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Reality Bites: The Illusion of Science in Bite-Mark Evidence

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ABSTRACT

More than a decade after Daubert, *years after the amendments to the Federal Rules of Evidence, and long after the courts in* Frye *jurisdictions started examining the empirical basis for expert claims before permitting such testimony in their courtrooms, judges are still evading their gatekeeping duties when it comes to criminal cases. A prime example of this can be found in bite-mark testimony. Although it comes dressed in the illusion of science, having experts with advanced degrees, a fancy name (forensic odontology), professional associations, and professional journals, that illusion belies the reality that bite-mark evidence utterly lacks empirical support for its claims. This Article examines the claims made for bite-mark testimony, and the empirical support for those claims. It discusses the avoidance techniques used by the courts which permit this testimony into evidence despite the experts' inability to provide empirical support. It analyzes the threshold relevance requirement as basic to a rational system of adjudication, the concept of reliability as an inextricable component of this analysis, and why cross-examination, engine of truth though it may be, cannot resolve the problem of bogus expertise. This matters, because the result of admitting such flawed testimony is not only an injustice to the individual; it also undermines the legitimacy of the justice system.*

INTRODUCTION

Accurate fact-finding is supposed to be the key to the structure of adjudication, whether in civil or criminal cases, with the ultimate goal of discovering the truth through a rational process.[1] While trials may be

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[1] Scott Brewer, *Exemplary Reasoning: Semantics, Pragmatics, and the Rational Force of Reasoning by Analogy*, 109 HARV. L. REV. 923, 929 (1996) ("[N]ormative order constituted by

imperfect mechanisms for achieving that goal, admitting bunkum into evidence cannot help. Nonsense masquerading as science has no place in being admitted into evidence to prove an issue disputed at trial. Half-baked theories and expert *ipse dixit* without empirical support have no place in this process. That is the basis for rules about the admissibility of expert evidence, including the *Daubert*[2] decision, its progeny, and the ensuing amendment to the Federal Rules of Evidence.[3] It was also the basis for the *Frye*[4] rule, although there the emphasis was entirely placed on general acceptance by the scientific community as a proxy for validity.[5]

This goal of accuracy applies to both civil and criminal cases, and the same rules governing admissibility of expert testimony apply to both contexts.[6] If anything, accurate fact-finding is even more important in criminal justice, because the legitimacy of the justice system depends on it.[7] In practice, however, despite the common goal of accurate factfinding and the common threshold of relevance and reliability, judicial application of gate-keeping standards in civil and criminal trials could not be more different.[8]

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the legal system, informed by 'rule of law' principles as well as by many others, aspires to be rational in significant ways."). As philosopher and legal scholar Susan Haack explains, "intellectual integrity requires a willingness to seek out evidence, and assess it, honestly." Susan Haack, *The Ideal of Intellectual Integrity, in Life and Literature*, 36 NEW LITERARY HIST. 359, 364 (2005). There are other goals, of course, and sometimes policy considerations trump accuracy (spousal privilege rules, for example, which promote conjugal harmony at the expense of truth). But no one contends that rules should promote false information. Yet that is exactly what is being promulgated with bite-mark evidence.

2 Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579 (1993).

3 FED. R. EVID. 702.

4 Frye v. United States, 293 F. 1013 (D.C. Cir. 1923) (excluding polygraph testimony in a criminal case).

5 For a discussion of the epistemological underpinnings of *Frye* and *Daubert*, and an explanation for the author's preference of *Daubert* over *Frye*, see ERICA BEECHER-MONAS, EVALUATING SCIENTIFIC EVIDENCE: AN INTERDISCIPLINARY FRAMEWORK FOR INTELLECTUAL DUE PROCESS 4-16 (2007). The point that I wish to make here, however, is that the courts are failing to engage in any analysis—neither *Frye* nor *Daubert*—when it comes to expert testimony in criminal cases.

6 An exception to this is Georgia, whose Supreme Court recently ruled that civil rules of evidence require reliability, but criminal rules do not. *See, e.g.*, Mason v. Home Depot U.S.A., Inc., 658 S.E.2d 603, 607 (Ga. 2008) (ruling that the Georgia Tort Reform Act of 2005, which affected the admissibility of expert testimony in tort actions but not criminal cases, violated neither the U.S. nor the Georgia constitutions, holding that "for purposes of evidentiary standards . . . the parties to civil cases are not similarly situated to those engaged in criminal prosecutions"). The effect of this ruling is that in Georgia, expert evidence affecting life and liberty is subjected to a far less stringent standard than that affecting property interests.

7 LARRY LAUDAN, TRUTH, ERROR, AND CRIMINAL LAW: AN ESSAY IN LEGAL EPISTEMOLOGY 2 (2006) ("Public legitimacy, as much as justice, demands accuracy in verdicts.").

8 *See* D. Michael Risinger, *Navigating Expert Reliability: Are Criminal Standards of Certainty Being Left on the Dock?*, 64 ALB. L. REV. 99 (2000) (demonstrating that, in the post-*Daubert* period studied, civil defendants won their reliability challenges to plaintiffs' proffers most of the time, while criminal defendants virtually always lost their challenges to prosecution

In post-*Daubert* civil trials, judges routinely hold hearings to examine the scientific validity of expert testimony proffered in their courts, even in *Frye* jurisdictions.[9] These judges have no compunction about excluding expert testimony that they deem shaky.[10] But, in contrast to the routine and extensive challenges to expert testimony in civil cases, especially in toxic torts, the validity of expert testimony is rarely challenged in criminal cases.[11] Moreover, when criminal defendants do challenge the scientific basis of the evidence against them, they nearly always lose.[12] The reasons for this disparity are puzzling. Factual accuracy can hardly be less important in criminal trials. The purpose of criminal proceedings is to correctly identify the perpetrator of the crime so that the perpetrator can be punished.[13] Yet, while ostensibly using the same standards to evaluate scientific evidence (*Daubert* or *Frye*, depending on the jurisdiction), judges in criminal cases overwhelmingly circumvent their gatekeeping responsibilities. A prime example of this phenomenon can be found in bite-mark testimony.

The science behind bite-mark testimony is murky at best. The underlying theory, that a mark found on a dead victim can be traced to the dentition of the perpetrator, is dubious. The uniqueness of human dentition is questionable, and there is little empirical support for such a proposition. Moreover, unlike dental casts of all the teeth, skin injuries to dead victims tend to be fragmentary and diffuse. The bite-marks consist at most of the anterior teeth, and usually not all of those teeth.[14]

evidence; and when plaintiffs challenged civil defendants' expert evidence, the defendants usually won, but when criminal defendants challenged prosecution evidence, they seldom won).

[9] *See, e.g.*, Haggerty v. Upjohn Co., 950 F. Supp. 1160, 1165 (S.D. Fla. 1996) (excluding testimony based on case reports because "they are no substitute for a scientifically designed and conducted inquiry"), *aff'd* 158 F.3d 588 (11th Cir. 1998); Shepard v. Barnard, 949 So. 2d 232 (Fla. Dist. Ct. App. 2007) (while ostensibly applying *Frye* to exclude plaintiff's causation testimony, the court examined the scientific basis of the expert opinion); Bouley v. Windschilt, No. A06-2145, 2008 WL 73297 (Minn. Ct. App. Jan. 8, 2008) (upholding exclusion of expert testimony as unreliable); Coratti v. Wella Corp., 831 N.Y.S.2d 358 (2006) (examining basis of expert causation opinion and finding case reports scientifically unreliable).

[10] *See, e.g.*, *In re* Vioxx Prods. Liab. Litig., MDL No. 1657, 05-4046, 2005 WL 3541045 (E.D. La. Dec. 6, 2005) (refusing to allow expert cardiologist to testify about any connection between vioxx and the decedent's heart attack on defendant's objection); *In re* Vioxx Prods. Liab. Litig., 401 F. Supp. 2d 565, 593 (E.D. La. 2005) (limiting plaintiff's expert cardiologist to testifying about the decedent's heart condition after an extensive *Daubert* hearing).

[11] Interestingly, in both *Daubert* and *Frye* jurisdictions, the exception to this is DNA testimony, where courts appear to routinely examine validity. *See* Brim v. State, 695 So. 2d 268 (Fla. 1997) (scrutinizing each step of DNA evidence for its scientific validity under *Frye*).

[12] *See* Risinger, *supra* note 8, at 99 ("[C]ivil defendants win their *Daubert* reliability challenges to plaintiffs' proffers most of the time, and . . . criminal defendants virtually always lose their reliability challenges to government proffers.").

[13] *See* PAUL ROBERTS & ADRIAN ZUCKERMAN, CRIMINAL EVIDENCE 101 (2004) (discussing legal relevance and the importance of accuracy in criminal adjudication).

[14] *See* C. Michael Bowers, *The Scientific Status of Bitemark Comparisons*, *in* SCIENCE IN THE LAW: FORENSIC SCIENCE ISSUES 246 (David L. Faigman et al. eds., 2002) (noting the "fragile

No population databases establish the frequency of bite-mark patterns. Nor is there any system of blind, external proficiency testing using realistic models. Error rates are unknown. The few tests that have been attempted demonstrate a disturbingly high level of false positives.[15]

Remarkably, most of this questionable testimony is admitted without challenge.[16] Perhaps this is because, despite the dubious science behind bite-mark expertise, it is a field replete with the trappings, if not the substance, of science. The testifying experts have advanced degrees, and often board certification. They have two professional associations, with impressive names. They publish in their own professional journals. They use the statistical product rule[17] to come up with remote-sounding probability statements. But those trappings do not make it science.

Nevertheless, these trappings of science seem to be persuasive to lawyers, judges and juries. In the few post-*Daubert* challenges to bite-mark evidence, courts focused on the credentials of the experts and avoided the question of scientific foundations, predominantly by citing to legal precedent. Courts frequently admit bite-mark testimony simply because other courts have done so.[18] They find that it is "not novel"[19]

foundation of minimally relevant empirical research" on which bite-mark testimony is based).

15 *See* C. Michael Bowers, *Problem-Based Analysis of Bitemark Misidentifications: The Role of DNA*, 159S FORENSIC SCI. INT'L S104, S107 (2006) (noting that bite-mark proficiency testing "shows a disturbingly high false-positive error rate").

16 Keith A. Findlay, *Innocents at Risk: Adversary Imbalance, Forensic Science, and the Search for Trust*, 38 SETON HALL L. REV. 893, 931 (2008) ("[T]he defense bar as a whole is generally unprepared to utilize or challenge scientific evidence adequately."). The failure of defense counsel to object to bite-mark evidence is astounding, considering the shaky basis of such testimony.

17 The statistical product rule is frequently used in DNA testimony and is defined by Hans Zeisel and David Kaye as follows:

> When alleles occur independently at each locus . . . and across loci . . . the proportion of the population with a given genotype is the product of the proportion of each allele at each locus, times factors of two for heterozygous loci.

HANS ZEISEL & DAVID KAYE, PROVE IT WITH FIGURES: EMPIRICAL METHODS IN LAW AND LITIGATION 322 (1997). Note the requirement that the variables (alleles in this instance) be independent. This is something that forensic odontologists have never been able to establish.

18 *See, e.g.*, People v. Wright, No. 179564, 1999 WL 33446496 (Mich. Ct. App. Apr. 23, 1999) (remanding for reconsideration of whether it was an error to admit testimony of forensic odontologist in rape-murder in which bite marks were all that linked defendant to crime scene). The appellate court concluded that any error was harmless in light of bite-mark testimony being admissible in 35 states.

19 *See, e.g.*, Verdict v. State, 868 S.W.2d 443, 447 (Ark. 1993) (no error in admitting bite-mark testimony of Dr. West because "evidence on human bite marks is widely accepted by the courts"); Carter v. State, 766 N.E.2d 377, 280 (Ind. 2002) (admitting bite-mark testimony because "defendant does not argue that it has become less reliable" than it was in 1977 when Indiana first admitted bite-mark testimony); State v. Timmendequas, 737 A.2d 55, 114 (N.J. 1999) (finding bite-mark testimony in a capital case reliable because "thirty states considering such evidence have found it admissible"); State v. Blamer, No. 00CA07, 2001 WL 109130 (Ohio Ct. App. Feb. 6, 2001) (holding, without analysis, that the challenged testimony was admissible); Seivewright v. State, 7 P.3d 24, 30 (Wyo. 2000) (holding it was no abuse of discretion for trial court to refuse to

or they let in this shaky testimony precisely because it is "not science."[20] One court, holding bite-mark testimony admissible, remarked that expert testimony is "often speculative" and left it at that.[21] This is a far cry from the exacting standards that the civil courts demand of expert evidence.

Nor can the federal courts be counted on to mop up the mistakes of the state courts in habeas relief by finding trials fundamentally unfair or by finding ineffective assistance when defense counsel fails to retain its own experts or challenge the prosecution's. The federal courts are no more willing than the state courts to engage in any analysis of the scientific grounds for bite-mark testimony.[22]

This is not because the evidence has been overwhelmingly correct and has therefore withstood the test of time (as is often argued in fingerprint cases[23]). A number of capital DNA exoneration cases have involved bite-mark testimony. In *State v. Krone*,[24] for example, a capital conviction involving expert testimony that the defendant was the source of a bite-mark found on the victim's body, the defendant was later exonerated through DNA analysis.[25] The cases of Roy Brown,[26] and Willie Jackson[27] also involved bite-mark testimony and post-conviction DNA exonerations.[28] Subsequent DNA tests also starred in the release of Dan Young, Jr., after twelve years in jail following a trial for rape and murder in which a forensic dentist had testified that his bite matched the marks on the victim's body.[29] In *Brewer*, a DNA

hold a *Daubert* hearing, "[g]iven the wide acceptance of bite mark identification testimony and [defendant's] failure to present evidence challenging the methodology").

20 *See, e.g.*, *Carter*, 766 N.E.2d at 377 (admitting bite-mark testimony because it was not science).

21 State v. Cazes, 875 S.W.2d 253 (Tenn. 1994).

22 In a typical example, *Kunco v. Att'y Gen. of Pa.*, 85 Fed. App'x 819 (3d Cir. 2003), where the petitioner claimed that admitting bite-mark testimony employing an ultraviolet light technique that even other odontologists had castigated as unreliable, unethical, and incredible, the court held that this was not enough to show the necessary violation of due process.

23 *See, e.g.*, United States v. Joseph, No. CR. A. 99-238, 2001 WL 515213 (E.D. La. May 14, 2001) (admitting fingerprint evidence because it had "proven to be a reliable science over decades of use"). As Simon Cole points out, however, the "test of time" is not an appropriate validation mechanism for fingerprints either. *See* Simon A. Cole, *"Implicit Testing": Can Casework Validate Forensic Techniques?*, 46 JURIMETRICS J. 117, 125 n.43, 124-26 (2006) (discussing the fallacy of relying on the adversarial process to exposes latent fingerprint misattributions).

24 182 Ariz. 319 (1995).

25 Michael J. Saks & Jonathan J. Koehler, *The Coming Paradigm Shift in Forensic Identification Science*, 309 SCI. 892, 893, 893 fig.2 (2005) (showing the bite-mark evidence exhibit from *Krone*).

26 People v. Brown, 618 N.Y.S.2d 188 (N.Y. County Ct. 1994), *aff'd*, 600 N.Y.S.2d 593 (N.Y. App. Div. 1993).

27 Jackson v. Day, 121 F.3d 705 (5th Cir. 1997).

28 The stories behind these cases are presented more fully in Craig M. Cooley & Gabriel S. Oberfield, *Increasing Forensic Evidence's Reliability and Minimizing Wrongful Convictions: Applying Daubert Isn't the Only Problem*, 43 TULSA L. REV. 285, 358-59 (2007).

29 Steve Mills & Jeff Coen, *12 Years Behind Bars, Now Justice at Last*, CHI. TRIB., Feb. 1,

exoneration case involving bite-mark testimony, the court ordered a new trial, but refused to vacate the defendant's capital conviction.[30] In yet another case involving charges that were ultimately dropped, the expert had testified that the only person who could have made the bite found on the victim was the defendant; that same defendant was subsequently exonerated by DNA analysis.[31]

This Article argues that admitting expert evidence that has never been able to demonstrate its validity (and is thus irrelevant) into criminal cases tears a gaping hole in the fabric of a justice system that values accuracy in adjudication. In Part II, this Article examines the science behind forensic expert bite-mark identification testimony. It examines the espoused theory of forensic odontologists, the assumptions made and the data supporting the theory, and the methodology, to conclude that the evidence is simply not supported. Despite the apparent existence of many of the *Daubert* factors, a closer examination reveals that there is no substance to the claims that forensic odontology is a science. Part III examines how post-*Daubert* courts have addressed the admissibility question and finds that despite the myriad weaknesses of the evidence, it is rarely challenged, and when it is challenged it is nearly always found to be admissible, and admissibility is almost always upheld on appeal. This is not because the courts are actually examining whether the evidence could meet *Daubert* or *Frye.* Instead, once the expert is qualified, courts tend to simply cite to precedent, or declare that the evidence is not science, so it does not have to meet *Daubert* or *Frye*.[32] At most, and infrequently, the courts glance at the *Daubert* factors, and check them off their list. Part IV asserts that relying on the trappings of science rather than examining the basis for the expert's assertions is a dereliction of judicial gate-keeping duties, whatever standard of admissibility the court uses. It discusses the flaws underlying the notion that cross-examination and the presentation of contrary evidence will solve the problem. This article

2005, at 1.

[30] Brewer v. State, 819 So. 2d 1169 (Miss. 2002). In 2007, Brewer was finally released on bail pending retrial. Not until 2008 was Brewer exonerated, following the databank identification and subsequent confession of another inmate. For further details of this saga, see Cooley & Oberfield, *supra* note 28, at 358-59.

[31] Otero v. Warwick, 614 N.W.2d 177, 178 (Mich. Ct. App. 2000) (negligence action against testifying prosecution expert); *see also* Cooley & Oberfield, *supra* note 28, at 300-01 (discussing the cases of Edmund Burke and Dale Morris, both involving bite-mark identifications of suspects against whom the charges ultimately had to be dropped because of conflicting DNA evidence).

[32] This loophole should have been closed by the Supreme Court's decision in *Kumho Tire*, but many courts persist in admitting expert testimony that cannot demonstrate its empirical validity as "nonscience." *See* D. Michael Risinger, *Goodbye to All That, or a Fool's Errand, By One of the Fools: How I Stopped Worrying About Court Responses to Handwriting Identification (And "Forensic Science" in General) and Learned to Love Misinterpretations of* Kumho Tire v. Carmichael, 43 TULSA L. REV. 447, 460 (2008) (discussing the courts' evasion of their gatekeeping duties in the context of handwriting analyses).

concludes that gate-keeping matters and offers some suggestions for implementing more rigorous gate-keeping in the criminal context. It acknowledges that in order for the adversary system to work in criminal cases, defense lawyers must challenge questionable expertise, like bite-mark evidence. But when they do, judges must do more than superficially examine credentials and cite to precedent before deciding on admissibility. Expert evidence that has no empirical basis has no relevance to any issue before the court. It cannot possibly help the jury to decide any disputed issue of fact.

I. DOES BITE-MARK TESTIMONY PASS *DAUBERT* (OR *FRYE*) MUSTER?

Interpreting Rule 702 of the Federal Rules of Evidence, which permits experts to testify "[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue,"[33] the Supreme Court in *Daubert* explained that the rule "clearly contemplates some degree of regulation of the subjects and theories about which an expert may testify" and placed judges squarely in the gate-keeping role.[34] In response to *Daubert* and its progeny,[35] Rule 702 was amended to require that expert testimony be based upon "sufficient facts or data," be the "product of reliable principles and methods," and that those principles and methods be reliably applied to the facts of the case.[36] Although not defined by the rule, reliability, in a case involving scientific evidence, "will be based upon scientific validity."[37] To guide this inquiry, the *Daubert* Court outlined four non-definitive factors (explicitly not to be used as a checklist): whether the theory can be and has been tested; its error rate; whether it has been subjected to peer review and publication; and whether it has met with general acceptance in the scientific community.[38]

A superficial application of these factors might give a judge the impression that bite-mark testimony meets these standards. It has after all, a theory that perhaps might be testable: that bite-marks are uniquely

33 FED. R. EVID. 702.

34 Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 589 (1993).

35 FED. R. EVID. 702 advisory committee's note (noting that it applies to all expert testimony).

36 FED. R. EVID. 702.

37 *Daubert*, 509 U.S. at 590.

38 *Id.* at 593. The Court did far more than simply list factors; it explained why they were important and discussed their limitations in an attempt to get gatekeepers to actually think about the expertise they were letting in or keeping out. For an article remarking upon the distressing habit of post-*Daubert* trial courts to use these factors as a "mechanical checklist, woodenly applied," see Risinger, *supra* note 32, at 460.

identifying. The testifying experts claim that there are studies to support this theory. These studies are published in peer-reviewed publications put out by their professional associations. The experts also claim a vanishingly small error rate (although they rarely explain what the error rate refers to). Bite-mark identification testimony is generally accepted by forensic odontologists. But any examination beneath the surface of these factors demonstrates the utter lack of science behind bite-mark testimony.

Not all the states have adopted the amended Rule 702. Some states prefer the general acceptance standard first enunciated by *Frye*.[39] But under either standard for scrutinizing expert testimony, the judge has the primary duty to decide whether the evidence is relevant.[40] And evidence that is based on nothing more than the illusion of science and the *ipse dixit* of the expert cannot have any tendency to make a fact of consequence more or less probable than it would be without the evidence.[41]

Simply put, bite-mark testimony cannot meet this standard. It has no empirical support. None of the trappings of science, the scientific sounding titles, group "certification" and publication in journals put out and reviewed by other members of the group, can serve to make bite-mark evidence helpful in deciding the perpetrator's identity unless the theory and assumptions on which the identification is based, the data supporting the theory, and the methodology used are sound.[42] Bite-mark testimony fails on each of these fronts: the theory is based on unsupportable assumptions, the data is absent and what we do have demonstrates the invalidity of the theory, and the methodology lacks professional guidelines or standards, and is entirely subjective. Absent empirical support, the testimony can have no tendency to make a disputed issue of identity more or less probable.

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[39] Frye v. United States, 293 F. 1013 (D.C. Cir. 1923) (excluding polygraph testimony in a criminal case). Notably, the operative question in *Frye* is whether the testimony at issue has achieved general acceptance in the scientific community. This standard is frequently misapplied in bite-mark evidence, where courts seem to believe that what counts is general acceptance by the courts. *See, e.g.*, State v. Swinton, 847 A.2d 921 (Conn. 2004) (citing other cases in upholding admissibility of bite-mark evidence); State v. Blamer, No. 00CA07, 2001 WL 109130 (Ohio Ct. App. Feb. 6, 2001) (holding that bite-mark evidence was admissible).

[40] As the *Daubert* Court explained, the requirement that expert testimony assist the trier of fact "goes primarily to relevance." *Daubert*, 509 U.S. at 591.

[41] *See* Gen. Elec. Co. v. Joiner, 522 U.S. 136, 146 (1997) ("[N]othing 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.").

[42] *Daubert*, 509 U.S. at 590 (requiring expert scientific testimony to be grounded in scientific method).

A. *What are These "Trappings of Science"?*

Qualifying a witness as an expert is generally the first step in determing whether expert testimony is admissible. In the majority of bite-mark cases, it tends to be the only step courts engage in, and the courts usually find these experts qualified in their field.[43] Most of the experts testifying about bite-mark identification (whether for the prosecution or defense) in criminal cases are dentists. In addition, most testifying experts are members of the American Board of Forensic Odontology ("ABFO"). Another professional association that many bite-mark experts belong to is the American Society for Forensic Odontology. These organizations have publications, and the articles published in them are peer-reviewed. Some of the articles published attempt to perform studies of various kinds that are later cited by experts in testimony.

So why is that not enough? First, the theory that bite-marks are unique has never been adequately tested—and may be untestable—so rather than even attempting to support it with data, testifying experts simply assert that it is so. Second, the few studies that have been attempted are so riddled with flaws that they cannot support the claims that their authors make, and would never be accepted into a mainstream scientific journal. This is at least partly attributable to the fact that there is no formal academic post-graduate training in the U.S. in forensic odontology. There is little funding for odontology research.[44]

Third, the methodology employed by forensic odontologists in making bite-mark identifications is entirely subjective. There are no objective standards by which to determine the minimal criteria for declaring a "match." ABFO attempted in 1984 to issue Guidelines to develop a scoring protocol that was supposed to achieve a reliable and objective method of quantifying similarities and differences between the marks and the questioned dentition.[45] This was supposed to be a more scientific approach,[46] but the authors soon retracted and advised "all

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[43] Even when serious questions about the experts' credentials have arisen, such as in the case of Michael West, who was expelled from one professional association and asked to resign from another, and had been the subject of a critical expose on CNN, courts managed to find him qualified. *See* Howard v. State, 945 So. 2d 326, 352 (Miss. 2006) (holding that there was no error in admitting Dr. West's testimony since the court had previously admitted his testimony and remarking that "[j]ust because Dr. West has been wrong a lot does not mean, without something more, that he was wrong here").

[44] *See* Iain A. Pretty, *The Barriers to Achieving an Evidence Base for Bitemark Analysis*, 159S FORENSIC SCI. INT'L S110, S119 (2006) (noting the absence of post-graduate programs in forensic odontology and the dearth of research funding).

[45] Am Bd. of Forensic Odontology, Inc., *Guidelines for Bite Mark Analysis*, 112 J. AM. DENTAL ASS'N 383 (1986).

[46] *See* Raymond D. Rawson et al., *Reliability of the Scoring System of the American Board of*

odontologists [to] await the results of further research" rather than rely on the Guidelines.[47] The world is still waiting.

B. *What is the Theory Underlying Bite-Mark Testimony?*

Bite-mark testimony is primarily offered by the prosecution as identification testimony. Occasionally, it is also offered to demonstrate the heinousness of the crime. While the latter use may be problematic with respect to whether the marks are actually bite-marks rather than bruises or abrasions, it is the first use, as identification evidence, that is the most troubling.

Prosecutors presumably have turned to bite-mark testimony because they were not able to obtain the far more scientific DNA evidence from the crime scene, or because the DNA evidence was degraded, contaminated in some way, or (for some other reason) the test results were equivocal. Typically, the prosecution expert purports to be able to identify the biter from the bruises left on the corpse of a victim (or, occasionally, from food left at the crime scene).[48] The theory behind the testimony is that each person has a unique bite-mark, and that the biter can be identified from the marks left on the skin of a dead victim.[49] This theory of uniqueness has grave underlying statistical and logical flaws, which have never been addressed by bite-mark experts.[50] Further, even if tooth morphology is a result of random processes (such as growth, disease, environmental insults, diet, etc.) rather than being genetically determined, coincidental matches between people may still be possible—a question that a database would be necessary to address.[51]

Forensic Odontology for Human Bite Marks, 31 J. FORENSIC SCI. 1235, 1259 (1986) (praising the guidelines as "a truly scientific approach").

[47] Gerald L. Vale et al., Letter, *Discussion of "Reliability of the Scoring System of the American Board of Forensic Odontology for Human Bite Marks,"* 33 J. FORENSIC SCI. 20 (1988).

[48] *See, e.g.*, State v. Ortiz, 502 A.2d 400 (Conn. 1985) (finding admissible forensic odontologist's testimony that defendant made the bites in apple found at crime scene); Banks v. State, 725 So. 2d 711, 716 (Miss. 1997) (expert witness matched the bite marks on a bologna sandwich left at the crime scene to the capital defendant's dentition); Doyle v. State, 263 S.W.2d 779 (Tex. Crim. App. 1954) (allowing identification of burglary suspect from bite-mark left in cheese at the crime scene); Seivewright v. State, 7 P.3d 24, 26 (Wyo. 2000) (comparing suspect's dentition with marks left on cheese at crime scene).

[49] *See, e.g.*, State v. Sager, 600 S.W.2d 541, 561 (Mo. Ct. App. 1980) (substantiating the admissibility of bite-mark identification testimony through the use of forensic odontology to identify unknown victims through dental records).

[50] For an explanation of the uniqueness fallacy, see Michael J. Saks & Jonathan J. Koehler, *The Individualization Fallacy in Forensic Science Evidence*, 61 VAND. L. REV. 199, 204-05 (2008) (explaining why it is a fallacy to assert that even snowflakes are unique simply because of the number of ways that water molecules can be arranged, and discussing the "faulty logic that equates infrequency with uniqueness").

[51] *See* David L. Faigman, *Identification from Bitemarks*, *in* SCIENCE IN THE LAW: FORENSIC SCIENCE ISSUES 256, 257 (David L. Faigman et al. eds., 2002) (discussing the study of identical

When asked about the foundation of bite-mark evidence, experts generally cite to the ability of forensic odontologists to identify victims of disaster or homicide.[52] With this kind of identification, an unknown victim is examined, and the dental records of a known person are compared to the dentition of the victim. A dentist armed with a full set of dental records can probably identify a corpse with a fair degree of certainty (although just how much certainty has never been studied, and is therefore still unknown). Using this technique, the dentist examines the (nominally) thirty-two teeth, with five surfaces each, making 160 possible surfaces which can each contain specific characteristics, and any fillings, decay, lost teeth, and mis-positioning. In addition, the forensic odontologist examines number, shape, type and placement of dental restorations, root morphology, bone patterns, and sinus morphology. Because each of these factors provides some individual characteristics, there is little controversy about the ability of a dentist to put them together to identify a dead person from a complete set of dental records, especially if there are anomalies in the teeth.[53]

Thirty-two teeth are not used in bite-mark comparisons, however, since at most, four to eight teeth are visible in bite-marks.[54] Unlike the identification of catastrophe victims from a full set of dental records, bite-mark identification consists of "matching" a mark on the victim with the anterior teeth of a suspect. Bite-mark experts only look at marks that are essentially bruises on a victim, and compare them with a model (or tracing of a model) of the suspect's teeth.[55] So although the use of dental records in identifying catastrophe victims is often cited in validation, bite-mark comparison bears little resemblance to identifying an unknown victim using a complete set of dental records.

The underlying theory for bite-mark comparisons thus depends on three assertions: first, that "the dental characteristics of anterior teeth involved in biting are unique among individuals;"[56] second, that this "asserted uniqueness is transferred and recorded in the injury;"[57] third, that human skin can maintain the accuracy of the marks over time, after

twins).

[52] *See, e.g.*, People v. Mattox, 237 N.E.2d 845, 846 (Ill. App. Ct. 1968) (identifying homicide victim from dental records).

[53] *See* Paul C. Giannelli, *Bite Mark Analysis*, 43 CRIM. L. BULL. 5, 5 (2007) (discussing the difference between use of forensic odontology to identify the deceased and its use to identify suspects in homicide cases).

[54] *See* Iain A. Pretty & David J. Sweet, *The Scientific Basis for Human Bitemark Analyses—A Critical Review*, 41 SCI. & JUST. 85, 89 (2001).

[55] *See* Iain A. Pretty, *Unresolved Issues in Bitemark Analysis*, *in* BITEMARK EVIDENCE 554, 557 (Robert B.J. Dorian ed., 2005) (discussing methods of comparison and the difference between dental identification and bite-mark comparison).

[56] *Id.* at 557.

[57] *Id.*

the death of the victim.[58]

All three are highly questionable assertions.[59] There is a great deal of controversy about the ability of forensic odontologists to identify marks left on a victim's body as bite-marks at all.[60] In one of the first bite-mark cases, *People v. Marx*,[61] the court concluded that "there is no established science of identifying persons from bite marks as distinguished from, say, dental records and X-rays."[62] There is no evidence that things have changed in this regard.

C. *What Data Support the Theory That Bite-Marks are Identifying?*

Testifying experts surmount the problems underlying the theory of uniqueness by simply assuming that the theory is valid. Rather than offering data to support the theory of uniqueness, testifying experts simply state that bite-marks are unique. Few empirical studies have even attempted to demonstrate the asserted uniqueness of bite-marks, and those few have critical flaws.[63] One study attempting to compare bites of identical twins, and concluding that each was unique, was flawed by being extremely small (five sets of twins), and failing to set

[58] *Id.* at 549-50 (discussing as "unresolved issues" the "highly viscoelastic" properties of human skin and citing studies demonstrating that "changes in bitemark appearance are likely to be greater as the injury grows older" in both living and dead victims).

[59] *See, e.g.*, Bowers, *supra* note 15, at S106 (2006) (castigating the linkage between injuries and a specific person as not being arrived at with scientific rigor and noting that the "dental literature . . . is surprisingly thin and sorely lacking in rigorous scientific testing"); Duane T. DeVore, *Bite Marks for Identification?—A Preliminary Report*, 11 MED. SCI. & L. 144 (1971) (questioning the accuracy of skin as a substrate for bite-mark impressions and the lack of a population database); Iain A. Pretty & Malcolm D. Turnbull, *Lack of Dental Uniqueness Between Two Bite Mark Suspects*, 46 J. FORENSIC SCI. 1487, 1487 (2001) (challenging the "central dogma" that human teeth are unique and that sufficient detail is rendered during biting to enable identification of the biter).

[60] *See, e.g.*, Ege v. Yukins, 380 F. Supp. 2d 852, 878 (E.D. Mich. 2005) (defense expert contended marks were the result of livor mortis rather than bite-marks), *aff'd in part, rev'd in part*, 485 F.3d 364, 366 (6th Cir. 2007) (holding that trial court's admission of expert's probability statement substantially prejudiced trial and that defense counsel's failure to object constituted ineffective assistance); Kinney v. State, 868 S.W.2d 463, 464-65 (Ark. 1994) (battling experts disagreed about whether the marks were bite marks at all); State v. Duncan, 802 So. 2d 533, 553 (La. 2001) (battling experts disagreed over whether marks were bites); Stubbs v. State, 845 So. 2d 656, 668 (Miss. 2003) (same); Brewer v. State, 725 So. 2d 106, 116 (Miss. 1998) (same).

[61] 126 Cal. Rptr. 350 (1975).

[62] *Id.* at 353. Remarkably enough, despite this concession, the testimony was admitted. But in that case, the defendant had distinctive irregularities in his teeth, and the mark was in skin overlying cartilage on the victim's nose, which resulted in one of the most distinct and deepest bite marks on record in human skin. *Id.* at 354 (explaining that most bite marks are on softer tissue and not very deep). These conditions are rarely met, and yet courts routinely continue to admit bite-mark testimony, often citing *Marx* as precedent.

[63] *See* Giannelli, *supra* note 53, at 4.

out a detailed methodology.[64] Because much of the variation observed could have been caused by the technique used to produce the comparisons, its results are suspect.[65] Moreover, whether the differences the study found in the twins' dentition would be observed in a bite-mark was not addressed.

Similarly flawed was a 1984 study attempting to apply a statistical probability theory to 397 bites chosen for their clarity, but without randomization.[66] Again, details of methodology were omitted, and techniques were combined.[67] Even worse, the study's conclusions were based on the flawed premise that the position of each tooth was independent of the position of the others, an assumption that has been shown to be incorrect.[68]

As noted above, armed with a full set of dental records (that is, records of all thirty-two teeth, present or absent, filled or broken) and a corpse, forensic odontologists have been able to identify catastrophic victims (usually from a finite list) with some degree of success. Whether the biting teeth are unique from person to person is the subject of a single study of fifty young adults.[69] First, the design is flawed: it is far to small to establish what it purports to establish. Moreover, the study examined only the question of whether "the occlusal surfaces of the upper and lower anterior teeth are specific to each individual" rather than the more salient question of "the probability of finding a sufficiently similar set of occlusal surfaces in a target population" which the authors acknowledge would require the development of a statistical database.[70] Nor did the study suggest that the features of the anterior teeth would be transferred to a bitten surface.[71] Or that the transfer would remain accurate over time.

But even if there were support for the theory that each person's mouthful of teeth is unique, that does not address the question of how unique are the marks made by those teeth.[72] And of that question, no

64 Reidar F. Sognnaes, Raymond D. Rawson et al., *Computer Comparison of Bitemark Patterns in Identical Twins*, 105 J. AM. DENTAL ASS'N 449 (1982).

65 *See* Iain A. Pretty, *The Barriers to Achieving an Evidence Base for Bitemark Analysis*, 159S FORENSIC SCI. INT'L S110 (2006) (noting flaws in twin study).

66 Raymond D. Rawson et al., *Statistical Evidence for the Individuality of the Human Dentition*, 29 J. FORENSIC SCI. 245 (1984).

67 *See* Pretty, *supra* note 44, at S115-16 (noting flaws in Rawson study).

68 *See id.*

69 Jules A. Kieser et al., *The Uniqueness of the Human Anterior Dentition: A Geometric Morphometric Analysis*, 52 J. FORENSIC SCI. 671 (2007). Earlier studies attempting to demonstrate uniqueness had been fatally flawed. One study failed to consider the registration of the features examined on human skin, and additionally concluded that it had not confirmed the uniqueness of the anterior teeth. T.W. MacFarlane et al., *Statistical Problems in Dental Identification*, 14 J. FORENSIC SCI. SOC. 247-52 (1974).

70 Kieser, *supra* note 69, at 675.

71 *Id.*

72 *See, e.g.*, DAVID J. BALDING, WEIGHT-OF-EVIDENCE FOR FORENSIC DNA PROFILES 54

systematic study has been made. There is, however, anecdotal evidence that demonstrates just the opposite.[73]

Although some bite-mark experts in criminal cases purport to quantify the chance of a coincidental match, they are doing so without an underlying database, which makes their numbers meaningless.[74] The problem with using the product rule to determine the likelihood of coincidental match in bite-mark cases is that, unlike DNA testing, there is no supporting database. Nor (again, unlike DNA evidence) is there any evidence that the factors being measured in bite-marks are independent, which is another requirement in using the product rule to determine the likelihood of coincidental matches.[75]

Even if bite-marks were not unique, they might be useful in identification, as long as the frequency of a particular bite-mark were known. For example, before the advent of DNA typing, blood groups were used as a fairly imprecise method of identification.[76] If blood found at the crime scene was not the same blood group as that of the defendant, it would make it less likely that the defendant was there. On the other hand, if the blood at the crime scene "matched" the type of the defendant, it did not mean very much, because it could also "match" many other people.[77] But by making the unsupported assumption that

(2005) (explaining that with respect to fingerprints, although "the suggestion that recorded fingerprints are unique has never been rigorously checked," the question before the court is whether the imperfect impression taken from a crime scene is "enough to establish the defendant and nobody else could have left it"). To answer that question one would need to know the frequency of those particular marks in the relevant population.

[73] *See, e.g.*, C. Michael Bowers, *supra* note 14 (demonstrating that two different people "matched" the same set of bite-marks); Bruce R. Rothwell, *Bite Marks in Forensic Dentistry: A Review of Legal, Scientific Issues*, 126 J. AM. DENTAL ASS'N 223, 230 (1995) (recounting the saga of the 1976 Milone murder trial, in which one defendant was convicted on the basis of bite-mark testimony, someone else later confessed, and his teeth also "matched" the marks).

[74] A similar problem in microscopic hair analysis caused the F.B.I. to reject it. *See* ERICA BEECHER-MONAS, *supra* note 5, at 115 (discussing the F.B.I.'s acknowledgment that microscopic hair analysis cannot be used as the basis for personal identification). In microscopic hair analysis testimony, experts often couch their conclusions in the form of a statistical likelihood so high that it suggests a very low probability of error. For example, if the hairs match eight characteristics out of twenty-six, there is a 1-in-4500 chance that the same characteristics would be found to match if the hairs came from different individuals. These are called Gaudette statistics. Although this may sound impressive, even the progenitor of this method acknowledges its subjectivity. *See id.* The real question is, assuming a match, what is the probability that the unknown and known hairs came from the same person? This question cannot be answered without knowing the size of the population from which the defendant came, something the Gaudette statistics cannot answer. The next most useful question is the probability of misinformation: Given a match, what is the probability that the crime scene hair came from someone other than the defendant? The Gaudette statistics do not answer that question either.

[75] See *id.*

[76] *See, e.g.*, WILSON J. WALL, GENETICS & DNA TECHNOLOGY: LEGAL ASPECTS 29-41 (2d ed. 2004) (discussing blood group identification and contrasting it with DNA profiling).

[77] *See, e.g.*, Cherry v. State, 959 So. 2d 702 (Fla. 2007) (finding that testimony that blood found at the crime scene matched the defendant's blood group typing, which was found in approximately 1.9% of the population). Notably, however, many of the DNA exonerations

bite-marks are unique, forensic odontologists give a specious illusion of accuracy.

D. *What Data Support the Theory that Human Skin Registers Bites?*

The second postulate upon which the theory of bite-mark identification rests is that human skin can accurately register bites. Two studies have attempted to demonstrate the validity of matching marks made on pigskin (which is said to be similar to human skin) to human dentition. In the first of these studies, the percentage of incorrect identifications ranged from 24% under ideal laboratory conditions immediately after biting, to 91% incorrect identifications after 24 hours.[78] In a later study, matching dental casts to marks in pig skin, incorrect identifications ranged from 12% to 22%.[79] With such a high error rate, the studies cannot purport to be measuring anything reliably.[80]

Further complicating this issue is the tendency of living human skin to distort marks made upon it. The third postulate of bite-mark identification theory requires that marks made upon the (presumably living) victim remain unchanged over time (and after death). On its face, this assertion seems dubious. Bite-marks are essentially bruising, blood tends to pool in various parts of the corpse (livor mortis), and human skin is highly malleable.[81] Skin responds to trauma differently in

involved faulty serology testimony. *See* Brandon L. Garrett, *Judging Innocence*, 108 COLUM. L. REV. 55, 82 (2008) (discussing the high percentage of faulty serology testimony involved in DNA exoneration cases).

78 David A. Whittaker, *Some Laboratory Studies on the Accuracy of Bite Mark Comparison*, 25 INT'L DENTAL J. 166 (1975) ("[T]he inability of examiners to correctly identify bitemarks in skin . . . under ideal laboratory conditions and when examined immediately after biting suggests that under sometimes adverse conditions found in an actual forensic investigation it is unlikely that a greater degree of accuracy will be achieved.").

79 Iain A. Pretty & David Sweet, *Digital Bite Mark Overlays—An Analysis of Effectiveness*, 46 J. FORENSIC SCI. 1385, 1390 (2001) (concluding that this "[p]oor performance" has "very serious implications for the accused, the discipline, and society").

80 Contrast these results with the requirements for statistical significance levels of p=0.05, or confidence intervals of 95%, without which judges routinely exclude expert testimony in toxic torts. *See, e.g.*, Knight v. Kirby Inland Marine, Inc., 482 F.3d 347 (5th Cir. 2007) (affirming exclusion of plaintiffs' expert testimony in toxic tort action for failure to meet statistical significance levels); Vanderwerf v. SmithKlineBeecham Corp., 529 F. Supp. 2d 1298 (D. Kan. 2008) (excluding plaintiff's testimony of link between paxil and suicidal ideation). These concepts of statistical significance are important in scientific studies because they reflect the scientific preference for false negatives over false positives, and therefore express the results of hypothesis testing as the chance of obtaining the observed data if the null hypothesis was correct. For an explanation of statistical significance, confidence intervals, and relative risk, see BEECHER-MONAS, *supra* note 5, at 60-62.

81 *See, e.g.*, Ege v. Yukins, 380 F. Supp. 2d 852, 878 (E.D. Mich. 2005) (defense experts testified that the marks on victim were livor mortis rather than a bite-mark).

different people, and at different times.[82] It is also highly elastic, so that it stretches when bitten and when evidence is collected.[83] Any bite-mark on skin may be distorted.[84] Areas with more underlying fat, or more prone to movement, are especially prone to distortion, and this may be compounded by the force of the bite.[85] The older the bite, the more distortions can be expected.[86] The inevitable distortions of a mark made on human skin are further compounded by movement of the victim's body, before and after death. Given the inevitability of distortions, comparisons of marks on skin with dentition are highly suspect.

E. *Unsupported Assumptions Bolstered by Unfounded Certainty: The Illusion of Statistical Support for Expert Conclusions*

Forensic odontologists generally bolster their conclusions of a "match" with impressive sounding certainty. The basis for this certainty originated in the statistical product rule.[87] For example, in an early case, the Arizona Supreme Court upheld the admissibility of bite-mark testimony finding "that there is an eight in one million probability that the teeth marks found on the [victim] . . . were not those of the [defendant]."[88] The expert based these figures on several points of comparison, citing two books and several articles employing the product rule for its use.[89] Although this use was upheld on appeal, subsequent cases have made experts more leery of using quantitative assertions, or even attempting to explain the product rule.[90]

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82 *See* DeVore, *supra* note 59 (noting distortions in human arm skin of live subjects).

83 *See* D. R. Sheasby & D. G. MacDonald, *A Forensic Classification of Distortion in Human Bite Marks*, 122 FORENSIC SCI. INT'L 75 (2001) (noting that the same biter may leave differing marks on the same victim).

84 DeVore, *supra* note 59 (noting distortions in human arm skin of live subjects).

85 *See* J. C. Barbenel & J. H. Evans, *Bite-Marks in the Skin—Mechanical Factors*, 14 J. FORENSIC SCI. SOC. 235 (1974) (studying distortions during and after biting).

86 *Id.*

87 *See, e.g.*, State v. Garrison, 585 P.2d 563 (Ariz. 1978) (upholding expert bite-mark testimony based on the product rule).

88 *Id.* at 566.

89 *Id.*

90 Professors Saks and Koehler give an elegant explanation of the product rule:

> According to the rule, the probability that each of a series of independent events will occur is given by the product of their unconditional probabilities. Attempts to use the product rule to support individualization run into several problems. First, proper application of the rule requires a set of reliable frequency estimates for the relevant set of forensic characteristics. Second, the characteristics must be independent of each other. Third, even if the first two problems are overcome, application of the product rule necessarily falls short of establishing unique individualization. The product of probabilities greater than zero always yields a value greater than zero. The probabilistic approach, therefore, always leads to the conclusion that a source other than the suspected individual or object might exist.

An example of this is found in *Ege v. Yukins*,[91] where the bite-mark expert, having first opined that the defendant's dentition was "highly consistent" with the marks on the victim, responded to the prosecutor's question by answering that no one else in a city of 3.5 million people (like Detroit, where the murder took place) would "match up."[92] Defense counsel did not object, instead proffering experts who opined that the marks were livor mortis rather than bite-marks, and even if they were bite-marks, they did not match the defendant's dentition.[93] Although the prosecution expert's figures were undoubtedly based on the product rule, the expert neither referred to it, nor explained it. Because the expert's probability statement was not supported by anything other than the size of the Detroit metropolitan area, where the murder took place, it was ultimately the basis for the Sixth Circuit's grant of habeas.[94]

The same prosecution expert who testified in *Ege* had testified previously in numerous cases, among them *People v. Wright*.[95] There, the expert explicitly based his statistics on an article published in the Journal of Forensic Science,[96] and opined that "if you have five unique points, . . . the chance of another individual making that same mark is 4.1 billion to one" and concluding that no one in the world "would have this unique dentition."[97]

The article on which Dr. Warnick based his testimony, however, is deeply flawed; the study design and execution are faulty and the statistical assumptions unsupportable.[98] In a nutshell, the author, using the product rule, and based on a determination that there were 150

Michael J. Saks & Jonathan J. Koehler, *The Individualization Fallacy in Forensic Science Evidence*, 61 VAND. L. REV. 199, 209 (2008).

91 485 F.3d 364 (6th Cir. 2007).

92 *Id.* at 368.

93 *Id.*

94 *See id.* at 373 (finding that although Ege's ineffective assistance claim for her counsel's failure to object was time-barred, because "it should have been obvious . . . that the *manner* in which this physical evidence was presented was objectionable . . . we cannot say that it should have been similarly obvious to Ege that the *substance* of the physical evidence—at least as presented by Dr. Warnick—was complete bunk"). The habeas writ was brought after the statute of limitations had expired, but the petitioner claimed that the statute had been tolled by the newly discovered evidence of a letter from the prosecutor's office "concerning the unreliability of Dr. Warnick as an expert witness in two previous murder trials." *Id.* at 370. Thus, while the Sixth Circuit agreed that the letter was newly discovered evidence with respect to the due process claims, it was not with respect to the ineffective assistance claims. *Id.*

95 No. 179564, 1999 WL 33446496 (Mich. Ct. App. Apr. 23, 1999), *rev'd*, 625 N.W.2d 783 (2001). This is one of the two cases that the Sixth Circuit cited in *Ege*, 485 F.3d at 372, where the bite-mark expert "was totally unreliable—in one case, because DNA evidence later excluded the defendant as a possible suspect; in the other, because a second expert undermined Warnick's probability determination."

96 Rawson, *supra* note 66.

97 *Wright*, 1999 WL 33446496 at *3 (showing testimony of prosecution expert, Dr. Warnick).

98 *See* Pretty & Sweet, *supra* note 54, 89-90 (discussing errors in Rawson's study).

possible positions for each tooth, found that the probability of finding two sets of six teeth each was 1.4×10^{13}. He assumed a world population of 4 billion, and stated that a match at five teeth would positively identify the biter to the exclusion of all others. The fundamental problem with using the product rule in this manner is that it assumes that each position of each tooth is independent, an assumption that has been shown to be false.[99] In addition, the article on which the expert based his testimony concerned the uniqueness of human dentition rather than the uniqueness of bite-marks, both of which have been criticized widely.[100] Ultimately, *Wright* was reversed and remanded to the trial court for an admissibility hearing regarding the statistical probability statement, the conviction was vacated, and remanded for a new trial.[101]

The more usual probability statements, however, are not quantified, but simply assert that the marks are "consistent"[102] with defendant's teeth; "positively match;"[103] or that the expert has a "reasonable degree of dental certainty" that the defendant's teeth made the marks.[104] These formulations for conclusions reflect current professional advice to experts, such as that in a treatise on bite-mark evidence, acknowledging that "there is no quantitative base for bite-marks analysis . . . [and] forensic dentists should refrain from such statistics."[105] Rather, in the next chapter, the text asserts that "human dentition is certainly unique; this has been established, although, as previously stated, not in a mathematically sound fashion."[106] Using words like "consistent" and "match" hardly solve the problem. These statements depend entirely on the expert's subjective assessment.[107]

99 *See id.*

100 *See, e.g.*, Rothwell, *supra* note 73, at 229 (explaining that "there is no study of large populations to establish [the theory of uniqueness] firmly" and noting that there is "no conclusive demonstration of the distinctive nature of a single bite pattern"). Notably, Dr. Warnick was sued for gross negligence by a murder suspect arrested for murder and later exonerated by DNA evidence. Otero v. Warnick, 614 N.W.2d 177 (Mich. Ct. App. 2000) (holding that there was no duty owed by the expert to the plaintiff). Dr. Warnick had testified in a preliminary hearing that Otero was the only person in the world who could have made the marks found on the victim's body. *Id.* at 178. When Otero was excluded as the source of DNA found on the victim's body, after spending five months in jail, he was released.

101 People v. Wright, 463 Mich. 993 (2001).

102 *See, e.g.*, Brooks v. State, 748 So. 2d 736 (Miss. 1999); Furtado v. State, No. 08-00-00230-CR, 2001 WL 959437 (Tex. Ct. App. Aug. 23, 2001); State v. Arredondo, 674 N.W.2d 647, 660 (Wisc. Ct. App. 2003).

103 *See, e.g.*, Morgan v. State, 639 So. 2d 6, 9 (Fla. 1994).

104 *See, e.g.*, State v. Cazes, 875 S.W.2d 253, 258 (Tenn. 1994).

105 Pretty, *supra* note 55, at 543.

106 *Id.* at 561.

107 *See* J. M. Kittelson et al., *Weighing Evidence: Quantitative Measures of the Importance of Bitemark Evidence*, 20 J. FORENSIC ODONTO-STOMATOLOGY 31, 36 (2002) ("[B]itemark evidence is inherently qualitative, and the use of quantitative measures to describe the importance of bitemark evidence would be misleading.").

Crucially, they mask the absence of data for the experts' unfounded assumptions about the uniqueness of bite-marks and the registration of these marks on the skin of the victim. Without data, such assertions are meaningless.

F. *Methodology*

Not only are the assertions of "match" subjective, but the methodology itself consists entirely of subjective comparisons. There are no official standards, no guidelines, and no criteria. The attempt of ABFO to achieve some methodological standardization was never implemented.[108] Although a number of variations exist,[109] the basic technique is comparing the marks made on the victim to a cast made of the defendant's teeth. Usually this is done by photographing the victim's marks, sometimes after excision, or, if there are impressions left in the skin, making a mold from the impressions. The defendant's model is either compared to a life-size photograph of the victim's marks, or a transparent overlay of the defendant's model is compared to the victim's marks. Dr. West, a forensic odontologist who practiced primarily in Mississippi, was wont to simply place the model onto the victim's wounds.[110]

At each step of the process, distortions may occur. Photographs must be taken quickly, since "the clarity and shape of the mark may change in a relatively short time in both living and dead victims."[111] Moreover, the position of the victim matters, because distortions will occur if photographed in a position other than the one in which the victim was bitten.[112] In order to judge the scale, some point of reference must be included in the photograph of the victim's marks.[113]

When making overlays and tracings, errors often are introduced.[114]

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108 *See* Bowers, *supra* note 15, at S106 (noting that ABFO's attempt to achieve objective guidelines "failed, not surprisingly, due to inter-examiner discord and unreliable quantitative interpretation").

109 *See, e.g.*, Pretty & Sweet, *supra* note 54, at 90 (noting "the wide variety of techniques").

110 *See, e.g.*, Howard v. State, 945 So. 2d 326 (Miss. 2006).

111 Rothwell, *supra* note 73, at 226.

112 *See, e.g.*, DeVore, *supra* note 59 (studying distortion of marks on living volunteers depending on the position of the volunteer during the photograph, and concluding that the degree of distortion was so great that only if the exact position of the body when bitten could be replicated should photographic images be used for comparison); Barbenel & Evans, *supra* note 85 (studying distortions in bite marks in both living and dead victims).

113 *See* Mark L. Bernstein, *Two Bite Mark Cases with Inadequate Scale References*, 30 J. FORENSIC SCI. 958 (1985) (noting the inaccuracy of small plastic rulers used as reference scales).

114 *See* David Sweet & C. Michael Bowers, *Accuracy of Bite Mark Overlays: A Comparison of Five Common Methods to Produce Exemplars from a Suspect's Dentition*, 43 J. FORENSIC SCI. 362 (1998) (finding that hand-traced overlays were inaccurate and generally unsuitable for use, and that radiographic overlays were more accurate).

When comparing the photographs or tracings of the victim's marks to the overlay or tracings of the suspect's teeth model, errors can be introduced also.[115] Moreover, even if more objective techniques are attempted, (by the use of radiographic overlays, for example) ultimately, the comparison of the photograph of a bite-mark to an overlay of the defendant's dentition is a subjective process.

When more precise methods have been attempted, they have been a dismal failure. When computerized complex image analysis was attempted in order to provide greater objectivity, and tested against a real legal case, a different biter from the already convicted (on the basis of expert bite-mark testimony) defendant was identified.[116] Either the defendant was wrongly convicted, or the computer was inaccurate, but the attempt at computerization was abandoned.

Error rates appear to be high, although they have never been rigorously quantified. A study published in 1974 found that false positive identifications occurred 24% of the time.[117] Proficiency testing was attempted by ABFO, which conducted four studies of its diplomates.[118] In the first study, ABFO found that error rates were "unsatisfactorily high."[119] Two subsequent studies were never published. The fourth reported an impressive sounding 85% successful match rate for the thirty-two diplomates analyzing four cases.[120] However, as Dr. Bowers points out in his critique, the poorest level achievable by this study was 71%.[121] Thus, as Dr. Bowers demonstrates, the actual median false positive rate (that is, declaring a match for a non-biter) was 63.5% and the false negative error rate (declaring no match when, in fact, the biter had made the marks) was 22%.[122] This error rate, especially the false positive rate, is disturbingly high.

115 *See* Rothwell, *supra* note 73, at 230 ("In even the most careful process, each stage introduces errors.").

116 *See* A.S. Naru & D. Sykes, *Digital Image Cross-Correlation Technique for Bite Mark Investigations*, 37 SCI. & JUST. 251 (1997) (observing that the skin may not record bites accurately enough to enable analysis).

117 Whittaker, *supra* note 78 (bite marks on porcine skin had a 24% false positive identification rate).

118 *See* Bowers, *supra* note 14, at 248-49 (discussing the four tests).

119 *Id.* at 248.

120 Kristopher L. Arheart & Iain A. Pretty, *Results of the 4th ABFO Bitemark Workshop—1999*, 124 FORENSIC SCI. INT'L 104-11 (2001).

121 Bowers, *supra* note 14, at 251, tbl.2 (explaining that if an examiner got one match wrong by linking it to an innocent suspect, he would still get the remaining five dentitions right by not erroneously matching them).

122 *Id.*

II. WHAT ARE THE COURTS DOING?

No one seriously contends that bite-mark testimony is based on "sufficient facts or data," or that it is the "product of reliable [meaning scientifically valid] principles and methods," reliably applied to the facts of the case.[123] If examined in any but the most superficial manner, it is obvious that not one of the *Daubert* factors can be met: the theory that partial impressions of unique dentition can be made on the skin of now-dead victims and that the marks made can be traced back to the biter is wholly untested, and all indications are that it is not true. The few times it has been tested, its error rate has been extraordinarily high. There are some articles reflecting this research placed in journals that are specialized for the purposes of criminal litigation, such as the Journal of Forensic Science and Forensic Odontology, the Journal of Forensic Odonto-Somatology, and a very few in the American Journal of Dentistry, but none in mainstream scientific journals like Science, Nature, and the Lancet.

No full-time academic graduate training exists for this specialty. There is little research, and no research is funded by major national granting agencies, such as the National Institute of Health. As for the field's general acceptance in the scientific community, it depends on how you define the community.[124] If the community is limited to people making their living testifying about bite-marks, it is a foregone conclusion that they will reach a consensus that it is "scientific."[125] It also depends on what the community in question must agree on. While testifying forensic odontologists may all agree on their assumptions about the uniqueness of human dentition and their own ability to "match" marks on the victim's skin to a particular person's dentition, there is simply no consensus (even among this limited group) about proper methodology. Although ABFO has issued guidance on many aspects of bite-mark comparisons, it has never addressed the best comparison method to use.[126] So how does this stuff get past the gatekeepers?

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123 FED R. EVID. 702 (as amended Dec. 1, 2000).

124 *See* Beecher-Monas, *supra* note 5, at 8 (discussing the problem of defining the "community" so narrowly that a small cohort of testifying "experts" can agree that their testimony is valid without ever being subject to the scrutiny of the general scientific community).

125 Notably, a number of forensic odontologists have been outspoken in their criticism of the empirical basis of their profession. *See, e.g.*, Bowers, *supra* note 14; Kittelson et al., *supra* note 107; Pretty & Sweet, *supra* note 54; Rothwell, *supra* note 73.

126 *See* Pretty & Sweet, *supra* note 54, at 91 (noting that a court would not be able to determine whether a bite-mark expert was using a generally accepted methodology by reviewing the literature).

A. *Failure to Challenge the Scientific Basis of Bite-Mark Evidence*

One of the huge flaws in the idea of judicial gate-keeping is its reliance on the adversary system to challenge suspect expert testimony. Many defense attorneys simply do not challenge the scientific basis of bite-mark evidence.[127] This failure to challenge prosecution experts could be attributed to under funded and overworked public defenders' offices. It also could be attributed to the defense's not being sufficiently informed. Surprisingly, however, many attorneys do not even seek to obtain expert assistance for their clients.[128] And when the defense does hire an expert, it is another forensic odontologist, who, for obvious reasons, is unwilling to expose his field as complete bunkum. For example, at the trial of Kennedy Brewer, who was later exonerated by DNA evidence, the defense stipulated "that there is a body of scientific knowledge which allows for the identification of individuals based upon bite mark examination on soft tissue."[129] Rather than challenge the science, the defense challenged the expert's qualifications (the infamous Dr. West, who had by this time been suspended from ABFO).[130] When

[127] *See, e.g.*, Ege v. Yukins, 485 F.3d 364 (6th Cir. 2007) (affirming in part and reversing in part the district court's grant of habeas, finding that although bite-mark evidence is admissible, and therefore an objection would have been unavailing, the statistics used to declare a match should have been objected to); State v. Duncan, 802 So. 2d 533 (La. 2001) (affirming the exclusion of defendant's photographic evidence of real victims' actual bite marks where counsel introduced expert testimony that the marks in question were not caused by bites, but counsel did not challenge the scientific basis of bite-mark evidence); Walters v. State, 720 So. 2d 856 (Miss. 1998) (no pre-trial motions seeking forensic odontologist); State v. Fortin, 917 A.2d 746 (N.J. 2007) (remanding on signature crimes testimony; bite mark match testimony apparently unchallenged); Del Torro v. State, No. 04-99-00599-CR, 2001 WL 487996 (Tex. Ct. App. May 9, 2001) (holding that it was not ineffective assistance to fail to request *Daubert* hearing); State v. Arredondo, 674 N.W.2d 647 (Wisc. Ct. App. 2003) (no ineffective assistance although defense counsel failed to challenge basis of match testimony).

[128] *See, e.g.*, Jackson v. Day, 121 F.3d 705 (5th Cir. 1997) (no attempt to obtain defense expert); Howard v. State, 945 So. 2d 326 (Miss. 2006) (defense counsel declined to hire expert); *Walters*, 720 So. 2d 856 (finding no ineffective assistance for failing to obtain a defense bite-mark expert because the defense cross-examined the prosecution expert and "bite mark evidence was but one small bit of evidence identifying the defendant").

[129] Brewer v. State, 725 So. 2d 106 (Miss. 1998); 819 So. 2d 1169 (Miss. 2002) (remanding on newly discovered DNA evidence).

[130] *Brewer*, 725 So. 2d at 125-26 (discussing West's suspension and remarking that the "organizational difficulties" did not affect his qualifications). In at least one case, habeas has been granted on the basis of the defense counsel's deficient performance in failing to object. *See* Ege v. Yukins, 380 F. Supp. 2d 852 (E.D. Mich. 2006) (finding that defendant was deprived of a fundamentally fair trial where the only evidence linking the defendant to the crime was the improperly admitted testimony of a forensic odontologist that a mark on the victim's cheek was a human bite that matched the defendant's dentition, and that out of 3.5 million people residing in the Detroit metropolitan area, the defendant was the only one whose dentition could match the mark). In two cases involving the notorious Dr. Michael West (who claimed to be able to identify marks by shining a blue light on them, a technique no one else could replicate, and which caused his suspension from the American Board of Forensic Odontology, and resignation from

the defense proffered its own expert, Dr. Souviron, he testified that Dr. West (the prosecution expert) was "brilliant" and that Souviron used the "direct comparison" method himself. The defense expert merely disagreed that the marks on the body (which was in "the early to moderate stages of decomposition") were bite-marks at all.[131]

In another such case, the evidence linking the defendant to the crime consisted primarily of two pieces of evidence: the defendant's confession and the testimony of a forensic odontologist that marks found on the victim's body "matched" the defendant's bite.[132] Apparently, the defendant's trial counsel failed to object to the prosecution's forensic odontologist, and did not proffer any counter-testimony.[133] Thus, one-half of the significant evidence in the case went wholly unchallenged. After defendant's conviction, the issues on appeal concerned the confession and the defendant's fitness to stand trial (the defendant had an IQ of 56, could not count backward, tell which direction was east or where the sun came up), but not the bite-mark testimony.[134] The habeas petition similarly omitted any reference to the bite-mark testimony.

On appeal, when appellate lawyers bring ineffective assistance claims, they also tend to overlook the bite-mark evidence, and those that do bring claims on that basis are singularly unsuccessful.[135] *Leal v.*

the International Association of Identification), the challenges were not to the scientific validity of the testimony, but to the expert's qualifications. *See, e.g.*, Brooks v. State, 748 So. 2d 736, 739 (Miss. 1999) (holding that even though the defense made no objection to the bite-mark testimony at trial, "because of the controversial nature of bite-mark evidence," the court took the opportunity to announce—without analysis—"that bite-mark identification evidence is admissible in Mississippi"); *Brewer*, 725 So. 2d at 125 (noting that although the defense challenged the expert's qualifications, the defense and prosecution "stipulated that there is a body of scientific knowledge which allows for the identification of individuals based upon bite mark examination on soft tissue"). For a discussion of the checkered history of Dr. West, as well as his continued use as a prosecution expert, see Paul C. Giannelli & Kevin C. McMunigal, *Prosecutors, Ethics and Expert Witnesses*, 76 FORDHAM L. REV. 1493, 1501-06 (2007) ("The reckless use of a tainted expert should be a due process violation.").

131 *Brewer*, 725 So. 2d at 116, 126.

132 United States *ex rel.* Young v. Snider, No. 01 C 6027, 2001 WL 1298704 (N.D. Ill. Oct. 25, 2001) (declining to issue writ of habeas), *aff'd*, Young v. Walls, 311 F.3d 846 (7th Cir. 2002) (upholding voluntariness of confession).

133 *Snider*, 2001 WL 1298704 at *2.

134 *Young*, 311 F.3d 846 (upholding refusal to issue writ of habeas corpus).

135 *See, e.g.*, Jackson v. Day, 121 F.3d 705 (5th Cir. 1997) (reversing the district court's holding that counsel's failure to retain a forensic odontologist was ineffective assistance because although "this expert testimony would have aided the defense, it merely would have rebutted the testimony of the state's expert"); Walters v. State, 720 So. 2d 856 (Miss. 1998) (holding that no ineffective assistance of counsel for failing to obtain a defense bite-mark expert because the defense cross-examined the prosecution expert and "bite mark evidence was but one small bit of evidence identifying the defendant"); Del Torro v. State, No. 04-99-00599-CR, 2001 WL 487996 (Tex. Ct. App. May 9, 2001) (finding that defense counsel was not ineffective for failing to seek appointment of forensic odontologist to prepare for cross-examination and provide exculpatory testimony, failing to interview prosecution expert odontologist before trial, and failing to voir dire the prosecution expert).

Quarterman,[136] a capital murder case involving prosecution bite-mark testimony, sought post-conviction relief twice, but without success.[137] Apparently, the defense had consulted an expert (another forensic odontologist) who agreed with the conclusion of the prosecution expert that the defendant's bite matched the marks on the victim.[138]

At the evidentiary hearing held in the state habeas action, the prosecution expert testified that he was sure "within a reasonable medical certainty" that the victim's bite-marks were caused by the petitioner's teeth.[139] The defense expert (who was consulted, but did not testify at trial) did not contest the validity of the field of expertise, nor the qualifications of the prosecution's expert, remarking instead that every dentist is qualified to render an opinion on bite-mark evidence,[140] illustrating the problem of having a small cadre of "experts" who all reinforce the appearance of science without ever having to explain its basis.

In *Howard v. State*,[141] the court held that there was no ineffective assistance of counsel despite the failure of the defendant's lawyers to seek a defense odontologist; despite their failure to voir dire or cross-examine the dental expert who prepared the molds of defendant's teeth; and despite defense counsels' failure to challenge the prosecution's odontologist (the infamous Dr. West).[142] In the direct appeal, the court had relied on the statements of defense counsel at sidebar that an expert, Dr. Richard Souviron, had been consulted, but the defense had decided not to call him because "his prediction was that he would probably concur" with Dr. West.[143]

136 No. SA-07-CA-214-RF, 2007 WL 4521519 (W.D. Tex. Dec. 17, 2007).

137 Leal v. Dretke, No. Civ. SA-99-CA-1301-RF, 2004 WL 2603736 (W.D. Tex. Oct. 20, 2004) (denying habeas); *Quarterman*, 2007 WL 45251519 (denying habeas based on International Court of Justice violation, but granting certificate of appealability).

138 *Dretke*, 2004 WL 2603736.

139 *Id.* at *13.

140 *Id.*

141 945 So. 2d 326 (Miss. 2006). The trial was complicated by the defendant's taking over his own case pro se because it had taken two and a half years to get to trial. *Id.* The original lawyers were directed to act as stand-by attorneys. Predictably enough, the defendant was convicted. *Id.*

142 More than twelve years ago Mark Hanson ran an exposé of West's testimony in the ABA Journal. *See* Mark Hanson, *Out of the Blue*, 82 A.B.A. J. 50 (Feb. 1996) (discussing the numerous cases in which West has testified on everything from bite marks to bleach stains and the complete lack of scientific evidence for any of the testimony). In several of the cases in which he testified about matching bite marks, DNA evidence from the victim has later excluded the convicted defendant. *Id.* This exposé did not, however, appear to have slowed West's testimonial exploits. He was the prosecution expert in *Brewer v. State*, 819 So. 2d 1169 (Miss. 2002), in which DNA found on the victim's body and tested after the conviction excluded the defendant as the source. *See* Shaila Dewan, *Despite DNA Result, Prosecutor Retries a '92 Rape-Murder Case*, N.Y. TIMES, Sept. 6, 2007, at A1 (discussing the capital murder trial and subsequent DNA test showing that the semen in the victim's body was not the defendant's, and noting that despite this apparent exoneration, the prosecution had decided to retry the defendant).

143 *Howard*, 945 So. 2d at 349 (emphasis omitted).

In his petition for post-conviction relief, however, the defendant proffered an affidavit from Dr. Souviron, which demonstrated that the defense counsel had misled the trial court, since Dr. Souviron stated that by the time of trial he had already disagreed in two cases with Dr. West, and in addition, because the victim's body had decomposed for five days, was exhumed and un-embalmed, it would be difficult to know if the marks were bite-marks at all.[144] Moreover, Dr. Souviron averred that, had he been retained, he could have guided the defense voir dire of the prosecution expert, because "Dr. West's statements during voir dire were either half true or misleading" regarding "his expulsion from ABFO, the American Academy of Forensic Sciences and the International Association of Identification" and regarding West's testimony in three prior cases where "the pattern injuries that were interpreted as bite marks by Dr. West were not bite marks."[145] Although the affidavits and other documents proffered by the petitioner "point out how many times Dr. West has been proven wrong and they discuss how unscientific his methods are" that was not enough for the court to provide relief.[146] The court, in denying the petition, found that petitioner "has not proven prejudice to his defense" and remarked that "[j]ust because Dr. West has been wrong a lot, does not mean, without something more, that he was wrong here."[147]

In a partial exception to the failure of most courts to find ineffective assistance for failing to object to bite-mark testimony, the Sixth Circuit granted habeas, in *Ege v. Yukins*,[148] finding a violation of due process because trial counsel did not to object to the 3.5 million to one odds given by the state's witness, Dr. Warnick.[149] In the course of its rather convoluted opinion, the Sixth Circuit took pains to explain that "[b]ite mark evidence may by its very nature be overly prejudicial and unreliable, but it may nevertheless be admitted under Michigan evidence law, and we do not question the Michigan courts' judgment with respect to admission of the bite mark evidence standing alone."[150] The court offers no explanation of how evidence that "by its very nature" may be "overly prejudicial and unreliable" can hope to meet due process standards of fundamental fairness.

The only physical evidence in this case linking the defendant to the crime was the purported bite-mark on the victim's cheek.[151] The initial autopsy report concluded the marks to be livor mortis. The victim's

144 *Id.* at 350.
145 *Id.* at 351 (emphasis omitted).
146 *Id.* at 352.
147 *Id.*
148 485 F.3d 364 (6th Cir. 2007).
149 *Id.* at 376.
150 *Id.* (footnote omitted).
151 *Id.* at 367.

body was exhumed, nine years after the murder, but it was too badly decomposed to be able to assess the marks. Dr. Warnick, relying on the original autopsy photographs, concluded that the marks were bites, and testified at trial that the marks matched the defendant's dentition to the exclusion of anyone else in the Detroit metropolitan area.[152]

Subsequent to Ege's conviction, the Sixth Circuit noted that Dr. Warnick's expert testimony was "found to be in essence a sham by a party on whose behalf the testimony was given"[153]—the Wayne County prosecutors' office. [154] Because the letter merely flagged the unreliability of bite-mark testimony, however, the Sixth Circuit found that Ege's "free-standing ineffective assistance claim—that her counsel blundered in not objecting to Dr. Warnick's bite mark evidence" was time-barred.[155]

On the other hand, the defendant's due process claim was based on the adequacy of the physical evidence presented against her. Because the court could not say that it should have been obvious to Ege "that the *substance* of the physical evidence–at least as presented by Dr. Warnick–was complete bunk" she was permitted to bring that claim.[156] Her due process claim was founded on the improper admission of the state's bite-mark testimony, which she claimed was "both substantively and probabilistically unsound."[157]

The Sixth Circuit found that there was no foundation for connecting the bite-mark to the defendant's dentition or for the probability statement.[158] However, because at trial the defense presented evidence that the marks were not bites at all, the Sixth Circuit held that the impact of the testimony was diffused so that any error was harmless. The probability statement, however, was not diffused because the defense experts did not directly rebut it. Therefore, defense counsel's failure to object to the probability statement at trial was "objectively unreasonable" and presenting defense experts did not insulate counsel's performance.[159] Thus, the Sixth Circuit upheld the admissibility of bite-mark evidence while overturning only the

152 *Id.* at 368.

153 *Id.* at 374.

154 In this letter, the Chief of Operations of the Wayne County Prosecutor's Office explained that Dr. Warnick's testimony in two cases had been totally unreliable. *Id.* at 372. In one case the defendant later had been excluded by DNA evidence, and in the other a second expert undermined his probability statement. *Id.* As a result, the county would not approve warrants "where the main evidence as to the identity of a potential defendant is the opinion of Dr. Warnick that he/she is the source of the bite marks." *Id.*

155 *Id.* at 373.

156 *Id.*

157 *Id.* at 374.

158 *Id.* at 374-75.

159 *Id.* at 379 (finding that Ege had met "both the nested cause and nested prejudice prongs" for ineffective assistance).

quantitative probability statement given in conclusion.

B. *Admitting Bite-Mark Testimony Because Other Courts Have*

When defense counsel do challenge bite-mark testimony, they are rarely successful. Courts simply decline to engage in any serious analysis of these challenges. By far the most widely used gate-keeping avoidance technique that judges employ is admitting bite-mark evidence because other courts have done so.[160] Rather than engage in any analysis of the scientific principles on which the testimony is based, the data underlying the testimony, the methodology, error rate, or general acceptance by the scientific community, these courts skirt the entire issue by finding neither a *Daubert* nor a *Frye* hearing necessary because other courts have previously admitted the testimony (also without such hearings). For example, the court in *People v. Moreno*,[161] held bite-mark evidence to have been properly admitted despite the absence of a *Frye* hearing, because courts had been admitting this type of evidence for more than fifty years.[162]

The court in *State v. Swinton*[163] mentioned *Daubert* in passing. However, it found that bite-mark evidence was neither unreliable nor controversial, citing (pre-*Daubert*) cases rather than examining the scientific basis for the testimony.[164] The court was more concerned about the computer-enhanced methodology used in the comparison (the prosecution's expert used the soft-ware programs Lucis and Adobe

160 *See, e.g.*, Calhoun v. State, 932 So. 2d 923, 925 (Ala. Ct. App. 2005) (finding bite-mark testimony admissible because it has "received evidentiary acceptance in nineteen jurisdictions" and "[n]o jurisdiction has rejected the admission of such evidence"); State v. Swinton, 847 A.2d 921 (Conn. 2004) (citing cases finding bite-mark testimony admissible); People v. Lester, No. 2004-198274-FH, 2006 WL 3421799 (Mich. Ct. App. Nov. 28, 2006) (finding bite-mark testimony admissible in Michigan without a "*Daubert/Frye* hearing" because it is generally accepted); Stubbs v. State, 845 So. 2d 656 (Miss. 2003) (holding that bite-mark testimony is admissible in Mississippi, citing cases); State v. Blamer, No. 00CA07, 2001 WL 109130 (Ohio Ct. App. Feb. 6, 2001) (citing Rule 702 and *Daubert* without analysis, stating "it is clear" that expert's testimony was qualified and citing other cases that found bite-mark testimony admissible); Seivewright v. State, 7 P.3d 24 (Wyo. 2000) (finding bite-mark testimony admissible in a burglary prosecution without a *Daubert* hearing because courts have widely accepted it). This phenomenon does not appear to be limited to bite-mark testimony. It also appears to be a common occurrence in handwriting testimony. *See* Risinger, *supra* note 32, at 468 (noting the string-citing of courts of appeals decisions as authority for the generic admissibility of handwriting expertise).

161 No. 1023104, 2003 WL 22132196 (Cal. Ct. App. Sept. 16, 2003).

162 *Id.* at *6. Moreover, even if the trial court had abused its discretion in not holding a *Frye* hearing, the appellate court found the testimony to be harmless error in light of other evidence in the case. *Id.* at *7.

163 847 A.2d 921 (Conn. 2004).

164 *See id.* at 933 n.14 (disagreeing with appellant's contention that bite-mark evidence was unreliable and controversial).

Photoshop, but did not create the Photoshop images himself), rather than scientific grounds.[165] Because the prosecution's bite-mark expert could not answer questions about how Photoshop worked, the court concluded that it was error to admit the Photoshopped images, but ultimately harmless, because the expert had concluded that there was a match even before seeing the images.[166]

C. *The "It Is Not Novel" Approach*

Another way that courts grandfather the admissibility of bite-mark evidence is the "it's not novel" approach. This strategy permits the judge to avoid gate-keeping because these courts assert that only novel scientific evidence requires scrutiny.[167] This was the approach of the Minnesota Supreme Court in *State v. Hodgson*,[168] which found that neither *Frye* nor *Daubert* applied to bite-mark testimony because it was "satisfied that basic bite-mark analysis by a recognized expert is not a novel or emerging type of scientific evidence."[169]

Such an approach not only ignores the cursory approach to evaluation taken by the earlier cases, but it also misconstrues the nature of scientific evidence. Just because courts made prior errors in admitting bite-mark evidence does not seem to be a particularly good reason to continue doing so, nor does it appear to be a very thoughtful approach to the problem. Moreover, even if the prior analyses had been sound, that is no guarantee that new information has not undermined the validity of the technique. These judges completely miss the changing nature of scientific information. New data may well demonstrate the fallacy of old assumptions.

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165 *Id.* at 954-55. The court disposed of the constitutional Confrontation Clause problem by finding that the defendant's expert had himself used Photoshop images to demonstrate the inadequacies of the prosecution expert's conclusion and thus had a "meaningful opportunity to probe the reliability of [the prosecution's expert's] identification testimony." *Id.* at 955.

166 *Id.* at 952, 957-58. In addition, the defense expert made what appears in retrospect to have been a huge blunder. To demonstrate the fallacy of prosecution expert's assertions regarding time of the bite in relation to the time of the victim's death, he used the molds of defendant's teeth to make a mark on his own arm, which the prosecution expert used to demonstrate to the jury what he considered to be the unique features of the dentition and how similar the marks were to those on the victim's breast. *Id.* at 958.

167 *See, e.g.*, People v. Quaderer, No. 242721, 2003 WL 22801204, at *1 (Mich. Ct. App. Nov. 25, 2003), *appeal denied*, 680 N.W.2d 899 (2004) (affirming child abuse conviction despite the absence of a *Frye* hearing because such a hearing is required only if the scientific principles are new); State v. Hodgson, 512 N.W.2d 95, 98 (Minn. 1994) (testimony connecting mark on defendant's arm to victim's teeth was not a novel type of scientific evidence).

168 *Id.*

169 *Id.*

D. *The "It's Not Science" Circumventing Gambit*

Even when courts acknowledge that some level of scrutiny is required for scientific evidence, they may avoid gate-keeping by finding that bite-mark evidence is not scientific. While *Kumho Tire* should have retired that particular gambit by explaining that gate-keeping requirements apply to all expertise, not just what the courts were calling "hard" science,[170] courts continue to permit bite-mark evidence in without scrutiny because it is not science. In *Carter v. State*,[171] for example, the court cited its own 1977 precedent for the proposition that bite-mark evidence was reliable, and then held that because such evidence was "simply a matter of comparison," it did not fall within the aegis of "scientific principles."[172] Nor did the court think there was any danger that the jury had "overestimated the value of the bite mark evidence," since it "was highly probative to rebut the defendant's contention that he was not a participant in the beating or murder of the victim but was merely present."[173] The court seems to have entirely missed the point that evidence without any empirical basis–whether or not it wishes to call it scientific–cannot be probative of anything.

The notion that "physical comparisons" are "not subject to the stringent standards applied to scientific tests" was similarly voiced by the Alabama Court of Appeals, in *Calhoun v. State*.[174] The court does not address the question of why the testimony of two prosecution experts was necessary to proclaim a match, if the jury could simply observe the marks and come to its own conclusions. Rather, the court cited bite-mark testimony's "evidentiary acceptance in nineteen jurisdictions" and noted that Florida had similarly decided that "the jury is able to see the comparison for itself."[175] This reasoning ignores the question fundamental to the relevance of bite-mark testimony: how likely the perceived physical similarity would be, had someone other than the defendant made the mark (a question that cannot be answered without a population database). Nor does the court address the distortions and subjectivity inherent in the models and photographs it believes that the jury can see for itself.

Acknowledging that bite-mark testimony could not meet *Daubert* standards, the Oklahoma solution was to exclude expert "match"

170 Kumho Tire Co. v. Carmichael, 526 U.S. 137, 147-48 (1999).
171 766 N.E.2d 377 (Ind. 2002).
172 *Id.* at 380-81.
173 *Id.* at 381-82.
174 932 So. 2d 923, 952 (Ala. Crim. App. 2005).
175 *Id.* at 952-53 (quoting Bundy v. State, 455 So. 2d 330, 349 (Fla. 1984), and rejecting the application of *Frye*'s general acceptance standard to bite-mark testimony).

testimony, while permitting expert testimony just short of that.[176] For example, in a capital murder trial, expert testimony was admissible that photographs taken of the defendant's right arm showed a "'probable bite-mark', which means, 'the pattern strongly suggests or supports origin from teeth, but could conceivably be caused by something else.'"[177] Despite the defense claims that such testimony was irrelevant because there was no connection made between the marks and the victim, the court nevertheless found it circumstantially relevant; not to the identity of the murderer, but to whether the defense had concocted the story he told the police that his brother had hit him before the murder.[178] Why or how that incident was connected to the murder the court does not explain, although the court stated that the marks could be relevant to malice aforethought.

Garrison is a troubling case. It was not tried until twelve years after the murder, and the only physical evidence linking the defendant to the murder were a piece of wire (that prosecution experts could not be sure came from a spool owned by the defendant) and a photograph of the contested marks on the defendant's arm. The defense challenged the prosecution's expert testimony and requested a *Daubert* hearing. Although the defense expert had to have transplant surgery shortly before the hearing, the judge would not postpone the hearing, and so the hearing proceeded without any defense expert.[179] At trial, the defense and prosecution experts disagreed over whether the mark was a bite at all.[180] On appeal, the defense claimed ineffective assistance of trial counsel for (among other things) failing to call an expert to testify at the *Daubert* hearing regarding the admissibility of the bite-mark testimony.[181] This reasoning completely misses the point of gatekeeping requirements and evades the appellate court's responsibility to monitor the trial court's adherence to these standards.

The court of appeals held that failing to produce an expert at the *Daubert* hearing was not ineffective assistance, even if it would have been beneficial, since the defense's bite-mark expert ultimately did testify at trial.[182] Nor did the court of appeals find that failing to grant a continuance for the hearing so that the defense expert could attend was abuse of discretion on the part of the trial judge.[183]

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176 *See* Garrison v. State, 103 P.3d 590, 603-06 (Okla. Crim. App. 2004) (citing Crider v. State *ex rel.* Dist. Ct. of Okla. County, 29 P.3d 577 (Okla. Crim. App. 2001)).

177 *Id.* at 603.

178 *Id.* at 596-604 (referring to the defendant's conversation with police, regarding charges that he had filed against his brother for assault nine days before the murder).

179 *Id.* at 613-14.

180 *Id.* at 596.

181 *Id.* at 612.

182 *Id.* at 614.

183 *Id.* at 619. *But see id.* at 619-20 (finding, however, that there was ineffective assistance regarding the mitigation phase of the capital proceedings, and thus remanding for resentencing).

E. *Absence of Meaningful Review*

The circumventing gambits of the lower courts would not be such a huge problem if there were meaningful review of their decisions. There is not. For one thing, the abuse of discretion standard gives reviewing courts ample opportunity to unthinkingly affirm the admissibility decision. For another, the courts are rightly reluctant to second-guess the credibility determinations made by the lower court.

Taking their review responsibilities seriously, however, does not entail either unthinking affirmance or appellate credibility evaluations.[184] Instead, it requires examining the process that the judge used to reach the admissibility determination.[185] Failure to follow the legally prescribed approach to admissibility determinations is not discretionary.[186] If the process was reasonably designed to discover whether there was a rational basis for the expert's testimony, then it should be upheld.[187] That is not, however, what is happening with bite-mark testimony. As noted above, the courts of appeals just uphold its admissibility based on precedent, its lack of novelty, or its unscientific basis.

Federal courts are also unwilling to step into the fray. Because habeas claims must be based on a violation of federal statute or constitutional law,[188] claims about the improper admission of bite-mark testimony tend to be based either on ineffective assistance of counsel (for failing to hire an expert, develop evidence, or make objections), sufficiency of the evidence, or due process/fundamental fairness. The

184 *See* Kumho Tires Co. v. Carmichael, 526 U.S. 137, 158-59 (Scalia, J., concurring) (Justice Scalia, joined by Justices O'Connor and Thomas, wrote: "I join the opinion of the Court, which makes clear that the discretion it endorses—trial-court discretion in choosing the manner of testing expert reliability—is not discretion to abandon the gatekeeping function. I think it worth adding that it is not discretion to perform the function inadequately. Rather, it is discretion to choose among *reasonable* means of excluding expertise that is *fausse* and science that is junky. Though, as the Court makes clear today, the *Daubert* factors are not holy writ, in a particular case the failure to apply one or another of them may be unreasonable, and hence an abuse of discretion.").

185 *See, e.g.*, Michael J. Saks, *The Legal and Scientific Evaluation of Forensic Science (Especially Fingerprint Expert Testimony)*, 33 SETON HALL L. REV. 1167, 1183 (2003) (delineating the post-*Daubert* courts' failures to grapple with the scientific validity of fingerprint expertise and noting that "[t]hree concurring Justices in *Kumho Tire* anticipated such evasions, and suggested that they were likely to constitute an abuse of discretion").

186 *See* Risinger, *supra* note 32, at 461 n.55 (noting that if a court violates the mandates of *Kumho Tire*, the appellate court should reverse and remand for a new determination absent harmless error).

187 *See Kumho Tire*, 526 U.S. at 152 (explaining that the standard applies to the question of how to decide reliability as well as the decision on admissibility).

188 *See* Herrera v. Collins, 506 U.S. 390, 400 (1993) (claims of innocence based on newly discovered evidence are not grounds for federal habeas relief absent independent constitutional violation occurring in the underlying state criminal proceeding).

admissibility of evidence in state courts is generally held to be a matter of state law.[189]

Thus, in *Milone*, when the petitioner claimed that the bite-mark evidence that had been used to convict him was unreliable under both *Frye* and *Daubert*, the Seventh Circuit held that because neither opinion purports to set a constitutional floor, the question would have to be "whether the probative value of the state's evidence was so greatly outweighed by its prejudice to Milone that its admission denied him a fundamentally fair trial."[190] Even though the petitioner's claim was that the bite-mark actually was made (and the murder committed) by someone else—a serial murderer who had confessed to the crime (and then hanged himself in his cell)—the court held that the bite-mark testimony did not deny him a fundamentally fair trial.[191] He had presented his own experts in court, and had cross-examined the prosecution experts. As for sufficiency,[192] there was opportunity, a link to the murder weapon, proximity, and—the bite-mark.[193]

Although the question before the court in *Thomas v. Beard*[194] was whether admitting unreliable evidence (bite-mark testimony) violated the petitioner's right to a fair trial, the court turned to state court precedent to determine whether bite-mark evidence was reliable.[195] Rather than examine the processes the state courts had engaged in to determine reliability, the federal court just cited to precedent, noting that "Pennsylvania courts have specifically allowed the use of bite-mark evidence, and provided there is adequate foundation for the testimony, such evidence is not per se fundamentally flawed."[196] That, of course, was precisely the petitioner's claim, that the evidence was fundamentally flawed. Rather than address that claim, the court turned to whether counsel had been ineffective in failing to present defense expert testimony on the bite-mark issue.[197] Because defense counsel had raised the issue of reliability in cross-examination and questioned the qualifications of the prosecution expert and the substance of his

189 *See* Milone v. Camp, 22 F.3d 693, 702 (7th Cir. 1994) ("[A] federal court can issue a writ of habeas corpus on the basis of a state court evidentiary ruling only when that ruling violated the defendant's right to due process by denying him a fundamentally fair trial.").

190 *Id.*

191 *Id.* (opining, without analysis, that "certainly there is some probative value to comparing an accused's dentition to bite marks found on the victim").

192 A federal court reviewing a state court conviction for sufficiency must determine "whether, after viewing the evidence in the light most favorable to the prosecution, any rational trier of fact could have found the essential elements of the crime beyond reasonable a doubt. *Id.* at 703 (quoting Jackson v. Virginia, 443 U.S. 307, 319 (1979)).

193 *Milone*, 22 F.3d at 703.

194 388 F. Supp. 2d 489 (E. D. Pa. 2005).

195 *Id.* at 527.

196 *Id.* (citing Commonwealth v. Henry, 569 A.2d 929, 934 (Pa. 1990), a pre-*Daubert* decision).

197 *Id.*

testimony, the court found counsel's performance "adequate."[198] Thus, no constitutional rights had been violated.

Raising claims of false testimony does not appear to be any more successful as a strategy. For example, in *Spence v. Johnson*,[199] the Fifth Circuit declined to characterize defense challenges to the prosecution's expert testimony as claiming false testimony. Rather, the court viewed claims of unreliability, backed up by the expert's misidentification of another woman and critiques of the expert's methodology and conclusions as going to the weight of the evidence, and as having been fully litigated in the state courts.[200] Moreover, "critically," according to the court, the defense expert (another forensic odontologist) had testified at trial that he could not rule out the defendant's teeth as a source of the bite marks.[201] This case and *Thomas* perfectly illustrate the conundrum of the defense: challenges to the entire field are undercut by presenting an expert in that same field; on the other hand, without a testifying defense expert, it is difficult to demonstrate the dissension in the field. Further, the approaches of both courts neatly ignore the crux of the matter: in *Thomas*, whether the whole field is so unreliable that a trial based on such evidence is fundamentally unfair; and in *Spence*, that an expert need not be lying to be testifying falsely. Testifying to nonsense, even nonsense the expert believes, is testifying falsely.

III. RELEVANCE REDUX: WHAT COURTS SHOULD DO

The commitment to a rational system of evidence entails the exclusion of irrelevant information.[202] If experts cannot demonstrate that their field of expertise has an empirical basis, whatever opinion the expert may have reached is irrelevant. It has no tendency to make any fact in issue more or less probable.

Relevance is the threshold criterion for admissibility. Even scholars arguing for "free proof" acknowledge the importance of screening information to ensure that it has some tendency to make a disputed issue in the case more or less probable.[203] As Roberts and Zuckerman explain the concept, "relevance, like physical presence and pregnancy, conforms to the concept of the excluded middle."[204] There

198 *Id.*

199 80 F.3d 989 (5th Cir. 1996).

200 *Id.* at 1000 (distinguishing Johnson v. Mississippi, 486 U.S. 578 (1988)).

201 *Id.*

202 *See* William Twining, *The Rationalist Tradition of Evidence Scholarship*, *in* RETHINKING EVIDENCE: EXPLORATORY ESSAYS 35 (1990) (discussing the rationalist tradition).

203 *See, e.g.*, Michael S. Pardo, *On Misshapen Stones and Criminal Law's Epistemology*, 86 TEX. L. REV. 347 (2007) (book review).

204 ROBERTS & ZUCKERMAN, *supra* note 13, at 99.

is no shade of gray here. Something is relevant or not, in relation to a disputed issue—here whether the accused can be linked to the victim through marks on the victim's body. Unless there is an empirical basis for the assertion that a link can be made, any assertion about a link is meaningless. It cannot make the link more or less probable. This legal test is basic to rationality. If something is not logically probative, no rational system of evidence should consider it.

The reason for admitting only relevant evidence is the danger that irrelevancies may be mistaken as bearing on the question at hand, and this may make the ultimate decision unfounded and inaccurate (or, if accurate, only by chance). Such evidence is affirmatively misleading. If the input is wrong, no reasoning process can be expected to make correct inferences.[205] Although inaccuracy is a possible factor in any evidence, not just expert testimony, baseless expert testimony is particularly pernicious because the entire reason it is being admitted is that the jury lacks the background knowledge necessary to evaluate it.[206] So do judges, but judges at least have the benefit of training in critical thinking, guidelines for the evaluation of scientific testimony, repeat exposure, and a measure of accountability.[207]

Moreover, there are good reasons to exclude irrelevant information from the decision process. Although irrelevant information should be disregarded in making a judgment, studies show that presenting decision makers with both irrelevant and relevant information leads to less accurate decisions than if only relevant information were presented.[208] Some of the pioneering work on this effect, known as the dilution effect, demonstrated that people responded differently to stories with the same relevant information if some were also presented with irrelevant information. For example, in making diagnoses, medical students made more accurate diagnoses when they were presented with only relevant information than if they were also given extraneous information.[209] Irrelevant information that ought to be ignored has a

205 *See* Alvin I. Goldman, *Simple Heuristics and Legal Evidence*, 2 L. PROBABILITY & RISK 215, 219 (2003) (explaining that even deductive reasoning requires true premises in order to reach true conclusions).

206 *See* Mark P. Denbeaux & D. Michael Risinger, Kumho Tire *and Expert Reliability: How the Question You Ask Gives the Answer You Get*, 34 SETON HALL L. REV. 15 (2003) (*Daubert* implies a view that misleading expert evidence is worse—and less amenable to correction through cross-examination—than misleading lay testimony).

207 *See* BEECHER-MONAS, *supra* note 5, at 33-35 (discussing why judicial gatekeeping has more potential for reaching accurate conclusions about expert testimony than simply admitting the evidence subject to cross-examination).

208 *See* Robyn M. Dawes, *Behavioral Decision Making and Judgment*, *in* THE HANDBOOK OF SOCIAL PSYCHOLOGY 497, 537 (Daniel T. Gilbert et al. eds., 4th ed. 1998) (citing studies explaining that exposure to uninformative information can influence decisions).

209 *See* Philip E. Tetlock et al., *The Dilution Effect: Judgmental Bias, Conversational Convention, or a Bit of Both?*, 26 EUR. J. SOC. PSYCHOL. 915, 916 (1996) ("[L]inking diagnostic with nondiagnostic evidence produced more regressive predictions than people would otherwise

way of creeping into, and skewing the decision.[210]

For example, when people are asked to decide whether someone has a particular characteristic (such as aggression), irrelevant information (such as the physical attractiveness of the person in question) tends to obscure what is relevant, making for inaccurate decisions.[211] This may be due to the fact that people listen for details around which they can construct stories that comport with their views about how the world works.[212] Even irrelevant information can go into constructing these stories.

This danger is particularly salient when the irrelevant information plays into commonly held stereotypes. Jurors' prior experiences filter and order their expectations.[213] The story model of jury decision-making also helps to explain the importance of basing judgments on accurate information. This model posits that juries weave stories from the testimony at trial that fit with their pre-existing views about how the world works.[214] One of these pre-existing views is the collective mythology that a suspect can be identified from marks left behind at the crime scene.[215] Thus, any story that includes the identification of the

have made.").

210 *See* Dawes, *supra* note 208, at 532 ("Dilution effects occur when evidence that does not distinguish between hypotheses in fact influences people to change their mind." (emphasis removed)).

211 Dennis J. Devine et al., *Jury Decision Making: 45 Years of Empirical Research on Deliberating Groups*, 7 PSYCHOL. PUB. POL'Y & L. 622, 679 (2001) (discussing leniency shift toward attractive defendants).

212 *See, e.g.*, J. RICHARD EISER & J. VAN DER PLIGT, ATTITUDES AND DECISIONS 100 (1988) ("[A]ccuracy declines considerably when the number of features or the number of alternatives increases. [And] reliability with which choice rules are used tends to decrease as the decision-maker's information load increases.").

213 *See* Shari S. Diamond, *How Jurors Deal with Expert Testimony and How Judges Can Help*, 16 J.L. & POL'Y 47, 51 (2007) (observing from a series of empirical studies that the "jury is not a blank slate that merely absorbs trial evidence and instructions").

214 *See* Nancy Pennington & Reid Hastie, *Evidence Evaluation in Complex Decision Making*, 51 J. PERSONALITY & SOC. PSYCHOL. 242, 243-45 (1986) (positing a model in which jurors use their preconceptions to create a story from the evidence they heard at trial, take the jury instructions and create verdict alternatives, and attempt to find the best correlation between the story and the verdict alternatives).

215 *See* Simon A. Cole, *Where the Rubber Meets the Road: Thinking About Expert Evidence as Expert Testimony*, 52 VILL. L. REV. 803, 836 (2007) (noting that, with respect to latent fingerprint evidence, the "power of the testimony derives from the talismanic power of the word 'fingerprint,' rather than from any articulation of the probative value of the evidence," and concluding that "the cultural mythos is so strong and so deep that even judicial control over testimony may be incapable of overcoming it"). Professor Cole asserts that courts and scholars have focused too much on admissibility and too little on the over-claiming that is characteristic of forensic expert testimony. *Id.* at 838-39. The kind of expert over-claiming that Professor Cole has identified in latent fingerprint testimony is also common in bite-mark testimony, judging from the published opinions. However, in forensic odontology, where there is a professional association with all the trappings of scientific endeavors, the problem is not only a lack of professional standards (the ABFO Guidelines are not mandatory), but the absence of any basis for them.

defendant as the perpetrator will be enormously influential.[216]

When it comes to expert testimony, relevance must be considered in tandem with reliability.[217] *Daubert* and amended Rule 702 both stress reliability of expert testimony as a facet of relevance, and therefore of admissibility.[218] Another way of expressing this notion of reliability is through the concept of warrant, which depends on how well the testimony is supported.[219] The task is to distinguish well supported from poorly supported evidence. This requires some judgment. With lay testimony, a judge can assess whether, if true, the testimony would have any tendency to make an issue in the case more or less true.[220] But with expert testimony, this requires another step. The reason for this is that unlike the opinions of lay witnesses, which must be "rationally based on the perception of the witness,"[221] expert witnesses testify on "scientific, technical, or other specialized knowledge."[222] In order to qualify as "knowledge" rather than rank speculation, the proponent of the evidence must demonstrate warrant. The problem is that warrant—unlike admissibility—is not an all or nothing proposition.[223]

Just as relevance must be considered in relation to some issue in the case, warrant (reliability) must be considered in relation to the claims that are being made for the evidence. For example, epidemiology studies are almost never perfectly analogous to a particular tort case being tried, having generally been done on some cohort that differs in some respects from the plaintiff, but they may still be sufficiently relevant and reliable to be admissible. The theory behind epidemiology is demonstrably sound, and as long as the tests have been

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216 *See, e.g.*, Saks & Koehler, *supra* note 50, at 202 (noting that "[p]opular television programs . . . reinforce the notion of individualization in the collective public imagination by offering confident pronouncements from scientists" and questioning the ability of forensic science to deliver on such claims).

217 Justice Blackmun explained that reliability for admissibility purposes is different from what scientists call reliability (which he defined as getting "consistent results") in that for legal purposes, reliability means scientific validity (which he defined as "the principle supports what it purports to show" and "trustworthiness"). Daubert v. Merrill Dow Pharm., Inc., 509 U.S. 579, 590 n.9 (1993).

218 *Id.* at 589 (finding that courts should screen expert evidence for relevance and reliability); FED. R. EVID. 702 (noting that to be admissible, expert testimony must be based on sufficient data and reliable methods).

219 *See, e.g.*, Susan Haack, *Of Truth, in Science and Law*, 73 BROOK. L. REV. 985, 997 (2008) (explaining the epistemic term "warrant").

220 Trustworthiness is also a concern with some types of lay testimony, which is why the Federal Rules exclude hearsay. *See* FED. R. EVID. 802 (a) ("Hearsay is not admissible . . . ."). Where indicia of trustworthiness exist, the rules make exceptions. FED. R. EVID. 802(b).

221 FED. R. EVID. 701(a).

222 FED. R. EVID. 702.

223 *See* Susan Haack, *Not Cynicism but Synechism: Lessons from Classical Pragmatism*, 41 TRANSACTIONS OF THE CHARLES S. PEIRCE SOC'Y 239, 240 (2005) (arguing that while admissibility is categorical, reliability is continuous).

properly performed with the requisite controls, and correctly statistically analyzed with outcomes similar to the harm suffered by the plaintiff, the imperfect reliability of the studies should not keep the testimony from being admissible. For the epidemiology example, the problem is one of extrapolation.[224]

In the case of bite-mark testimony, however, the theory of unique dentition has never been demonstrated, nor has the empirical determination that two different items (a mark on the victim and a mold of the dentition of the suspect) contain sufficient detail to substantiate a match, there are no controls, and the statistics employed are complete balderdash. Thus, while reliability may be a continuum, bite-mark identification testimony fails to reach even the extreme low end. Bite-mark testimony cannot even meet threshold relevance requirements for admissibility.

Indeed, as the Habers have pointed out with respect to fingerprint evidence, even the preliminary foundations necessary before one can begin to evaluate the empirical basis necessary for the technique's relevance have yet to be done.[225] For one thing, before the accuracy of the methodology can be assessed, the proponents of the technique must be able to establish an official protocol, or agreed description of the method.[226] As noted above, bite-mark specialists have yet to accomplish even this preliminary step. Once the protocol has been adopted by general consensus, the profession "needs to write and then adopt a report form that examiners complete that shows that each step is followed."[227] This step is necessary to ensure the reliability (i.e., replicability) of the method, and whether the practitioner has adhered to each of its steps. Formal training in the protocol, and an assessment of how well the practioner is following are also important, so that "it can be determined whether individual trainees or working examiners have learned and use the steps of the method correctly."[228] Finally, before the validity of the methodology can be evaluated, the profession must establish proficiency tests reflecting the difficulty of normal casework, and measuring performance during each step of the technique. Without such a preliminary foundation, which bite-mark experts have yet to lay, there is really no way to evaluate their claims to expertise.

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224 *See* ZEISEL & KAYE, *supra* note 17.

225 See Lynn Haber & Ralph N. Haber, *Scientific Validation of Fingerprint Evidence Under* Daubert, 7 L. PROBABILITY & RISK 87, 88 (2008) ("[T]he ACE-V method [for fingerprint identification] has not been tested for validity, and until the necessary work is performed to quantify the method and ensure that examiners are using the method correctly and consistently, the method cannot be validated.").

226 *Id.*

227 *Id.* at 93 (explaining the importance of documenting the steps the expert took to reach a conclusion).

228 *Id.* at 94 (discussing the importance of setting specific goals and assessment of whether the goals were met by the practitioner).

While reliability may be a continuum rather than categorical, at some point in the continuum, there is simply not enough support for a proposition to be relevant to any issue in the case. In popular parlance, there is no "there" there. That is precisely the problem for forensic odontology. While it may be logically defensible to admit testimony (subject to cross-examination) that has a solid scientific foundation, but has questionable application to the case at hand, that is not the situation with bite-mark identification testimony. When a forensic scientist offers testimony that a particular bite-mark is unique without any data to support that assertion, it simply cannot be warranted.[229]

Because determining relevance and reliability require the exercise of judgment, judges frequently punt on this issue, sending the evidence to the jury for its weight.[230] It is sheer nonsense—and a dereliction of gate-keeping responsibilities—to say, as courts are wont to do, that the flaws of bite-mark testimony go to its weight rather than its admissibility. First, admitting expert testimony in the first place implies that the court has found the testimony relevant and reliable—the jury knows that relevance is a basis for exclusion. Second, it is the proponent's obligation to substantiate the basis for admissibility, and admitting unreliable expert testimony transfers responsibility for demonstrating unreliability (in a criminal trial) onto the defense.[231] Third, conflicting accounts about what counts as science tend to divert the jury from the question that primarily concerns them (in criminal cases, whether this evidence demonstrates the defendant's guilt).

When experts come to different conclusions, even though both experts base their conclusions on solid science, that goes to weight. Even scientists with integrity, whose work is based on solid research, can reach different conclusions, drawing different inferences from the available evidence. But that is not the situation with bite-mark testimony. If expert conclusions, like those of bite-mark experts, are based on the illusion of science without its substance, that "expertise" should be excluded. Without an empircal basis, expert testimony simply has no place in court. It has no tendency to make the identification of the perpetrator—the disputed issue of fact to which the evidence is related—any more or less probable, and is therefore irrelevant.

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229 *Cf.* David L. Faigman, *Judges as "Amateur Scientists,"* 86 B.U. L. REV. 1207, 1224 (2006) (characterizing forensic identification evidence as "possibly the biggest embarrassment to the legal profession at this time" because "[u]nlike scientists who often make inferential leaps from general research to particular cases, forensic experts generally do not have any general data at all[, making them] . . . . essentially technicians who apply a technology built upon general statistical models that do not exist").

230 *See* Gary Edmond, *Specialised Knowledge, the Exclusionary Discretions and Reliability: Reassessing Incriminating Expert Opinion Evidence*, 31 U. NEW S. WALES L.J. 1 (2008) (using the example of facial mapping testimony in Australia).

231 *See id.* at 28.

Although cross-examination and the presentation of contradictory expert testimony are the traditional cures for "attacking shaky but admissible evidence,"[232] expert testimony that lacks any empirical foundation is resistant to this kind of correction. The reason for this phenomenon is that without data the assumptions made by the expert sound perfectly plausible. As Justice Learned Hand (over a century ago) expressed the jury's dilemma with respect to expert testimony, "how can the jury judge between two statements each founded upon an experience confessedly foreign to their own?"[233]

For example, in mock jury studies about the effectiveness of cross-examination, it apparently made little difference whether the defense challenged the expert testimony; whether the defense pointed out in cross examination that the expert's conclusions were inconsistent with prior research and that the expert had not followed standard methodology; whether the defense not only cross-examined the prosecution expert, but also put on its own expert.[234] Although the jurors discussed the expert evidence in their deliberations, and although there was a strong correlation between the prosecution expert's testimony and the jury's verdict preferences, the results did not vary among the first three conditions. This illustrates the fallibility of expecting cross-examination to expose the flaws in bite-mark testimony.

On the other hand, when an expert acknowledges a high error rate before announcing a conclusion, it does appear to make a difference. In a fourth condition, where the prosecution expert acknowledged that there was a sixty-six percent error rate in the methodology, but nonetheless opined a conclusion supporting the prosecution, there was a significant reduction in verdicts favoring the prosecution.[235] Unfortunately, no such acknowledgment has been forthcoming from bite-mark experts, who testify with certainty and without acknowledging error rates.

Empirical studies of jury decision making also demonstrate that when decision makers are unable to evaluate the expert testimony, they resort to cues, defer to expertise, and accept the most prestigious source.[236] When there is a battle of the experts, one expert may appear

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232 Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 596 (1993) ("Vigorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence.").

233 Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 HARV. L. REV. 40, 54 (1902).

234 *See* Joseph Sanders, *The Merits of the Paternalistic Justifications for Restrictions on the Admissibility of Expert Evidence*, 33 SETON HALL L. REV. 881, 936 (2003) (discussing the experimental work of Shari Diamond, et al., and concluding that "rulings excluding unreliable evidence promote jury accuracy even if we assume jurors are as good as judges in assessing reliability").

235 *Id.* at 933.

236 *See* Diamond, *supra* note 213, at 56. Professor Diamond suggests that judges permit jurors

more credible for reasons that have little to do with the scientific validity of the testimony.[237]

If, as the story model of juror decision making suggests, jurors decide cases by selecting the competing story that best fits their notions of plausibility,[238] scientific evidence that is embedded in the narrative may make the story seem more plausible than is warranted.[239] When one expert testifies that based on the marks found on the victim's body, and the model of the defendant's bite, there is a match, that is pretty persuasive story telling. Far more persuasive, for example, than the story is that we simply cannot tell what made those marks, or—if anyone—who made them.

CONCLUSION

The use of good science is a crucial component of justice. It is an important facet of justice for the litigants in the criminal justice system, it is important to the rationality of the judges' role and it is important in jury reasoning towards an accurate verdict. It is intellectually indefensible, and even cynical to continue admitting as expert testimony evidence that has not been able to demonstrate its empirical basis. Dressing the evidence in the trappings of science does not make it scientific. Science is not magic; it is the hard, painstaking work of careful research. Unless forensic odontologists are willing to engage in that empirical endeavor, they can have no knowledge to impart to the fact-finder, and their testimony should not enter a courtroom. For at least a decade now, judges have known that they are responsible for keeping junk science out of the courtroom. Yet, circumventing their gate-keeping responsibilities, judges continue to admit bite-mark testimony into evidence.

Part of this is the fault of the defense for failing to challenge the evidence.[240] Under-resourced and overworked public defenders,

to ask questions of the experts, and notes that when such questions are permitted, many questions focused on alternative explanations for expert observations. *Id.* at 58.

237 *See* Goldman, *supra* note 205, at 221 ("[O]ne expert's greater surface credibility than his opponent may be the subjectively best cue available for choosing between them, but surface credibility might be a notably unreliable cue.").

238 *See* Nancy Pennington & Reid Hastie, *A Cognitive Theory of Juror Decision Making: The Story Model*, 13 CARDOZO L. REV. 519, 520 (1991).

239 *See* Gary Edmond, *Science, Law and Narrative: Helping the 'Facts' to Speak for Themselves*, 23 S. ILL. U. L.J. 555, 579 (1999) (noting that when "embedded in a narrative, especially if considered legitimately scientific, [evidence] may heavily influence the perception of the plausibility of particular aspects of a narrative and possibly the entire narrative").

240 *See, e.g.*, Risinger, *supra* note 8, at 135 (noting an "apparent systematic failure to seriously litigate these issues on the part of the criminal defense bar" particularly with regard to bite-mark evidence, where between 1993 and 1999, in only four or five of the forty-eight cases in the study

however, have little incentive to devote time and energy to a battle that has been lost in almost every case where it has been attempted. Without a judiciary willing to take its gate-keeping role seriously, there is little point in making fruitless objections.

Moreover, unless the appellate courts are also willing to take their review duties seriously, there is little prospect for change. The abuse of discretion standard of review for trial court evidentiary decisions, made explicitly applicable to expert testimony admissibility decisions in *Joiner*,[241] gives trial court judges a great deal of leeway in making bite-mark admissibility decisions. This standard does not give unlimited leeway, however, and certainly not the kind of leeway that courts reviewing bite-mark admissibility have been giving. Any serious review of courts' strategems to avoid serious evaluation of the methodology could not but find that the courts holding bite-mark testimony admissible had failed to engage in the process set out by the federal rules and *Daubert*, and thus had abused their discretion.

The empirical inquiry envisioned by the *Daubert* trio and the amendment to Federal Rule of Evidence 702 has simply been discarded in favor of categorical admissibility by relying on precedent. Early cases in which no reliability inquiry was performed have become precedent for admissibility decisions in perpetuity, so that courts never have to address the underlying issues. This is exacerbated because in the criminal context, the only cases that are appealed are those in which the prosecution evidence was admitted, and the defendant was convicted, which tends to skew the appellate decisions in the direction of affirming admittance.[242] While habeas courts could put a stop to this by finding the admissibility of such flagrantly bogus expertise a violation of fundamental fairness, only *Ege* has done this, and then only for the quantification opinion, rather than for the bite-mark identification.

The lower courts have the tools to make proper validity assessments. The *Daubert* trilogy and the amendment to Rule 702 have been implemented routinely and (for the most part) well in the civil context. The appellate courts could find that trial courts refusing to employ these tools of analysis—or employing them in a "wooden"[243] fashion—have abused their discretion. And habeas courts could find that state systems that admit evidence without any empirical foundation

was there "any indication that that the foundational reliability of such evidence was challenged"). In the period from January 2000 through August 2008, of the forty-six bite-mark identification cases I found, there were seven foundational reliability challenges, but none that were successful.

241 Gen. Elec. Co. v. Joiner, 522 U.S. 136, 142-43 (1997).

242 *See* Risinger, *supra* note 32, at 469 (noting the problem of skewed appellate decisions in the context of criminal handwriting cases).

243 *Id.* at 460 (noting the mechanical way in which *Daubert* is applied in handwriting cases); *see also* Saks, *supra* note 185, at 1171 (noting that in post-*Daubert* fingerprint cases, "the number of cases in which the courts conscientiously applied *Daubert* and *Kumho Tire* [was] zero").

in a criminal case have violated precepts of fundamental fairness.

It does take some intellectual effort. But lawyers and judges are trained in critical thinking. Admitting testimony into evidence that has no empirical basis violates every precept of logic, rule of evidence, and notion of fundamental fairness. To continue to admit such testimony just because it has been admitted in the past defies reason. Failing to demand that the proponents of this evidence demonstrate its validity defies justice.