving AHT when proper imaging studies were done and were almost never present in accidental head injury cases. *See* Arabinda Kumar Choudhary et al., *Spinal Subdural Hemorrhage in Abusive Head Trauma: A Retrospective Study*, 262 RADIOLOGY 216, 217 (2012). Similar findings have been documented in research conducted in the United Kingdom. *See* THE ROYAL COLL. OF PATHOLOGISTS, REPORT OF A MEETING ON THE PATHOLOGY OF TRAUMATIC HEAD INJURY IN CHILDREN 4–5, 8 (2009) (demonstrating that approximately 30 to 66% in abuse group and 40% in accident group showed spinal SDH). However, other researchers have documented that these injuries, although present, can be missed on imaging studies. *See* Kenneth W. Feldman et al., *Cervical Spine MRI in Abused Infants*, 21 CHILD ABUSE & NEGLECT 199, 203–04 (1997).

[130] *See* Brennan et al., *supra* note 128, at 232.

[131] These injuries have previously been reported in autopsy findings, see, e.g., Brennan et al., *supra* note 128, at 233–34, but have not been extensively reported on from MRI evaluations. *See* Feldman et al., *supra* note 129, at 200–04 (discussing the previous difficulties including the long periods of immobility required from the child getting an MRI).

[132] *See* Burg, *supra* note 63, at 667 & nn.62–63; Gena, *supra* note 63, at 711–12 & nn.110–13; Quint, *supra* note 63, at 1848 & nn.49–50; Tuerkheimer, *The Next Innocence Project*, *supra* note 63, at 20 & n.122; Walker, *supra* note 63, at 23–25 & n.152 (citing Bandak's article throughout with no discussion of flaws or critiques and describing how she used Bandak as an expert witness to win an acquittal in a 2008 head trauma case); Findley et al., *supra* note 63, at 237 & n.96 (citing Ronald H. Uscinski, *Shaken Baby Syndrome: An Odyssey*, 46 NEUROLOGIA MEDICO-CHIRURGICA 57, 59, 61 (2006) (Japan),

uniformly fail to acknowledge the extensive, well-known, and easily accessible critiques of Dr. Bandak's work listed above. As any first-year law student should know, the selective citation to work that favors an author's opinion along with the omission of evidence discrediting such work is problematic scholarship—especially when authors hold themselves out as objective researchers. More importantly, by repeatedly citing Dr. Bandak and ignoring his critics, these purported law and science experts provide an unwarranted imprimatur of validity (to judges, law clerks, and the media) while concealing multiple errors.

The problem transcends law professors and students because the Bandak article is also cited favorably by child abuse defense medical witnesses who neglect to inform courts that this paper has been the subject of extensive criticism.[133] When medical "experts" provide this type of testimony, it raises

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which relies heavily on Dr. Bandak's article to support the proposition that the forces necessary to produce subdural hemorrhage and axonal injury "would cause extensive cervical spine injury or failure (*i.e.*, neck injury) before causing such effects" and erroneously referencing Prange et al., *supra* note 101 as support for this claim). It is interesting to note that rather than citing to the widely critiqued Bandak paper for support, these authors cite instead to an opinion piece written by Dr. Uscinski, who (in turn) *does* cite to the Bandak article as the sole authority for this proposition—without discussing any of the critiques of Dr. Bandak's work. This type of selective citation creates the appearance of appropriate support by insulating against discovery of the problematic sources and extensive critique.

[133] *See, e.g.*, 8 Reporter's Record: Statement of Facts at 208, State v. Thomas, No. D-1-DC-06-301206 (Tex. 390th Dist. Ct., Travis Cnty. Oct. 26, 2007) (testimony of Dr. Patrick Barnes) (on file with the authors) (stating without qualification that according to evidence-based science and the neuropathology and biomechanical studies, shaking alone could not produce the brain injuries to the victim without also causing injury to the neck); *Id.* at 213 ("I don't know if you can harm a baby by shaking them, but I do know that the science says you can't get these types of injuries from shaking a baby unless you also have injuries to the neck muscles, soft tissues, or to the baby's bones in his neck . . . which we don't have."); Petition for Post Conviction Relief: Testimony of Dr. Patrick David Barnes at 44, Maze v. State, No. 2002-D-2361 (Tenn. 20th Dist. Ct., Davidson Cnty. June 9, 2008) [hereinafter Testimony of Dr. Barnes] (on file with authors) ("And all the recent literature tells us that if shaking only is going to produce this type of brain injury we'd probably have to have neck injury, spine injury or spinal cord injury with it because that's the weakest part of the head and neck."); *id.* at 72 (acknowledging on cross-examination that he was relying on the Bandak study); Testimony of Dr. Ronald Uscinski at 82–86, State v. Ferguson, No. 2007-GS-26-4843 (S.C. Ct. Gen. Sess., Horry Cnty. Nov. 16, 2009) (on file with authors) (asserting without qualification that subdural hemorrhage *cannot* be caused by shaking—citing the Duhaime study and a later study by Prange—and opining that if one were to shake a baby violently the baby would sustain a broken neck—citing the Bandak study); Transcript of *Daubert* Hearing at 38–120, Commonwealth v. Davis, No. 04-CR-205 (Ky. Cir. Ct., Greenup Cnty. Mar. 29, 2006) (on file with authors) (testimony of Dr. Ronald Uscinski) (asserting without qualifications that biomechanics research of Duhaime establishes that subdurals cannot be caused by shaking and opining, based on the Bandak study, that neck fracture or neck injury would occur before brain injury).

ethical concerns beyond the normal witness obligation to "tell the whole truth." As Dr. Albert and his coauthors recently noted in the *Journal of the American Medical Association*, when doctors testify in AHT/SBS cases, "[o]rganized medicine has a responsibility to ensure that unbiased and evidence-informed opinion is used to explain to a judge and jury the significance of medical findings."[134] It is inappropriate and unethical for experts to advance untested or unacceptable views, promote discredited theories without informing the court of existing critique, or advance conclusions that fail to consider all available relevant evidence.[135]

Dr. Bandak's mischaracterization of Dr. Duhaime's work, his mathematical errors, his selection of sources for his derivative work, and his failure over the past eight years to respond to published critiques of his paper raise real questions regarding the validity of his research methods and conclusions, testimony or arguments by others based on his work, and any court's reliance on his "expertise" to draw conclusions regarding AHT/SBS.

B. Dr. Mark Donohoe, "Evidence-Based Medicine and Shaken Baby Syndrome, Part I: Literature Review, 1966–1998"

Justice Ginsburg cites to a 2003 article, *Evidence-Based Medicine and Shaken Baby Syndrome, Part I: Literature Review, 1966–1998*,[136] quoting Dr. Mark Donohoe's assertion that "[b]y the end of 1998, it had become apparent that there was inadequate scientific evidence to come to a firm conclusion on most aspects of causation, diagnosis, treatment, or any other matters pertaining to SBS," and that "the commonly held opinion that the finding of [subdural hemorrhage] and [retinal hemorrhage] in an infant was strong evidence of SBS was unsustainable."[137]

1. Dr. Donohoe's Methods and Conclusions

Dr. Donohoe's three-page article purports to subject thirty-two years of medical literature to scrutiny, using evidence-based medicine principles. The length of the Donohoe article reflects the thin quality of the author's review and analysis. More specifically, the first page provides an overview of the background

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[134] Albert et al., *supra* note 47, at 40.

[135] *Id.*; Catherine Williams, *Expert Evidence in Cases of Child Abuse*, 68 ARCHIVES DISEASE CHILDHOOD 712, 714 (1993); *see also* Holmgren, *supra* note 51.

[136] Mark Donohoe, *Evidence-Based Medicine and Shaken Baby Syndrome, Part I: Literature Review, 1966–1998*, 24 AM. J. FORENSIC MED. PATHOLOGY 239, 239–42 (2003). Dr. Donohoe's paper purports to critique the scientific reliability of AHT/SBS by applying "evidence based" medical (EBM) criteria to research published between 1966 and 1998. *Id.* Although, Dr. Donohoe specifically stated that he planned a two-part article (with the second part devoted to the post-1998 literature), these plans were apparently abandoned, as this second article has not been published. *Id.* at 239. Accordingly, Dr. Donohoe's stated conclusions have no application to the hundreds of research articles published since 1998.

[137] Cavazos v. Smith, 132 S. Ct. 2, 10 (2011) (Ginsburg, J., dissenting).

and purpose of the article and another full page lists the references. Thus, Dr. Donohoe devotes just a page and a half to all of the following sections, which normally would comprise the core of his scientific analysis: (1) the overview and methods section, (2) the results of quality of evidence ratings, and (3) the results and conclusions section. Although Dr. Donohoe claims to utilize evidence-based medicine principles, he devotes less than half a page to defining the Quality of Evidence Ratings (QER) that he purportedly used to rank the existing literature.[138] Because he fails to explain how he applied these QERs to the reviewed articles and abstracts, it is impossible to independently assess, replicate or verify Dr. Donohoe's results or conclusions.

Dr. Mark Donohoe is a physician with advanced degrees in nutritional and environmental medicine.[139] He is also the author of a blog, *Dr. Mark's Medical Site*, which prominently features arguments challenging the existence of AHT/SBS and expressing concern about the safety and efficacy of childhood vaccines.[140] Despite his advocacy views, Dr. Donohoe claims that the aim of his work is "to be neutral on the subject of SBS."[141] However, he is careful to define "neutrality" as "mean[ing] that there is no selective quotation of the literature, and literature is not chosen to support any particular view."[142]

Dr. Donohoe's methods and conclusions have been the subject of extensive, significant, and readily accessible critique. As a threshold matter, evidence-based

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[138] For example, according to Dr. Donohoe, the highest QER rankings should be reserved for "[c]onsistent evidence obtained from more than 2 independent, randomized, and controlled studies or from 2 independent, population-based epidemiologic studies. Studies included here are characterized by sufficient statistical power, rigorous methodologies, and inclusion of representative patient samples. Meta-analysis of smaller, well-characterized studies may support key findings." Donohoe, *supra* note 136, at 240. Of course, because child abuse research never involves randomized controlled studies, these criteria are especially inapt for his purposes.

[139] *See Dr. Donohoe's Practice*, DOCMARKY.COM, http://docmarky.com/DoctorMark/Practice.html (last visited Nov. 24, 2013). Dr. Mark Donohoe has an undergraduate bachelor's degree in medicine (from the University of Sydney) along with postgraduate course work in nutritional and environmental medicine from the Australian College of Nutritional Medicine, see *id.*, which, according to its promotional materials, focuses its program on treatment involving "removal of certain foods from the diet or toxins from the patient's environment, or prescription of supplements such as vitamins, minerals, trace elements and essential fatty acids." *About Us*, ACNEM, http://www.acnem.org/about/what-is-nem (last visited Nov. 24, 2013). An obvious question posed by this background is what "expertise" Dr. Donohoe possesses to evaluate evidence relevant to an AHT/SBS diagnosis, even from a strictly literature-based standpoint, other than the fact that he possesses a medical degree.

[140] *Dr. Donohoe's Practice*, *supra* note 139.

[141] Donohoe, *supra* note 136, at 239.

[142] *Id.* Notably, this definition in this context is meaningless. Dr. Donohoe does not quote from any literature in his paper, and his selection of literature to review is ostensibly based on his search terms (SBS) and not any personal selection criteria.

medicine was not generally accepted until 1998 or 1999, a fact acknowledged by Dr. Donohoe.[143] Thus, his decision to rely solely on (undefined) QER standards to review literature published between 1966 and 1998 guaranteed that all AHT/SBS articles predating the advent of evidence-based medicine—regardless of quality—would not meet his QER standards. Although this may be obvious, the intentional selection of evaluative criteria that cannot be applied to most of the relevant data pool of medical literature purportedly under review raises serious doubt about the quality of the research, the value of the conclusions, and perhaps the "neutrality" of the researcher.

Dr. Donohoe's methodology is even more troubling. Even the most cursory review of this paper would reveal that Dr. Donohoe conducted his "research" by simply searching the Internet and the Medline database[144] for the term "shaken baby syndrome."[145] Dr. Donohoe reported that this single-term search generated 71 medical articles.[146] He then examined the abstracts and (only in some cases) the text of two-thirds (54) of these articles.[147] Based on this review, he concluded that only one article involved a "randomized control trial," 26 involved case series, and together the 54 articles documented just over 300 cases of SBS. On the basis of these findings, Dr. Donohoe concluded that there were "serious data gaps, flaws of logic, [and] inconsistency of case definition," and that "the commonly held opinion that the finding of [subdural hemorrhage] and [retinal hemorrhage] in an infant was strong evidence [of] SBS was unsustainable, at least from the medical literature."[148]

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[143] *Id.*

[144] Medline did not even include the term "shaken baby syndrome" as a medical subject heading until 2002. Not surprisingly, this produced problems with Dr. Donohoe's search methodology. *See, e.g.*, Greeley, *supra* note 76, at 276 (noting that search criteria would necessarily need to include different strategies based on diagnostic, therapeutic, epidemiologic, or biomechanics references).

[145] *Id.*; Donohoe, *supra* note 136, at 240.

[146] Donohoe, *supra* note 136, at 240. Dr. Donohoe's reference section only identified the fifty-four articles he purportedly reviewed and omitted the additional seventeen articles he had apparently identified using his chosen search term. *See id.* at 240–42.

[147] *See id.* at 240 (acknowledging that he did not read the text of many of the articles that he cites). Dr. Donohoe's paper does not reveal whether the articles that he opted to read, including the references listed in those articles, yielded additional relevant articles that his single-term Medline search methodologies did not detect. Assuming this to be the case, see *infra* note 156 and accompanying text, this literature review would further discredit his methodology. Of course, he could not identify additional relevant articles, unless he read the articles he did find. Because Dr. Donohoe does not specify which of the fifty-four cited articles he actually read, re-creation of his methodology is impossible.

[148] *See* Donohoe, *supra* note 136, at 241. *But see* S. Maguire et al., *Which Clinical Features Distinguish Inflicted from Non-Inflicted Brain Injury? A Systematic Review*, 94 ARCHIVES DISEASE CHILDHOOD 860, 860 (2009) (concluding based on a systematic review of 320 studies resulting in inclusion of 14 studies involving 1,655 children that retinal hemorrhages and apnea had a high odds ratio and positive predictive value for inflicted

2. Critique of Dr. Donohoe's Work

(a) Critique of Dr. Donohoe's Methodology

Over the last ten years, Dr. Donohoe's article has been widely criticized for its numerous blatant methodological flaws.[149] In fact, on May 29, 2004, shorty after publication of the Donohoe paper, the *British Medical Journal* published a letter to the editor—signed by 106 physicians—which stated in part,

> One striking limitation of the Donohoe paper is that he used only the keywords "shaken baby syndrome" to search the literature whereas many of the articles on the subject use keywords such as "inflicted childhood neurotrauma," "childhood head injury," "craniocerebral trauma," "inflicted traumatic brain injury," as well as several others. We know of a number of qualified studies that were not included. If the search had been appropriately more inclusive, the resulting conclusions would likely have been quite different.[150]

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brain injury); Matschke et al., *supra* note 38, at 1587–88 (examining autopsies of 715 infants over a fifty year time frame and finding fifty cases of SDH with virtually no incidences of unexplained subdural hemorrhage, those outside of identified medical conditions, except in AHT cases); Narang, *supra* note 34 (applying *Daubert* principles to an analysis of the medical literature and offering a statistical analysis of retinal hemorrhages and subdural hematomas as valid diagnostic criteria for AHT findings); Brandon Togioka et al., *Retinal Hemorrhages and Shaken Baby Syndrome: An Evidence Based Review*, 37 J. EMERGENCY MED. 98, 98–99 (2009) (concluding from a systematic review of multiple clinical studies that retinal hemorrhages were highly associated with AHT and were extremely infrequent in accidental circumstances).

[149] *See, e.g.*, Greeley, *supra* note 76, at 276–77 (noting Dr. Donohoe's numerous methodological shortcomings). Another commentator notes that Dr. Donohoe incorrectly uses the quality of evidence ratings system. The author asserts that the

> best evidence is "Level 1" quality of evidence (RCTs), and this is not found in the diagnostic studies involving AHT/SBS. However . . . RCTs (the "Level 1" quality of evidence) are NOT appropriate for diagnostic studies. The AHT literature, like many other diagnoses (such as migraine headaches), should not be criticized for the existence of a "higher" level of evidence that is inappropriate to the question being asked. Thus, even the most ardent [Evidence-Based Medicine] advocate would admit that the best quality of evidence that can be expected in diagnostic studies is "Level 2" evidence (well-designed case series). And of this . . . there is abundant evidence in the AHT literature.

Narang, *supra* note 34, at 535.

[150] Robert Reece, *The Evidence Base for Shaken Baby Syndrome, Response to Editorial from 106 Doctors*, 328 BMJ 1316, 1316–17 (2004). This letter to the editor originally appeared in the May 29, 2004, issue of the *British Medical Journal*. In fact, one

In another response to Dr. Donohoe's article, Dr. Greeley repeated the online search using more appropriate search terms.[151] While Dr. Donohoe purportedly found just 71 articles, Dr. Greeley found 791 medical articles describing AHT/SBS written during the same 1966–1998 time frame—an elevenfold increase. This led Dr. Greeley to conclude that the 2003 Donohoe paper had "obvious weakness[es]," was "poor scholarship,"[152] and to quip astutely that "having 'evidence based' in the title does not make it so."[153] The fact that Dr. Donohoe was either unaware of the existence of this large body of medical literature (or perhaps chose to ignore it) along with his use of grade-school level Internet search techniques raises real questions about the validity of his conclusions.

Over the years, Dr. Donohoe's article has repeatedly been cited by other researchers as "a prime example of poor medical literature, which somehow makes its way into a medical publication," despite the fact that "[i]ronically, the article itself suffers from fatal methodological flaws and data gaps, but professes to assess the methodology of SBS studies and finds 'data gaps' in them."[154] Not only did Dr. Donohoe's decision to search just for "shaken baby syndrome" cause him to miss a vast quantity of relevant medical literature, he "offer[ed] no critical analysis of any of the articles cited, no assessment of the designs of any of the individual studies, no reference to the statistical information, and no analysis of any of the statistical data or the inferences drawn from them."[155] By his own admission, he did not even bother to read one-third of the articles he found.[156]

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of the articles not discovered using Dr. Donohoe's single-term search was Dr. John Caffey's seminal 1972 article on the subject of SBS. *See* Donohoe, *supra* note 136, at 241–42 (omitting Caffey, *Theory and Practice*, *supra* note 34). A second glaring omission was an article by Dr. Norman Guthkelch, who is widely recognized as having published the first medical article identifying SBS. *See id.* (omitting A.N. Guthkelch, *supra* note 34).

[151] *See* Greeley, *supra* note 76, at 276–77.

[152] *See id.* at 276. Dr. Donohoe also claimed that "[a]pproximately half of all indexed medical publications on the subjects of SBS and shaken-impact syndrome were published before 1999 and half since that time." Donohoe, *supra* note 136, at 239. This claim is likewise questionable in light of Dr. Greeley's research.

[153] *See* Greeley, *supra* note 76, at 277. ("Those who cite Donohoe as 'evidence based' are either inexperienced in medical literature appraisal or are being disingenuous; there is no third option.").

[154] Narang, *supra* note 34, at 534. By contrast, those questioning the AHT/SBS diagnoses invariably cite the Donohoe paper in favorable terms without identifying its numerous deficiencies. *See infra* Part III.B.3.

[155] Narang, *supra* note 34, at 534–35.

[156] Donohoe, *supra* note 136, at 240. Given the significant methodological errors, one might reasonably wonder about the quality of the review of even the small number of articles identified in the single search. *See* Greeley, *supra* note 76, at 276–77 (noting Dr. Donohoe's admission that he did not read many of the articles that were retrieved); *see also* Donohoe, *supra* note 136, at 240 ("It was impossible to review the full original article in many cases, although all of the major articles were reviewed in full. The remainder was assessed for categorization using the authors' abstracts."). Donohoe does not identify the

(b) Critique of Dr. Donohoe's Misuse of Evidence-Based Medicine Rankings

Dr. Donohoe has also been criticized for his misunderstanding and misuse of evidence-based rankings. The highest forms of evidence-based medicine would require randomized controlled research with an actual infant population. Obviously, this type of experimental research cannot be done with children. Although Dr. Donohoe acknowledged this point,[157] he proceeded to ignore its significance when allocating rankings.[158] Simply put, Dr. Donohoe applied a

articles he reviewed in full or those in which he reviewed only the abstract, nor does he explain why it was "impossible" to review the full original article. Of course, by not reading the full text of the fifty-four articles he did obtain, Dr. Donohoe could ignore any articles that were referenced in these articles (which would have resulted in an expansion of his identified list). Indeed, if Donohoe *had* reviewed the articles referenced in the fifty-four selected articles he identified and compared them against his own search list, it would have (at least partially) revealed additional missed articles. To cite just one glaring example, Dr. Donohoe references Duhaime et al., *supra* note 110. A review of the eighty-six references cited in this paper reveals that Dr. Donohoe originally only cited five of them. Dr. Donohoe should have identified a minimum of thirty-two additional relevant papers if he had read Dr. Duhaime's reference section. Moreover, this is clearly a major article and one published at the conclusion of Dr. Donohoe's time frame, thereby making it more likely to be more inclusive of articles published prior to that date, that is, those within Dr. Donohoe's selected time frame of research. As another example, Dr. Donohoe's single term computer search apparently did not yield M.G.F. Gilliland & Robert Folberg, *Shaken Babies—Some Have No Impact Injuries*, 41 J. FORENSIC SCI. 114 (1996), despite the article title bearing similar inclusion terms. Even a cursory review of the reference section contained in this article reveals fifteen relevant papers, only seven of which are included in the Donohoe paper.

[157] Donohoe, *supra* note 136, at 239 (noting that "[i]t is clearly unethical to intentionally shake infants to induce trauma," but then claiming "there is an obvious problem with studies and reports that rely on either indirect or disputed evidence of the occurrence, severity, or type of trauma").

[158] This point is not limited to AHT/SBS cases. Obviously, we do not experimentally cause fracture injuries in children to determine the precise mechanism for how these injuries are caused, or to determine whether they are caused by abuse. Nevertheless, courts routinely permit expert witness testimony describing the mechanisms for fracture injuries and whether they are caused by abuse based on the same types of clinical research and experience that is central to the diagnostic process in AHT/SBS. *See generally* MYERS, *supra* note 37 (discussing this issue and citing numerous cases as examples). Moreover, the reliability of medical literature dealing with the diagnosis of fracture injuries (interpretation of injury pattern, specificity for abuse) is determined using the same types of diagnostic processes as are used for AHT/SBS, namely case series reports. *See* Paul K. Kleinman & Patrick D. Barnes, *Head Trauma*, *in* PAUL K. KLEINMAN, DIAGNOSTIC IMAGING OF CHILD ABUSE 285 (2d ed. 1998); Paul K. Kleinman et al., *Radiologic Contributions to the Investigation and Prosecution of Cases of Fatal Infant Abuse*, 320 NEW ENG. J. MED. 507, 507 (1989); Gail J. Lonergan et al., *Child Abuse: Radiologic-Pathologic Correlation*, 23 RADIOGRAPHICS 811 (2003).

ranking system ill-suited for the assessment of AHT/SBS research because these studies are invariably based on data from children who exhibit abuse injuries in hospital settings. Thus, Dr. Donohoe's blanket allocation of lower evidence-based ratings to the only available child abuse research methodology cannot diminish the scientific validity of AHT/SBS research.

3. Despite Significant Methodological Flaws, Dr. Donohoe's Work Continues to Be Cited by Child Abuse Defense Witnesses and Legal Academics

Despite the patent shortcomings of Dr. Donohoe's work, defense-retained medical witnesses routinely cite this paper as an indictment of the quality of AHT/SBS medical research in their courtroom testimony[159] and published writings.[160] These witnesses invariably also fail to mention the extensive well-substantiated published critiques of Dr. Donohoe's work.

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[159] *See, e.g.*, Testimony of Dr. Barnes, *supra* note 133, at 20 ("And what we found out in the previous thirty years, prior to 1998, was a relatively low quality of evidence ratings, particularly in the Shaken Baby Syndrome and child abuse literature, of which I published quite a bit in that literature, including in the book and a chapter in the Kleinman textbook that wasn't written in terms of adhering to those principles."); Transcript of Evidentiary Hearing (Day 1) at 29–30, 37, State v. Edmunds, No. 96-CF-555 (Wis. Cir. Ct. Jan. 25, 2007) (testimony of Dr. Patrick Barnes) (on file with authors) (noting that literature prior to 1998 did not comport with evidence-based medicine standards and asserting there were no scientific studies to support conclusion that shaking alone can cause the triad of injuries related to SBS); Transcript of Motion Hearing at 23–26, State v. Mendoza, No. 071908696 (Utah Dist. Ct. Nov. 10, 2008) (testimony of Dr. Janice Ophoven) (on file with authors) (identifying the Donohoe paper as an exhibit in a motion hearing to exclude evidence of SBS and stating that "[i]n Dr. Donohoe's paper he was unable to find any decent evidence-based criteria to support the original theory of shaken baby syndrome"); Testimony of Dr. Ronald Uscinski, *supra* note 133, at 48–50 (commenting that Donohoe determined the research on SBS revealed that the "methodology was flawed" and brought into question the scientific basis used to support medical testimony on this mechanism of injury in legal proceedings).

[160] *See, e.g.*, Barnes et al., *supra* note 76; Barnes, *supra* note 112; Gabaeff, *supra* note 62, at 144; Geddes & Plunkett, *supra* note 62, at 719 (noting the Donohoe study and his findings of "scientific evidence to support a diagnosis of shaken baby syndrome to be much less reliable than generally thought"); Jan E. Leestma, *Case Analysis of Brain-Injured Admittedly Shaken Infants: 54 Cases, 1969–2001*, 26 AM. J. FORENSIC MED. & PATHOLOGY 199, 210 (2005) [hereinafter Leestma, *Case Analysis*] (noting Donohoe identified several methodological problems with case-based research findings and commenting that, "in most child-abuse cases, little, if any, information is ever provided by the alleged abuser, . . . making any case study on allegedly "shaken" babies very difficult"); Jan E. Leestma, *"Shaken Baby Syndrome": Do Confessions by Alleged Perpetrators Validate the Concept?*, 11 J. AM. PHYSICIANS & SURGEONS 14, 15 (2006) [hereinafter Leestma, *"Shaken Baby Syndrome"*] (criticizing the Biron and Shelton report for not citing "an important paper by Donohoe"); Leestma, *supra* note 62, at 26 (stating that the Donohoe paper is a "damning exposé"); Rubin Miller & Marvin Miller,

Child abuse defense witnesses who cite approvingly to the 2003 Donohoe article also frequently fail to mention the following paradox: in their own work they rely on the same AHT/SBS research that they simultaneously claim Dr. Donohoe has discredited. For example, Dr. Jan Leestma in his 1995 book chapter on forensic neuropathology relied on nine AHT/SBS articles allegedly discredited by Dr. Donohoe.[161] Defense witnesses further undermine Dr. Donohoe's conclusions when they rely on pre-1998 articles describing AHT/SBS that Donohoe failed to find using his single search term Internet research methodology.[162] Logically, there are only two possible explanations for these myriad scientific inconsistencies and contradictions. The first is that some child abuse defense witnesses have relied on AHT/SBS research for support (despite the fact that they actually shared Dr. Donohoe's belief in its qualitative shortcomings). The second is that they have relied on Dr. Donohoe's article (despite the evidence

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Overrepresentation of Males in Traumatic Brain Injury of Infancy and in Infants with Macrocephaly, 31 AM. J. FORENSIC MED. & PATHOLOGY 165, 169 (2010) (discussing Donohoe's determination that "scientific foundation of SBS [is] lacking"); Waney Squier, *Shaken Baby Syndrome: The Quest for Evidence*, 50 DEVELOPMENTAL MED. & CHILD NEUROLOGY 10, 11 (2008) (stating that "[t]he literature is fraught with problems" and citing to Donohoe); Uscinski, *supra* note 132, at 60 (noting Donohoe's research and subsequent conclusion that "inadequate scientific evidence [exists] to establish a firm conclusion on most aspects of causation, diagnosis, treatment, or any other matters pertaining to shaken baby syndrome").

[161] *See* Jan E. Leestma, *Forensic Neuropathology*, *in* PEDIATRIC NEUROPATHOLOGY 243, 259–62 (Serge Duckett ed., 1995). Although Dr. Leestma did not reveal that he was relying on work that he believed was not evidence-based when he wrote this book chapter, Dr. Leestma has apparently had a recent change of heart and now agrees with Dr. Donohoe's indictment of the AHT/SBS literature. *See, e.g.*, Leestma, *Case Analysis*, *supra* note 160; Leestma, *"Shaken Baby Syndrome,"* *supra* note 160, at 15; Leestma, *supra* note 62. Similarly, Dr. Patrick Barnes (who now testifies exclusively as a defense witness) previously coauthored an article on AHT, which was published in a leading pediatric text. *See* Kleinman & Barnes, *supra* note 158, at 285 (favorably citing 17 of the 54 articles referenced by Dr. Donohoe and identifying several hundred other relevant articles not uncovered by Dr. Donohoe's research methodology). Dr. Barnes now claims that much of his own research and writing was not of good quality. *See supra* note 159.

[162] *See* Leestma, *supra* note 161 (exposing, unintentionally, additional flaws in Dr. Donohoe's work by identifying more than ten articles that should have been discovered by Dr. Donohoe based on their titles and content). In Dr. Leestma's confession article published in 2005, he cited to an additional twenty-nine relevant articles published during this 1966–1998 time period not cited by Dr. Donohoe, including case reports involving twenty-seven confessions to shaking. *See* Leestma, *Case Analysis*, *supra* note 160; *see also infra* Part III.E (extensively discussing Dr. Leestma's *Case Analysis* article). Nevertheless, Dr. Leestma repeatedly cites favorably to the Donohoe article and ignores the obvious deficiencies noted above.

demonstrating its qualitative shortcomings).[163] Of course, as discussed above in the context of the Bandak article, repeated reliance on the Donohoe paper by defense witnesses who disregard the problems inherent to the work and the well-known critiques raises serious professional and ethical questions.[164]

Finally, even nonscientist judges should easily recognize that the Donohoe article is not even marginally relevant to legitimate assessment of the quality and reliability of the vast scientific evidence base involving AHT/SBS. This is particularly true if the court considers the hundreds of journal articles published after 1998 on this topic. The overwhelming bulk of this "new science" confirms the accuracy of the AHT/SBS diagnosis, cannot support a paradigm shift in mainstream medical thought, and fails to create scientific doubt over whether infants can be critically or fatally injured by shaking.

As with the Bandak article, numerous recent legal academic articles—ostensibly challenging the scientific foundation for AHT/SBS—continue to rely on the Donohoe article.[165] Here again these law professors and students fail to

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[163] *See* Greeley, *supra* note 76, at 276–77 ("Those who cite Donohoe as 'evidence based' are either inexperienced in medical literature appraisal or are being disingenuous; there is no third option.").

[164] *See supra* notes 133–135 and accompanying text. For example, is the "expert" unethical if she fails to disclose the limitations of Donohoe's paper (or the derivative work of others who rely uncritically on Dr. Donohoe's work) in her own writings or sworn trial testimony? *See, e.g.*, Chadwick & Krous, *supra* note 51, at 319–21 (discussing the damaging effects of "irresponsible testimony" by medical experts). *See generally* Albert et al., *supra* note 47 (discussing the heavy impact expert medical witnesses have on verdicts in criminal cases involving SBS). More specifically, does the failure to disclose the limitations of the Donohoe paper during courtroom testimony violate the witness's sworn obligation to testify to "the whole truth" or the expert's obligation to be impartial? *See, e.g.*, Holmgren, *supra* note 51 (discussing legal standards for appropriate testimony and multiple ethical standards promulgated by various medical organizations). Finally, what professional obligations inure based on the likelihood that future courts may unwittingly rely on flawed or discredited research? Consider, for example, that in granting a new trial, the *Edmunds* court relied on defense expert witness claims of "shifted science" and "inadequate science" and supported by references to the Donohoe paper. Would this same result have followed if the court had been aware, for example, if the witnesses had self-disclosed, that these witnesses had themselves relied on the research disparaged by Donohoe, or cited hundreds of other research articles his methodology ignored? The fact that the *Smith* dissenters rely on the *Edmunds* findings in this respect begs this very question.

[165] *See, e.g.*, Burg, *supra* note 63, at 665 (quoting Dr. Donohoe as saying that "there was inadequate scientific evidence to come to a firm conclusion on most aspects of causation, diagnosis, treatment, or any other matters pertaining to SBS"); Gena, *supra* note 63, at 706 (crediting Dr. Donohoe's research for indicating that "there may be other causes of the triad"); Caitlin Plummer & Imran Syed, *"Shifted Science" and Post-Conviction Relief*, 8 STAN. J. C.R. & C.L. 259, 268 (2012) (citing Dr. Donohoe's determination that the medical evidence supporting SBS prior to 1998 was "inadequate" and "unsustainable"); Ramsey, *supra* note 63, at 26 (analyzing Dr. Donohoe's "exhaustive review of the SBS

acknowledge Dr. Donohoe's methodological problems or address the readily available published critiques of his work. This type of skewed academic research cannot plausibly form the basis for any conclusions regarding AHT/SBS and raises serious concerns about the accuracy of the message communicated to the courts, media, and public.

C. Dr. Ronald Uscinski, "Shaken Baby Syndrome: An Odyssey"

Justice Ginsburg cites to a 2006 article, *Shaken Baby Syndrome: An Odyssey*,[166] quoting Dr. Ronald Uscinski's assertion that "[t]he hypothetical mechanism of manually shaking infants in such a way as to cause intracranial injury is based on a misinterpretation of an experiment done for a different purpose, and contrary to the laws of injury biomechanics as they apply specifically to the infant anatomy."[167]

The author of that article, Dr. Uscinski, a private practice neurosurgeon and regular child abuse defense witness, is a frequent and vocal opponent of the diagnosis of AHT/SBS whose advocacy extends to criticizing as "tyrannical" state laws designed to combat child abuse and neglect.[168] Dr. Uscinski first testified as a

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literature" and his conclusion that the scientific evidence supporting SBS was "much less reliable than generally thought"); Symposium, *supra* note 63, at 225 (statement of Professor Keith Findley) (crediting Dr. Donohoe's work for re-evaluating the SBS evidence and determining that none of the SBS theories "rose to sufficient quality under the evidence-based medicine standards"); Findley et al., *supra* note 63, at 237–38, 291–92 (defending the Donohoe paper against critiques and restating its propositions); Tuerkheimer, *The Next Innocence Project*, *supra* note 63, at 12 (citing Dr. Donohoe's influential research as a main contributor in "transform[ing] SBS from a certain diagnosis into its current state of flux"); Walker, *supra* note 63, at 28 (crediting Dr. Donohoe's research for challenging "the scientific methodology used in the 'research' which created the SBS diagnosis").

[166] Cavazos v. Smith, 132 S. Ct. 2, 10 (2011) (Ginsburg, J., dissenting) (citing Uscinski, *supra* note 132, at 59).

[167] *Id.*

[168] According to Dr. Uscinski,

> the United States [is] a republic founded on legal, moral and ethical principles that have served us well . . . [and it] is not wise to become complacent, or to be forgetful or ignorant of such principles[,]. . . .[but the] words "chaos," perhaps even "tyranny," come to mind when reading the D.C. code provision that states that "[w]here the petition alleges a child is a neglected child by reason of abuse, evidence of illness or injury to a child who was in the custody of his or her parent, guardian, or custodian for which the parent, guardian or custodian can give no satisfactory explanation shall be sufficient to justify an inference of neglect."

Ronald H. Uscinski, *The Larger Tragedy in an Unjust Accusation*, WASH. POST, Mar. 9, 2008, at B8.

defense witness during the well-publicized 1997 trial of Boston au pair Louise Woodward.[169] In that case, Dr. Uscinski opined for the defense that eight-month-old Matthew Eappen had suffered head trauma on an earlier occasion, had shown no symptoms of this injury, suffered from a rebleeding of an earlier subdural hematoma, and then spontaneously collapsed and died while in the defendant's care.[170]

Following his testimony in that case, Dr. Uscinski's alternative cause of death theories were pilloried in a letter to the *Journal of Pediatrics* signed by more than seventy medical professionals.[171] Since that time, Dr. Uscinski has repeatedly been hired by the defense to testify to alternative (non-abusive) causation theories in numerous AHT/SBS cases. This has included testimony from Dr. Uscinski that all that is necessary to cause a spontaneous rebleed of a subdural hematoma in an infant would be "hopping on one foot, coughing, sneezing, straining at having a bowel movement, bouncing a baby up and down on your knee."[172] In his articles and courtroom testimony, Dr. Uscinski routinely portrays his sources as unequivocal and dispositive and invariably fails to acknowledge or address the extensive critiques and limitations of his work or the works of others upon whom he relies.[173] Although the American Association of Neurological Surgeons has

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[169] *See* Commonwealth v. Woodward, 7 Mass. L. Rep. 449 (Super. Ct. 1997), *aff'd and remanded*, 694 N.E.2d 1277 (1998). In his *Odyssey* article, Dr. Uscinski claims that in consulting on this case he "researched the entire body of literature referencing the so-called 'shaken baby syndrome.' This article is a product of that effort, and in a sense represents an intellectual 'odyssey'." Uscinski, *supra* note 132, at 57. If this claim were in fact true, Dr. Uscinski would have needed to read nearly eight hundred articles published to that point in time. *See, e.g.*, *supra* notes 151–153 and accompanying text. However, Dr. Uscinski's article cites to virtually none of these sources. Either his claim in this regard is unsupported, or he simply dismisses this entire volume of material as a "sham," a term he uses to refer to SBS.

[170] *See* Findley et al., *supra* note 63, at 228; Testimony of Dr. Ronald Uscinski at 29, State v. Hancock, 2007 CF 2381 (Wisc. Cir. Ct., Dane Cnty. Apr. 6, 2009) (on file with the authors).

[171] *See* Chadwick et al., *supra* note 71.

[172] Transcript of Dr. Ronald Uscinski at 21, State v. Cutro, No. 94-GS-4021178 (S.C. Ct. Gen. Sess., Richland Cnty. June 11, 1999) (on file with authors). His assertions of "minimal trauma" producing traumatic injuries from "rebleeding" cannot logically coexist with Dr. Uscinski's repeated assertions that violent shaking cannot produce intracranial bleeding as a primary event. Dr. Uscinski's controversial claims are not confined to the child abuse arena. In a recent and highly publicized adult homicide case, Dr. Uscinski was hired as an expert for the defendant George Huguely, who was charged with the 2010 murder of his girlfriend, University of Virginia senior Yeardly Love. In this case, Dr. Uscinski bizarrely claimed that the victim's injuries were consistent with head trauma, but not brain trauma. *See* Christina Ng & Cleopatra Andreadis, *George Huguely Trial: Defense and Prosecution Rest Their Cases*, ABC NEWS (Feb. 18, 2012), http://abcnews.go.com/US/george-huguely-trial-defense-prosecution-rest-cases/story?id=15744129#.T06QqIflPGY.

[173] *See, e.g.*, Commonwealth v. Davis, No. 04-CR-205, slip op. at 6–7 (Ky. Cir. Ct., Greenup Cnty. Apr. 17, 2006) (summarizing testimony from Dr. Uscinski from a *Daubert*

formally censured Dr. Uscinski for his biased "expert" testimony on these topics,[174] he continues to proffer similar claims in his opinion letters and courtroom testimony[175] and self reports that he can command $750 per hour and $10,000 per day for his child abuse defense work.[176]

1. Dr. Uscinski's Methods and Conclusions

Even a cursory review of Dr. Uscinski's article reveals that it is a commentary piece containing no original research. Indeed, to these authors' knowledge, Dr. Uscinski has never published any original research in this field.[177] Thus, because

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hearing wherein he alleged that shaking could not cause injury without impact, asserted that rebleeds could produce sudden and catastrophic collapse, and cited research in support of these propositions without identifying any limitations). A transcript of this testimony is on file with the authors. The trial court's exclusion of testimony on SBS, which was based on Dr. Uscinski's testimony, was reversed on appeal. Commonwealth v. Martin, 290 S.W.3d 59, 67–69 (Ky. Ct. App. 2008). In a recent Connecticut case, Dr. Uscinski refused to acknowledge that there were any limitations to use of biomechanics research involving adult primates as applied to the immature infant brain. *See* Testimony of Dr. Ronald Uscinski at 72, 113–17, State v. Listro, No. TTD-CR08-0092447-T (Conn. Super. Ct., Rockville Mar. 12, 2010) (on file with authors).

[174] In November 2012, the American Association of Neurological Surgeons formally censured Dr. Uscinski for violating its rules by "testifying as an advocate rather than as an unbiased neurosurgical expert witness." *Notice of Disciplinary Actions: Member Censure*, AM. ASS'N NEUROLOGICAL SURGEONS, http://www.aansneurosurgeon.org/210613/8/3268 (last visited Oct. 22, 2013). Dr. Uscinski's censure was upheld on appeal. *Id.*

[175] Letter from Dr. Ronald Uscinski, to Damon Chetson (Sept. 28, 2013) (on file with the authors). Dr. Uscinski's letter is a consultation letter that he provided to a defense attorney in connection with a criminal prosecution surrounding a shaken baby incident, wherein Dr. Uscinski opines, consistent with his position in dozens of other cases, that the victim sustained rebleeding of a chronic subdural from a fall, precipitating a sudden collapse and increased intracranial pressure causing retinal hemorrhages. Dr. Uscinski's letter further claims that the biomechanics literature "demonstrated . . . on two separate occasions under controlled experimental circumstances that humans are incapable of inflicting intracranial injury in the form of subdural hematoma in infants by manual shaking; moreover were such shaking were [sic] to occur, one would first expect to see injury to the infant neck." *Id.* at 3. Dr. Uscinski presented similar claims during his actual trial testimony. Notably, these same types of claims were the very subject of the findings made by the American Association of Neurological Surgeons determining that Dr. Uscinski had on multiple occasions provided biased expert testimony, and which resulted in Dr. Uscinski's censure.

[176] *See supra* note 68.

[177] *See* Huffman *ex rel.* Huffman v. Sec'y of Health & Human Servs., No. 07-81V, 2011 WL 995958, at *2 (Fed. Cl. Feb. 28, 2011) (to be published). The decision of the Special Master noted that Dr. Uscinski has authored several papers but "none involved original research" and that although Dr. Uscinski testified that his second paper in the Japanese journal involved "research," this so-called research did not involve experiments.

he has no work of his own, the S*mith* dissenters selected a quote from Dr. Uscinski's paper that purports to restate the conclusions of Dr. Ann-Christine Duhaime and Dr. Faris Bandak, both of whom are discussed above.[178] In his paper, Dr. Uscinski makes the following claims: (1) Dr. Duhaime has "addressed experimentally the impossibility of causing intracranial injury in infants by manual shaking,"[179] and (2) Dr. Bandak's research clarified "that if an infant is subjected to shaken baby syndrome accelerations one should expect to see injury in the infant neck before it is seen in the head. Moreover, such injury should include injury to the cervical spinal cord and brainstem, obviously with the expected clinical picture."[180]

2. Scientific Critiques of Dr. Uscinski's Work

(a) Dr. Uscinski's Misuse of Sources

Dr. Uscinski's assertions are not merely derivative—they are misleading and false. As noted above, Dr. Duhaime has never claimed (in the cited article or in any other article) that it is "impossible" to cause intracranial injury in infants by shaking.[181] Instead, in the article relied upon by Dr. Uscinski, Dr. Duhaime made the entirely different point that shaking alone may cause infant intracranial injury, but that the most severe forms of abusive injury also usually involve impact.[182]

Id. at *15. Dr. Uscinski's other "nonresearch" based publications include: Ronald Uscinski, *The Shaken Baby Syndrome*, 9 J. AM. PHYSICIANS & SURGEONS 76, 76–77 (2004); Ronald H. Uscinski & D.K. McBride, *The Shaken Baby Syndrome*: *An Odyssey—II Origins and Further Hypotheses*, 48 NEUROLOGIA MEDICO-CHIRURGICA 151 (2008) (Japan); Ronald Uscinski, *Shaken Baby Syndrome: Fundamental Questions*, 16 BRIT. J. NEUROSURGERY 217, 217–19 (2002); *see also* Plunkett, *supra* note 73 (including Uscinski as a coauthor and critiquing the validity of SBS).

[178] Uscinski, *supra* note 132, at 58–59, 61 nn.1, 7 (citing Bandak, *supra* note 77; Duhaime et al., *supra* note 86). The research of Dr. Duhaime and Dr. Bandak are discussed *supra* Part III.A.

[179] *Id.* at 59.

[180] *Id.*

[181] *See supra* Part III.A.1.

[182] *See* text accompanying *supra* note 100 (quoting Duhaime et al., *supra* note 86, at 414); *see also supra* note 109 and accompanying text. An additional quote from the biomechanical portion of the abstract—"[i]t was concluded that severe head injuries commonly diagnosed as shaking injuries require impact to occur and that shaking alone in an otherwise normal baby is unlikely to cause the shaken baby syndrome"—is frequently cited by defense witnesses, despite the fact that this statement does not appear in the text of the article. Duhaime et al., *supra* note 86, at 409. Moreover, in the quarter century since the article was published, the validity of this section of the abstract has been severely called into question. *See supra* notes 101–106 and accompanying text.

Thus, contrary to the claim by Dr. Uscinski[183] cited by the *Smith* dissenters,[184] Dr. Duhaime has never concluded that it is "impossible" to cause intracranial injuries

[183] Dr. Uscinski also repeatedly restates these "impossibility" claims during his courtroom testimony without acknowledging any limitations to these assertions. *See supra* note 173.

[184] Several other defense witnesses also improperly cite Duhaime's 1987 article as authority for their opinion that it is impossible for shaking to cause subdural hematoma, brain injury and retinal hemorrhages. *See* Barnes, *supra* note 62, at 212 ("From the current biomechanical evidence base . . . it can be concluded that . . . shaking may not produce direct brain injury but may cause indirect brain injury if associated with neck and cervical spinal cord injury . . . ."); Jan E. Leestma, *Child Abuse: Neuropathology Perspectives*, *in* FORENSIC NEUROPATHOLOGY 561, 576–77 (Jan E. Leestma ed., CRC Press, 2d ed. 2009) [hereinafter Leestma, *Neuropathology Perspectives*] (referencing Duhaime's 1987 biomechanical research); Leestma, *supra* note 73 (stating that biomechanical data has shown that "free shaking of a baby model cannot produce sufficient angular accelerations or G forces (about 10 G) that are apparently needed to produce subdural hematomas, brain injury and hemorrhage, retinal hemorrhages, axonal injury, etc. (100s of Gs);" but that "if impact occurs[,] the threshold for subdural hematoma and brain injury is easily reached[, thus the] conclusion is that pre-impact movements probably have nothing to do with the pathology observed and ascribed to shaking"); Leestma, *supra* note 62, at 19 (stating "it appears biomechanically impossible to cause intracranial pathology (subdural hemorrhages, brain edema and axonal damage) and retinal hemorrhages by shaking alone (without impact)" and describing how the theory that deep brain injury can occur from rotational movement by shaking has been shown to have "no basis in fact" by Drs. Duhaime and Prange who purportedly have found that "[i]t is not possible by human manual shaking to attain sufficient levels of acceleration to cause the brain to move sufficiently inside the skull to produce brain injury, often referred to as 'diffuse axonal injury' or DAI"). Various legal commentators have parroted similar inaccurate statements regarding Dr. Duhaime's conclusions. *See, e.g.*, Burg *supra* note 63, at 666 (misquoting Duhaime, stating "Shaking alone does not produce the shaken baby syndrome"); Lyons, *supra* note 63, at 1123 (opining that the Duhaime study proved that "shaking as a cause of injury had no theoretical basis"); Symposium, *supra* note 63, at 226 (statement of Professor Keith Findley) ("[H]uman adults simply cannot shake an infant hard enough to inflict the kinds of head injuries that we see in these cases, but the trauma from impact, even what appears to be relatively minor impact, can . . . ."); Tuerkheimer, *Science-Dependent Prosecution*, *supra* note 63, at 517 n.24 (claiming that "many scientists now believe that shaking cannot possibly cause the triad" defined as subdural hemorrhage, retinal hemorrhage, and cerebral edema, and referencing back to her earlier law review article), Tuerkheimer, *The Next Innocence Project*, *supra* note 63 (misstating Dr. Duahime's conclusions); Walker, *supra* note 63, at 3 & n.18 (mischaracterizing Dr. Duhaime's 1987 paper as a study that "demonstrated the impossibility that a human being could create enough force by shaking alone to cause brain injuries in young infants and children" and citing Duhaime's 1987 paper). These commentators, following Dr. Uscinski's example, flagrantly misquote Dr. Duhaime and appear to be wholly ignorant of her actual research and writings. For example, none of Dr. Duhaime's biomechanics research addresses retinal hemorrhages, such that the citation to her research to support claims that shaking cannot produce retinal hemorrhages is simply false. Moreover, none of these legal commentators

to an infant by shaking alone, nor has she ever opined that these injuries are nonabusive.

The extent of Dr. Uscinski's misrepresentation of Dr. Duhaime's conclusions can be further illuminated using data from the clinical portion of Dr. Duhaime's cited study. This data clearly show that Dr. Duhaime found that approximately one-third of the children who suffered AHT/SBS injuries had *no evidence of impact trauma*, which indicates that their injuries were caused by shaking alone.[185] In the years since 1987, Dr. Duhaime has published numerous additional articles and in none of these articles has she opined that her research demonstrates the "impossibility of causing intracranial injury in infants by manual shaking."[186] Of

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cite to her additional papers or reference her conclusions and comments that these neurological and ophthalmological injuries are the result of AHT, thereby revealing their lack of familiarity with the full corpus of her work.

[185] Duhaime et al., *supra* note 86, at 410 (showing that 37.5% of children with AHT had "no evidence of blunt impact to head"). Medical research repeatedly documents that approximately one-quarter to one-third of AHT cases have no evidence of impact pathology. *See, e.g.*, James R. Gill et al., *Fatal Head Injury in Children Younger than 2 Years in New York City and an Overview of the Shaken Baby Syndrome*, 133 ARCHIVES PATHOLOGY LABORATORY MED. 619, 619–20 (2009) (reviewing fifty-nine head injury deaths of children under two, including forty-six homicides, of which ten (22%) of the homicides had no evidence of impact and cause of death was certified as whiplash shaking); *see also* Randall Alexander et al., *Incidence of Impact Trauma with Cranial Injuries Ascribed to Shaking*, 144 AM. J. DISEASES CHILDREN 724 (1990); Minns, *supra* note 87; Chris N. Morison & Robert A. Minns, *The Biomechanics of Shaking*, *in* SHAKING AND OTHER NON-ACCIDENTAL HEAD INJURIES IN CHILDREN, *supra* note 35, at 106 (collecting numerous case series identifying these findings; moreover, this research also consistently demonstrates that the injuries sustained between the groups of children with evidence of impact trauma and those without (e.g., retinal hemorrhages, encephalopathy, or other abuse injuries) are similar).

[186] Uscinski, *supra* note 132, at 59; *see, e.g.*, Ann-Christine Duhaime et al., *Head Injury in Very Young Children: Mechanisms, Injury Types, and Ophthalmologic Findings in 100 Hospitalized Patients Younger Than 2 Years of Age*, 90 PEDIATRICS 179 (1992); Ann-Christine Duhaime, *Head Trauma*, *in* A PRACTICAL GUIDE TO THE EVALUATION OF CHILD PHYSICAL ABUSE AND NEGLECT 147 (1997); Ann-Christine Duhaime et al., *Long-Term Outcome in Infants with the Shaking-Impact Syndrome*, 24 PEDIATRIC NEUROSURGERY 292 (1996); Ann-Christine Duhaime et al., *Nonaccidental Head Injury in Infants—The "Shaken-Baby Syndrome,"* 338 NEW ENG. J. MED. 1822 (1998) [hereinafter Duhaime, *Nonaccidental*]. *But see* Prange et al., *supra* note 101, at 147 (including Dr. Duhaime as a coauthor and noting contrary research, explaining limitations to their biomechanical research, and stating that "[t]here has been much debate on whether shaking alone is sufficient to cause the typical primary brain injuries seen in inflicted neurotrauma in infancy, specifically, SDH and/or TAI, or whether impact is necessary[; moreover, recent] evidence suggests that injury to the cervicomedullary junction may be found in some cases of fatal inflicted head injury, and the role of this finding in the pathophysiology of apnea, hypoxia, and secondary cellular events is, at present, incompletely understood"). Notably, this description of injury mechanisms involving the cervicomedullary junction is the same

equal (or perhaps greater) importance is Dr. Duhaime's conclusion that no other spectrum of infant injuries mimics the injuries seen in AHT/SBS cases. According to Dr. Duhaime,

> No other medical condition fully mimics all the features of the shaking-impact syndrome. Several patterns of clinical and radiographic findings allow a definitive diagnosis. These include a history of trivial or no trauma, acute subdural hemorrhage, and unexplained extracranial bony injuries or clearly inflicted soft-tissue injuries; and a definite history of no possibility of trauma with clear physical or radiologic evidence of head impact with subdural hemorrhage. Although not necessary for the diagnosis, the findings of retinal hemorrhages or multiple fractures in different stages of healing make the diagnosis more certain.[187]

Thus, contrary to Dr. Uscinski's assertion, Dr. Duhaime has never opined that it is impossible to cause infant intracranial bleeding by manual shaking.

Dr. Uscinski also relies on Dr. Bandak's paper, which was addressed in some detail above. Dr. Uscinski cites the 2005 Bandak article to support his opinion that short falls (from distances as small as three feet) produce "twice the skull fracture energy for an infant . . . as demonstrated by Dr. Bandak"[188] and that "the majority of such [short] falls may be seen superficially as innocuous, [but] there exists demonstrably proven potential for serious injury."[189]

In actuality, neither the Bandak article nor the cited 1987 Duhaime research provide support for Dr. Uscinski's opinion that seemingly innocuous short falls lead to serious brain injuries. In fact, Dr. Duhaime's subsequent research directly refutes any assertion that short falls create forces that cause serious brain injury.[190] This conclusion is also refuted by the biomechanical research on animal brains indicating that infant brains are more susceptible to rotational injury (the type of injury caused by shaking) and less susceptible to injury from translational forces

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as that put forward by the prosecution's experts in *Smith*. *See* Cavazos v. Smith, 132 S. Ct. 2, 4–5 (2011). In a recent editorial, Dr. Duhaime commented that "violent shaking by an adult can cause the subdural hemorrhage and major neurological sequelae seen in many infants is a hypothesis that to date has eluded direct proof, although a body of indirect evidence remains supportive of this possibility in some cases." Ann-Christine Duhaime, *Calling Things What They Are*, 3 J. NEUROSURGERY PEDIATRICS 472, 472 (2009). The references listed *supra* notes 87, 115, 185 and *infra* notes 288–293 and accompanying text reflect that this "body of indirect evidence" is substantial, albeit not exclusive.

[187] Duhaime, *Nonaccidental*, *supra* note 186, at 1827.

[188] Uscinski, *supra* note 132, at 59.

[189] *Id.*

[190] *See* Prange et al., *supra* note 101, at 143 (listing Dr. Duhaime as a coauthor, discussing that their biomechanical research supports the claims that short falls do not produce severe and injurious forces).

(the type of injury caused by falls).[191] Additionally, any claim that infant falls from three feet or fewer cause serious injury and death is belied by decades of contradictory medical evidence including vast data collections that clearly demonstrate the rarity of such injuries.[192] Finally, as the *Smith* dissenters should have easily recognized, claims regarding lethal short falls are also belied by common sense and everyday experience. If infant short falls from three feet or fewer routinely produced twice the energy force necessary to fracture infant skulls, emergency rooms would be flooded with infants and children suffering from skull fractures and traumatic head injuries after minor tumbles. We know this is not the case. As one scientific author has astutely commented, "It does not make any

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[191] *See* Raghupathi & Margulies, *supra* note 115; *see also* Tim Jaspan, *Current Controversies in the Interpretation of Non-Accidental Head Injury*, 38 PEDIATRIC RADIOLOGY S378, S378–81 (Supp. 2008) ("Recent research employing finite element modeling indicates that the rotational component of the shaking motion is responsible for the large majority of the strain placed upon bridging veins. The inertial forces associated with impact and translational head accelerations are less likely to produce severe head injury, consistent with the rarity of concussion and profound neurological abnormality in the large number of infants admitted to hospital following witnessed low-level domestic falls associated with impact trauma to the head (scalp bruising, skull fractures).").

[192] *See, e.g.*, David Chadwick et al., *Annual Risk of Death Resulting from Short Falls Among Young Children: Less than 1 in 1 Million*, 121 PEDIATRICS 1213 (2008) (summarizing decades of research on short falls, documenting the extreme rarity of such events, and noting that this research overestimates the risk of short fall deaths since this incidence data is predicated on reported short falls to medical providers or other data collection sources, whereas the vast majority of short falls result in no injury whatever and are never reported to these entities). Notably, Dr. Uscinski seeks to misstate and misapply Dr. Duhaime's research to support his "impossibility" claims of shaking causing injury, but then completely ignores her research that refutes his claims that short falls can cause serious injuries. Dr. Uscinski's opinions that short falls cause fatal injuries were recently commented on by the Sixth Circuit, who refused to order a new trial predicated on this opinion and others proposed by Dr. Uscinski. *See* Flick v. Warren, 465 F. App'x 461, 465 (6th Cir. 2012) ("Dr. Uscinski swore that had he been at trial he would have testified that David's death was caused by a short fall and not by shaken baby syndrome."). The Sixth Circuit also noted,

> After surveying the scientific research on the issue, the [trial]court found that, while some scientists including Dr. Uscinski had begun to question shaken baby syndrome by the time of Flick's trial [in 1999], the questioning was not so pervasive that it was unreasonable for trial counsel to have been unaware of the controversy. What controversy there was apparently represented the minority view. In the end, even if trial counsel had attempted to mount a *Daubert* challenge to the prosecution's experts, he likely would have failed to unseat the prevailing scientific consensus.

Id.

difference how smart you are, who made the guess, or what his name is—if it disagrees with experiment [or experience] it is wrong."[193]

(b) The Spontaneous "Rebleed" Theory

Finally, Dr. Uscinki's article restates his spontaneous "rebleed" theory of injury causation for acute subdural hematoma in infants.[194] According to Dr. Uscinski, his own personal observations of "rebleeds" of subdural hematomas "leads one to conclude that for an infant presenting with ostensibly unexplained intracranial bleeding with or without external evidence of injury under given circumstances, accidental injury from a seemingly innocuous fall, perhaps even a remote one, or even an occult birth injury, must be considered before assuming intentional injury."[195] The theory that occult birth injuries "rebleed" has been discredited by decades of easily accessible peer-reviewed medical research and

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[193] RICHARD FEYNMAN, THE CHARACTER OF PHYSICAL LAW 150 (1994).

> In general we look for a new law by the following process. First we guess it. Then we compute the consequences of the guess to see what would be implied if this law that we guessed is right. Then we compare the result of the computation to nature, with experiment or experience, compare it directly with observation, to see if it works. If it disagrees with experiment it is wrong. In that simple statement is the key to science. It does not make any difference how beautiful your guess is. It does not make any difference how smart you are, who made the guess, or what his name is—if it disagrees with experiment [or experience] it is wrong.

Id. Ironically, Dr. Uscinski's closing paragraph suggests this very point. He comments that scientific understanding may come from two different means. Uscinski, *supra* note 132, at 60. One is by objective observation of phenomenon occurring in nature and correlation of this observation with what is already known to produce greater understanding. *Id.* The second is by controlled experimentation where hypotheses are formulated and tested. *Id.* He concludes, "When [scientific] methodology produces descriptions and explanations that are in conformity, one has glimpsed a truth. When such descriptions and explanations are at variance, something is amiss, and truth is not identified." *Id.* Selective reporting of data and acceptance of data that have obvious shortcomings does not lead to identification of truth, but instead to the perpetuation of a false controversy.

[194] Uscinski, *supra* note 132, at 59–60.

[195] *Id.* at 60. This alternative theory of injury causation appears in a large percentage of Dr. Uscinski's "expert witness" reports and testimony. *See, e.g.*, Huffman *ex rel.* Huffman v. Sec'y of Health & Human Servs., No. 07-81V, 2011 WL 995958, at *37 (Fed. Cl. Feb. 28, 2011) (to be published) (discussing Dr. Uscinski's testimony that the child suffered a rebleed of a birth subdural hematoma while ignoring other abusive fracture injuries); Testimony of Dr. Ronald Uscinski, *supra* note 170 (acknowledging that he has offered this theory in close to a dozen cases). Indeed, Dr. Uscinski was recently censured for repeatedly providing such claims without scientific support. *See supra* notes 174–175.

repeatedly identified as a "courtroom diagnosis" unsupported by any valid medical evidence.[196]

The 2006 Uscinski paper is a commentary that involves no original research, mischaracterizes and exaggerates the conclusions of other authors, advances idiosyncratic and discredited outlier "theories" as alternative explanations for injuries that have been diagnosed as abusive, and was written by someone who has publicly denounced child abuse laws as "tyrannical."[197] Under the circumstances, Justice Ginsburg should not have relied on Dr. Uscinski's sweeping assertion that it is simply impossible to "manually shak[e] infants in such a way as to cause intracranial injury . . . [because that is] . . . contrary to the laws of injury biomechanics"[198] to draw any conclusions regarding AHT/SBS.

D. Dr. Waney Squier, "Shaken Baby Syndrome: The Quest for Evidence"

Justice Ginsburg cites the 2008 review article, *Shaken Baby Syndrome: The Quest for Evidence*,[199] quoting Dr. Waney Squier's assertion that "head impacts onto carpeted floors and steps from heights in the 1 to 3 feet range result in far greater . . . forces and accelerations than shaking and slamming onto either a sofa

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[196] A recent review conducted by a pediatric child abuse specialist, a pediatric neuropathologist, and a pediatric neurosurgeon of the extant literature on the "rebleed" phenomenon in children concluded there was no support for this theory as an explanation for the injuries ascribed to SBS/AHT and the baby's precipitous collapse. *See* Barbara L. Knox et al., *Subdural Hematoma Rebleeding*, *in* ABUSIVE HEAD TRAUMA: POCKET ATLAS (K. Rauth-Farley & L. Frasier eds.) (forthcoming 2013); *see also* Block, *supra* note 15, at 262 (concluding the "rebleed" diagnosis is a "courtroom diagnosis" unsupported by medical evidence and clinical experience); Kent P. Hymel et al., *Intracranial Hemorrhage and Rebleeding in Suspected Victims of Abusive Head Trauma: Addressing the Forensic Controversies*, 7 CHILD MALTREATMENT 329 (2002) (discussing why "rebleeds" of older subdural hematomas do not manifest as an acute onset of symptoms precipitating a sudden collapse).

Notwithstanding this body of literature, defense witnesses and academics have recently claimed that Dr. Uscinski's opinions on spontaneous rebleeding are no longer a "courtroom diagnosis" but instead are now "widely accepted, even by supporters of the SBS/AHT hypothesis." Findley et al., *supra* note 63, at 228–29 (citing Marguerite M. Caré, *Neuroradiology*, *in* ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN: A MEDICAL, LEGAL, AND FORENSIC REFERENCE, *supra* note 28, at 73, 81). What is conspicuously omitted from Professor Findley's citation is Dr. Caré's clear statement that "[e]pisodes of rebleeding should not result in acute deterioration in the child's neurological status . . . ." *Id*. This point that directly impugns Dr. Uscinski's "rebleeding" courtroom claims and the selective omission of this critical information by Professor Findley impugns the reliability of his conclusions.

[197] *See supra* note 168 and accompanying text.

[198] *See supra* note 167 and accompanying text.

[199] Cavazos v. Smith, 132 S. Ct. 2, 10 (2011) (Ginsburg, J., dissenting) (citing Squier, *supra* note 160, at 13).

or a bed."[200] Here again, the *Smith* dissenters have selected an article that is not a clinical study or experimental research, but instead merely expresses Dr. Squier's opinion which is based on the author's undisclosed personal communications and a selective and incomplete literature review.[201]

1. Dr. Squier's Methods and Conclusions

As discussed above, the extensive medical literature, common sense, and everyday experience tell us that falls from one to three feet do not routinely result in traumatic brain injury and that violent shaking and inflicted slamming of infants' heads causes more serious injuries.[202] Thus, careful attention must be paid to Dr. Squier's methodology. Dr. Squier has apparently based her conclusion almost exclusively on her undisclosed personal communications with Chris Van Ee, a biomedical engineer frequently retained by the defense in AHT/SBS cases,[203] and on mischaracterizations of the biomechanical research.

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[200] *Id.* The full quote from Dr. Squier's paper reads as follows:

> It has been shown that head impacts onto carpeted floors and steps from heights in the 1 to 3 feet range result in far greater head impact forces and accelerations than shaking and slamming onto either a sofa or a bed (C. Van Ee, personal communication 2007; Fig. 1) reproducing the findings from Duhaime and Prange noted above.

Squier, *supra* note 160, at 13.

[201] *See* Greeley, *supra* note 72, at 13–14 ("[I]n no way can [Squier's paper] be construed as an academic paper nor can it be construed as a Review. Instead, this is an opinion paper which has been mislabeled 'Review' and, obviously, it was written for legal proceedings, to create doubt. . . . With only a cursory reading, one may not appreciate the profound and misleading intent in this paper. A more critical eye will uncover the systematic and pervasive flaws in it, however. The use of incomplete references to citations supporting sweeping generalizations, other opinion papers used to support novel concepts, and unrelated citations are but a few of the techniques used to lead the reader astray. . . . There is an artful use of selective citations, personal experience, and 'personal communication' that frames the author's obvious opinion.").

[202] *See, e.g.*, Jaspan, *supra* note 191, at S382 ("The evidence base for this is not forthcoming and runs contrary to many published series of witnessed low-level falls in which the incidence of significant intracranial injury is very low. In a large population-based study, Warrington et al. found a high incidence of low-level domestic falls, but an extremely low morbidity rate, supporting the wide clinical experience of the benign nature of witnessed low-level falls. Whilst skull fractures may occur, infants are rarely obtunded and significant intracranial injury is rare.").

[203] *See, e.g.*, Grant v. Warden, No. TSRCV030004233S, 2008 Conn. Super. LEXIS 1402, at *27–29 (2008) (describing testimony by Van Ee for defense in habeas petition that shaking would not produce subdural hematoma based on Duhaime's 1987 research); *see also* Chris Van Ee, *Biomechanic Presentation By Dr. Van Ee*, MED. MISDIAGNOSIS RES. (Mar. 15, 2010), http://medicalmisdiagnosisresearch.wordpress.com/?s=Biomechanic+Pres

2. Scientific Critique of Dr. Squier's Work

Dr. Squier's article raises significant concerns about her methods and conclusions. First, she includes a figure (table graph) purporting to represent the findings of her biomechanical analysis. Although she appears to chart "data," this figure actually represents nothing more than her personal communications with Van Ee that cannot be assessed and have never been published or subjected to any type of peer review.[204]

Second, Dr. Squier represents that her personal communications with Van Ee are confirmed by research conducted by Drs. Duhaime and Prange.[205] This statement is false. As noted above, Dr. Duhaime has never stated that severe or traumatic brain injury can be caused by one-to-three-foot falls onto carpeted surfaces nor has Dr. Prange. In fact, Dr. Prange's published research directly refutes this conclusion[206] because it shows that falls from fewer than 1.5 meters (approximately five feet) typically do *not* result in forces reaching presumed thresholds for traumatic brain injury.[207] Third, as noted above, these claims are contradicted by four decades of medical research into short fall injuries and deaths, which has repeatedly and extensively established the infrequency of traumatic

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entation+By+Dr.+Van+Ee (illustrating a prepared biomechanics presentation for court to refute SBS); Ardis Baad, *New Trial Won by Man Convicted in Baby's Death*, BATTLE CREEK ENQUIRER (Mich.), Dec. 31, 2003, at A3 (commenting on testimony of Dr. Van Ee and Dr. Uscinski at a postconviction hearing that challenged trial evidence that the child died from SBS and claiming there is no scientific support for this diagnosis).

[204] *See* Squier, *supra* note 160, at 12. The citing of unpublished data is unfortunately an increasingly common practice amongst child abuse defense witnesses. This practice provides a convenient end-run around the peer-review process, where such data would likely be scrutinized by suggesting legitimacy through publication in a secondary unreviewed forum. The citation of unpublished data also conveniently operates to conceal the sources of information when one article cites to an earlier article that cites to an unpublished source. In court, this problem is compounded when defense witnesses cite to the paper that relies on unpublished data without disclosing that the data that forms the basis of the author's conclusions is unpublished. One frequent example from the child abuse defense medical literature is the repeated reference to unpublished eye findings by Patrick Lantz during a conference presentation. *See* Barnes, *supra* note 112, at 218; Gabaeff, *supra* note 62, at 157 n.45; Miller & Miller, *supra* note 160, at 170 n.102; Squier, *supra* note 73, at 539 n.87.

[205] *See* Squier, *supra* note 160, at 13. Squier curiously cites not to Duhaime and Prange's published biomechanical research on this issue (which she includes in her references) but instead to a news bulletin quoting Duhaime and a book chapter written by Prange. *Id.* at 13 nn.18–19.

[206] *See* Prange et al., *supra* note 101, at 143 (crediting Dr. Duhaime as a coauthor, discussing that their biomechanical research supports the claims that short falls do not produce severe and injurious forces).

[207] *Id.* at 147 (noting that "[t]hese results suggest a higher likelihood of injury from inflicted impacts against hard surfaces than from vigorous shaking, or from falls of 1.5 m or less" and noting limitations from study in predicting injury from short falls generally).

infant injuries and fatalities.[208] Finally, although Dr. Squier claims that biomechanical evidence "undermines the accepted hypotheses" of AHT/SBS,[209] she fails to address (or even acknowledge) the well-documented shortcomings of these studies, even when these limitations are fully described in the same articles she has cited.[210]

Most notably, Dr. Squier relies on the discredited work of Dr. Jennian Geddes.[211] Dr. Geddes proposed a "Unified Hypothesis" positing that hypoxic injury (low oxygen to the brain) can *itself* cause subdural hematoma through a variety of physiological response mechanisms.[212] Not only is "Geddes' Unified Hypothesis . . . untested by the rigors of scientific falsifiability and unsupported by the medical literature,"[213] but Dr. Geddes herself subsequently clarified that her

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[208] *See* Chadwick et al., *supra* note 192, at 1214, 1220 (concluding that the best estimate for short-fall fatalities is less than 0.48 deaths per 1 million young children per year).

[209] Squier, *supra* note 160, at 11. As support for this assertion, Dr. Squier references Cory & Jones, *supra* note 87; Duhaime et al., *supra* note 86; Prange et al., *supra* note 101.

[210] *See, e.g.*, Cory & Jones, *supra* note 87, at 331–32 (noting limitations on results of biomechanical experiments). Other research that undermines the biomechanics research relied on by the defense also goes unacknowledged by Dr. Squier. *See supra* notes 87, 115, 185 and *infra* notes 289–293 and accompanying text.

[211] J.F. Geddes et al., *Dural Hemorrhage in Non-Traumatic Infant Deaths: Does It Explain the Bleeding in 'Shaken Baby Syndrome'?*, 29 NEUROPATHOLOGY & APPLIED NEUROBIOLOGY 14 (2003) [hereinafter Geddes et al., *Dural Hemorrhage*]. Other papers have sought to defend against the critiques raised to the Geddes Unified Hypothesis. *See* J.F. Geddes & H.L. Whitwell, *Inflicted Head Injury in Infants*, 146 FORENSIC SCI. INT'L 83 (2004); J.F. Geddes et al., *Violence Is Not Necessary to Produce Subdural and Retinal Hemorrhage: A Reply to Punt et al.*, 7 PEDIATRIC REHABILITATION 261 (2004). One major critique of these articles is that they bizarrely suggest that violence may not be necessary to cause the findings associated with AHT/SBS, despite the fact that many children in their research studies have neck injuries involving hyperflexion of axons leading to apnea and that many other infants had impact injuries to the head. *See supra* notes 125–126 and surrounding text. For similar findings in other studies, see also notes 128–131. Moreover, such claims are directly inconsistent with alternative claims raised by defense witnesses, including Dr. Squier herself, that violent shaking cannot cause cerebral hemorrhage or brain injuries. *See supra* notes 73 and 184 and accompanying text.

[212] *See* Geddes et al., *Dural Hemorrhage*, *supra* note 211, at 19.

[213] Narang, *supra* note 34, at 568; Narang et al., *supra* note 15, at 264–81; *see also* Robert W. Block, *Fillers*, 113 PEDIATRICS 432, 432 (2004) (criticizing Geddes's *Dural Hemorrhage in Non-Traumatic Infant Deaths* for, among other things, including intrauterine, perinatal, and neonatal deaths and abortions in the data set to compare findings regarding inflicted head trauma in children); Jerold F. Lucey, *In Reply*, 113 PEDIATRICS 432, 432 (2004) (describing Geddes's *Dural Hemorrhage in Non-Traumatic Infant Deaths* as "junk science"); J. Punt, *Inflicted Head Injury in Infants: Issues Arising from the Geddes Hypothesis*, 91 ARCHIVES DISEASE CHILDHOOD 714 (2006) ("It is remarkable that such an unfounded assertion, carrying powerful implications, was permitted to go forward in a distinguished scientific journal. It would be of interest to learn whether the first two papers

Unified Hypothesis is merely a hypothesis meant to stimulate debate and should not be mistaken for scientific fact.[214]

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were reviewed prior to publication by any practitioner who had clinical care of babies and infants in life."); J. Punt et al., *The 'Unified Hypothesis' of Geddes et al. Is Not Supported by the Data*, 7 PEDIATRIC REHABILITATION 173 (2004) (criticizing Geddes's Unified Hypothesis in *Dural Hemorrhage in Non-Traumatic Infant Deaths*). These articles and letters prompted several defense witnesses to defend Dr. Geddes's article, notwithstanding the previously published, but unacknowledged refutation by Dr. Punt. *See* Marvin Miller et al., *A Sojourn in the Abyss: Hypothesis, Theory, and Established Truth in Infant Head Injury*, 114 PEDIATRICS 326, 326 (2004). This letter was apparently written before Dr. Geddes herself clarified that her "hypothesis" was not scientifically proven to be factual during sworn testimony. *See infra* note 214. In addition to Punt's work, two recent studies disprove the Unified Hypothesis theory that hypoxic injury accounts for the presence of subdural hematoma or retinal hemorrhage. *See, e.g.*, Roger W. Byard et al., *Lack of Evidence for a Causal Relationship Between Hypoxic-Ischemic Encephalopathy and Subdural Hemorrhage in Fetal Life, Infancy, and Early Childhood*, 10 PEDIATRIC & DEVELOPMENTAL PATHOLOGY 348, 350 (2007) (examining eighty-two fetuses, infants, and toddlers with severe hypoxic-ischemic injury and finding no subdural hemorrhaging); M. Hurley et al., *Is There a Causal Relationship Between the Hypoxia-Ischaemia Associated with Cardiorespiratory Arrest and Subdural Haematomas? An Observational Study*, 83 BRIT. J. RADIOLOGY 736, 743 (2010) (concluding that, consistent with Byard et al., "cardiopulmonary collapse *per se* and the attendant hypoxic-ischaemic sequelae do not cause SDH" and that "the possibility that the observed haemorrhage may be traumatically inflicted must be considered"). As one study has observed, the Geddes hypothesis has been "excoriated by most, but embraced by few." Matschke et al., *supra* note 38, at 1592. Notwithstanding the widely accepted conclusion that the Geddes hypothesis is not supported by valid medical evidence, it remains canon for defense witnesses. *See, e.g.*, Barnes, *supra* note 62, at 213 (advancing the Unified Hypothesis by dismissing the critiques, ignoring the self-refutation, and claiming work has been validated by other research); Findley et al., *supra* note 63, at 60–63 (same); Waney Squier & Julie Mack, *The Neuropathology of Infant Subdural Haemorrhage*, 187 FORENSIC SCI. INT'L 6, 10 (2009); Transcript of Evidentiary Hearing (Day 1) at 16–30, State v. Edmunds, No. 96-CF-555 (Wis. Cir. Ct. Jan. 25, 2007) (testimony of Dr. Patrick Barnes) (on file with authors).

[214] During legal proceedings in the United Kingdom in 2005, Dr. Geddes, at the beginning of her cross-examination, accepted that the Unified Hypothesis was never advanced with a view to being proved in court. She said that it was meant to stimulate debate. Further, she accepted that the hypothesis might not be quite correct, or as she put it: "I think we might not have the theory quite right. I think possibly the emphasis on hypoxia—no, I think possibly we are looking more at raised pressure being the critical event." R v. Harris, [2005] EWCA (Crim) 1980, [2006] 1 Crim. App. 5, [58] (appeal taken from Eng.). When she was asked about the fact that "cases up and down the country are taking place where [her Unified Hypothesis paper] is cited by the defence time and time again as the reason why the established theory is wrong," she responded as follows:

> That I am very sorry about. It is not fact; it is hypothesis but, as I have already said, so is the traditional explanation. I would be very unhappy to think that cases were being thrown out on the basis that my theory was fact. We asked

3. Judicial Commentary on Dr. Squier's Expertise and Bias

Any discussion of Dr. Squier's work must also include the fact that in recent published child abuse decisions from the United Kingdom, two separate courts have impugned her objectivity and her competence.[215] In the first case, the judge found that Dr. Squier has "fallen into that category of expert . . . who has developed a scientific prejudice," that she "has permitted her convictions to lead her analysis," and that "[e]ach of the significant factual errors made by her served to support her hypothesis of choking and hypoxia" despite the fact that "the overwhelming preponderance of evidence in this case is to the effect that, as of today, medical opinion is that hypoxia does not lead to subdural haemorrhages and retinal haemorrhages."[216] In the second case, the U.K. High Court found that "Dr. Squier's stance, in oral evidence before us, casts significant doubt upon the reliability of the rest of her evidence and her approach to this case. It demonstrates, to our satisfaction, that she was prepared to maintain an unsubstantiated and insupportable theory in an attempt to bolster this appeal."[217]

As with the previously discussed authors, Justice Ginsburg's reliance on Dr. Squier's paper and opinions to draw any conclusions regarding AHT/SBS defies logic and common sense. A jurist need not have expertise in biomechanics to appreciate that it is patently absurd to argue, as Dr. Squier does, that "head impacts onto carpeted floors and steps from heights in the 1 to 3 feet range result in far greater . . . forces and accelerations than shaking and slamming onto either a sofa

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the editor if we could have "Hypothesis Paper" put at the top and he did not, but we do use the word "hypothesis" throughout.

Id.; *see also* Richards et al., *Shaken Baby Syndrome*, 91 ARCHIVES DISEASE CHILDHOOD 205, 205–06 (2005) (summarizing court's rejection of Geddes' Unified Hypothesis). Dr. Geddes subsequently claimed that her testimony was not a retraction of her theory and that other research supports her hypothesis. Jennian F. Geddes, *Nonaccidental Trauma: Clinical Aspects and Epidemiology of Child Abuse*, 39 PEDIATRIC RADIOLOGY 759, 759 (2009). Dr. Squier supports this position. *See* Findley et al., *supra* note 63, at 61 (selectively quoting from the full context of Dr. Geddes's testimony cited above).

[215] *See* Narang, *supra* note 34, at 589–90 (citing Henderson v. R, [2010] EWCA (Crim) 1269, [2010] 2 Crim. App. 24, [188], [190] (appeal taken from Eng.); A Local Auth. v. S, [2009] EWHC (Fam) 2115, [63], [199], [201]–[203] (Eng.), *available at* http://www.bailii.org/ew/cases/EWHC/Fam/2009/2115.html).

[216] *Id.* at 590.

[217] *Id.* Such critiques of Dr. Squier's testimony by other courts, like similar critiques of other defense witnesses in the United States, are readily discoverable through simple legal research. Notwithstanding these critiques, other defense witnesses and legal academics continue to join with Dr. Squier in promoting the "controversy" that asserts that AHT/SBS is a flawed medical diagnosis that is not supported by quality medical research. *See* Findley et al., *supra* note 63 (including Dr. Squier as a coauthor).

or a bed."[218] A jurist also does not need to be skilled in scientific literature appraisal to recognize that Dr. Squier's reliance on undisclosed personal conversations for "scientific" support is problematic. A closer look would have revealed that Dr. Squier's cited source materials actually refute her conclusions (e.g., Dr. Prange's finding that falls from five feet do not exceed injury thresholds) and, like the other authors cited by the *Smith* dissenters, Dr. Squier ignored the conflicting infant short fall data which comprises dozens of studies over several decades and is readily accessible to any novice researcher. But if this information was not enough to create concern, in publicly available records similar to Dr. Uscinski's censure by the American Association of Neurological Surgeons discussed above, two separate courts had recently opined that Dr. Squier is incapable of providing an objective medical opinion in a child abuse case.

E. Dr. Jan Leestma, "Case Analysis of Brain-Injured Admittedly Shaken Infants"

Justice Ginsburg's dissent cited to the 2005 article, *Case Analysis of Brain-Injured Admittedly Shaken Infants*, written by Dr. Jan Leestma for the proposition that "most of the pathologies in allegedly shaken babies are due to impact injuries to the head and body."[219]

As a preliminary matter, the dissenters' reliance on Dr. Leestma's article is problematic because the article has little bearing on the legal and medical issues in *Smith*. The 2005 Leestma article addressed the specific question of whether confessions confirm injuries attributed to shaking without impact evidence. First, this article has no bearing on *Smith* because the defendant made admissions and gave conflicting statements of fact, but did not confess and in fact denied at trial, that she had shaken or injured the victim.[220] Second, any discussion of "pure shaking" as a mechanism of injury is irrelevant because the autopsy in *Smith* revealed impact trauma to seven week-old Etzel's head. Third, the dissenters' reliance on the Leestma article is generally problematic because Dr. Leestma discounts the evidentiary value of all "confessions," which cannot be reconciled

[218] Cavazos v. Smith, 132 S. Ct. 2, 10 (2011) (Ginsburg, J., dissenting). The full quote from Dr. Squier's paper reads as follows: "It has been shown that head impacts onto carpeted floors and steps from heights in the 1 to 3 feet range result in far greater head impact forces and accelerations than shaking and slamming onto either a sofa or a bed (C. Van Ee, personal communication 2007; Fig. 1) reproducing the findings from Duhaime and Prange noted above." Squier, *supra* note 160, at 13.

[219] *Cavazos*, 132 S. Ct. at 10 (Ginsburg, J., dissenting) (citing Leestma, *Case Analysis*, *supra* note 160, at 199, 211).

[220] *See id.* at 4–5 (majority opinion); People v. Smith, No. B118869, slip op. at 4 (Cal. Ct. App. Feb. 10, 2000). The Ninth Circuit noted Smith's brief trial testimony denying any abuse to the victim. *See* Smith v. Mitchell, 437 F.3d 884, 885 (9th Cir. 2006).

with the significant weight the Supreme Court has traditionally assigned to confession evidence.[221]

1. Dr. Leestma's Methods and Conclusions

Dr. Leestma is a pathologist and neuropathologist who began his career as the author of numerous medical articles endorsing the diagnostic validity of AHT/SBS.[222] For the past fifteen years, however, he has become a regular child

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[221] As Justice Byron White commented, "[T]he defendant's own confession is probably the most probative and damaging evidence that can be admitted against him." Bruton v. United States, 391 U.S. 123, 139 (1968) (White, J., dissenting). Justice White also noted that a confession is

> admitted as reliable evidence because it is an admission of guilt by the defendant and constitutes direct evidence of the facts to which it relates. Even the testimony of an eyewitness may be less reliable than the defendant's own confession. An observer may not correctly perceive, understand, or remember the acts of another, but the admissions of a defendant come from the actor himself, the most knowledgeable and unimpeachable source of information about his own conduct.

Id. at 139–40. Although confessions to some crimes are later found to have been false, in the context of AHT/SBS it is increasingly common for defense medical witnesses and legal academics to argue that *all* confessions to shaking and injuring children are unreliable. *See, e.g.*, Findley et al., *supra* note 63, at 256–61 (discounting confessions as corroborative evidence of shaking injury); Tuerkheimer, *Science-Dependent Prosecution*, *supra* note 63, at 516, 523, 541–44 (noting challenges to the validity of "confessions"); Tuerkheimer, *The Next Innocence Project*, *supra* note 63, at 30–31 (noting the problematic use of any statements made by the caretakers as "admissions" or "confessions"); *see also* 3 Transcript of Proceedings - *Daubert*/*Taylor* Hearing, *supra* note 81, at 90–91 (testimony of Faris Bandak) (asserting that confessions to shaking are not plausible in the absence of neck injury based on biomechanical research that establishes adults cannot generate sufficient forces from shaking to cause injuries ascribed to SBS).

[222] *See, e.g.*, JAN E. LEESTMA, *Neuropathology of Child Abuse*, *in* FORENSIC NEUROPATHOLOGY 333, 338–49 (1988) (providing guidance in interpretation of child head trauma during autopsy to determine whether child abuse resulted in the death of the child); Leestma, *supra* note 161, at 260–65 (explaining the neuropathological processes through which shaking damages the infant's brain and results in death).

> The basic principles involved in the neuropathologic features of the shaken baby syndrome are that when an infant is shaken, acceleration and shearing forces affect the brain parenchyma and the vessels within it. These forces can sever axons of long passage, stretch and damage or break small vessels in the brain, or break bridging veins at the cortical surface. Similar changes may occur in the brain stem and/or upper cervical cord. Undoubtedly, neurons and their processes may be stretched or deformed, causing internal injury to components

abuse defense witness and has publicly rejected his own earlier research in his courtroom testimony and writings.[223] His current position is that the AHT/SBS "hypothesis" is supported solely by its "proponents" whom he accuses of "blandly and earnestly in courts of law, tak[ing] the sacred oath to tell the truth, and then proceed[ing] to propagate known falsehoods to the detriment of the system of justice and the individual accused of harming a baby by having shaken it in some fashion."[224] To support his argument, Dr. Leestma has advanced a number of alternative explanations for traumatic brain injuries, which he continues to provide for the defense in child abuse and child homicide prosecutions. These alternative theories have been proffered in a range of child abuse cases, including those where the defendant has confessed to shaking an infant victim or inflicting impact trauma by striking the infant's head onto a surface and where the confession evidence is consistent with the medical findings.[225]

> of the nerve fibers that may eventually become evident, participating in a cascade of reactions.

Leestma, *supra* note 161, at 260.

[223] Dr. Leestma currently advocates against AHT/SBS, asserting that

> [i]t is often said that observed injuries would only occur in a major automobile accident or a fall from great height such as 3–4 stories onto concrete—or by shaking. The scientific support for these assertions is lacking. This idea seems to have just been made up and perpetuated, possibly by Chadwick, a well-known child abuse expert from California. Others regularly parrot this position in spite of its absurdity.

Leestma, *supra* note 62, at 24. Dr. Leestma also suggests that expert testimony unsupported by scientifically verifiable facts contributes to the extreme prejudice of child abuse trials depriving the accused of a fair trial. *See* Leestma, *supra* note 73. The vitriol of these comments reasonably calls into question the independence of Dr. Leestma's views. Ironically, at least one court has ruled that it was improper for a prosecutor to establish Dr. Leestma's "bias" by asking him about his regular appearances as a defense witness in child homicide and abuse cases, noting that he had been retained in forty-six such cases. *See* State v. Werts, 677 N.W.2d 734 (Iowa 2004) (stating that such cross-examination by the prosecution was an "improper effort to demean the witness" and remanding to the district court). Other courts have not been as sympathetic. *See, e.g.*, Henderson v. R, [2010] EWCA (Crim) 1269, [2010] 2 Crim. App. 24, [188], [190] (appeal taken from Eng.) (commenting that the willingness of Dr. Leestma to advance propositions that he subsequently had to withdraw in the light of his greater knowledge of the case, coupled with his lack of up-to-date experience, severely damaged and undermined his opinions and questioning his qualifications to give expert evidence).

[224] Leestma, *supra* note 62, at 26.

[225] *See, e.g.*, Testimony of Jan E. Leestma, M.D. at 23, 36–37, 47–48, 68–72, People v. Thomas, No. 08-1074 (N.Y. Rensselaer Cnty. Ct. Oct. 16, 2009) (on file with authors). Dr. Leestma testified that the infant victim had died of a bacterial infection of the brain and a rebleed of a chronic subdural despite evidence of AHT/SBS and the fact that the

Dr. Leestma seeks to challenge the extensive literature that uses confession evidence to confirm the injury mechanism in AHT/SBS cases.[226] His wholesale rejection of all child abuse confession evidence is purportedly based on his personal review of "detailed individual case information" from 324 cases of alleged child abuse reported in 23 case studies.[227] According to Dr. Leestma, of these 324 cases, only 54 included confessions.[228] Of these 54 confession cases, only 11 involved admitted shaking without what he defined as medical evidence of cranial impact (i.e., scalp injury, facial bruising, or skull fracture).[229] Dr. Leestma classified the 11 cases as "admittedly shaken no impact" (in his tables)[230] and somewhat confusingly as "shaken-only" (in his discussion).[231] Based solely on this review, Dr. Leestma concluded that there is insufficient data to generate any "valid statistical analysis or support for many of the commonly stated aspects of the so-called shaken baby syndrome."[232]

As a threshold matter, Dr. Leestma's methods are suspect because he completely fails to account for the fact that, even by his idiosyncratic methodology, 20% of his selected cases involved confession evidence plus

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defendant admitted shaking and then throwing the victim onto a mattress. *Id.*; *see also* United States v. Bourgeois, No. C-07-223, 2011 WL 1930684, at *74–76 (S.D. Tex. May 19, 2011) (finding that Dr. Leestma acknowledged that the victim had been repeatedly assaulted but proposed coagulopathy and venous thrombosis as an alternative cause of death; an opposing expert accused Dr. Leestma of "omit[ing] any reference to intercranial evidence of trauma" and failing to "mention[] . . . shearing of the fibers in the brain").

[226] Leestma, *Case Analysis*, *supra* note 160, at 199; Leestma, *"Shaken Baby Syndrome," supra* note 160.

[227] Leestma, *Case Analysis*, *supra* note 160, at 199–204.

[228] *Id.* at 204.

[229] *Id.*

[230] *Id.* at 200–03 (listing the pathology findings and injury patterns for forty-one of the fifty-four cases where shaking was admitted to have occurred).

[231] *Id.* at 211.

[232] *Id.* at 199. *But see* Maguire et al., *supra* note 148, at 860 (concluding, based on a systematic review of 320 studies resulting in inclusion of 14 studies involving 1,655 children, that retinal hemorrhages and apnea had a high odds ratio and positive predictive value for inflicted brain injury); Matschke et al., *supra* note 38, at 1587 (examining autopsies of 715 infants over a 50-year time frame and finding 50 cases of SDB with virtually no incidences of unexplained subdural hemorrhage outside of identified medical conditions, except in AHT cases); Narang, *supra* note 34, at 576–95 (applying *Daubert* principles to his analysis of other nonconfession literature and offering a statistical analysis of retinal hemorrhages and subdural hematomas as valid diagnostic criteria for AHT findings); Narang et al., *supra* note 15 (providing statistical information for many diagnostic criteria related to SBS/AHT and the lack of such evidence for alternative causation theories); Togioka et al., *supra* note 148, at 104 (concluding from a systematic review of multiple clinical studies that retinal hemorrhages were highly associated with AHT and were extremely infrequent in accidental circumstances).

"shaking only" medical findings—a fact that clearly undermines his conclusion.[233] Instead, he deals with this problematic discrepancy by speculating that these infants could have sustained some sort of impact or neck injury that was undetectable without a full autopsy, which could not be performed because eight of the eleven children did not die.[234]

2. Scientific Critique of Dr. Leestma's Work

Dr. Leestma's paper, like the other cited articles discussed above, contains the hallmarks of methodologically flawed research: (1) inaccurate and misleading assertions, (2) misrepresented data, and (3) exclusion of conflicting data.

(a) Inaccurate and Misleading Assertions

Dr. Leestma concluded that "[o]wing to a paucity of collateral information in the cases examined, it cannot be conclusively known which injuries occurred because of inflicted or accidental physical forces or by underlying or secondary disease processes."[235] As noted above, this finding is unsupported by the data he examined and is directly contradicted by the source articles that form the basis of Dr. Leestma's derivative work. Indeed, the authors of all 23 case studies had concluded that their cases involved AHT/SBS and that the injuries were *not* caused by disease or accident. Moreover, as Dr. Leestma acknowledged, more than half of the 37 cited cases included evidence of older injuries or additional injuries,[236] medical evidence that normally would be used to help confirm that the more recent head injuries were abusive. Based on the case and case study evidence, Dr. Leestma cannot plausibly conclude that these traumatic infant brain injuries must have resulted from accidental physical forces or secondary disease processes.

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[233] As Dr. Robert Minns has commented, "Even a single, carefully documented case of shaking alone is sufficient to establish the possibility that shaking alone can result in head injury." Minns, *supra* note 87, at 7. The possibility of traumatic brain injury from shaking alone is further confirmed by the confessions cases. *See* Jaspan, *supra* note 191, at S379 ("Irrespective of the validity of confessional admissions, the frequency of reports of shaking as the main or associated component of the presentation of an infant to medical authorities suggests that in at least a proportion of cases this was instrumental in the child's injury. Even if only a small number of cases could be validated, this would support the likelihood of shaking as the cause of the triad."). Together this evidence effectively refutes the "denialism" claim that SBS does not exist.

[234] *See* Leestma, *Case Analysis*, *supra* note 160, at 211.

[235] *Id.*

[236] *Id.* at 203 tbl.2.

(b) Misrepresentation of Underlying Data

Dr. Leestma also misrepresents his own data. Although he reported that he collected and analyzed 270 additional "nonconfession" AHT cases (representing 84% of his total data set), Dr. Leestma failed to include any description of his findings or analysis of these 270 AHT/SBS cases in this paper.[237] Instead, he stated that he would address the nonconfession cases in a subsequent publication.[238] To date, no such paper has ever been published. However, in an advocacy article published the following year, Dr. Leestma made the following misleading claim about the total cohort of AHT/SBS cases in his 2005 paper:

> When [the 11 shaking-only confession cases] cases were compared with 270 other cases in which no admission of shaking was reported, no statistical correlation could be obtained that could validate the notion that shaking alone was likely to be causally related to subdural hemorrhages, retinal hemorrhages or any other cranial pathology . . . . When the case series is examined it is clear that impacts to the heads of infants is the most critical event, whether or not shaking preceded or was a part of the injury scenarios.
>
> Thus the case literature does not provide support or proof that shaking is causal for any brain pathology.[239]

In actuality, approximately half of the 54 confession cases showed no evidence of impact.[240] Thus, it would be reasonable to infer that a similar percentage of the cohort of 270 "nonconfession" cases also showed no evidence of impact.[241] But if Dr. Leestma had accurately reported pure shaking/nonimpact as

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[237] *Id.* at 204.

[238] *Id.*

[239] Leestma, *supra* note 62, at 20. The statistical comparison of the 270 nonconfession cases with the 54 confession cases (including the 11 purported "shaking only" confession cases) was omitted from Dr. Leestma's original article. If this analysis *was* conducted by Dr. Leestma, he clearly chose not to include the results in his original paper or any subsequent peer-reviewed papers, except this advocacy piece. Of course, this strategy ensures that his methods and data cannot be examined or challenged. In the alternative, if this analysis *was not* done by Dr. Leestma, he grossly misstates the actual findings from his original article. Dr. Leestma's findings are also contrary to Dr. Duhaime's own conclusions as stated in her papers. *See supra* Part III.A.1.(a)–(c) and notes 182–187 and accompanying text.

[240] Dr. Leestma reported that only eleven cases involve "shaking-only" evidence. This number is inaccurate, and half of the fifty-four cases appear to have no evidence of impact. *See infra* notes 244–252 and accompanying text (indicating that the data on which he relied actually establish twenty-six to twenty-seven "shaken only" cases).

[241] In fact, medical research repeatedly documents that approximately one-quarter to one-third of AHT cases have no evidence of impact pathology. *See* Duhaime et al., *supra* note 86, at 410 (stating that 37% of children in clinical portion of study showed no

the injury mechanism for half of the 54 "confession" cases, it would have undermined his conclusion. Moreover, if he had also included a similar percentage of the 270 (nonconfession) cases as pure shaking/nonimpact, he would have been required to potentially analyze as many as 100 additional nonimpact cases, data that would have made it impossible for him to opine that "most of the pathologies in allegedly shaken babies are due to impact injuries to the head and body, regardless of what came before"[242] or to claim that "impact" is the "critical event" and that shaking is not a "causal" mechanism for brain pathology.[243]

Dr. Leestma's identification of just eleven "shaking-only" cases in his discussion ("admittedly shaken no impact," in his tables) raises different methodological concerns. Dr. Leestma includes in his Table 2 just 37 of the 54 "confession" cases, despite the fact that in the heading for the table he claims to include 41 cases.[244] This discrepancy suggests that Dr. Leestma selectively omitted seventeen confession cases, which is problematic because these seventeen cases were reported in the studies that constitute his research base, were summarized in his "Case Details" section, and were repeatedly cited in his paper and his tables.[245] Dr. Leestma attempted to explain away this discrepancy by stating that it is (partially) attributable to his decision to exclude thirteen confession cases contained in a study authored by Dr. Hadley.[246] He claims to have excluded these cases because "it could not be determined from the reports if, in fact, the child had actually been admittedly shaken."[247]

Dr. Leestma's explanation is undermined by Dr. Hadley's original study. Dr. Hadley specifically found that these thirteen confession cases involved "shaking only" events and clearly stated that

> [o]f the 36 infants who sustained nonaccidental head injuries, 13 of whom met two specific criteria: (1) a documented history of infant shaking as admitted by the parent-boyfriend-babysitter perpetrator, and (2) no historical, clinical, or radiographic evidence of direct impact trauma to the craniofacial region. We consider this select population of nonaccidental cranial trauma patients (36% of the total group) to be an isolated whiplash-shake injury subgroup.[248]

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evidence of impact, although all of the fatal cases did); Minns, *supra* note 87, at 6; Morison & Minns, *supra* note 185, at 114–20 (collecting numerous case series identifying these findings); Gill et al., *supra* note 185, at 619 (reviewing retrospectively fifty-nine head injury deaths to children under two, including forty-six homicides, of which ten (22%) had no evidence of impact and cause of death was certified as whiplash shaking).

[242] Leestma, *Case Analysis*, *supra* note 160, at 211.

[243] Leestma, *supra* note 62, at 20.

[244] Leestma, *Case Analysis*, *supra* note 160, at 202–03 tbl.2.

[245] *Id.* at 204–10.

[246] *See generally* Hadley et al., *supra* note 125, at 538–39.

[247] Leestma, *Case Analysis*, *supra* note 160, at 204.

[248] Hadley et al., *supra* note 125, at 538.

Thus, Dr. Leestma ignored Dr. Hadley's findings when he inexplicably failed to classify these confession cases as "shaking only,"[249] and he compounded this mistake when he inaccurately classified six of these thirteen cases as containing evidence of impact.[250]

In a similar mischaracterization of the supporting data, Dr. Leestma omitted two of the three cases described in the cited Benzel and Hadden study.[251] A review of the Benzel and Hadden study reveals that these researchers did not describe any "impact" pathology in these two cases. So these cases (like the thirteen cases identified by Dr. Hadley) should also have been classified as "shaking only" by Dr. Leestma.[252] Finally, Table 2 in Dr. Leestma's article identified twelve cases in which no "impact" pathology was listed. Here once again (without explanation), Dr. Leestma classified just eleven of these cases as "shaking-only" in Table 1. Some of these discrepancies could have been discovered by simply reading the 2005 Leestma paper, others required a review of the source material, but all should be easily comprehensible to a nonscientist. Because Dr. Leestma's case study review underreported the number of "shaking-only" cases and overreported the cases containing evidence of impact, this effectively distorted the data creating doubt regarding the quality of his methods and analysis and the validity of his conclusions.

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[249] *See id.* More significantly, the thirteen "confessed shaking no impact" victims in the Hadley series shared the clinical features Dr. Leestma claimed he was attempting to correlate with the "shaking only" mechanism of trauma. All thirteen children had subdural or subarachnoid hemorrhage, retinal hemorrhages, evidenced seizures, and arrived at the hospital with a severely decreased level of consciousness. Five of the children had additional evidence of neck injury at autopsy. Eight of the children died and the other five had profound neurologic injury. *See* Gilliliand & Floberg, *supra* note 156, at 114 (describing similar findings of head and eye injuries from a "shaking only" mechanism, which Leestma also fails to acknowledge in his paper).

[250] Leestma, *Case Analysis*, *supra* note 160, at 201 (improperly classifying six of Hadley's cases as involving skull fractures and head impact in Table 1). Dr. Leestma also included cases reported by Dr. Caffey in which a nurse admitted to shaking and injuring two babies, both of whom died. *See* Caffey, *Whiplash*, *supra* note 34, at 397. However, Dr. Leestma has subsequently written in a recent book chapter that this "nurse *allegedly* caused the death of three infants and 'maimed two others' *apparently* by shaking them." Leetsma, *Neuropathology Perspectives*, *supra* note 184, at 596. Although Dr. Leestma acknowledged that Dr. Caffey reported both clinical and autopsy findings, he noted that the cases were never published in full or reported elsewhere and expressed concern that he could not locate the autopsy reports. Dr. Leestma has used this inaccurate and incomplete characterization of Dr. Caffey's work to argue that AHT/SBS is an unverified and untested hypothesis. *See id.*

[251] Leestma, *Case Analysis*, *supra* note 160, at 201, 209 (citing Edward C. Benzel & Theresa A. Hadden, *Neurologic Manifestations of Child Abuse*, 82 S. MED. J. 1347 (1989)).

[252] *Id.*

(c) Exclusion of Conflicting Data

Dr. Leestma ignored relevant, preexisting, and readily accessible confession research that would have conflicted with his findings and undermined his conclusions.[253] For example, Dr. Leestma ignored two medical articles that reviewed a large number of AHT/SBS confession cases. The lead author for both articles was Dr. Suzanne Starling.[254] Both of Dr. Starling's papers were published before Dr. Leestma's article was submitted for publication, and he has subsequently acknowledged intentionally excluding these studies from his paper.[255] Had Dr. Starling's data been considered and addressed, these findings would have further undermined Dr. Leestma's claims.

Dr. Starling's research involved 69 AHT/SBS confession cases, 32 of which involved admissions to shaking without impact, in which 28 showed neither scalp injury nor skull fracture.[256] In the opinion of experts familiar with both articles,

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[253] *See, e.g.*, Geddes I, *supra* note 125, at 1295 (noting eight cases with no evidence of impact assumed to be shaking cases with one case in which the caretaker admitted to shaking and including detailed autopsy findings); W. James King et al., *Shaken Baby Syndrome in Canada: Clinical Characteristics and Outcomes of Hospital Cases*, 168 CAN. MED. ASS'N J. 155, 157 (2003) (presenting ninety-six cases of witnessed or confessed shaking confirming assault); Stephen Lazoritz et al., *The Whiplash Shaken Infant Syndrome: Has Caffey's Syndrome Changed or Have We Changed His Syndrome?*, 21 CHILD ABUSE & NEGLECT 1009 (1997) (presenting eleven shaking admissions); Lawrence Ricci et al., *Abusive Head Trauma in Maine Infants: Medical, Child Protective, and Law Enforcement Analysis*, 27 CHILD ABUSE & NEGLECT 271, 276 (2003) (presenting four of nineteen cases (21%) involving confession). Dr. Leestma's selection criteria or selection bias for case reports only up to 2001 seems particularly telling in the wake of this list of studies he does not review or include that predate his two confession papers published in 2005 and 2006. An unbiased researcher would alert a reader to a large body of additional research data that is at odds with the conclusions reported. Most well-researched medical articles contain discussion of the limitations of their data or attempt to note and reconcile conflicting data. Position papers for use in court proceedings by partisan advocates, otherwise known as litigation-driven science, do not share these qualities. *See* Derrick J. Pounder, *Shaken Adult Syndrome*, 18 AM. J. FORENSIC MED. PATHOLOGY 321, 323 (1997) (documenting an admitted fatal shaking case involving an adult victim with no impact trauma, a case report which is likewise not acknowledged in Dr. Leestma's article).

[254] *See* Suzanne P. Starling et al., *Abusive Head Trauma: The Relationship of Perpetrators to Their Victims*, 95 PEDIATRICS 259, 259–62 (1995) (thirty-seven confessions); Suzanne Starling et al., *Analysis of Perpetrator Admissions to Inflicted Traumatic Brain Injury in Children*, 158 ARCHIVES PEDIATRICS & ADOLESCENT MED. 454 (2004) [hereafter Starling et al., *Analysis of Perpetrator*] (69 of 81 perpetrator admissions providing enough information to define the mechanism of inflicted head injury).

[255] *See* Jan E. Leestma, *Response to Drs. Spivack and Krous*, 27 AM. J. FORENSIC MED. & PATHOLOGY 363, 363 (2006).

[256] Starling et al., *Analysis of Perpetrator*, *supra* note 254, at 454–56. In four of these thirty-two cases there was evidence of impact trauma, suggesting that in these four cases the perpetrator had not confessed to all of the blunt head trauma that was involved. In the

inclusion of "[t]hese 28 cases would have markedly increased the statistical power of Leestma's sample and led to a very different conclusion."[257]

The flaws in Dr. Leestma's work have also repeatedly been highlighted by more recent readily available medical literature, which clearly demonstrates that confessions can help to confirm shaking without impact as a mechanism of infant head injury and trauma.[258] Indeed, in a recent article, one set of researchers using a prospective study found that the absence of "impact" injury was statistically associated with cases of AHT/SBS that were confirmed through confession evidence. When the absence of impact finding was combined with findings of subdural hemorrhage and severe retinal hemorrhages the predictive value of AHT/SBS was 100%.[259]

Finally, there are a multitude of additional reasons for rejecting Dr. Leestma's illogical conclusion that confession evidence is uniformly unreliable and that physicians and courts should not use confession evidence to support a finding of AHT/SBS.

First, there is no evidence that parents and other caregivers (when questioned by doctors, social services personnel, or the police) are likely to fabricate or

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remaining twenty-eight cases, however, the physical findings were consistent with the perpetrator's admissions reflecting "shaking only" mechanisms.

[257] *See* Betty Spivack & Henry Krous, *Case Analysis of Brain-Injured Admittedly Shaken Infants: Fifty-four Cases, 1969–2001, A Reply*, 27 AM. J. FORENSIC MED. & PATHOLOGY 363, 363 (2006).

[258] *See* Adamsbaum et al., *supra* note 38, at 546–55 (providing detailed documentation of several confessions); Erica Bell et al., *Abusive Head Trauma: A Perpetrator Confesses*, 35 CHILD ABUSE & NEGLECT 74, 74 (2011) (providing detailed documentation of a confession to a "pure shaking" incident); Minns, *supra* note 87, at 6 (identifying 124 cases of AHT in which 23% involved admissions most evidencing no signs of impact); Mathieu Vinchon et al., *Confessed Abuse Versus Witnessed Accidents in Infants: Comparison of Clinical, Radiological, and Ophthalmological Data in Corroborated Cases*, 26 CHILDS NERVOUS SYS. 637, 637 (2010) (describing a prospective study of 39 confirmed AHT cases based on confessions and examining statistical correlations between subdural and retinal hemorrhages and other head findings); *see also* Dean Biron & Doug Shelton, *Perpetrator Accounts in Infant Abusive Head Trauma Brought About by a Shaking Event*, 29 CHILD ABUSE & NEGLECT 1347, 1347 (2005) (reporting on 52 confessed cases over 10 year time period, 13 of which were classified as "shaken only"). Dr. Leestma separately critiqued this study in another paper. *See* Leestma, *"Shaken Baby Syndrome," supra* note 160. This paper includes many of the same flawed claims made in Leestma's earlier confession paper, but again cites only the two confession papers written by Dr. Starling as additional confession data, while simultaneously disregarding her data and ignoring the other confession data listed above.

[259] *See* Michael S. Pollanen et al., *Fatal Child Abuse-Maltreatment Syndrome: A Retrospective Study in Ontario Canada, 1990–1995*, 126 FORENSIC SCI. INT'L 101, 101–02 (2002); Vinchon et al., *supra* note 258, at 642 (citing similar findings made by other researchers). Notably the Vinchon paper carefully considered the potential for circularity in their methodology, a criticism raised by Dr. Leestma and others regarding research using case series.

exaggerate the degree of physical force they used with an infant. In fact, logic and human nature suggest that an underestimation of their role in causing the infant's injuries is far more likely.[260] Moreover, the fact that some confessions made to police officers may later be found inaccurate cannot support claims that all (or even most) confessions to a particular crime are presumptively unreliable. Indeed the extant evidence suggests that there is no demonstrable evidence of a trend towards false confessions in such cases.

Second, there is no reason to suspect that confessions in AHT/SBS cases are any less reliable than confessions to any other forms of child maltreatment or to any other types of crimes. In fact, the extent to which the physical evidence (i.e., clinical and medical findings) parallels specific admissions is strong corroboration of the reliability of confession evidence. Additionally, admissions and confessions include descriptions of pure shaking, pure impact, and shaking combined with impact. It is patently absurd to suggest that confessions and admissions describing pure impact and shaking combined with impact are reliable; but confessions and admissions describing pure shaking are unreliable.

Third, there is no empirical support for the assertion that interviewing tactics by police, physicians, nurses, EMT technicians, family members, or others involved with child abuse cases are designed to provoke false confessions or that the personal and emotional dynamics of caretakers make them especially susceptible to suggestive influences.[261] Moreover, any such personal or emotional

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[260] *See* Patrick Kelly et al., *Non-Accidental Head Injury in New Zealand: The Outcome of Referral to Statutory Authorities*, 33 CHILD ABUSE & NEGLECT 393, 396 (2009); Leestma, *"Shaken Baby Syndrome," supra* note 160, at 14 (citing psychological research supporting this assertion); Starling et al., *Analysis of Perpetrator*, *supra* note 254, at 454–56; Vinchon et al., *supra* note 258, at 642.

[261] In both confession papers, Dr. Leestma asserts that coercive questioning methods contribute to false confessions. None of the case series he examines, however, contain any information on the questioning methods used to obtain the confessions to shaking. Accordingly, Dr. Leestma's assertions in this respect are merely speculative as they pertain to any of the confessions elicited in AHT/SBS cases. Instead, Dr. Leestma supports his speculations with citations to psychological research involving "false confessions." *See generally* Richard P. Conti, *The Psychology of False Confessions*, 2 J. CREDIBILITY ASSESSMENT & WITNESS PSYCHOL. 14 (1999); S.M. Kassin, *On the Psychology of Confessions: Does Innocence Put Innocents at Risk?*, 60 AM. PSYCHOL. 215 (2005); Richard A. Leo & R.J. Ofshe, *The Consequences of False Confessions: Deprivation of Liberty and Miscarriages of Justice in the Age of Psychological Interrogation*, 88 J. CRIM. LAW & CRIMINOLOGY 429 (1998). None of this research has been conducted on subjects accused of AHT/SBS. Accordingly, it is unknown whether this research has any application to the suspect population involved in such cases. Moreover, there is no litmus test for "false confessions" in AHT/SBS cases similar to DNA exonerations that have formed the basis for much of the "false confession" literature. Indeed, the presence of compelling physical-medical findings in abuse cases and the limited opportunities for individuals to cause these injuries (i.e., they are not caused by strangers such that there is no potential for eye-witness misidentification) militates against the potential for erroneous

dynamics, if they exist, would be present or absent regardless of whether the injuries were caused by pure shaking, pure impact, or shaking combined with impact. Because the vast majority of people who commit these acts do not make admissions or confessions, it would be equally (if not more) plausible to infer that caretakers of infants are actually *less* inclined to make false confessions.

Fourth, notwithstanding the fact that some child abuse suspects will initially make false denials in the interview process, a substantial percentage of perpetrators ultimately admit their abusive conduct.[262] It is illogical to assert that these admissions and confessions are false statements produced by a coercive legal process. To the extent that many of these admissions occur during plea negotiations, judges carefully ensure that the defendant's decisions are both knowing and voluntary.[263] Moreover, because child abuse is a global problem, admissions and confessions occur in a range of settings all across the world. This fact further belies the defense argument that there is something peculiar to the American criminal justice system that makes admissions and confessions describing child abuse crimes presumptively false and coerced.[264]

F. Dr. Marvin Miller, "Overrepresentation of Males in Traumatic Brain Injury of Infancy and in Infants with Macrocephaly"

Justice Ginsburg cites a 2010 article by Dr. Marvin Miller as support for her conclusion that "[i]n light of current information, it is unlikely that the prosecution's experts would today testify as adamantly as they did in 1997."[265]

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suggestions or inaccurate information leading to "false confessions." Nevertheless, the Innocence Project has suggested that research is needed to explore "false confessions" in AHT/SBS cases. *See* Keith Findley, Clinical Professor of Law, *What Role Should Confessions Play in Diagnosing Abusive Head Trauma?*, Presentation at the Twelfth International Conference on Shaken Baby Syndrome/Abusive Head Trauma (Oct. 1, 2012); *see also* Symposium, *supra* note 63, at 232 (statement of Professor Keith Findley) (proposing that confessions and adjudications are not reliable for supporting the "hypothesis" of SBS).

[262] *See* Bell et al., *supra* note 258, at 75–76.

[263] To pass constitutional muster, a plea must be voluntarily, understandingly, and knowingly entered and the record must reflect these facts. *See* Boykin v. Alabama, 395 U.S. 238 (1969). As a general matter a plea is deemed "intelligent" if the accused has the advice of counsel and understands the consequences of the plea, and it is deemed "voluntary" if it is not the product of actual or threatened physical harm, mental coercion overbearing the defendant's will, or the defendant's sheer inability to weigh his options rationally. *See* FED. R. CRIM. P. 11; Brady v. United States, 397 U.S. 742 (1970).

[264] *See, e.g.*, Adamsbaum et al., *supra* note 38, at 547 (documenting judicial admissions to AHT/SBS in France); Biron & Shelton, *supra* note 258 (documenting confession in Australia).

[265] Cavazos v. Smith, 132 S. Ct. 2, 10 (Ginsburg, J., dissenting). In light of the medical evidence cited throughout this Article, the prosecution experts, if testifying today, could cite to an increasingly robust scientific basis in support of their testimony, rather than

More specifically, the dissenters note that, in *Smith*, the prosecution experts all testified that the presence of "old (i.e., chronic) blood in Etzel's brain and around his optic nerves did not change their initial cause-of-death findings, because rebleeding of old subdural blood does not occur in infants."[266] According to the dissenters, Dr. Miller's work shows that "[r]ecent scientific opinion undermines this testimony."[267]

1. Dr. Miller's Methods and Conclusions

Overrepresentation of Males in Traumatic Brain Injury of Infancy and in Infants with Macrocephaly was written by Dr. Marvin Miller, a pediatric geneticist from Wright State University, and Rubin Miller, B.A. (whose qualifications and

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agreeing with the purported claims of a small minority of outlier defense witnesses and advocates suggesting that there has been a significant shift in scientific opinion on these issues. Indeed, in the Audrey Edmunds case, Judge Moeser rejected many of these same scientific challenges. He presided over both the original trial and both of her postconviction proceedings and was intimately familiar with all of the proof. In a lengthy written order denying her 2006 postconviction petition Judge Moeser commented,

> The prosecution's expert witnesses were also well qualified. They effectively countered the defense experts' theories and possible explanations. They convincingly and powerfully challenged the defense expert's opinions as to the various causes of NLB's injuries and death by addressing and countering each theory advanced by the defense. The continued development of medical science in diagnosing the injuries and cause of death in children similar to NLB does, in some ways, make the prosecution's case even stronger than in 1996 when all of NLB's injuries are considered. The prosecution's experts opine that the incredible severity of NLB's injuries, especially the eye findings, along with the lack of other evidence supporting the defense experts' various possible theories, indicate severe trauma and make remoter the likelihood of any meaningful lucid interval between the moment of trauma to obviously visible symptoms. The research and literature since 1996, when applied to NLB's injuries, makes the case even stronger for the prosecution according to the prosecution's experts.

See State v. Edmunds, No. 96-CF-555, slip op. at 7, (Wis. Cir. Ct. Mar. 29, 2007).

These observations and conclusions are particularly important given that the *Edmunds* appellate ruling has repeatedly been portrayed inaccurately as an "exoneration" based on new and improved scientific evidence creating a paradigm shift in scientific thinking. *See* Burg, *supra* note 63; Findley et al., *supra* note 63; Tuerkheimer, *The Next Innocence Project*, *supra* note 63; Symposium, *supra* note 63, at 231 (statement of Professor Keith Findley) (commenting that Edmunds was granted a new trial by the Wisconsin court of appeals on the basis of "new scientific evidence" following which "the State then dismissed all charges against her, completing her exoneration after she'd spent eleven years in prison for this crime that she did not commit").

[266] *Cavazos*, 132 S. Ct. at 10 (Ginsburg, J., dissenting).

[267] *Id.* (citing Miller & Miller, *supra* note 160).

relationship to Dr. Miller are not disclosed).[268] Dr. Miller, like most of the other authors cited by the dissenters, is a regular defense witness in child abuse and child homicide cases.[269] However, Dr. Miller is best known for his promulgation of Temporary Brittle Bone Disease (TBBD), a theory of injury causation that he has repeatedly offered in court to provide an alternative explanation for multiple fracture injuries in infants and children that have been diagnosed as child abuse.[270] The work of Dr. Miller and his colleague Dr. Colin Paterson[271] on TBBD has been thoroughly and repeatedly discredited in the medical literature and in a position paper issued by the Society for Pediatric Radiology.[272] In spite of these critiques, Dr. Miller has continued to espouse this medically unsubstantiated diagnosis.[273]

In the AHT/SBS article cited by Justice Ginsburg, Dr. Miller opined that

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[268] Mr. Rubin Miller has not authored any other medical papers.

[269] *See, e.g.*, State v. Talmadge, 999 P.2d 192, 193–97 (Ariz. 2000); *In re* Jett, No. 302732, 2011 WL 4503347 (Mich. Ct. App. Sept. 29, 2011) (per curiam), *available at* http://publicdocs.courts.mi.gov:81/opinions/final/COA/20110929_C302732_38_302732.OPN.PDF (affirming trial court's rejection of Dr. Miller's testimony attributing child's abuse fractures to Temporary Brittle Bone Disease); *In re* J.D., No. 231322, 2002 WL 1275632, at *9 (Mich. Ct. App. June 7, 2002) (per curiam), *available at* http://www.michbar.org/opinions/appeals/2002/060702/15242.pdf (concluding that the trial court erred in considering Dr. Miller's testimony attributing child's multiple abuse fractures were caused by Temporary Brittle Bone Disease because this disease was not generally accepted in the medical community); *In re* Gavin R., No. M2005-01868-COA-R3-CV, 2007 WL 2198288, at *5, *8–9 (Tenn. Ct. App. July 23, 2007).

[270] *See* Marvin E. Miller & T.N. Hangartner, *Temporary Brittle Bone Disease: Association with Decreased Fetal Movement and Osteopenia*, 64 CALCIFIED TISSUE INT'L 137 (1999); Marvin E. Miller, *Temporary Brittle Bone Disease: A True Entity?*, 23 SEMININARS PERINATOLOGY 174, 174 (1999) (advocating the existence of the entity); *see also* Marvin Miller, *Another Perspective as to the Cause of Bone Fractures in Potential Child Abuse*, 30 PEDIATRIC RADIOLOGY 495, 495 (2000) (opining that injuries to children in a specific case were caused by TBBD not abuse); Marvin Miller, *Fractures During Physical Therapy*, 32 PEDIATRIC RADIOLOGY 536, 537 (2002) (proposing that another article describing fracture injuries during physical therapy is evidence of TBBD).

[271] Dr. Paterson had his medical registration suspended in the United Kingdom for repeatedly proffering the diagnosis of TBBD in legal proceedings. Letter from Prof'l Conduct Comm., Gen. Med. Council, to Dr. Colin Ralston Paterson (2004) (Eng.) (on file with authors).

[272] Block, *supra* note 15, at 269 (concluding that TBBD is lacking scientific data to support its existence); Kenneth L. Mendelson, *Critical Review of "Temporary Brittle Bone Disease,"* 35 PEDIATRIC RADIOLOGY 1036, 1040 (2005) (summarizing the lack of medical evidence supporting the existence of TBBD and specifically addressing Miller's papers on the subject); *see also* Moreno, *supra* note 15, at 531 (exploring the unscientific diagnosis of TBBD offered by defense witnesses to explain fracture injuries in children).

[273] *See, e.g.*, Marvin Miller, *The Death of Temporary Brittle Bone Disease Is Premature*, 98 ACTA PAEDIATRICA 1871, 1871–73 (2009) (arguing that Dr. Paterson's defense of TBBD is justified).

> [s]mall, asymptomatic [subdural hematomas] from the normal trauma of the birth process can spontaneously rebleed or rebleed with minimal forces, enlarge, and then present with clinical symptoms and [subdural hematoma, retinal hemorrhages, and neurologic dysfunction] in the first year of life . . . . [This situation] mimic[s] child abuse, and we believe many such infants in the past have been mistakenly diagnosed as victims of child abuse, when they were likely not.[274]

As shown below, Dr. Miller's opinion regarding AHT/SBS mimics, like his work positing that multiple infant fractures diagnosed as abusive injuries were instead caused by the purported abuse mimic of TBBD, should raise serious concerns even for nonscientists.

2. Scientific Critique of Dr. Miller's Work

Dr. Miller's article states that "coerced confessions have been part of the foundation of the SBS literature that have misled the scientific community to believe that shaking alone can cause the triad."[275] Dr. Miller supports this broad conclusion by citing a single 2005 opinion article written by another child abuse defense witness[276] and by ignoring the numerous medical articles documenting confessions and their corroborative role in the diagnosis of AHT/SBS, discussed above.[277]

In Dr. Miller's view, biomechanical experimentation with animals extrapolated to humans suggests "that the forces generated by shaking are insufficient alone to cause the triad."[278] This claim is both false and misleading. It is false because biomechanical experiments designed to assess the forces necessary to cause retinal hemorrhages (one of the so-called triad findings) have never been conducted or reported.[279] It is misleading because Dr. Miller fails to address any of

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[274] Miller & Miller, *supra* note 160, at 170.

[275] *Id.* at 169 (discussing the triad that represents the findings of subdural hematoma, retinal hemorrhage, and brain encephalopathy).

[276] *See* James LeFanu, *Wrongful Diagnosis of Child Abuse—A Master Theory*, 98 J. ROYAL SOC'Y MEDICINE 249, 249–54 (2005).

[277] *See supra* notes 253–259. Dr. Miller also cites to Dr. Leestma's confession article discussed extensively in the preceding section but similarly does not reference the extensive additional confession literature not acknowledged by Dr. Leestma.

[278] Miller & Miller, *supra* note 160, at 169.

[279] The biomechanical studies repeatedly cited by the defense and extensively discussed above, see *supra* Part III.A, C, have reported on forces necessary to produce concussion, subdural hemorrhages, axonal damage, and purported neck injuries. None of these studies document retinal findings. Nevertheless, defense witnesses and legal academics frequently claim, erroneously, that the biomechanical literature also disproves the causation of retinal hemorrhages. *See supra* Part III.A.1.b, and note 184 and accompanying text.

the shortcomings and well-supported and widely available criticism of the biomechanical literature that he cites and which has been discussed in detail above.[280]

Finally, Dr. Miller simply repeats the theory, also posited by Dr. Uscinski, that birth-related subdural hematomas spontaneously rebleed—a theory that has been extensively and repeatedly discredited in the relevant medical literature.[281] The dissenters' reliance on Dr. Miller's opinions regarding the rebleed theory is especially troubling because even a cursory review of this paper would reveal that his rebleed speculations are unsupported by all of his cited references and specifically rejected by one of them.[282] Moreover, and paradoxically, the rebleed theory is also refuted by Dr. Miller's own empirically well-supported statement that birth-related subdural hematomas are typically clinically silent and reabsorb without incident.[283]

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[280] *See supra* Part III.A, C. In fact, Dr. Miller has restricted his sources principally to a small group of outlier defense witnesses. Multiple articles by Dr. Uscinski and Dr. Leestma, in addition to those of Dr. Donohoe and Dr. Bandak, are referenced, as is the discredited Unified Hypothesis article by Dr. Geddes, which is fully embraced by Dr. Miller in his addendum. Dr. Miller also relies on multiple articles that have been widely discredited in the medical community. *See, e.g.*, Nobuhiko Aoki & Hideaki Masuzawa, *Infantile Acute Subdural Hematoma*, 61 J. NEUROSURGERY 273, 274 (1984) (proposing falls on tatami mats as explanations for severe AHTs). Dr. Miller notes the critiques of this study in his paper but then claims without support that new research confirms the claims of the authors. Miller & Miller, *supra* note 160, at 170. A second discredited article Dr. Miller references is Matthew A. Howard et al., *The Pathophysiology of Infant Subdural Hematoma*, 7 BRIT. J. NEUROSURGERY 355, 356–57 (1993) (suggesting racial differences in the frequency of subdural hematomas). No physiological differences between Caucasian and non-Caucasian children support these authors' conclusion of a race-dependent pathophysiology for subdural hematomas. Notably, Dr. Leestma similarly cites to this discredited paper in his writings. *See* Leestma, *Neuropathology Perspectives*, *supra* note 184 (favorably citing the Howard article, as well as multiple articles by Marvin Miller and Colin Paterson dealing with the scientifically unsupported claims of TBBD). Likewise, Dr. Barnes favorably cites to both of these papers. Barnes, *supra* note 112.

[281] *See supra* note 196 and accompanying text (referencing the medical literature discrediting the "rebleed" theory).

[282] Miller & Miller, *supra* note 160, at 167 (citing Hymel et al., *supra* note 196, which discusses why rebleeding is not a valid theory to explain acute traumatic injury in infants with a rapid collapse).

[283] *Id.* at 170. Birth-related subdural hemorrhages typically resolve by one month of age and are distinct from both the acute hemorrhages and the older subdural hematoma found in Etzel's brain. The scattered pattern of acute subdural and subarachnoid bleeding throughout Etzel's brain is also inconsistent with the theory that a chronic subdural from birth has rebled.

G. Dr. Robert Minns, "Shaken Baby Syndrome: Theoretical and Evidential Controversies"

Finally, Justice Ginsburg quoted the 2005 article, *Shaken Baby Syndrome: Theoretical and Evidential Controversies*,[284] in which Dr. Robert Minns stated, "[D]iagnosing 'shaking' as a mechanism of injury is not possible, because these are unwitnessed injuries that may be incurred by a whole variety of mechanisms solely or in combination."[285]

This citation raises unique questions about the quality of the dissenters' independent fact-finding and their selection and evaluation process entirely distinct from the questions raised by the first six articles. On its face, this quote appears to suggest that, like the other six authors, Dr. Minns disputes the validity of the AHT/SBS diagnosis and disputes shaking as a mechanism of infant brain injury. Nothing could be further from the truth.

The actual quote from which Justice Ginsburg selected this excerpt reads as follows:

> Although shaking may cause an acute encephalopathy, SDH, and retinal hemorrhages, diagnosing "shaking" as a mechanism of injury, to a particular child who presents with these clinical findings is not possible, because these are unwitnessed injuries that may be incurred by a whole variety of mechanisms solely or in combination. The brain may be injured by impact acceleration, impact deceleration, compression, penetration, rotational injury, or rotation with impact. The "Principle of the Transposed Conditional" does not allow a "diagnosis" of the mechanism, but a more generic diagnosis such as [Non-Accidental Head Injury] or inflicted head injury should be used in preference to SBS which implies a specific mechanism of injury.[286]

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[284] Minns, *supra* note 87.

[285] Cavazos v. Smith, 132 S. Ct. 2, 10 (Ginsburg, J., dissenting).

[286] Minns, *supra* note 87. The American Academy of Pediatric has recently revised its own position paper on SBS to be more inclusive of the multiple mechanisms by which AHT may be inflicted. Christian et al., *supra* note 33, at 1410 (setting forth the American Academy of Pediatrics position paper and noting that the Academy determined it was necessary to modify the terminology for describing inflicted head trauma to recognize the multiple mechanisms by which the spectrum of injuries could be inflicted including shaking, impact, a combination, and additional mechanisms). Contrary to misrepresentations made by many defense witnesses and legal commentators, this position statement does not do away with shaking as a mechanism of injury but reaffirms it. "Shaken baby syndrome is a subset of AHT. Injuries induced by shaking and those caused by blunt trauma have the potential to result in death or permanent neurologic disability." *Id.* at 1409–10. "The goal of this policy statement is not to detract from shaking as a mechanism of AHT but to broaden the terminology to account for the multitude of primary and secondary injuries that result from AHT." *Id.* at 1410.

Thus, it quickly becomes clear that the cited portion of Dr. Minns's statement has been taken entirely out of context. It also appears that neither the Justices nor their clerks read the remainder of the paragraph or the article because Dr. Minns would clearly disagree with the dissenters' mischaracterization of his work. Even if one reads just the above-quoted passage, it is clear that Dr. Minns is merely opining that the name "shaken baby syndrome" could be misunderstood to suggest that infant head trauma can *only* be inflicted by shaking, despite the well-established fact that infant brain injuries can be inflicted by a range of different mechanisms including "impact acceleration, impact deceleration, compression, penetration, rotational injury, or rotation with impact."[287] A full review of the article reveals that, unlike the other six authors cited by the dissenters, Dr. Minns explicitly endorses the diagnostic validity of AHT/SBS.[288]

According to Dr. Minns, approximately one-third of the cases of children with nonaccidental subdural hematoma show no evidence of impact trauma, which "is, in itself, strong evidence in favor of the syndrome."[289] In his view, the confession studies and other documented case studies provide additional significant support for the diagnostic validity of AHT/SBS without impact.[290] Dr. Minns specifically referenced medical evidence from studies involving older children and adults[291] and "evidence from animal, biomechanical, and computer modeling research that

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[287] Minns, *supra* note 87, at 10.

[288] More specifically, Dr. Minns eloquently describes four principle patterns of presentation of AHT cases. Notably, he describes the first of these as

> the hyperacute encephalopathic presentation or cervico-medullary syndrome, which accounts for about 6% of all cases and probably is the result of extreme whiplashing forces where the infant sustains acute injury to the brain stem with localized axonal damage at the cranio-cervical junction, in the cortico-spinal tracts, and in the cervical cord roots, consistent with hyperflexion-hyperextension injury. Such severe cases are usually fatal, the child presenting with acute respiratory failure from direct medullary trauma and with cerebral oedema evidence by the "big black brain" on imaging.

Id. at 11–12. This is a description of the same traumatic mechanism testified to by the prosecution's three expert medical witnesses in Smith's trial.

[289] *Id.* at 6.

[290] *Id.* at 7.

[291] *Id.* (referencing the well-documented case of a Palestinian prisoner shaken to death by Israeli guards); *see also* Pounder, *supra* note 253, at 322 (noting that Israeli guards admitted to shaking the prisoner as a form of torture and no evidence of impact trauma was described or observed). The documentation of typical shaking injuries in adult victims (retinal hemorrhages, intracerebral bleeding, traumatic brain injuries) is a compelling refutation of the defense claims that adults cannot shake tiny infants with enough force to cause these injuries.

supports the 'shaking alone' mechanism."[292] Thus, in Dr. Minns's view, the "cumulative evidence is strongly supportive of the contention that adults do shake young infants, and that shaking alone may produce extensive brain injury."[293]

So, in a strange twist of logic, the *Smith* dissenting Justices managed to find one article that could have undermined their conclusions. Instead of reading the article like sophisticated nonscientists and using Dr. Minns's research to question their own assumptions, they adopted the skewed and problematic research methods of the other six cited authors and read only what they expected from Dr. Minns, instead of what he had written.

IV. CONCLUSION

> *The law extends equal dignity to the opinions of charlatans and Nobel Prize winners.*[294]

> *One of the most cherished hopes of a scientist is to make an observation that shakes up a field of research. Scientists have a streak of closeted anarchism, hoping that someday they will turn up some unexpected fact that will force a disruption of the framework of the day. That's what Nobel Prizes are given for. In that regard, any assumption that a conspiracy could exist among scientists to keep a widely current theory alive when it actually contains serious flaws is completely antithetical to the restless mind-set of the profession.*[295]

Some scientific controversies are real; some are manufactured. In child abuse and child homicide cases, jurors and judges must increasingly distinguish between the two. In the child homicide case of *Cavazos v. Smith*, a majority of the Supreme Court Justices reached the correct decision on the postconviction legal and medical questions without embroiling themselves in the purported AHT/SBS "controversy." Unfortunately, the three dissenting Justices decided, without need or explanation, to use their authoritative, if uninformed, commentary to promote a false controversy with far-flung and deadly public health ramifications.

As shown above in extensive detail, these problems arose when the *Smith* dissenters engaged in sloppy independent fact-finding using opaque selection criteria, which led them to microfocus on scientific-sounding sources unworthy of reliance. This type of decisionmaking might be understandable in a naive law

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[292] Minns, *supra* note 87, at 10.

[293] *Id.*

[294] Peter Huber, *Junk Science in the Courtroom*, OVERLAWYERED.COM, http://overlawyered.com/articles/huber/junksci.html (last visited Nov. 23, 2013) (quoting Professor Donald Elliot).

[295] FRANCIS S. COLLINS, THE LANGUAGE OF GOD: A SCIENTIST PRESENTS EVIDENCE FOR BELIEF 58 (2006) (describing the anti-evolution movement).

student's journal article. It is unacceptable from three Justices of the highest court in the land.

Child physical abuse and homicide cases involving AHT/SBS typically involve extensive and complex medical testimony presented by the government and the defense during multiple stages of juvenile and criminal court proceedings, from pretrial motion hearings to trials, to state and federal postconviction proceedings. As *Smith* illustrates, judges at every level of the child abuse adjudication process must evaluate the medical evidence and, increasingly, they must also distinguish real scientific controversies from manufactured controversies, legitimate medical research from litigation-driven research, and well-credentialed neutral experts from charlatans and biased stakeholder for-hire witnesses. This is no easy task for judges (or for jurors) who will frequently find the medical science challenging. Over the past two decades, trial and appellate courts have developed experience determining the admissibility of scientific/medical opinions and data under state or federal evidentiary rules and in applying *Frye* and *Daubert* standards. However, judges' and jurors' ability to accurately evaluate the relevance and scientific merit of conflicting medical opinions, without the type of specific guidance aimed at nonscientists provided in this Article, will be impeded by their lack of formalized scientific training and by the resource and time constraints imposed on our overburdened courts.

Thus, in child abuse and child homicide cases, judges must depend on the integrity, professionalism, and neutrality of expert witnesses. These experts have a professional obligation to testify, not just to their own idiosyncratic or self-serving views, but to provide judges and juries with a contextual framework that accurately and appropriately reflects the global state of scientific and medical knowledge. It is well known that expert witnesses are easily qualified under the state and federal evidentiary rules.[296] The problem in these cases is, for the most part, not the expert's qualifications, but the difficulty that legal fact-finders encounter when assessing the quality of the experts' methods, the accuracy of their opinions, and the validity of any claimed evidentiary base.

As shown above, courts may also be confused by the apparent legitimacy of published medical work. *Daubert* suggested that judges consider peer review and publication when assessing the validity of scientific evidence. But the mere fact of publication, even publication following some sort of peer review, can be a poor basis for assessing the quality of scientific-sounding evidence. This is true when articles contain little or no original research; reach conclusions based on cherry-picked data and manipulation of statistical methods; rely on opinion and commentary, nonrandomized retrospective case reports (without comparative control groups), and scientifically unsubstantiated opinions of other "mercenary witnesses;" and mischaracterize and omit existing and easily ascertainable

[296] *See* FED. R. EVID. 702 (describing the standards to qualify as an expert witness). *See also* sources cited *supra* note 7. The court's designation of a witness as an "expert" lends a further air of legitimacy to their testimony.

AHT/SBS research. This is also true when journals respond to public attention and media controversy by publishing articles—*not* because the editors or peer reviewers endorse the methods or conclusions of the authors—but in a deliberate effort to provoke critique and encourage scientific discourse and debate.

The *Smith* dissenters' reliance on outlier medical articles of dubious validity to draw sweeping conclusions regarding AHT/SBS reveals the general risk of independent judicial fact-finding in science-based cases. Federal Rule of Evidence 706 provides federal judges with the opportunity to retain independent experts to help with their review of scientific, medical, or technical evidence.[297] Apparently the *Smith* dissenters opted not to avail themselves of these resources or to conduct even the most rudimentary research before wading into this critical and complex debate. In fact, in some cases it is not even clear whether the cited articles were fully read.

Smith is emblematic of the fact that postconviction challenges to AHT/SBS convictions have increased dramatically in the past several years. These challenges are fueled in part by recent interest from the Innocence Project, the ready availability of a small cadre of child abuse defense witnesses with an interest in providing evidence to support postconviction claims, and legal academics and law students capitalizing on the (false) notion that they have uncovered a medical scandal of vast proportions. The "bad science," "shifted science," and "new science" AHT/SBS claims are a convenient fit for the procedural requirements for postconviction review, which typically involve claims of newly discovered evidence, ineffective assistance of counsel, factual innocence, prosecutorial misconduct, and a range of constitutional challenges involving due process violations. Postconviction motions predicated on newly discovered evidence or factual innocence also provide a tailor-made opportunity for much of the manufactured controversy and litigation-driven science discussed above to be paraded before trial and appellate courts, the media, and the public. If future courts follow the lead of the *Smith* dissenters, they will accept specious but scientific sounding claims without scrutiny. As one state court judge recently noted, the introduction of this type of evidence during postconviction review of child abuse and child homicide cases presents "a potential quagmire of epic proportions: the strong likelihood of constant renewed prosecution and relitigation of criminal charges as expert opinion changes and/or evolves over time."[298]

Finally, although errors may be uncovered in individual postconviction cases, "[t]he admission of evidence does not provide a basis for habeas relief unless it rendered the trial fundamentally unfair in violation of due process."[299] Given the legal requirements, *Smith* demonstrates that appellate judges cannot properly determine whether the admission of medical evidence of AHT/SBS rendered a trial

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[297] FED. R. EVID. 706.

[298] Grant v. Warden, No. TSRCV030004233S, 2008 Conn. LEXIS 1402, at *1 (Conn. Super. Ct. Jun. 4, 2008).

[299] Holley v. Yarborough, 568 F.3d 1091, 1101 (9th Cir. 2009).

fundamentally unfair, or whether "new science" claims would produce a different result in a new trial, unless and until courts develop a more accurate understanding of the nature of these claims and place them within the context of an accurate and unbiased understanding of the large and ever-expanding body of legitimate medical literature.

Ironically, our call for judges to better understand the child abuse medical science is utterly consistent with the mantra of the Innocence Project, which has consistently and effectively advocated for countless postconviction DNA tests by urging courts to become more sophisticated consumers of scientific evidence.[300] However, when the Innocence Project focuses money and time arguing that infants cannot be seriously or fatally injured by shaking,[301] they abandon their pro-science vantage, reject the laudable goal of scientific literacy, and increase the risk that future trial and appellate courts will rely on outlier discredited scientific-sounding claims parroted by a handful of stakeholder witnesses. This Article calls upon judges to respond by more carefully and accurately evaluating the medical evidence and opinion testimony offered in future AHT/SBS cases. This will prevent our criminal and civil courts from inadvertently promoting dangerous, false, and unscientific claims and will help promote public health efforts to prevent child abuse, secure the safety of the most vulnerable, and ensure that perpetrators of these crimes are punished.

[300] *See* Peter J. Neufeld, *The (Near) Irrelevance of* Daubert *to Criminal Justice and Some Suggestions for Reform*, 95 AM. J. PUB. HEALTH S107, S109 (2005) (arguing that judges should take a gatekeeping role in admitting scientific evidence).

[301] *See, e.g.*, *Spotlight on Shaken-Baby Syndrome*, MEDILL JUSTICE PROJECT, http://www.medilljusticeproject.org/news-on-shaken-baby-syndrome (last visited Nov. 24, 2013).