

February 2, 2011

Shaken-Baby Syndrome Faces New Questions in Court

By EMILY BAZELON

At 4 months, Noah Whitmer was an easy baby. *Super tranquilo*, remembers Trudy Eliana Muñoz Rueda, who took care of Noah at her home day care center in Fairfax County, Va. Rueda and Noah's mother, Erin Whitmer, both noticed when he stopped taking his bottle well and napping as usual in the middle of his fifth month, in April 2009. Whitmer thought this was because Noah had just started eating solid food. She and Rueda talked about it early on April 20, both of them hunched over Noah in his car seat when Whitmer dropped him off.

That afternoon, after a morning in which Noah didn't nap and drank only a couple of ounces of formula, Rueda says she prepared a bottle for him while he lay on a mat. In her native Peru, Rueda, who is 46, ran a travel agency and taught college courses for prospective tour guides. Her husband was trained as a lawyer. After they moved to the United States in 2001, the couple had a second child, and three years later Rueda converted her basement into a home day care center so she could work while spending time with her two kids. When Rueda sat down to feed Noah, her 13-year-old daughter was at school, her 5-year-old was upstairs watching TV and the four other children in her care were taking naps. Rueda's sister-in-law, who spent the morning with the children while Rueda was at a doctor's appointment, had just left the house. "Everything was calm and quiet," Rueda, who has soft features and dark hair, told me in Spanish while her lawyer translated.

There are two irreconcilable versions of how that calm shattered. Rueda says that Noah was crying, and she picked him up, sat on the couch and gave him the bottle to help put him to sleep. While she was feeding him, she felt Noah's arm go limp, and when she moved to take the bottle out of his mouth, he made a sound that she didn't recognize. "I could tell something was happening," she says. She stood up and put Noah on her shoulder, patting him on the back. "As I did this, his body tensed up in a ball. It was as if he was looking for air, and he couldn't breathe." Rueda put Noah on the floor and started C.P.R., at the same time reaching for her phone to call 911. She put the dispatcher on speakerphone so she could keep tending to Noah. "I said, 'Please, please get someone here,'" she said. "I knew it could hurt him if there wasn't enough oxygen going to his brain."

Erin Whitmer's account of the moments before Noah lost consciousness is entirely different. "Around 2:30 on April 20, 2009, Noah was shaken," she wrote on her [blog Noah's Road](#), on the one-year anniversary of the incident. "He'd been crying. He needed something that his day care provider wasn't providing him. Maybe he was tired of lying on the mat where she'd had him. Maybe he needed a hug, a laugh, a kind touch. Instead, she picked him up, her fingers

gripping him tightly, feeling the softness of his velour pants and his cotton onesie under her fingers, and she shook him.”

Whitmer's account of what Rueda must have done to Noah was based on evidence presented at Rueda's trial and information from the doctors who treated him after he was rushed to Inova Fairfax Hospital. The doctors gave Noah a [CT scan](#), which showed subdural hemorrhaging (bleeding in a space between the skull and the brain) and an ophthalmological exam revealed retinal hemorrhaging (bleeding at the back of the eyes). Also, his brain was [swelling](#). For decades, these have been the three telltale signs linked to the kind of child abuse commonly called shaken-baby syndrome.

Noah had no external marks on his body — no bruises or cuts or fractures, no sign that he was forcefully gripped and no evident [neck injury](#) that would seem to result from vigorous shaking. But an [M.R.I.](#) confirmed the CT scan findings and showed that the subdural bleeding was extensive. The doctors at Inova Fairfax tested Noah for clotting disorders that can cause these kinds of hemorrhages. The tests came back negative. The doctors told Erin and Michael Whitmer, who are both 32, that they strongly suspected Noah was violently shaken in the moments before he [stopped breathing](#). While Noah lapsed into a [coma](#), police went to question Trudy Rueda. A day later, Rueda was arrested. She was charged with two felony counts: abuse of a child causing serious injury and cruelty to a child.

Before April 20, 2009, Noah was a healthy baby. Trudy Rueda also had nothing suspect in her past. In five years as a day care provider, she had a pristine record with state regulators — she had taken the classes required for her license and extra ones as well. She cared for a boy with [autism](#) and a girl with one arm, reportedly with calm and assurance. “She was more patient than all of us,” one mother testified at Rueda's trial. A second said, “What she's accused of now I could not begin to imagine Trudy doing.” And yet Noah emerged from her home with terrible and permanent injuries.

Between 1,200 and 1,400 children in the United States sustain head injuries [attributed to abuse](#) each year. Most of them are less than a year old. Usually, there's not much dispute that these children were abused, because doctors discover other signs of mistreatment — cuts, bruises, burns, fractures — or a history of such injuries. There is no exact count of shaken-baby prosecutions, but law-enforcement authorities think that there are about 200 a year. In an estimated 50 percent to 75 percent of them, the only medical evidence of shaken-baby syndrome is the triad of internal symptoms: subdural and retinal hemorrhage and brain swelling.

For a year after Noah came out of his coma, he had as many as 32 [seizures](#) a day. Now he is 2, and his parents watch as his 1-year-old brother surpasses him developmentally. Noah sometimes nods his head “yes” and gives high fives, but he is not yet talking; doctors are not sure of his cognitive prognosis. Erin Whitmer, a slender woman with large brown eyes who chose Rueda for part-time day care after a careful search, cried when she found out that Rueda had

been arrested. Now she says, “It will never completely leave me, the horror that I trusted my son with someone and she did this to him.”

At Rueda’s trial in January 2010, the prosecutor presented six doctors who testified that Noah’s brain scans showed he had been abused. The doctors’ reading of the scans were the main evidence that a crime had taken place, of its timing and even of Rueda’s state of mind, since they agreed that only an act of great violence could inflict such injuries. Two doctors who treated Noah in the hospital said that the baby’s scans showed that he had an acute [subdural hemorrhage](#) — the bleeding had begun suddenly — which was, as one doctor stated, “inconsistent with accidental trauma.” Another witness, Craig Futterman, a doctor at Inova Fairfax and president of the board of the Shaken Baby Alliance, put it more bluntly, “This child was shaken, or shaken and slammed against something.”

The usual explanation for how a caregiver can become an abuser is that in a moment of intense frustration, she snaps. The prosecutor, Gregory Holt, imagined for the jury a scenario in which Rueda was aggravated that she could not get Noah to stop crying: “Put him on the mat, put him on the chair, he’s not drinking his milk. Getting a little bit frustrated?” And he claimed that Rueda confessed to shaking Noah.

On the day of Noah’s injuries, Rueda spoke to the police without a lawyer and denied hurting him. The next day, Joslyn Waldron, a social worker for Virginia’s Child Protective Services, visited Rueda at home. Waldron knew that Noah’s doctors at Inova Fairfax suspected that he had been abused because of his symptoms. She and Rueda spoke together in Spanish while a detective, who did not speak Spanish, was present. At the trial, Waldron testified that Rueda confessed to shaking Noah when he was crying and before she gave him a bottle. The social worker said she wrote in her notes, “Might have shaken him about three times, but not sure” (using a standard Spanish word, *sacudir*, for shake).

As is protocol in her department, Waldron offered to tape the interview; Waldron says Rueda declined. Rueda has denied telling Waldron that she shook Noah. At the trial, she testified in heavily accented, halting English, frequently interrupting herself because she didn’t understand the questions. Rueda said that she told Waldron, “I probably moved kind of rough with Noah,” at the moment that she lifted him to give him the bottle, but that she had not gotten frustrated with the baby or harmed him.

When her lawyer asked her what she thought happened to Noah, Rueda answered: “I imagine the parents, we all want to know what happened. But I cannot give you an explanation about what I don’t know.”

The Whitmers dismissed Rueda’s denials of guilt. “It’s a complicated thing to look at someone who always smiled at you, to know that your baby loved her, and to know that because of her, you struggle each day to adapt to a new sense of reality,” Erin Whitmer [wrote on her blog](#), which has had more than a million visits, after Rueda’s first criminal hearing. Michael Whitmer expressed his rage at Rueda’s next hearing by wearing a T-shirt he made. On the back is a

picture of Noah taken in the hospital, with tubes coming out of his mouth and the words: “Ask me what happens when you shake a baby.”

At the trial, the prosecution presented one more piece of testimony against Rueda. The pediatrician who saw Noah in the I.C.U. told the jury that given the severity of the baby’s injuries, their “onset would have been very rapid, so it would have been within minutes of when the injury occurred.” This meant that the person with the baby right before he stopped breathing — Rueda — was necessarily the guilty party.

Rueda’s lawyer didn’t challenge this assumption directly. Medical experts, however, have begun to point out that clinical observations show that it’s possible for a child to have a [brain injury](#) and still remain conscious. The child may be lethargic or fussy or may not eat or sleep normally for hours or days, while the subdural hemorrhage and other injuries become more serious, ending in acute crisis. This has made some doctors wary of pinpointing the timing of a child’s injury — even when they are sure that abuse occurred — lest the wrong adult take the blame. “The police want us to time it within one to three hours,” says John Leventhal, a Yale [pediatrics](#) professor and medical director of the child-abuse programs at Yale-New Haven Children’s Hospital. “But sometimes we can only time it to within days.”

In this case, because Rueda had been at the doctor that morning and her sister-in-law stayed to help with lunch, she spent only about an hour alone with the children in the day care center before calling 911. Arguing that another adult had harmed Noah would have meant implicating Rueda’s sister-in-law, whom Rueda says she has never suspected, or the Whitmers, whom no one has accused. Rueda, her husband and their lawyers decided not to take this tack. The defense relied primarily on Ronald Uscinski, a neurosurgeon on the faculty of the [medical schools of George Washington University](#) and Georgetown. When he took the stand, Uscinski refuted all the prosecution experts who said that Noah’s hemorrhaging was acute — the sudden result of a new injury. Uscinski testified that he saw chronic subdural bleeding on the scans, which he said was the result of trauma at birth. “Rebleeds” like Noah’s, he testified, “can occur with minimal or no trauma. They can occur spontaneously.” On cross-examination, Uscinski said that he earned approximately \$200,000, which was about 30 percent of his income, as an expert witness in 2009.

For the prosecution, Cindy Christian, a pediatrics professor at the [University of Pennsylvania](#), who has published extensively about shaken-baby syndrome, rejected Uscinski’s reading of Noah’s brain scans. “That’s false, he did not have a rebleed from a chronic hematoma from birth,” she said. “There was no evidence of that.”

After five days of testimony, the jury deliberated for five hours and voted to convict. Virginia’s sentencing guidelines called for a minimum sentence of 3 years and a maximum of 15. The jury recommended 10½ years and Erin and Michael Whitmer took the stand in support of that punishment. “This is a life sentence for my son, for my wife, for me, and for our family,” Michael Whitmer told the jury.

“Really still, now, I can’t comprehend it,” Rueda told me, looking wan and bereft when I visited her at the Fluvanna Correctional Center for Women in Virginia. Rueda’s daughters have gone to live with her older sister in Peru while her husband works extra hours to support the family and pay for her appeal. Rueda can rarely speak to her children. “It is so hard to talk about this separation,” she said, and started to cry.

A dozen years ago, the medical profession held that if the triad of subdural and retinal bleeding and brain swelling was present without a [fracture](#) or bruise that would indicate, for example, that a baby had accidentally fallen, abuse must have occurred through shaking. In the past decade, that consensus has begun to come undone. In 2008, the Wisconsin Court of Appeals, after reviewing a shaken-baby case, [wrote that](#) there is “fierce disagreement” among doctors about the shaken-baby diagnosis, signaling “a shift in mainstream medical opinion.” In the same year, at the urging of the province’s chief [forensic](#) pathologist, the Ontario government [began a review](#) of 142 shaken-baby cases, because of “the scientific uncertainty that has come to characterize that diagnosis.” In Britain, after one mother’s shaken-baby conviction was overturned, Peter Goldsmith, then attorney general, reviewed 88 more cases. In 2006, he [announced doubts](#) about three of the convictions because they were based solely on the triad; in the other cases, Goldsmith said, there was additional evidence pointing to the defendant’s guilt.

A small but growing number of doctors warn that there can be alternate explanations — infections or [bleeding disorders](#), for example — for the triad of symptoms associated with shaken-baby syndrome. Across the country, the group of lawyers that has succeeded in exonerating hundreds of people based on [DNA evidence](#) is now mounting 20 to 25 appeals of shaken-baby convictions. “No one wants child abuse,” says Keith Findley, a lawyer for the Wisconsin Innocence Project. “But we should not be prosecuting and convicting people in shaken-baby cases right now, based on the triad of symptoms, without other evidence of abuse. If the medical community can’t agree about all the conflicting data and research, how is a jury supposed to reach a conclusion that’s beyond a reasonable doubt?”

Much of the science of shaken-baby syndrome dates from the late 1960s, when a neurosurgeon named Ayub Ommaya conducted a brutal animal experiment to figure out how much acceleration it took to cause a head injury. Ommaya took more than 50 rhesus monkeys and strapped each one into a chair mounted on wheels, leaving their heads unsupported. He placed the chair on a 20-foot-long track, and an air-powered piston sent the monkeys zooming into a wall. Fifteen emerged with some kind of [cerebral hemorrhage](#). Eight of those also had injuries to the brain stem or cervical cord.

Ommaya’s experiment involved neither shaking nor infants. Still, two pediatric specialists, John Caffey and A. Norma Guthkelch, each wrote a paper that pointed to the work as evidence that unexplained subdural bleeding in babies could occur without direct impact to the head and with or without a visible neck injury. In the 1980s, the term “shaken-baby syndrome” came into broad use, and a national prevention and awareness campaign was set in motion.

As the diagnosis of shaken-baby syndrome took hold in medicine, and prosecutors began to bring charges based on it, doctors testified that shaking could generate the same terrible force as throwing a child from a second-story window. It turned out they were wrong. In 1987, a neurosurgeon named Ann-Christine Duhaime published a paper that included the autopsy results of 13 babies with symptoms associated with shaken-baby syndrome. In all of them she found evidence of trauma that was actually caused by impact. She **teamed up** with biomechanical engineers to create infant-sized dummies equipped with sensors to measure acceleration. “We shook them as hard as we could, and we thought something was wrong, because the accelerations we measured were unexpectedly low,” Duhaime says. Instead, the force level shot up when the testers released the dummies after shaking them, even if they hit a soft surface like a bed or a couch.

Later experiments confirmed this finding and have made some doctors and biomechanical engineers skeptical that shaking alone can cause severe brain damage or death. At the same time, the experiments have not ruled this out, Duhaime says. Among other things, the dummies are not live children, and while their heads and necks can exhibit the effects of acceleration, impact on brain tissue is still hard to model.

Many doctors who treat child abuse say that decades of clinical observation, as well as confessions, show that it’s possible for shaking alone to cause the triad of subdural and retinal bleeding and brain swelling. A 2009 **position paper** from the **American Academy of Pediatrics**, written by Cindy Christian, recommends that doctors use the more general term “abusive head trauma” but also calls shaking an “important mechanism” of such trauma. Many doctors who testify for the defense agree that shaking could in theory cause the triad of symptoms but only if there is an injury to the neck or spinal cord, “where the breathing center is,” as one doctor puts it. It’s the absence of signs of this kind of an injury that makes some shaken-baby cases particularly fraught.

In 1993, Audrey Edmunds left her job as a secretary and started caring for children in her home near Madison, Wis. Like Trudy Rueda, Edmunds says that a baby she was taking care of, 7-month-old Natalie Beard, suddenly collapsed while drinking a bottle of milk; Natalie was propped up with the bottle in a car seat while Edmunds was out of the room getting her two daughters and another child ready for preschool. In the hospital, a CT scan showed that Natalie had the triad of shaken-baby symptoms but no spinal-cord injury. The baby died, and the doctors agreed that Edmunds, who was pregnant with her third child, had to be responsible. She was charged with first-degree reckless homicide.

At Edmunds’s trial, a librarian testified that she once heard a thump and then the cries of a child who was with Edmunds, but she didn’t see what had happened. Edmunds denied ever harming a child in her care. Her neighbors testified to her calm around children. Natalie “was a real fussy baby,” one said, “but Audrey was very patient with her.” Another day care provider in the neighborhood said, “I looked up to Audrey . . . when I started doing my day care.”

Still, the prosecution's medical experts said that only Edmunds's violence could explain Natalie's injuries. A forensic pathologist, Robert Huntington, testified that the baby most likely had been abused at some point during the two hours before her collapse — which was when she was with Edmunds. The jury convicted Edmunds, and she was sentenced to 18 years; she went to prison two days after her youngest daughter's first birthday.

A decade later, Edmunds had a hearing to determine whether she should have a new trial. Huntington this time took the stand on her behalf. When Keith Findley, her lawyer, asked whether Huntington was comfortable with his 1996 testimony, the pathologist said, "No, sir, no I am not." He explained that in the years since her trial, he observed a child with subdural and retinal bleeding who was lucid for a period between her brain injury and her collapse. After that, he returned to the medical literature and found research to support this possibility. Huntington now believed that a "lucid interval is a distinct, discomfoting but real possibility." He said he could no longer precisely time the injury that caused Natalie's death. For how long could Natalie have appeared relatively normal — fussy, but not obviously in crisis? "I'm sorry, I just don't know," Huntington said.

Huntington's change of heart reflects a new explanation for the manifestation of brain injury in babies. In a [2001 study](#), the British neuropathologist Jennian Geddes found that most babies with the triad of shaken-baby symptoms suffered not from a rupture of the nerve fibers of the brain but rather from a lack of blood caused by oxygen deprivation to the brain's cells.

The rupture of the brain's nerve fibers is immediate and produces instant coma; the effects of oxygen deprivation can be slower and more subtle. This can explain how a child with the triad of shaken-baby symptoms could, for some period of time, seem fussy or lethargic or stop eating or sleeping well. In 2005, Christian [co-wrote a study](#) that concluded, "Although infrequent, young victims of fatal head trauma may present as lucid before death."

This possibility introduces questions about whether the last person to care for a child before he or she stops breathing is necessarily guilty of abuse. In most cases of assault or murder, jurors could weigh this doubt in light of other evidence — witness testimony, perhaps, or the motive the defendant would have had to commit the crime. In shaken-baby cases, however, this kind of additional evidence is often absent. Doubts raised about the medical testimony loom large because it's so central to the prosecution.

At Edmunds's hearing for a new trial, five doctors joined Huntington on the side of the defense. Opposing them were four doctors for the prosecution. The Wisconsin Court of Appeals ruled in January 2008 that the disagreement among the physicians represented a shift in medical opinion and warranted a new trial: a jury would have to hear both sides. Edmunds called her daughters to tell them she was coming home. Six months later, prosecutors dropped the charges against her.

Audrey Edmunds's successful appeal was built on a foundation laid by defense lawyers a decade earlier in the first big courtroom fight over shaken-baby syndrome. In that case, prosecutors in Massachusetts charged an English

au pair, [Louise Woodward](#), with the murder of 8-month-old [Matthew Eappen](#), who stopped breathing in her care. Matthew had the triad of shaken-baby symptoms, along with a [skull fracture](#). Woodward, who was 19, told the police that she shook Matthew lightly when she couldn't wake him from a nap. Prosecutors decided that the shaking must have been violent. They also said that to cause the skull fracture, Woodward must have smashed Matthew's head on a hard surface at a velocity of more than 25 miles per hour.

Woodward's lead counsel was [Barry Scheck](#), who went on to found the Innocence Project at Cardozo law school with Peter Neufeld. He enlisted seven medical experts, including Ommaya, the neurosurgeon who experimented with the rhesus monkeys, and Ronald Uscinski, a colleague. The defense's theory was that Matthew's skull fracture was three weeks old when he died, and that because of it, a slight jarring could have caused his fatal bleeding. Scheck didn't try to explain how the fracture happened. "We didn't know, so we didn't claim anything," he told me. But the defense experts testified that because tests showed no swelling at the site of the fracture, it had to be old.

The prosecution, for its part, lined up the doctors who treated Matthew at Children's Hospital in Boston. Among them was Patrick Barnes, then a pediatric radiologist at Children's. He had written, with another doctor, a chapter in a textbook that embraced the traditional theory of shaken-baby syndrome and shared the assumptions that pointed to Woodward's guilt.

Barnes testified for the prosecution at the trial, saying Matthew's brain scans showed his injuries were a result of shaking as well as a skull fracture. The prosecutors also asked Barnes to help them prepare for their cross-examination by briefing them on what to expect from the defense's doctors. He spent evenings watching Court TV tapes of their testimony. He heard doctors from fields other than pediatrics — biomechanics, [neurosurgery](#) and neuropathology — discuss scientific findings about traumatic brain injury that contradicted his belief in the traditional method for diagnosing shaken-baby syndrome. He started to question his assumptions. "I'd been in lockstep with the child-abuse establishment for 20 years," he told me. "For the first time, I saw that there were well-qualified experts on the other side giving opinions I'd never heard, that I knew nothing about."

Woodward's case ended in a stalemate. After the jury found her guilty of second-degree murder, the judge reduced the conviction to involuntary manslaughter and released her for time served. But a lasting legacy of that case was the eventual conversion of Patrick Barnes from an upholder of the medical orthodoxy surrounding shaken-baby cases to one of its strongest critics.

After Woodward's trial, Barnes continued to think about his newfound doubts. He read widely in the medical literature. He started to look at brain scans brought to him by defense lawyers. In a New York case in which a father was being prosecuted, Barnes says, he found strong support in the medical literature for a diagnosis of infant [stroke](#), which he thought was likely related to an infection like [meningitis](#). Now he says that he sometimes sees other explanations for the triad of symptoms. "There are a number of things you have to look for in these children —

infections, bleeding and clotting problems,” Barnes says. “Even now, I am most concerned about looking very carefully for predisposing or complicating medical conditions, in particular for infants younger than 6 months.”

Trudy Rueda’s lawyer asked Barnes to review Noah Whitmer’s brain scans before her trial. Barnes wasn’t able to testify because of a scheduling conflict, but he says the scans indicate that the baby had a thrombosis — a blood clot within a blood vessel. The prosecution’s doctors saw the thrombosis, too, but they claimed it was a result of abuse. To Barnes, the clotting suggested infant stroke, which can be triggered by an infection. He says the fact that Noah was not taking a bottle or napping normally in the days before he was hospitalized suggests that his condition could have been subtly deteriorating during that time. “It’s a very striking pattern,” Barnes says of the thrombosis. “The baby not eating well may reflect the process which starts this. Usually, it’s not a process that happens acutely and the baby crashes. It can start relatively slowly.”

Barnes also testified at Audrey Edmunds’s hearing challenging her conviction. He said that it was difficult to know for sure what had happened to Natalie Beard based on her scans; at the time of her death, [hospitals](#) were using CT scans, rather than also using M.R.I.’s, which provide more detail. But he did say that he saw the possibility of a thrombosis.

To a degree, some of the alternative explanations from defense-side doctors are accepted in the child-abuse field. A 2009 textbook that Cindy Christian co-edited includes a discussion of diseases and accidental injuries that can mimic the effects of abusive head trauma. Leventhal, the Yale pediatrician, told me about an unusual case involving an accidental fall. “A child who was sitting in a highchair and put his feet up on the table in front of him and rocked himself backward,” Leventhal said. “When the child was taken to the hospital, the ophthalmologist said, ‘This is shaken baby,’ because of the massive retinal bleeding. Luckily, there were seven people playing cards in the room when the baby fell.” Leventhal continued, “The subdural hematoma continued to bleed, and it turned out he had a previous bleeding disorder, a clotting problem.”

Leventhal and others in the child-abuse field emphasize that such hemorrhaging as a result of a fall is very rare. In order for doctors to determine what caused an injury, they begin with a list of alternatives, ruling out the ones that don’t match a patient’s symptoms until they arrive at a diagnosis, with a reasonable degree of medical certainty. But defense-side doctors like Barnes say that in a criminal case, physicians should be more careful about testing their assumptions, and they should give the possibility of an alternative explanation — a stroke, say, caused by an infection — more weight.

It’s on this question of probable causes that the doctors who testify in these cases split. Prosecution-side experts rely on a set of studies that indicate that when children have subdural bleeding and extensive retinal hemorrhaging, they are far more likely to have been abused than injured in any other way. In a [2010 paper](#) in *Pediatrics*, Christian and the pediatric ophthalmologist Alex Levin concluded that the evidence supporting the “diagnostic specificity” of

“severe” retinal hemorrhaging has significantly increased. “Some children have such severe retinal hemorrhaging that it is much more likely to be from abusive head trauma,” Christian told me. She testified to this at Rueda’s trial, because Noah Whitmer had severe retinal hemorrhaging. Levin similarly called Natalie Beard’s retinal bleeding “textbook severe” when he testified for the prosecution at Audrey Edmunds’s 2007 hearing. When the prosecutor asked him how significant these findings were for diagnosing shaken-baby syndrome, Levin answered: “Very important. We really don’t have any other cause for this particular kind of hemorrhaging and retinal findings.”

Defense experts, however, criticize the methodology of these studies. And even taken at face value, they say, the studies show that severe retinal hemorrhaging is far more common in abuse cases, not that it’s never found in any other circumstance. At the 2010 meeting of the American Academy of Forensic Sciences, the Canadian forensic pathologist [Evan Matshes](#) presented the results of a study, under peer review, of 123 autopsies performed on infants in Miami-Dade County who died under natural or accidental circumstances, or from homicides. Of the children with retinal hemorrhages, 53 percent died from accidental or natural causes, and 47 percent died as a result of homicide. Severe retinal hemorrhages were identified in some of the children in the accident group. Although the children in the homicide group were more likely to have severe retinal hemorrhages than the other groups, this finding could be explained by factors other than abuse, according to Matshes. The children in the homicide group had isolated head injuries and were more likely to be resuscitated for a period of time, he says. In the aftermath, they were more likely to develop brain swelling and bleeding disorders that may explain the severe retinal hemorrhaging. Matshes puts his conclusions like this, “It is simply incorrect to state that severe retinal hemorrhaging is diagnostic of abuse or shaking.” He is now working on a study that looks at whether infants with subdural and retinal hemorrhaging might in fact have neck injuries, which could indicate shaking, that go undetected, because doctors haven’t looked in the right place for them. Matshes and his team are conducting autopsies of the entire cervical spinal column, which is not usually dissected in shaken-baby cases. The goal is to determine whether injuries there could explain how shaking can cause brain damage or death — and whether this additional diagnostic tool might one day help distinguish which babies have in fact been abused, and which have subdural and retinal bleeding from other causes.

Underlying the clash over the medical research on shaken-baby syndrome is another one about human nature. How likely is an adult with no history of wrongdoing to do terrible harm to a child by violently shaking it? To pediatricians like Leventhal and Christian, the sad answer, born of experience, is that such a lapse is all too possible. When I described Trudy Rueda’s case to Leventhal, he told me about cases in which he had met and liked a parent or caregiver who ended up confessing to harming a child. Was there truly *no* indication that the adult in question was capable of such an act? The doctors who treat abused children insisted that sometimes, there isn’t. They described disturbing confessions, like one that made headlines in Florida last year after a 22-year-old mother told the police that she had shaken her 3-month-old baby and perhaps caused him to hit his head, because he wouldn’t stop crying while she was playing FarmVille. Leventhal cites a 2010 study that included 29 people who confessed in the French courts to shaking infants and who described the abuse as extremely violent.

Doctors like Barnes, on the other hand, emphasize that confessions are not always reliable. The exonerations of recent years have shown that people sometimes falsely admit to crimes because of police pressure or the promise of a plea bargain. In the first case from Canada's shaken-baby inquiry to reach the Ontario Court of Appeal, the judges [overturned the conviction](#) of Dinesh Kumar, a 44-year-old father who pleaded guilty to shaking his 5-week-old son to death. Kumar says now that at the time of his guilty plea, he believed he had no hope of prevailing against the damning testimony of the state's pathologist, who has since been discredited for giving error-riddled testimony based on botched autopsies.

In response to the critics who question the basis for some shaken-baby convictions, many in the child-abuse-treatment field have fired back with a critique of their own. Christian and Leventhal dismiss defense-side experts' alternate explanations, like Uscinski's theory that children suffer spontaneous rebleeds from birth injuries. "Every year they come up with a new alternate theory that we have to refute," Christian says.

Normally, of course, this is how science progresses: One researcher comes up with a hypothesis, which others question and test. But shaken-baby cases are haunted by the enormous repercussions of getting it wrong — the conviction of innocent adults, on the one hand, and on the other, the danger to children of missing serious abuse. In one study, researchers looked into the deaths of five children who had head injuries that initially were misjudged to be accidents and found that four of them could have been prevented if an earlier pattern of abuse had been detected. If parents are the focus of a shaken-baby investigation, doctors must weigh this risk in helping the state determine whether a child should be removed from the home. "When babies are sent home with an injury that's misattributed to an accident, we know that one-quarter to one-third of them will come back with another serious injury or, in some cases, death," Leventhal says.

Barnes, who is now part of a child-abuse-protection team at Stanford, doesn't dispute the need to investigate shaken-baby symptoms. But he says that most of his colleagues don't present the science dispassionately. "They have built their careers, their entire standing on this issue." His opponents, for their part, dismiss the defense experts as hired guns. "They're aggrandizing themselves and making a lot of money testifying," says Robert Block, the president-elect of the American Academy of Pediatrics. While it's true that experts like Uscinski can make six figures a year testifying (he says he testifies free when a defendant cannot afford to pay him), it's also the case that some witnesses for the prosecution are paid. Barnes no longer takes fees to testify in either criminal or custody cases. Neither did four of the other five defense experts who testified for Audrey Edmunds.

Last September, the fight among the doctors broke out in public on the Web, after Deborah Tuerkheimer, a former prosecutor and a law professor at DePaul, wrote a New York Times [Op-Ed warning of wrongful convictions](#) and calling on the [National Academy of Sciences](#) to referee the shaken-baby-syndrome dispute. On the Web site CommonHealth, about [20 doctors commented](#), mostly to express outrage. One of them was Block. He wrote that

Tuerkheimer had “been beguiled by a group of physicians who are using the courtroom to distort science, facts and reality.” And he denounced her for “furthering the cause of the so-called innocence project.”

Philipp Baumer was born after a difficult delivery and spent his first week in the newborn-intensive-care unit. His mother, Victoria, who had given up her last baby for adoption, struggled with [drug addiction](#). Her sister Julie, who was 27 and a loan officer for a mortgage company, was helping take care of Victoria’s oldest child. She volunteered to adopt Philipp. “I didn’t want to see anyone else leave the family,” she told me in November when I met her in Ann Arbor, Mich.

When Philipp came home, neither Julie Baumer nor her parents could get him to take a bottle regularly. On Oct. 3, 2003, when he was 6 weeks old, Philipp was not able to keep down food for 12 hours, Baumer says. She called his pediatrician, who sent her to the emergency room at Mount Clemens Regional Medical Center outside of Detroit.

The E.R. doctor who saw Philipp found he was dehydrated and septic, gave him fluids and [antibiotics](#) and ordered a CT scan. But the test was canceled when Philipp was scheduled for transfer to the region’s specialty facility for pediatrics, Children’s Hospital of Michigan in Detroit. At Children’s, Philipp went straight to intensive care. But he waited 28 hours for the CT scan. By then, Philipp had been in the hospital for a total of 33 hours. The scan showed subdural bleeding, which was so extensive that his fontanelle (the soft spot on a baby’s head) was bulging. An ophthalmologist saw retinal bleeding. Philipp also had a skull fracture, although it was not near the site of the hemorrhage. In an emergency operation, a shunt was placed to relieve the pressure on Philipp’s brain, but it was too late to prevent severe damage. Philipp, who is now 7, has [cerebral palsy](#); he cannot walk on his own, talk or see.

Four months after Philipp’s injuries occurred, Julie Baumer was charged with child abuse in the first degree. The prosecutor didn’t present a theory about why Baumer would have harmed Philipp, saying that it was the state’s job to show that Baumer intended to shake the baby, not what motivated her. Two doctors from Children’s Hospital testified for the prosecution: Steven Ham, the neurosurgeon who put in the shunt; and Cristie Becker, a radiologist who treated Philipp later. Becker said Philipp’s injuries were inflicted by shaking and timed them to “likely within 24 hours” of the CT scan. She said the skull fracture may have been an old birth-related injury. Looking at the scan, Ham said the fracture was new and that Philipp’s injuries were the result of blunt-force trauma that occurred “within the previous 12 to 24 hours.” He said he could pinpoint the timing based on “how sick the child was, and then the fact that in looking at the scan we could see fresh blood in the scan.”

Becker and Ham didn’t note in court that their 24-hour time frame meant that Philipp would have started hemorrhaging while he was at Children’s — and no longer in Baumer’s care. (When I called Becker, she said, “I don’t care to revisit that issue, and best of luck trying to find the truth in the midst of that trial.” Ham did not return my calls.) Baumer’s trial lawyer failed to point out this flaw in the prosecution’s case. The lawyer also did not find a defense expert who could read Philipp’s brain scans. Baumer had no money to hire one, and her lawyer didn’t know

that he could have asked for court funds to cover the expense. In 2005, Baumer was convicted and sentenced to 10 to 15 years.

Baumer was raised Catholic, and in 2007, a nun saw her name on a prayer list and came to visit her in prison. When she heard her story, the nun asked Baumer if she needed a new lawyer and wrote on her behalf to Charles Lugosi, then a professor at the Catholic law school Ave Maria. Lugosi agreed to take Baumer's case and enlisted the help of a former prosecutor, Carl Marlinga, who had opened a defense practice. Later, the [University of Michigan Innocence Clinic](#) joined the defense.

The defense team sent Philipp's brain scans to Patrick Barnes. At the bottom of the images, Barnes saw a distinctive bright triangle surrounding the major vein that brings blood in and out of the brain. To Barnes, the triangle clearly pointed to a diagnosis unrelated to abuse: Venous sinus thrombosis, or stroke, probably from an infection — an explanation similar to the one Barnes gave for Noah Whitmer's injuries. Another radiologist and a forensic pathologist concurred with Barnes's reading of Philipp's scans. The defense experts also saw suggestions of an earlier smaller stroke, which could have triggered the feeding problems that led Julie to call Philipp's pediatrician. This reading of the scans matched the time frame Becker and Ham had given at trial: Philipp could have started to show some symptoms, and then had a major stroke after he was admitted to the hospital. The defense experts agreed with Becker that the skull fracture was old. They said it was likely the result of Philipp's difficult birth.

This testimony won Baumer a new trial. It also gave the defense team an answer to the question that hovers over every shaken-baby prosecution: What happened to hurt the child? During a trial, solving that mystery isn't supposed to be the defense's responsibility — the burden of proof rests with the prosecution. But a credible response makes it easier to lift the weight of the medical evidence from the shoulders of the defendant.

At Baumer's second trial, which took place in October, the defense called neighbors and friends who testified that she was gentle and loving with children. The prosecution introduced no evidence to the contrary. Baumer has two drunken driving offenses on her record from the late 1990s, but they weren't introduced at the trial.

Back on the stand, Ham and Becker now said they had misspoken about the time frame, and came up with new estimates: Becker said that Philipp's internal bleeding could have begun five days before the CT scan, and Ham said one or two days. They both remained convinced that Philipp's hemorrhages were inflicted. "Before they testified, they both said that it was their opinion from the beginning that the injuries occurred before Philipp came to the E.R.," Richard Goodman, the prosecutor at the second trial, says. And the prosecution's doctors disagreed with Barnes and the other defense-side experts that Philipp's scans showed a thrombosis. On cross-examination, Baumer's lawyer, Marlinga, asked Ham and Becker if they were trying to deflect criticism of the hospital for failing to give Philipp the care he needed because of the delay of his CT scan. The doctors denied that their revised testimony had anything to do with protecting the hospital.

The jurors began their deliberations by taking a poll. Nine out of 12 thought Baumer should be found not guilty. “For me, it came down to this: For the prosecution to be right, I was required to believe that a woman with no history or indication of violent tendencies or instability hit this baby’s head so hard that she fractured his skull, and shook him so hard that she caused extensive brain damage, while leaving no marks on him,” says Carman Minarik, a juror who is a minister at First United Methodist Church in Mount Clemens. “That just didn’t make a lot of sense to me.”

Sera Miller, a claims representative for the [Social Security Administration](#), was one of the three jurors who thought at first that Baumer was guilty. She found the medical testimony dense and confusing. “I think we needed 12 doctors on that jury,” she said. After an afternoon of deliberations, she went home and couldn’t sleep. In the morning she decided that the defense had done enough to introduce reasonable doubt. The jury found Baumer not guilty.

When Philipp was 3 months old and ready to leave the hospital, he was put into [foster care](#) with Debi and Phil Zentz, who later adopted him and changed his name to Ben. When the second jury announced that it found Baumer not guilty, the Zentzes were in court. Baumer looked at Debi. “I was hoping for a bridge between the families,” Baumer says. Instead, Debi Zentz gave this statement to the press: “The verdict does not change our belief. Reasonable doubt does not equate to innocence.” When I called her in January, she said, “I have absolutely no doubt that Julie Baumer shook and horribly injured my son.”

The Whitmers also feel certain that Trudy Rueda harmed their son and that she wronged them by putting them through a trial. “We got to a point where we said that if she stands up and admits what she did, we might be able to put this behind us,” Michael Whitmer said. “But now, how do you forgive?”

He and his wife were sitting on a couch in their living room, in the Cape Cod-style house in Alexandria, Va., that Michael renovated by hand. Noah, his blue eyes sometimes focused and sometimes vacant, walked a bit unsteadily on the floor in front of us, picking up books and toys and putting them in his mouth. Noah can see now because a few months after his injury, he slept standing up for weeks to drain the blood from behind his eyes. His seizures have stopped, but only thanks to a strict and labor-intensive ketogenic diet. How *could* the Whitmers forgive, given the medical testimony from doctors they trust? Rueda’s conviction is now on appeal, with a hearing scheduled for mid-February.

As for Audrey Edmunds, she has been out of prison for about three years. Now 49, she is blond and slim, and when I met her at a mall near her home outside Minneapolis, she talked to me about her three daughters. She wore jeans and open-toed sandals and showed me pictures of her children at a Twins game and talked about the delight she takes in taking snacks to her youngest girl’s soccer practice. For a few minutes, her 11 years in prison seemed like a balloon she has let go.

But Edmunds does not live with her children. Her husband divorced her four years into her sentence; she says the separation was just too much for him. He stopped taking the girls to see her every week. When she got out of prison,

she moved in with a friend and took a job at a Kwik Trip convenience store. Better work is hard to come by because of the time Edmunds served in prison. She also wants the early shift so she can see her kids in the afternoons. Sometimes, though, they go on a trip with their father and forget to call. "I was gone for so long," she says.

Edmunds said, however, that she had to come to terms with the drive to prosecute her. As we walked through the mall, she pointed out a Dora the Explorer display she thought young kids would like. Then she turned away from it. "A baby has died," she said simply. "They want to blame somebody."

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