

Court of Appeals of Arizona,  
Division 1, Department B.  
STATE of Arizona, Appellee,  
v.  
Enrique Mejia GARCIA, Appellant.  
No. 1 CA-CR 98-0587.  
Oct. 5, 1999.  
As Corrected Oct. 15, 1999.  
Review Denied Oct. 31, 2000.

Janet Napolitano, Attorney General by Paul J. McMurdie, Chief Counsel, Criminal Division, Jon G. Anderson, Assistant Attorney General, Phoenix, for Appellee.  
Dean W. Trebesch, Maricopa County Public Defender by Lawrence S. Matthew, Deputy Public Defender, Phoenix, for Appellant.

OPINION

PATTERSON, Judge.

In this appeal, we are called upon to apply *Frye v. United States*, 293 F. 1013 (D.C.Cir.1923), to determine the admissibility of complex statistical evidence concerning the interpretation of mixed DNA samples using likelihood ratios<sup>1</sup>. Appellate review of the admissibility of this particular type of evidence is a matter of first impression. For the reasons that follow, we hold that the statistical formulas used to determine the likelihood ratios corresponding to the DNA matches in this case satisfy the *Frye* standard for admissibility of scientific evidence. Because defendant raises no other issues on appeal, we affirm his convictions and sentences.

FACTS

On the evening of October 9, 1995, Michelle S., a fourteen-year-old girl, and her fifteen-year-old boyfriend, Edgar, were approached by defendant at a Phoenix apartment complex. Neither Edgar nor Michelle knew defendant. Defendant informed Edgar that "a few people" at the complex said that they would "take" Michelle "one way or another." In response, Edgar, who had gone to the apartment complex to visit his uncle, asked defendant if he would give Michelle and him a ride home. Defendant told Edgar that he could not drive them home, but that he could take them to a car that they could use to drive home. At about this time, a man named "Ramiro," whom defendant identified as his brother, joined the group. Defendant, accompanied by Ramiro, then drove Edgar and Michelle to the supposed location of the other car. When the group arrived at the location of the car, however, defendant pushed Edgar out of his vehicle, and defendant and Ramiro drove away with Michelle.

The two men drove Michelle to a location not far from the apartment complex where the incident began. Defendant told Michelle that he intended to kill a man who lived in a nearby house, and that he needed her help in luring the man out of his residence.

Defendant then showed Michelle an ice pick or sharpened screwdriver and told her that, if she did not come with him, he would kill her. Defendant took Michelle to a nearby alley and entered the backyard of an abandoned house. Once inside the backyard, defendant stated, "I can kill you or fuck you." After ordering Michelle to disrobe and lie on the ground, he attempted to engage in anal sexual intercourse with her without success. He then raped her vaginally. Shortly thereafter, Ramiro entered the yard. Before leaving, defendant handed the ice pick or sharpened screwdriver to Ramiro. Ramiro then raped Michelle.

After being pushed from defendant's car, Edgar contacted the Phoenix police, and he accompanied an officer to the apartment complex where he and Michelle met defendant earlier that evening. While Edgar and the officer were at the complex, defendant returned on foot, and the police arrested him.

Michelle eventually escaped from Ramiro and ran to a nearby residence for help. Like Edgar, she immediately notified the Phoenix police of the incident. Michelle identified defendant in a one-man show-up later that evening.

The state subsequently charged defendant with kidnapping, sexual conduct with a minor, attempted sexual conduct with a minor, and aggravated assault. The state further alleged that each of the offenses was a dangerous crime against children in violation of Arizona Revised Statutes Annotated (A.R.S.) section 13-604.01. A jury convicted defendant of all counts, and defendant timely appealed. We have jurisdiction pursuant to article 6, section 9 of the Arizona Constitution and A.R.S. sections 12-120.21, 13- 4031, and 13-4033(A).

## DISCUSSION

The sole issue we address on appeal is whether the trial court properly determined that the expert statistical testimony concerning DNA evidence obtained in the case met the *Frye* standard.

### I. The DNA Evidence

Michelle was treated at the emergency room of a local hospital following the assault. During the examination, the physician obtained evidence by using a sexual assault kit, which was subsequently submitted to the Phoenix Police Department's crime laboratory. Cynthia Souther, the criminalist who analyzed the evidence, testified at defendant's trial that, in addition to the sexual assault evidence kit, she examined several pieces of Michelle's clothing. Souther discovered stains on Michelle's shirt and jeans. Tests of those stains revealed the presence of semen. The testing further revealed that the stains were "mixed stains," meaning that more than one person contributed to them. After conducting enzyme comparisons of the stains with blood samples obtained from defendant and Michelle, Souther determined that defendant could not be excluded as a possible contributor to the mixed stains.

Debra Figarelli, a criminalist with the Arizona Department of Public Safety, subsequently created restricted fragment length polymorphism (RFLP) profiles of the mixed stain from Michelle's shirt and the known blood samples from defendant and Michelle. From her analysis of the shirt stain, Figarelli concluded that at least two males had contributed to the stain. She further concluded that defendant could not be excluded as one of those contributors.

Figarelli testified that, although she was comfortable performing the statistical analysis necessary to determine the match probabilities in single donor cases, she did not have the statistical training to perform such an analysis on a mixed stain created by two or more donors. Accordingly, she recommended that the state consult Dr. Bruce Weir, a professor of genetic statistics at North Carolina State University.

Acting on Figarelli's advice, the state forwarded the DNA information to Dr. Weir for his review. Apparently, however, after doing some work on the case, Dr. Weir requested that his colleague, Dr. Christopher Basten, take over the case because Dr. Weir no longer acted as a testifying expert. Dr. Basten assumed the case from Dr. Weir. Using published formulas created by Dr. Weir, Dr. Basten performed his own calculations, obtaining different results than Dr. Weir had during his initial work on the case.

Defendant subsequently requested a *Frye* hearing on Dr. Basten's (i.e., Dr. Weir's) method for determining the statistical probability of a random DNA match. At the hearing, Dr. Basten explained the process of computing statistical probabilities in the context of mixed samples or stains:

[W]hat you'd do is calculate the probability of [one] proposition versus competing propositions. So for example, it might be that one proposition is that a defendant contributed to the evidence, and a competing proposition would be that the defendant did not; some unknown person did. You simply apply population genetics to calculate the probability of the evidence in either case. Then you divide those probabilities to get a likelihood ratio which gives you a number, and that number gives you the strength of the evidence.

Dr. Basten testified that, to obtain the likelihood ratios in this case, he relied on formulas set forth by Weir and other genetic statisticians in an article published in the *Journal of Forensic Sciences* in 1997. See Bruce S. Weir et al., *Interpreting DNA Mixtures*, 42 *J. Forensic Sci.* 213 (1997). Dr. Basten informed the court that the formulas had been subjected to peer review prior to the article's publication. He also testified that Dr. Charles H. Brenner, an independent consultant in forensic mathematics, had prepared a formal proof of some of Dr. Weir's formulas. *Id.* at app. 2. Dr. Basten also testified that he was not aware of anyone who had rebutted Dr. Weir's formulas.

Dr. Basten was the only witness who testified at the *Frye* hearing. Relying on his testimony, the trial court concluded that Dr. Weir's formulas were generally accepted in the relevant scientific community, and it permitted Dr. Basten to testify about the statistical results he obtained from his use of those formulas.

A recitation of the specific likelihood ratios Dr. Basten obtained in this case is not necessary to resolve the issue on appeal. It is enough to note that Dr. Basten provided the jury with likelihood ratios (broken down by population subgroups such as Caucasians, African Americans, and the like) for three distinct scenarios involving the sources of the DNA mixture found in the stain: (1) victim, defendant and unknown versus victim and two unknowns; (2) victim, defendant and unknown versus defendant and two unknowns; and (3) victim, defendant and one unknown versus three unknowns.

## II. The *Frye* Standard

Forensic DNA analysis involves a three-step process. "First, through a lengthy process of chemical treatment and 'photographing' using radioactive probes and X-ray film, profiles (autorads) are created of DNA evidence samples from the crime scene and samples taken from the victim and the suspects. Second, the profiles are analyzed to determine whether any of the samples match.... Finally, the significance of the match is articulated, usually by calculating the probability of a random match." *State v. Hummert*, 188 Ariz. 119, 122, 933 P.2d 1187, 1190 (1997) (citing *State v. Bible*, 175 Ariz. 549, 577, 858 P.2d 1152, 1180 (1993)).

The DPS criminalist, Figarelli, conducted the first and second steps of the DNA analysis. Figarelli's methods and conclusions are not at issue in this appeal. Dr. Basten conducted the third step of the DNA analysis and presented his findings in the form of likelihood ratios. On appeal, defendant does not challenge the use of likelihood ratios per se as a method for expressing the probability of DNA matches. Rather, his sole argument is that the state failed to prove that the statistical formulas used by Dr. Basten, i.e., Dr. Weir's formulas, were generally accepted by the relevant scientific community, the sine qua non for admission of scientific evidence under *Frye*.<sup>2</sup> See: *State v. Bogan*, 183 Ariz. 506, 509, 905 P.2d 515, 518 (App.1995); see also *State v. Jones*, 130 Wash.2d 302, 922 P.2d 806, 808 (1996).

Of course, general acceptance in the relevant scientific community does not equate with scientific unanimity. See: *People v. Dalcollo*, 282 Ill.App.3d 944, 218 Ill.Dec. 435, 669 N.E.2d 378, 387 (1996). "[T]he mere existence of a dispute does not preclude a finding that a procedure is generally accepted. Rather, only significant disputes between qualified experts will preclude a finding of 'general acceptance.'" *Id.* (citations omitted); see also *United States v. Yee*, 129 F.R.D. 629, 631 (N.D. Ohio 1990) ("If a scientific process is reliable, or sufficiently accurate, courts may also deem it 'generally accepted.'" ) (quoting *United States v. Franks*, 511 F.2d 25, 33 n. 12 (6th Cir.1975)).

"[W]e conduct a de novo review to determine whether a scientific principle used as a basis for expert testimony is generally accepted in the relevant scientific community." *Bible*, 175 Ariz. at 578, 858 P.2d at 1181. In addition to the record before the trial court, we consider outside sources such as scientific literature, legal articles, and decisions of other jurisdictions. "The relevant inquiry [under *Frye*], however, is acceptance by scientists, not by the courts or legal commentators." *Jones*, 922 P.2d at 809.

Judges and lawyers usually possess scant, if any, familiarity with the scientific principles they must subject to the *Frye* analysis. As a result, their ability to accurately discern whether those principles have attained general acceptance in the relevant scientific community is limited at best. The problem is especially evident in cases, such as this one, when even the "relevant scientific community" itself concedes that the subject is a difficult one. See: National Research Council (NRC), *The Evaluation of Forensic DNA Evidence* 130 (1996) (describing the statistical analysis of mixed DNA samples as "complex") [hereinafter NRC II ]. Nevertheless, fully acknowledging our shortcomings as both statisticians and geneticists, we will attempt to determine whether the formulas relied upon by Dr. Basten in calculating the likelihood ratios in this case are generally accepted in the relevant scientific community.

Our survey of the relevant scientific literature reveals no significant dispute concerning the validity of Dr. Weir's formulas. Prior to their publication in a reputable journal, the formulas were subjected to peer review. As the United States Supreme Court observed in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, "submission to the scrutiny of the scientific community is a component of 'good science,' in part because it increases the likelihood that substantive flaws in methodology will be detected." 509 U.S. 579, 593, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993). Moreover, our research has revealed no post-publication criticisms of the formulas, nor has defendant identified any such critiques in his brief.

Most importantly, however, our review of NRC II persuades us that, contrary to defendant's contention, the NRC has recognized the reliability of Dr. Weir's formulas.

The NRC is comprised of "a distinguished cross section of the scientific community." *State v. Johnson*, 186 Ariz. 329, 334, 922 P.2d 294, 299 (1996) (quoting *United States v. Porter*, 618 A.2d 629, 643 n. 26 (D.C.1992)). The NRC's recognition of the reliability of given methods for calculating probability estimates "can easily be equated with general acceptance of those methodologies in the relevant scientific community." *Porter*, 618 A.2d at 643 n. 26. Thus, as the court concluded in *Johnson*, endorsement by the NRC is "strong evidence" that a methodology or formula satisfies *Frye*. 186 Ariz. at 334, 922 P.2d at 299.

In discussing the statistical analysis of mixed samples in its 1996 report, the NRC acknowledged that a likelihood-ratio analysis offers "a clear advantage and is particularly suitable." *NRC II, supra*, at 129. The Committee observed that the "correct procedure" for calculating likelihood ratios for a mixed sample was described by Professor Ian Evett and others in a 1991 article. *Id.* at 130 (citing Ian W. Evett et al., *A Guide to Interpreting Single Locus Profiles of DNA Mixtures in Forensic Cases*, 31 J. Forensic Sci. Soc'y 41-47 (1991)). Dr. Weir's formulas involve the same method advocated by Evett. See Weir, *supra*, at 213 ("Mixed-stain evidence was discussed by Evett et al. (1991), and more recently by Aitken (1995). Their method, which is the same as the one we use, has been endorsed by the National Research Council (1996).").

*NRC II* concluded its discussion of mixed samples by directing the reader to a "fuller treatment" of the subject in a then-unpublished article by Dr. Weir and others. See *NRC II, supra*, at 130 and 239. That article, *Interpreting DNA Mixtures*, which was subsequently published in the *Journal of Forensic Sciences*, is the source of the formulas upon which Dr. Basten relied in this case. Finally, the following comments from *NRC II* concerning the use of likelihood ratios in criminal cases support a finding that Dr. Weir's formulas satisfy *Frye*:

Although LR [likelihood ratios] are rarely introduced in criminal cases, we believe that they are appropriate for explaining the significance of data and that existing statistical knowledge is sufficient to permit their computation. None of the LR [likelihood ratios] that have been devised for VNTR [variable number tandem repeats] can be dismissed as clearly unreasonable or based upon principles not generally accepted in the statistical community. Therefore, legal doctrine suggests that LR [likelihood ratios] should be admissible unless they are so unintelligible that they provide no assistance to a jury or so misleading that they are unduly prejudicial. *NRC II, supra*, at 200.

We accept the NRC's reference to likelihood ratios in general, and Dr. Weir's article in particular, as strong evidence that Dr. Weir's formulas satisfy *Frye*.<sup>3</sup> Accordingly, we affirm the trial court's ruling on *Frye* admissibility. Because defendant does not otherwise challenge the admissibility of the likelihood ratios, we reach no conclusion as to whether their admission was otherwise appropriate.

## CONCLUSION

Finding no error in the trial court's *Frye* ruling, we affirm defendant's convictions.

CONCURRING: RUDOLPH J. GERBER, Judge.

THOMPSON, Judge, concurring.

I agree with the majority opinion in all respects, except that I do not join in the discussion in footnote two.

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<sup>1</sup> A likelihood ratio, which is a ratio of conditional probabilities, is a measure of the strength of a piece of evidence in distinguishing between hypotheses. See: Geoffrey K. Chambers et al., *Forensic DNA Profiling: The Importance of Giving Accurate Answers to the Right Questions*, 8 *Crim. L.F.* 445, 454-55 (1997).

<sup>2</sup> Because of defendant's narrow tailoring of the argument, we need not address other potential evidentiary difficulties attendant to the use of likelihood ratios. Some commentators contend that likelihood ratios are too complex and confusing to be of assistance to jurors and should therefore be deemed inadmissible. See, e.g., Jonathan J. Koehler, *On Conveying the Probative Value of DNA Evidence: Frequencies, Likelihood Ratios, and Error Rates*, 67 *U. Colo. L.Rev.* 859, 876-80 (1996). Indeed, Professor Koehler argues that even some experts are confused by the distinction between likelihood ratios and other methods of expressing statistical probabilities. *Id.* at 876. Our review of the record in this case lends some credence to Professor Koehler's observations. Questions posed to Dr. Basten by the prosecutor, defense counsel and even the court suggest fundamental confusion over the results and the significance of Dr. Basten's statistical analysis. Remarkably, despite its potential importance, the state failed to discuss any of the DNA evidence in its closing argument. Further, during deliberations, the jury requested a clarification of Dr.

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Basten's findings, but were told that Dr. Basten's conclusions were a "factual issue" that they must resolve on their own.

<sup>3</sup> Defendant argues that *NRC II*'s reference to Dr. Weir's article does not equate with endorsement or approval of that article by the NRC. In support of this argument, he cites, out of context, a portion of the preface from *NRC II* to the effect that "statements in the text are not intended to have the force of formal recommendations." *Id.* at vi. When the statement from the preface is viewed in its entirety, however, it is evident that the NRC was referring to recommendations concerning the appropriate application of DNA technology and/or areas for further research, not "recommendations," i.e., endorsements, of particular scholarly research:

Specific recommendations are numbered and given at the ends of the chapters and are reproduced in the Executive Summary and Overview. Other statements in the text are not intended to have the force of formal recommendations, although we do make a number of suggestions.

*Id.*