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Supreme Court of Kentucky

2014-SC-000345-MR

ALFRED IVEY JR. — APPELLANT

V.

ON APPEAL FROM HARDIN CIRCUIT COURT
HONORABLE KELLY M. EASTON, JUDGE
NO. 12-CR-00382

COMMONWEALTH OF KENTUCKY — APPELLEE

OPINION OF THE COURT BY JUSTICE NOBLE

AFFIRMING

The Appellant, Alfred Ivey, Jr., was convicted of two counts of rape of a minor. The crime resulted in a child, and a DNA paternity test was used as evidence against Ivey. On appeal, he alleges two errors related to expert testimony about the DNA evidence of his paternity: (1) that the trial court erred in allowing the expert to testify about the probability of paternity based on an improper statistical method; and (2) that the expert invaded the province of the jury by instructing it on how to consider the evidence. Finding no error, we affirm.

I. Background

Ivey was in a long-term sexual relationship with his half-sister, Novina Peel.[1] They lived together in Hardin County, Kentucky, from 1994 to 2007. Peel had a daughter, Karen,[2] from a previous relationship.

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[1] They shared the same father, Alfred Ivey, Sr.

[2] We refer to the daughter with a pseudonym to protect her identity.

In 2003, when Karen was thirteen years old, she became pregnant. When Peel asked her who had fathered the child, Karen replied that she did not know. Peel speculated that Karen had been raped at a school dance, a story that Karen went along with. Karen gave birth to a daughter the following year, and Peel raised the child as her own.

By 2010, Karen had become an adult, moved to Oregon, and gotten married. At that time, she revealed that Ivey was the father of her child. She claimed that when she was between nine and eleven, Ivey had forced her to have sexual intercourse on multiple occasions, and that when she got old enough to understand that it was wrong, Ivey had threatened her and her mother. She claimed that he raped her again when she was thirteen, and that she got pregnant at that point.

Not knowing what to do, Peel contacted the child-support office in Garrard County. The office obtained a court order for paternity testing, which showed that Ivey was the father. Peel also contacted the police in Hardin County about criminal proceedings. Police obtained a search warrant for a second DNA sample. An expert later testified that paternity testing of this sample showed a 99.9999% probability of Ivey being the father of Karen's child.[3]

Ivey was indicted on two counts of first-degree rape. Before trial, his counsel moved for an evidentiary hearing on the reliability of the method used to calculate the 99.9999% probability of paternity and to exclude that evidence from the trial. The court held a hearing and denied the motion, and the DNA

[3] This figure is based on certain assumptions and is discussed further below.

evidence was admitted at trial. Karen did not wish to testify, but she did so nevertheless, describing the abuse she suffered from Ivey.

The jury convicted Ivey on both counts, and he was sentenced to life in prison. He appeals to this Court as a matter of right. Ky. Const. § 110(2)(b).

II. Analysis

Ivey raises two issues on appeal. First, he claims that the trial court erred in not holding an evidentiary hearing on one of the statistical methods used in evaluating the DNA test and in admitting the testimony about the method because it was unreliable. Second, he claims that the Commonwealth's DNA expert improperly instructed the jury on how to weigh the evidence.

A. The statistical DNA evidence was properly admitted.

As to the DNA evidence, Ivey's complaint is narrowly focused. He does not challenge the DNA test itself, nor does he challenge all of the statistical conclusions that can be drawn from that test. Instead, he complains about the use of a 50% "prior probability" of paternity in calculating the final probability of paternity, which is the last of three conclusions that can be drawn from the DNA test. This Court previously upheld the use of that 50% figure in *Butcher v. Commonwealth*, 96 S.W.3d 3, 7 (Ky. 2002), concluding that it did not violate the presumption of innocence. Ivey claims that he was nevertheless entitled to a hearing under *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), because no scientific method is forever beyond challenge, and that the method used by the expert was improper and unreliable.

The trial court held a hearing on Ivey's motion at which the reliability of the probability-of-paternity calculation was questioned. In support of his

position, Ivey proffered an academic article, Ernest P. Chiodo *et al.*, *An Error in Statistical Logic in the Application of Genetic Paternity Testing*, J. Mod. Applied Stat. Methods, Winter 2002, Vol. 1, Issue 1, at 126, but did not offer any additional proof, such as expert testimony. His argument at that hearing was based solely on the article, which criticizes the use of the 50% prior probability to calculate the probability of paternity in some circumstances because it "highlights a serious error in statistical methodology known as the 'principle of indifference.'" *Id.* at 128.

The trial court concluded that the evidence would be admissible. The court specifically concluded that *Butcher* had decided the question of the use of the 50% prior probability, and declined to hold a "new" *Daubert* hearing because the use of the 50% figure was a reliable method. Instead, the court concluded, Ivey was free to challenge the use of the figure on cross-examination and inquire about the expert's statistical assumptions.

DNA paternity tests and the various statistical methods used to analyze the results of those tests have consistently been upheld as sufficiently reliable to be admitted under KRE 702. Indeed, they are considered so reliable that they no longer require a pre-trial *Daubert* hearing before they may be admitted. *See Fugate v. Commonwealth*, 993 S.W.2d 931, 937 (Ky. 1999) (concluding that reliability of DNA testing "has been sufficiently established as to no longer require a *Daubert* hearing"); *Goodyear Tire and Rubber Co. v. Thompson*, 11 S.W.3d 575, 579 (Ky. 2000) ("[A] trial court may take judicial notice of the reliability of these methods of analysis.").

Ivey, of course, is correct that even these well-established methods "are not forevermore beyond the reach of the application of *Daubert*," *Goodyear Tire*, 11 S.W.3d at 579, and that "a party still may challenge the reliability of ... methods of DNA analysis," *id.* But there are limits to what a defendant may demand. In essence, Ivey sought a "reverse" *Daubert* hearing on the 50% figure at which he would "bear[] the burden of proving that the methods of analysis are not, or are no longer, reliable under KRE 702." *Id.* But the problem with Ivey's claim is that he *was* given a hearing. As noted above, he presented evidence, in the form of the statistics article, but the trial court was not convinced that it undermined the reliability of the method. Though the court stated that no "new" *Daubert* hearing was needed, the hearing that was held was, in fact, the reverse *Daubert* hearing that Ivey was entitled to.

Thus, to the extent that Ivey's complaint is that he did not receive a *Daubert* hearing, there was no error. He received all that he was entitled to: a hearing on his motion at which he presented and argued the one item of evidence he discussed in that motion. He was not denied the opportunity to present further proof; he simply failed to do so. (In fact, he did present further proof at trial, in the form of his own expert.)

Ivey's real complaint is that the trial court erred in concluding that the statistical method used to calculate what is called a probability of paternity is reliable in the face of the proof he offered. In essence, he now complains that by presenting the statistics article, he satisfied the burden laid out in *Goodyear Tire* of proving the unreliability of this method, and that the trial court erred in admitting it. This Court concludes that he has not met his burden.

Ivey's claim, however, cannot be understood without some context, if only because the statistical method at issue is not common knowledge. It is thus necessary to lay out the basics of how paternity testing works, at least in a summary fashion.

Like other types of DNA testing, paternity testing first requires that a set of DNA profiles be developed for comparison. Paternity testing compares three profiles, one of the child, one of the mother, and one of the putative father. This is the standard type of DNA profiling that is commonly discussed in other cases. But as in every case, DNA profiles do not speak for themselves; they must instead be compared to each other.

When it comes to the comparison, paternity testing is not the same as other kinds of DNA testing, such as that typically used for a criminal case in which a biological sample is compared to a defendant's to see if there is a match. This is because a child receives half its DNA from each parent. Thus, there will never be a complete match between the two DNA profiles, that of (putative) father and child. Instead, paternity testing looks at whether there is shared or common DNA. Using this comparison, an examiner first determines whether the putative father is excluded as a possible contributor to the child. If not, the examiner can then calculate a "paternity index, and [a] probability of paternity." *Butcher*, 96 S.W.3d at 6.[4]

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[4] *Butcher* also referred to a "probability of exclusion," 96 S.W.3d at 6, which is a different concept from excluding the putative father. The probability of exclusion looks at the percentage of the male population that can be excluded from possibly being the father. Michael I. Meyerson & William Meyerson, *Significant Statistics: The Unwitting Policy Making of Mathematically Ignorant Judges*, 37 Pepp. L. Rev. 771, 781 (2010). If the defendant is included in the relevant population, the probability of exclusion is probative of paternity, in that it reduces the size of the population that could have

The first step, determining exclusion, looks at whether an alleged father's DNA could have contributed at all to the child's DNA. In other words, at its most basic, a DNA paternity test has two possible outcomes: the putative father is excluded, meaning he is shown not to be the father, or he is "included," meaning he is *possibly* the father. *Butcher*, 96 S.W.3d at 6; *Griffith v. State*, 976 S.W.2d 241, 242–43 (Tex. App. 1998). To conduct the exclusionary determination, a DNA examiner compares locations on the child's and putative father's DNA—frequently called loci. If the putative father is "included," then his DNA necessarily matches portions of the child's DNA. In *Butcher*, the examiner compared eight different genetic markers. In this case, fifteen loci were compared. Ivey was found not to be excluded because his DNA matched portions of the child's DNA at all fifteen loci.

The next step, if the putative father is not excluded, is to calculate the paternity index.[5] Rather than a physical test, this process employs "a statistical evaluation to say how likely that match that we see is." *Butcher*, 96 S.W.3d at 6. As the Commonwealth's expert in this case described it, the statistical examination is "to assess that potential relationship that is being supported by the DNA" and to "give a significance to how strong of a potential relationship

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fathered the child. But this calculation is different from excluding the defendant. The defendant is either excluded or not, to the extent that the DNA test itself is accurate. The DNA expert in this case did not testify as to the probability of exclusion.

[5] As some commentators have noted, this value is actually the combined paternity index, though it is often simply called the paternity index. *See* Meyerson & Meyerson, *supra*, at 782 n.62. A paternity index is calculated for each loci tested, and those indexes are multiplied together to arrive at the combined paternity index, which is the figure admitted into evidence. *Id.*

could that be." The result is "expressed numerically as a paternity index." *Butcher*, 96 S.W.3d at 6. We have described the paternity index as follows:

> The paternity index is a value reflecting the likelihood that a tested man is the father of the child as opposed to an untested man of the same race. It is expressed as a number. If a paternity index can be assigned to a man, it means that he is that many more times likely to be the father than any other randomly selected male of his race.

Id. at 6–7 (quoting *Griffith*, 976 S.W.2d at 243).

This description, however, is not completely accurate. The paternity index "does not measure the chance of defendant's paternity compared to that of a randomly selected man." D.H. Kaye, Plemel *as a Primer on Proving Paternity*, 24 Willamette L. Rev. 867, 877 (1988).[6] That would be the "probability of paternity," *id.*, which is a different calculation, discussed below. Technically speaking, the paternity index is the ratio of "the probability of the alleged father transmitting the alleles and the probability of selecting these alleles at random from the gene pool." D.H. Kaye, *The Probability of an Ultimate Issue: The Strange Cases of Paternity Testing*, 75 Iowa L. Rev. 75, 89 (1989–1990). It has been described as a "likelihood ratio," that is, "a ratio of two conditional probabilities," but "is not itself a probability." 1 *McCormick on Evidence* § 211 n.17 (7th ed. 2013) "Unlike probabilities, which are bounded by 0 and 1, the likelihood ratio can exceed one. The larger the ratio, the more probative the evidence." *Id.* Thus, the paternity index is probative of paternity, but it does not actually tell us the probability the person tested is the father.

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[6] Professor Kaye's works are cited throughout because he has written frequently on the subject, perhaps more frequently than any other commentator, and is an expert in the field.

For example, in *Butcher*, the paternity index was 388/1 (or simply 388). We said that this meant the defendant was "388 times more likely to be the father of the child than a randomly selected male of the same race." 96 S.W.3d at 7. Again, this is not, strictly speaking, completely accurate. *See* 1 *McCormick on Evidence* § 211 n.18 (7th ed. 2013) (noting that *Butcher's* formulation commits "the transposition fallacy" and is a "misinterpretation"); *see also id.* § 210 ("A juror who hears that only one out of every five, or for that matter, one out of every 10,000 persons, possesses the traits that characterize the true offender, may be tempted to subtract this statistic from one to arrive at the incorrect conclusion that the remainder is the probability that the defendant is guilty. In the statistical literature, this reasoning is known as the transposition fallacy."). Instead, a paternity index of 388 "means that it is [388] times more likely that a union of [the defendant] and [the mother] would produce a child with the observed set of markers than would a union of [the mother] and a set of alleles picked at random from men of [the defendant's] race." Kaye, Plemel *as a Primer*, *supra*, at 874. Or to apply a simpler description by Professor Kaye, to *Butcher's* facts: "Men of [the defendant's] phenotype, when crossed with the mother, would produce offspring with the child's phenotype [388] times as frequently as would randomly selected men." Kaye, *The Probability of an Ultimate Issue*, *supra*, at 91.

In Ivey's case, the paternity index was 11,900,000. (This likelihood ratio is substantially higher than that in *Butcher*, at least in part, because many more loci were compared.) Ivey's index is therefore that much more probative of paternity than the index in *Butcher*.

The third step is to calculate a probability of paternity, which is usually expressed as a percentage. This calculation uses Bayes' theorem,[7] *Butcher*, 96 S.W.3d at 7, which "show[s] the effect of a new item of evidence on a previously established probability," 1 *McCormick on Evidence* § 211 (7th ed. 2013). "On its most basic level, the formula is nothing more than a mathematical way of representing how we incorporate new information into our reasoning." Michael I. Meyerson & William Meyerson, *Significant Statistics: The Unwitting Policy Making of Mathematically Ignorant Judges*, 37 Pepp. L. Rev. 771, 783 (2010). The new evidence in paternity testing is the result of the DNA test, specifically the paternity index. The established probability (of paternity), often referred to as a "prior probability," depends on other evidence, such as "access to the mother, fertility, and date of conception." *Butcher*, 96 S.W.3d at 7; *see also* Meyerson & Meyerson, *supra*, at 785 (noting that the other evidence can include "whether [the defendant] had sexual relations with the mother and ... how many other men she had sexual relationships with, as well as the timing of each sexual encounter"). Applying Bayes' theorem to the prior probability results in what is called a posterior probability; in the context of paternity testing, the posterior probability is simply referred to as the probability of paternity.

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[7] When applied to paternity testing, assuming a paternity index has been calculated, the formula is:

$$\frac{\text{Paternity Index} \times \text{Prior Probability}}{(\text{Paternity Index} \times \text{Prior Probability}) + (1 - \text{Prior Probability})}$$

Butcher, 96 S.W.3d at 7. This gives a decimal that is the probability of paternity and which may then be expressed as a percentage.

Because Bayes' theorem is a ratio of probabilities, a lower prior probability will necessarily result in a lower final probability of paternity than would a higher prior probability. The prior probability can thus have a significant effect on the probability of paternity. Ideally, the other, non-DNA evidence in the case could be evaluated to assess a prior probability, which could then be compared with the DNA test to arrive at a final number.

In theory, the prior probability could vary dramatically depending on the proof in a case. The prior probability can be any number between zero and one (that is, more than 0% and less than 100%).[8] For example, very strong, but not unassailable, proof of an alibi should result in a lower prior probability than proof showing that the defendant was present but simply denies having had sex with the victim. Similarly, evidence that a defendant had had a vasectomy—an effective but imperfect method of sterilization—would also result in a very low prior probability that he was the father.

"In the context of criminal cases, however, those using this formula to determine paternity typically insert a standard prior probability of .5 regardless of any other factors, which indicates a fifty percent chance that the alleged father actually had sexual intercourse with the mother." *Butcher*, 96 S.W.3d at 7. This again is somewhat of a misstatement. Rather than showing a 50% chance that the alleged putative father had intercourse with the mother, the 50% prior probability indicates a 50% probability, before the DNA test, that the alleged father is the biological father. This distinction is crucial because having

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[8] Zero could never be used, because that would mean that we are certain that the defendant is not the father. Nor can one (or 100%) be used, as that would mean we are certain that he is the father.

intercourse does not guarantee a pregnancy, a fact acknowledged elsewhere in *Butcher*. In Ivey's case, using the 50% prior probability, his probability of paternity was calculated to be 99.9999%.

In *Butcher*, this Court specifically approved of the use of a 50% prior probability, over two dissents. The defendant in that case had claimed that use of that figure violated the presumption of innocence. But this Court instead concluded: "The use of a prior probability of .5 is a neutral assumption. The statistic merely reflects the application of a scientifically accepted mathematical theorem which in turn is an expression of the expert's opinion testimony." *Id.* at 8 (quoting *Griffith*, 976 S.W.2d at 247). The Court also noted: "The jury is free to disregard it. It can be weakened on cross and in argument." *Id.* (quoting *Griffith*, 976 S.W.2d at 247).

Butcher, however, was not directly about whether the use of a 50% prior probability satisfies the reliability requirement of *Daubert*. In fact, *Butcher* mentions neither *Daubert* nor KRE 702. Nor did *Butcher* address the scholarly criticism now raised by Ivey or other criticism that has turned up in the Court's legal research.[9] Ivey claims now that the use of the 50% prior probability fails the requirement of reliability, at least in light of the statistics article he submitted to the trial court. Because *Butcher* did not directly address this question, we cannot rely on that decision as dispositive.

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[9] The Court that decided *Butcher* appears to have been at least aware of some of the criticism, however. It cited, for example, an article criticizing the use of the 50% prior probability, albeit for a different proposition. *See Butcher*, 96 S.W.3d at 6 (citing Kaye, *The Probability of an Ultimate Issue*, *supra*).

The statistics article Ivey presented claims that paternity testing "can lead to incorrect conclusions," where there is a problem with the "statistical assumptions," specifically in "assuming equal prior (pre-test) probabilities for an event in the face of ignorance concerning the actual probabilities." Chiodo *et al.*, *supra*, at 126. In other words, the authors claim that the use of the 50% prior probability is a logical error.

But the "error," to the extent it is one, appears to matter only under unrealistic conditions. The article uses as an example paternity testing based on a single genetic marker occurring in only 1% of the population. *Id.* at 127. With a 50% prior probability, the probability of paternity in such circumstances is 99.01%. *Id.* But the article points out that lower prior probabilities result in significantly lower probabilities of paternity under the hypothetical scenario. For example, if the prior probability was 0.001 (or 0.1%), which is a fairly low prior probability, the probability of paternity would be only .091, or 9.1%. *Id.* Or, to employ an example more germane to this case, as will become apparent shortly, if the prior probability was .01, or 1%, then the resulting probability of paternity would be only 50.25%.[10]

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[10] This figure can be arrived at by first calculating the paternity index resulting from the hypothetical in the article, since that figure is not given. (This is because the authors used a slightly different formulation of Bayes' theorem.) As noted above, the probability-of-paternity calculation shows the relationship between three numbers: the paternity index, the prior probability, and the resulting probability of paternity. Because we know two of these numbers used in the article, the prior probability and the probability of paternity, we can calculate the paternity index through a simple application of algebra. The formula is

$$\frac{PI \times PP}{(PI \times PP) + (1 - PP)} = PoP$$

where *PI* is the paternity index, *PP* is the prior probability, and *PoP* is the probability of paternity. In the example in the article, the *PP* is .5 (or 50%), and the resulting *PoP* is .9901. With those figures plugged into the formula, we have

But in this case, even with very low assumed prior probabilities, the probability of paternity exceeded 99.99%. The Commonwealth's expert explained generally to the jury how the prior-probability notion affected the probability of paternity, albeit without getting into the details of Bayes' theorem, and postulated several variations less than the assumed standard 50%. For example, the expert explained that if the prior probability were only 1%, or .01, then the probability of paternity dropped only to 99.9991%. The extreme example of a low prior probability, .1%, or .001, used in the Chiodo article also results in very high probability of paternity for Ivey. Though the expert did not testify to this number, it can easily be calculated with the formula laid out elsewhere in this opinion, with the resulting probability of paternity being 99.9916%.

Presumably, this is because the genetic testing used in Ivey's case is simply more extensive than what was used in *Butcher*. In *Butcher*, only eight loci were compared, whereas fifteen were tested in this case. More importantly, the number of loci tested is significantly higher than the number used in the hypothetical example in the Chiodo article, which again looked at but one genetic marker.

$$\frac{PI \times .5}{(PI \times .5) + (1 - .5)} = .9901$$

Simplified, it is

$$\frac{.5PI}{.5PI + .5} = .9901$$

Solving algebraically for *PI*, we get 100.01. That number is likely an approximation, given that the *PoP* was rounded to four digits, but it is close enough for our present purposes.

With the paternity index, 100.01, we can easily calculate other probabilities of paternity based on other prior probabilities, again with the same formula. A prior probability of .01 (or 1%) results in a probability of paternity of .5025, or 50.25%.

The simple fact is that the hypothetical used by the article is unrealistic. Modern genetic testing is not going to rely on a single genetic marker—for exactly the reasons argued in the article. Ivey's evidence, again consisting of but a single statistics article, was insufficient to require the trial court to question the reliability of the statistical techniques used in this case. Paternity testing of this sort is regularly used in the courts of this Commonwealth and across the United States.

Interestingly, the example used in the Chiodo article appears to have been chosen very intentionally. As noted in footnote 10 above, the paternity index describing the scenario in the article's hypothetical appears to be approximately 100.01. The Uniform Parentage Act creates a rebuttable presumption of paternity in cases where "the man has at least a 99 percent probability of paternity, using a prior probability of 0.50, as calculated by using the combined paternity index obtained in the testing," and there is "a combined paternity index of at least 100 to 1." Uniform Parentage Act § 505(a) (2002); *see also* KRS 406.111 (applying same probability of paternity and paternity index requirements but having no requirement as to prior probability). The example used in the article barely meets this threshold. To that extent, it ably demonstrates the absurdity of using the 50% prior probability with threshold cases, at least if only that number is used to calculate a probability of paternity.

But again, in this case, the paternity index far exceeds the minimum threshold. And though the Kentucky presumption statute was not at issue in this case, as it was a criminal prosecution, the paternity index was sufficiently

high, and resulted in such high probabilities of paternity with even very low prior probabilities, that Ivey's paternity is all but guaranteed. We cannot say that the method was unreliable in this case, even given the criticism in the Chiodo article.

That, of course, does not mean that use of the 50% prior probability is forever beyond a reverse *Daubert* challenge.[11] Most commentators outside the blood-testing community, such as statisticians and law professors, have objected to the use of a 50% prior probability because the notion that it is neutral is demonstrably false. *See, e.g.*, Meyerson & Meyerson, *supra*, at 786–87 (noting that it cannot be a neutral number because it assumes a 50% chance that the defendant is the father); Kaye, *The Probability of an Ultimate Issue*, *supra*, at 94 (noting the "neutral" argument is "unconvincing" and laying out several arguments for why that is the case); 1 *McCormick on Evidence* § 211 (7th ed. 2013) (noting that the conception of .5 as neutral "cannot withstand examination"); *id.* § 211 n.26 ("Virtually all commentators outside of the paternity testing community concur."). And former members of this Court, albeit a minority at the time, have agreed. *See Butcher*, 96 S.W.3d at 12 (Cooper, J., concurring); *id.* (Stumbo, J., dissenting).

Those critical of using a 50% prior probability have a point. That number assumes that there is a prior probability at all that the defendant is the father, which may be inescapable since a 0% probability cannot be used. But, more

[11] That is the case at least until the General Assembly adopts the 50% prior probability by statute, as is in the Uniform Parentage Act. But even then, that calculation would only be required in civil paternity suits, not criminal cases where proof of paternity would be relevant.

importantly, that prior probability is fairly high (almost satisfying the civil burden of proof by itself). Despite our assertions in the past, it is not a truly neutral number. It, at best, gives us a "useful working hypothesis." Meyerson & Meyerson, *supra*, at 788 n.96 (quoting Jack P. Abbott *et al.*, *Joint AMA-ABA Guidelines: Present Status of Serologic Testing in Problems of Disputed Parentage*, 10 Fam. L.Q. 247, 262 (1976)).

Perhaps a hypothetical, suggested by Professor Kaye, best illustrates why a 50% prior probability is far from neutral. *See* Kaye, Plemel *as a Primer*, *supra*, at 874. Assume a situation where the paternity index is 178. Further assume the uncontradicted proof is that a year before the child's conception, the defendant had a vasectomy, and that the medical proof shows, beyond question, "the odds are one to a million that he could father a child." *Id.* Despite the nearly astronomical pre-DNA test odds against the defendant being the father, using the 50% prior probability results in a 99.44% probability of paternity. Surely in such a case, it would be absurd to allow an expert to testify to a 99.44% probability of paternity, or to affirm a conviction based on such evidence.[12] Of course, to their credit, it is unlikely that DNA experts would give such testimony under those circumstances. But if followed literally, *Butcher* would allow it.

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[12] The hypothetical is not without some basis in reality. In several instances of pre-DNA genetic testing, such as HLA typing, a sterile man was calculated to have had a probability of paternity exceeding 95% and approaching 100%. *See, e.g.*, *O'Bannon v. Azar*, 435 So. 2d 1144 (La. Ct. App. 4th Cir. 1983) (affirming verdict for defendant who had 99.91% paternity probability but who previously had a successful vasectomy); *Cole v. Cole*, 74 N.C. App. 247, 328 S.E.2d 446 (1985) (reversing finding of paternity based on a 95.98% paternity probability where it was undisputed that the alleged father previously had a successful vasectomy).

The problem is that the paternity index measures only the strength of the evidence, in this case, the DNA test itself. *Id.* But DNA testing, at this point, is simply not 100% accurate, especially in the context of paternity, nor is it likely ever to be since we do not have DNA profiles of everyone on the planet. And the paternity index "tells us nothing about the prior odds." *Id.* It "reveals how far we can move from a given starting point, but it does nothing to reassure us that we are starting at the right point." *Id.* Using the 50% prior probability then "treats the genetic findings as the very first datum, to be evaluated *before* any other evidence is available." *Id.* at 880.

If it is the first evidence to be considered, "the fairest thing the laboratory can do is to say that as far as it can tell, considering only the untested vials of blood, the accused man is no more likely than any other male in the relevant population to be the father." *Id.* But that means that "if there are more than two men biologically capable of fathering the child, then the prior probability for the defendant is less than .5." *Id.* And with fairly low paternity indexes, it appears that the relevant population would include more than one possible father.

Thus, some commentators have suggested that jurors be presented with "a spectrum of prior and posterior probabilities." *Id.* at 881; *see also* 1 *McCormick on Evidence* § 211 (7th ed. 2013) ("[T]he expert could show the jury how the test results would affect not merely a prior probability of one-half, but a whole spectrum of prior probabilities."); David H. Kaye, *DNA Evidence: Probability, Population Genetics, and the Courts*, 7 Harv. J.L. & Tech. 101, 167 (1993–1994) (urging that an "expert present[] the jury with a table or graph

showing how the posterior probability changes as a function of the prior probability"). Though this proposed approach has drawn some criticism, *see* Meyerson & Meyerson, *supra*, at 789 (stating that "[t]his proposal, though well-meaning, is hopelessly misguided"), it is not without its charm. It avoids the problem of the expert using a 50% prior probability without disclosing what that figure means, and allows the jury to use "Bayes's rule merely ... as a heuristic device, displaying the force of the evidence across a wide range of prior probabilities." Kaye, *DNA Evidence*, *supra*, at 167. And this approach has been used in some courts, especially before DNA testing became as refined as it is today. *See State v. Spann*, 617 A.2d 247, 264–65 (N.J. 1993); *Plemel v. Walter*, 735 P.2d 1209, 1219 (Or. 1987).

We need not decide today whether such an approach is required. We note it only as one possible solution to the problem of the 50% prior probability. Whether presenting a spectrum is definitively a better method than simply assuming a 50% prior probability is a question better left, in the first instance, to a trial court presented with evidence to evaluate whether it better fits under *Daubert* and KRE 702. And it is likely that such an examination will be unnecessary, as even in *Butcher*, we noted that the use of a 50% prior probability could be disregarded by the jury and that it could "be weakened on cross and in argument." 96 S.W.3d at 8 (quoting *Griffith*, 976 S.W.2d at 247). And defendants are free to offer their own expert witness critical of the 50% prior probability, as happened in this case.

But we also note the spectrum approach because it is, in essence, what was used in this case. As noted above, the Commonwealth's expert testified as

to the effect of several lesser prior probabilities, including 1%, on the resulting probability of paternity. In each instance, the probability of paternity remained above 99.99%. Thus, the jury could see the effect of different prior probabilities on the resulting probability of paternity. If this is the norm in the testimony of paternity experts, then it appears they have anticipated the primary objections that Ivey has brought to bear. If there is any prejudice from ever using a 50% number, even as a "working hypothesis," that prejudice is likely attenuated by spectrum testimony like that given in this case.

That said, as much as anything, improvements in DNA testing techniques have lessened the need for testimony about a spectrum of prior probabilities. The example used in the Chioda statistics article, for example, used only one genetic marker. One of the cases discussed by Meyerson & Meyerson, *State v. Spann*, 130 N.J. 484, 617 A.2d 247 (1993), used only two genes. Our own case, *Butcher*, had evidence of but eight loci, which resulted in a paternity index of only 388/1. But in this case, the testing was of fifteen loci, and the resulting paternity index approached 12 million. And that number, when run through Bayes' theorem, consistently results in probabilities of paternity over 99.99%, even with very low prior probabilities.

As Professor Kaye noted in 1989, as genetic testing becomes "more refined ... the controversy over [probability of paternity] will wither." Kaye, *The Probablity of an Ultimate Issue*, *supra*, at 88 n.64. This prophesy has not completely born out, as questions are still being raised more than 25 years later. But as testing improves, we are convinced those questions are becoming of little consequence.

In the end, Ivey's complaints do not undermine the reliability of the evidence in this case. The evidence, therefore, was properly admissible. Rather than going to the admissibility of the evidence, his complaints go to its weight. And the jury was presented with ample proof to allow it to determine the proper weight to assign to the testimony.

B. The DNA expert's testimony was not erroneous.

Ivey next complains that the trial court erred in allowing the Commonwealth's expert to "instruct jurors on how to weigh the evidence." Specifically, he complains about the expert's testimony about prior probabilities other than 50%, as discussed above.

After the expert testified to the 99.9999% probability of paternity based on the 50% prior probability, the Commonwealth asked her whether that number took into account "all DNA evidence and non-DNA evidence." The expert replied that it did not and reflected only the DNA evidence. The Commonwealth then asked what the "other evidence" would be. Ivey objected, and the court stated it was a legal issue, presumably referring to what things in *this* case would constitute the evidence. Instead, the court allowed the expert to give examples of other types of evidence. She answered: "testimony provided by other individuals, any testimony other than what I'm talking about right now."

The Commonwealth then asked the expert whether the probability of paternity, the final percentage she had calculated, took into account the other evidence. The expert testified that it did not because she did not know what that evidence was. Instead, she said, she tried to be neutral, though "ideally"

the probability of paternity *would* take into account all the other evidence. She said that instead, she assumed a 50% probability, as discussed above, to avoid "giving weight to either side of the argument, and ... [to] only represent[], in the probability of paternity, the DNA results." She testified that 50% was the only neutral number that would not weigh the results one way or the other.

The expert did not expressly describe how the probability of paternity is arrived at, as it is laid out above. For example, she made no mention of Bayes' theorem. But her testimony in this regard implicitly described it, particularly its evaluation of a prior probability in light of new evidence (e.g., a DNA test).

The Commonwealth asked the expert if she had calculated a probability of paternity based on other prior probabilities. She said yes, noting that she had used 1% and several other values. In explaining her use of 1%, she said: "If I were to assume 1% prior probability, that means the trier of fact, in this case the jury, if you were to assign a probability to all the other evidence other than the DNA evidence—" Ivey then objected and asked to approach; the trial court stated, "No. Overruled." The expert then continued with her answer:

> If the trier of fact were to assign a probability of all the other non-DNA evidence, before anything about DNA, and at that time, based off all the non-DNA evidence, believed there was only a 1% probability that the alleged father was the biological father, that's what assuming a one percent probability would mean.

She then went on to explain other prior probabilities that the jury might arrive at in considering the non-DNA evidence.

Ivey now claims that the expert was instructing the jury how to consider the evidence by this testimony. He notes our case law condemning testimony removing from the jury its historic function of assessing credibility, such as

Stringer v. Commonwealth, 956 S.W.2d 883, 894 (Ky. 1997). He also cites cases from other jurisdictions, many of which pre-date DNA testing and address blood-type or other early forms of genetic testing, stating that expert proof of probabilities of paternity exceeding 99% cannot be viewed as conclusive of the question of paternity.

To some extent, this argument is a repetition of the one addressed above. Ivey simply wants this Court to disapprove of the probability-of-paternity calculation because it inherently requires an assessment of the proof in the case to arrive at a prior probability. We decline to do so, as explained above.

Rather than instructing the jury on how it had to consider the evidence, or hiding the probability-of-paternity calculation behind a veil of assumed scientific authority, the expert's testimony actually opened the options for the jury. We already approved in *Butcher* the use of the 50% prior probability in that calculation because it is purportedly neutral, even though it also includes an implicit assumption about the other evidence in the case. But here, the expert explained the significance of that figure and how the other evidence of paternity would "ideally" be taken into account. She also explained to the jury the results of the probability-of-paternity calculation if it had believed the other non-DNA evidence weighed strongly against paternity (thus the 1% figure). The expert's testimony thus opened up the available options, albeit only slightly given the very high probability of paternity even with a very low prior probability. Rather than invading the province of the jury, the expert gave testimony that would assist the jury "to understand the evidence or to

determine a fact in issue." KRE 702. That is exactly what expert witnesses are for. There was, therefore, no error.

III. Conclusion

The trial court held the only hearing requested by Ivey, and did not err in allowing the DNA expert to testify about a probability of paternity based on a 50% prior probability of paternity, especially since she also testified about lesser prior probabilities. And the expert did not invade the province of the jury by explaining how the other lesser prior probabilities, which would depend on the evidence in the case, would affect the probability of paternity. Finding no error, this Court affirms the judgment of the Hardin Circuit Court.

All sitting. Minton, C.J.; Cunningham, Hughes, Keller and Wright, JJ., concur. Venters, J., concurs in result only by separate opinion.

VENTERS, J., CONCURS IN RESULT ONLY: I concur in result only. The majority rejected Ivey's complaint that the calculation used to determine the probability of paternity in this sexual assault case was unreliable. I submit that the method was improper, but would hold that error to be harmless. The issue, however, is more appropriately framed as whether the probability of paternity as calculated for a paternity determination is a relevant fit for a rape or sexual assault case. "'Fit' is not always obvious, and scientific validity for one purpose is not necessarily scientific validity for other, unrelated purposes." *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 591 (1993) (citation omitted).

Like all evidence, statistical and probability evidence must be relevant to a fact in issue. Bayes Theorem consists of a prior probability multiplied by a

likelihood ratio, which results in a posterior probability. The theorem is routinely applied in paternity cases. Federal Judicial Center, *Reference Manual on Scientific Evidence* 172 (3d ed., National Academies Press 2011). However, the logic that justifies its use for proving paternity does not necessarily apply for proving sexual assault. Specifically, using the prior probability that the putative father had sexual relations with the mother makes logical sense in a paternity case; but using it to determine the likelihood that a male suspect had sexual relations with the female victim in a sexual assault case is illogical because it presupposes the truth of the issue it purports to prove.

The likelihood ratio, by itself, is a probability-based method for evaluating the probative value of forensic evidence and may be presented without the prior probability estimation. Colin Aitken, Paul Roberts, & Graham Jackson, *Communicating and Interpreting Statistical Evidence in the Administration of Criminal Justice: Practitioner Guide No. 1, Fundamentals of Probability and Statistical Evidence in Criminal Proceedings* 35-36 (Royal Statistical Society 2010); Roberto Puch-Solis, Paul Robert, Susan Pope & Colin Aitken, *Practitioner Guide No. 2, Assessing the Probative Value of DNA Evidence* (2012). The likelihood ratio expresses "the extent to which evidence supports a particular proposition in terms of two likelihoods: (i) the likelihood of the evidence if one proposition is true; and (ii) the likelihood of the evidence if the other proposition is true." Colin Aitken, Paul Roberts & Graham Jackson, *Practitioner Guide No. 1, Fundamentals of Probability and Statistical Evidence in Criminal Proceedings* at 35.

In criminal proceedings, the likelihood ratio is obtained by comparing the likelihood of the evidence given the prosecutor's proposition that the accused is guilty to the likelihood of the evidence given the defense's proposition that the accused is not guilty. *Id.* at 35. "The relative values of these two likelihoods provide a measure of the meaning and probative value of the evidence." *Id.* at 36. The larger the likelihood ratio, the more probative is the first proposition as compared to the second proposition. In this case, the paternity index, based on the DNA evidence alone, without the Bayes prior probability estimation, results in a likelihood ratio highly favorable to the prosecutor's proposition that the defendant had sex with the alleged victim.

Bayes Theorem's introduction of the prior probability of the ultimate fact in issue (that the defendant had sex with the victim) is not appropriate when, as part of its inferential reasoning, "it involves making selection between (potentially) contested facts, a role properly reserved to the fact-finder." Graham Jackson, Colin Aitken, & Paul Roberts, *Communicating and Interpreting Statistical Evidence in the Administration of Criminal Justice: Practitioner Guide No. 4, Case Assessment and Interpretation of Expert Evidence* 37 (2015). The probability of paternity formula used here included the prior probability that Ivey had sexual intercourse with the victim, and thereby interjected an *assumption* of sexual intercourse, the very fact the Commonwealth was required to prove.

Simply stated, it is improper to prove that sexual intercourse, the *corpus delicti* of the rape charge, occurred by using a statistical formula that presupposes the probability that sexual intercourse occurred with the

defendant. Consequently, with the incorporation of this assumption, the probability of paternity is not a relevant calculation for deciding whether a defendant committed sexual assault. The formula is not "fit" for the purposes of proving sexual assault. Moreover, by excluding the use of the prior probability, and presenting only the paternity index derived from the DNA analysis, the jury's "common sense" inferential reasoning for assessing the disputed facts is not usurped.

Nevertheless, given the high paternity index obtained in this case, and the other evidence from which the fact of intercourse is easily inferred, the use of the irrelevant prior probability was very plainly harmless error.

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