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## When the Blue Bus Crashes into the Gate: The Problem with *People v. Collins* in the Probabilistic Evidence Debate

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# COMMENTS

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*"Probabilistic . . . of, relating to, or based on probability."\**

### I. INTRODUCTION

Fact: Every lawyer must deal with probabilities on an intimate level.<sup>1</sup> Fact: Every lawyer practicing in America must accept the scientific approach to life that permeates her society. Fact: Every lawyer must apply her education and life experiences to the practice of her craft.<sup>2</sup> Inference: Therefore, every lawyer in America must accept the scientific application of mathematical theory to probability assessments. Reality: Probabilistic evidence faces an almost insurmountable resistance in the American criminal courtroom.<sup>3</sup>

There is a current debate in the scholarly literature on the

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\* WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 1806 (4th ed. 1976).

1. This is perhaps most fundamentally illustrated by the acceptance of a case by counsel. Throughout a case an attorney must evaluate the probability of an outcome favorable to her client.

2. Any other mode of operation would be inconceivable because to imagine a practice outside one's experience is impossible. It also would be unimaginable to the practitioner to practice in a manner contrary to her educational experience. This method of practice denies a client the zealous advocacy to which she is entitled.

3. There are instances in which general statistical evidence and the probabilistic application thereof are accepted. DAVID W. BARNES, STATISTICS AS PROOF 33-35 (1983). Along with these general situations, this Comment disregards any situations in which non-randomness is the *subject* of the litigation, as such situations would require the admission of relevant probabilistic evidence that was properly founded and authenticated.

acceptability/desirability of probabilistic evidence in the courtroom,<sup>4</sup> with the major point of contention being its use in criminal cases. The commentary variously argues wide use,<sup>5</sup> almost no use,<sup>6</sup> and a middle ground.<sup>7</sup> As used in the current literature, the term "probabilistic evidence" refers to the application of mathematical theories to statistical<sup>8</sup> or assumed<sup>9</sup> distributions of characteristics within a group to help establish the likelihood that a certain event is a non-random occurrence.<sup>10</sup>

For the majority of the discussion surrounding this issue, the arguments are sophisticated and well supported. However, there is a problem throughout the debate with the frequent and uncritical use of the 1968 California decision of *People v. Collins*.<sup>11</sup> This case is significantly flawed in its supporting rationale and the pragmatic considerations that motivated it. Therefore, use of *Collins* is unhelpful in understanding or furthering the academic debate on the admissibility of probabilistic evidence. In the recent case of *Rachals v. State*,<sup>12</sup> the

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4. For the most complete collection of Articles and Comments on this debate, see *Decision and Inference in Litigation*, 13 CARDOZO L. REV. nn.2-3 (1991); 66 B.U. L. REV. nn. 3-4 (1986).

5. See, e.g., Michael O. Finkelstein & William B. Fairley, *A Bayesian Approach to Identification Evidence*, 83 HARV. L. REV. 489 (1970); Richard D. Friedman, *Generalized Inferences, Individual Merits, and Jury Discretion*, 66 B.U. L. REV. 509 (1986). See generally Peter Tillers, *Introduction*, 66 B.U. L. REV. 381 (1986).

6. See, e.g., L.J. COHEN, *THE PROBABLE AND THE PROVABLE* (1977); Charles Nesson, *Agent Orange Meets the Blue Bus: Factfinding at the Frontier of Knowledge*, 66 B.U. L. REV. 521 (1986).

7. See, e.g., Richard Lempert, *The New Evidence Scholarship: Analyzing the Process of Proof*, 66 B.U. L. REV. 439 (1986).

8. There are various methods of probability analysis, the most familiar of which is probably Bayes' Theorem. See *infra* Appendix pp. 1005-08. All the methods require that probabilities first be assigned to the characteristics of interest. Both statistical and empirical probability use statistical data. The method of probability factor assignment chosen does not in any way influence the computational method chosen later. See generally TERENCE ANDERSON & WILLIAM TWINING, *ANALYSIS OF EVIDENCE* 404-16 (1991).

9. Those analyses making use of assumed probability figures are classical, metaphysical, subjective and logical probability. *Id.* at 407-15.

10. See, e.g., Finkelstein & Fairley, *supra* note 5; Laurence H. Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329, 1350-58 (1971). Although these articles often specifically address so-called "naked statistical evidence," that is, evidence of guilt based solely on statistical evidence, this does not affect the analysis mathematically. Because this Comment is confined to the narrow issue of the unhelpful nature of *Collins* and its misuse, discussion of the collateral debate on the admissibility of naked statistical evidence versus statistical evidence in conjunction with other admissible evidence will not be pursued here.

11. 438 P.2d 33 (Cal. 1968) (In Bank). For the facts of *Collins* and the test established therein, see *infra* text accompanying notes 34-64.

12. 361 S.E.2d 671 (Ga. Ct. App. 1987), *aff'd*, 364 S.E.2d 867 (Ga. 1988), *cert. denied*, 487 U.S. 1238 (1988). The Supreme Court of Georgia affirmed the Court of Appeals without addressing the probabilistic evidence issue.

Court of Appeals of Georgia affirmed the admission of probabilistic evidence by the trial court. The court briefly discussed *Collins*, which disallowed probabilistic evidence at trial, citing it as a decision contrary to the controlling precedent in Georgia.<sup>13</sup> However, even in that brief discussion, the court managed to misuse *Collins*<sup>14</sup> by merely stating the result without successfully interpreting or critiquing the rationale,<sup>15</sup> and by encouraging the reader to look to the *Collins* appendix<sup>16</sup> for help in understanding the principles involved in probability analysis. This cursory, uncritical treatment is typical of the use of *Collins* by courts and academics.<sup>17</sup> In addition, the *Collins* appendix is neither fully correct<sup>18</sup> nor, even in its accurate statements, particularly helpful to non-mathematicians.<sup>19</sup>

The *Collins* decision has been cited with some frequency in both court opinions<sup>20</sup> and scholarly literature.<sup>21</sup> The main argument in the scholarly literature concentrates more specifically on the application of the *Collins* rationale to the use of Bayesian analysis, a probability calculus, in similar settings.<sup>22</sup> In arguing their respective positions on this issue, those on both sides of the admissibility debate have repeatedly relied on *Collins* to provide case law to support their claims.<sup>23</sup> This reliance on *Collins* is misplaced. The use of *Collins* to support an argument on the admissibility of probabilistic evidence presents at

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13. *Id.* at 675.

14. See *infra* text accompanying notes 195-205.

15. *Rachals*, 361 S.E.2d at 675.

16. *Id.*

17. The specific mention of *Rachals* here is to give the reader a quick and simple example of the poor use of *Collins*.

18. See William B. Fairley & Frederick Mosteller, *A Conversation About Collins*, 41 U. CHI. L. REV. 242 (1974); see also Robert P. Charrow & Robert L. Smith, *A Conversation About "A Conversation About Collins,"* 64 GEO. L.J. 669 (1976).

19. In discussion with other students during the evidence course in which this case was discussed, the general consensus was that the material was fairly dense and difficult to understand. Part of this is due, no doubt, to the lack of mathematical expertise that seems to prevail in legal circles.

20. See, e.g., *People v. Brown*, 726 P.2d 516, 528 (Cal. 1985), *as modified* (1986); *People v. Cella*, 188 Cal. Rptr. 675, 683 (Cal. Ct. App. 1983); *People v. Heard*, 72 Cal. Rptr. 374, 378 (Cal. Ct. App. 1968).

21. See, e.g., Jonathan J. Koehler & Daniel N. Shaviro, *Veridical Verdicts: Increasing Verdict Accuracy Through the Use of Overly Probabilistic Evidence and Methods*, 75 CORNELL L. REV. 247, 254 n.26 (1990); Daniel Shaviro, *Statistical-Probability Evidence and the Appearance of Justice*, 103 HARV. L. REV. 530, 545 (1989).

22. See L.J. COHEN, *supra* note 6; Tribe, *supra* note 10; see also *supra* note 3.

23. Among those scholars endorsing the use of probabilistic evidence are Ward Edwards, *Summing Up: The Society of Bayesian Trial Lawyers*, 66 B.U. L. REV. 937, 941 (1986); Stephen E. Fienberg, *Gatecrashers, Blue Buses, and the Bayesian Representation of Legal Evidence*, 66 B.U. L. REV. 693, 697 (1986). Among scholars arguing against the use of such evidence is Tribe, *supra* note 10.

least three fundamental problems. First, the scope of the *Collins* decision is not well defined. That is, the court did not give a clear indication of what use, if any, was to be made of probabilistic evidence at trial. This ambiguity results from the court's inconsistent rationales and unsound pragmatic motivations.<sup>24</sup> The rationales either stem from poor use of the evidence or from a desire to prevent the use of such evidence due to policy concerns. This Comment illustrates the conflict between these rationales as presented in *Collins*. Likewise, the pragmatic motivations, including fear of abuse of the evidence and ineffective rebuttal, are no more necessitated by this evidence than many other types of evidence. Nonetheless, commentators have argued that the standards set forth by the *Collins* court are clear and distinct.<sup>25</sup>

Second, the courts that have subsequently interpreted *Collins*<sup>26</sup> have failed to consistently and critically examine the rationales used by the *Collins* court. This leaves those authors who relied upon *Collins* without a present basis of support in *Collins* itself<sup>27</sup> and also without a way to work with the rule in those situations that do not find *Collins* specifically on point.<sup>28</sup> When subsequent decisions fail to interpret and apply precedent consistently, reliance upon the precedent for its original statement of the law is not only pragmatically useless in the courtroom, but any theoretical basis in the original decision is also lost if used to support the original court's rationale for its opinion.

Third, the ever-changing face of science makes reliance upon *Collins* insupportable in light of the standard by which scientific evidence (of which, it must be admitted, probability analysis is a member) is judged in other contexts.<sup>29</sup> The scientific evidence standard

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24. See *infra* text accompanying notes 147-156, 170-173 & 176-186.

25. Commentators typically use four factors actually stated by the California Supreme Court, but without noting that the factors have incompatible effects on the outcome of future cases. See, e.g., Neil B. Cohen, *Confidence in Probability: Burdens of Persuasion in a World of Imperfect Knowledge*, 60 N.Y.U. L. REV. 385, 389 (1985). But see Tribe, *supra* note 10, at 1335-37.

26. See *infra* Part III.

27. There are several examples of cases in which the result in *Collins* should arguably be the controlling precedent. These cases rely heavily on statistical analysis and probability assessments. See *People v. Axell*, 1 Cal. Rptr. 2d 411 (Ca. Ct. App. 1991) (holding DNA evidence admissible in murder trial); *People v. Nation*, 604 P.2d 1051 (Cal. 1980) (allowing ABO blood typing and identification of the genetic marker phosphoglucumutase to help eliminate a percentage of population as semen donors); *Cramer v. Morrison*, 153 Cal. Rptr. 865 (Cal. Ct. App. 1979) (allowing the result of Human Leucocyte Antigen paternity test into evidence).

28. See *infra* text accompanying notes 229-235.

29. See *Frye v. United States*, 293 F. 1013-1014 (D.C. Cir. 1923) ("[test at issue] has not

allows for admission when merited by the advance of technology.<sup>30</sup> The test for the admissibility of scientific evidence has been clearly established.<sup>31</sup> Failure to successfully incorporate the *Collins* test with this standard causes a direct conflict between the two tests. This conflict not only contravenes the common law method of adjudication by reliance on precedent, but also necessarily weakens both standards—a jurisprudentially unfavorable result. If the law is truly a “seamless web,” then meaningless conflicts (if not all conflicts) within the law, and a fortiori within a given area of the law (here scientific evidence), will operate to destroy the force not only of the conflicting strands, but also of the entire web.

This Comment does not make any final evaluation of the desirability of the use of probabilistic/statistical evidence.<sup>32</sup> Rather, it illustrates how *Collins* is not in *any* manner dispositive of the acceptability of such evidence. Parts II, III, and IV of this Comment explain why the three reasons given above mandate rejection of *Collins* as a touchstone in the current debate. Following the conclusion, an appendix will briefly set forth the basic principles of Bayesian analysis.<sup>33</sup> This appendix provides a guide for those unversed in the mathematical theory that undergirds the larger debate. Furthermore, it should prove helpful to those who wish to further investigate this arena.

## II. *COLLINS'* INCONSISTENCIES

### A. *The Test in Collins*

At 11:30 a.m. on June 18, 1964, Mrs. Juanita Brooks was pushed to the ground in an alley, stunned and in pain.<sup>34</sup> She looked up to see

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yet gained such standing”) (emphasis added); *United States v. Downing*, 753 F.2d 1224, 1238 (3d Cir. 1985) (establishing a test that admits scientific evidence upon a showing of reliability).

30. *Frye* is the controlling federal decision, which California expressly adopted in *People v. Kelly*, 549 P.2d 1240, 1247 (Cal. 1976).

31. See, e.g., *People v. Morris*, 245 Cal. Rptr. 52 (Cal. Ct. App. 1988); *People v. Brown*, 709 P.2d 440 (Cal. 1985), *as modified* (1986); see also text accompanying notes 209-212.

32. Although this Comment takes no position on the desirability of admission of probabilistic evidence, any discussion of probabilistic evidence must be accompanied by at least a cursory knowledge of the mathematics involved. Because Bayes' Theorem is most widely discussed in the literature, see *supra* note 8, the Appendix is constructed to explain the basics of that theorem. The basics of Bayes' Theorem coincide with the basics of the other computational probability theorems and will be of use when addressing probability theories generally.

33. For a more extensive explanation of the mathematics of Bayes' Theorem, see COHEN, *supra* note 6; Finkelstein & Fairley, *supra* note 5; David McCord, *A Primer for the Nonmathematically Inclined on Mathematical Evidence in Criminal Cases: People v. Collins and Beyond*, 47 WASH. & LEE L. REV. 741 (1990).

34. *People v. Collins*, 438 P.2d 33, 34 (Cal. 1968) (In Bank).

a young woman with blond hair running away from her.<sup>35</sup> Upon investigating, Mrs. Brooks discovered that her purse was gone.<sup>36</sup> John Bass, who lived nearby, heard "crying and screaming" from the direction of the alley, and looked up to discover a woman running away.<sup>37</sup> The woman entered a "yellow" car driven by a bearded, mustachioed black male.<sup>38</sup> Malcolm and Janet Collins were arrested twenty-one days later and charged with second degree burglary.<sup>39</sup> Ms. Collins had blond hair, which she wore in a ponytail.<sup>40</sup> Mr. Collins was black and had worn a mustache and beard on occasion.<sup>41</sup> In addition, Mr. Collins owned a yellow Lincoln automobile with an off-white top.<sup>42</sup> The only eyewitness identification was questionable, and the couple maintained that they were at the home of friends at the time of the robbery.<sup>43</sup>

During the trial, the prosecution offered the testimony of a mathematician from a state college to bolster its claim that it was the Collinses who committed the robbery.<sup>44</sup> The witness explained the "product rule" of probability analysis<sup>45</sup> and, after being supplied with probability factors by the prosecution, computed what was argued to be the probability that any couple other than Mr. and Mrs. Collins were the perpetrators of the crime.<sup>46</sup> This "probability" was one in 12 million.<sup>47</sup> The defense objected to the admission of this evidence;<sup>48</sup> the court overruled;<sup>49</sup> and the Collinses went to jail.<sup>50</sup> Malcolm Collins appealed his conviction, contending that court erroneously admitted the evidence of identification based on probability.<sup>51</sup> The

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35. *Id.*

36. *Id.*

37. *Id.*

38. *Id.*

39. *Id.* at 35.

40. *Id.*

41. *Id.*

42. *Id.* at 34.

43. *Id.*

44. *Id.* at 36.

45. The product rule theorizes that if any number of "outcomes" (here, characteristics) are mutually independent—that is, the presence of one does not influence the presence of the others—then the probability of their occurring together is the product of their individual probabilities. For example, the chance of rolling "boxcars," or two sixes, with a pair of dice is calculated as follows: The chance of rolling a 6 on any one die is 1/6. When a pair of dice is thrown, according to the product rule, the chance of boxcars (or any doublet) is  $1/6 \times 1/6 = 1/36$ .

46. *Collins*, 438 P.2d at 36-37.

47. *Id.* at 37.

48. *Id.*

49. *Id.*

50. *Id.* at 33.

51. *Id.* at 37-38.

California Supreme Court agreed and reversed.<sup>52</sup>

The *Collins* opinion does not purport to abolish the use of mathematical evidence in all situations.<sup>53</sup> However, this has been its practical effect, because of other courts' reliance on the "test" established therein.<sup>54</sup> The decision of the California Supreme Court in *Collins* has been commonly regarded as establishing a four-prong test for the admissibility of probabilistic evidence at trial.<sup>55</sup> The text of the opinion does not explicitly enumerate the requirements for admissibility of probabilistic evidence as prongs of a single test. In fact, the opinion identifies two fundamental problems involved with the evidence at issue.<sup>56</sup> However, the opinion splits these two problems into four distinct issues from which the prongs have been derived.<sup>57</sup>

To meet the *Collins*' test, a litigator must show: (1) that the mathematical analysis was performed using probability factors<sup>58</sup> that accurately represent the actual distributional frequency<sup>59</sup> of those characteristics to which they were ascribed;<sup>60</sup> (2) that the mathematical calculations were properly performed in a correct application of the theory from which they were derived;<sup>61</sup> (3) that the party to which the characteristics are ascribed actually possessed them;<sup>62</sup> and (4) that the evidence tends to prove that there was only one distinct unit (here, a couple)<sup>63</sup> that could have possessed these characteristics.<sup>64</sup>

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52. *Id.* at 33.

53. *Id.*

54. See *infra* notes 233-235 and accompanying text.

55. See, e.g., Cohen, *supra* note 25, at 388-89; Tribe, *supra* note 10. But see Hans Zeisel, *Dr. Spock and the Case of the Vanishing Jurors*, 37 U. CHI. L. REV. 1, 13-16 (1969) (alleging three "errors").

56. *Collins*, 438 P.2d at 38. See also Randolph N. Jonakait, *When Blood is Their Argument: Probabilities in Criminal Cases, Genetic Markers, and, Once Again, Bayes' Theorem*, 1983 U. ILL. L. REV. 369, 373-374 (1983) (splitting the first fundamental error into two prongs).

57. *Collins*, 438 P.2d at 38.

58. Probability factors are those probabilities assigned to outcomes (here, characteristics) that are used in computation of aggregated probabilities. See *supra* note 45; see also *infra* text accompanying notes 248-251.

59. As used in this Comment, "distributional frequency" is defined as the frequency that an outcome (characteristic) occurs in a given population.

60. *Collins*, 438 P.2d at 38.

61. *Id.* at 39. This is an example of the incorrect application of the product rule. The problem is not with the theory involved, but that the theory was not followed.

62. *Id.* at 40.

63. In *Collins* the unit of interest in the probabilistic analysis was a couple, a black man and a white woman. The paradigmatic inquiry of a probabilistic analysis would involve analyzing the characteristics of an individual. However, this is not required. It is only necessary that a distinct unit (an individual, a couple, a trio) is the subject of the inquiry.

64. *Collins*, 438 P.2d at 40.



Prong one demands that the party who proffers statistical probabilities of characteristics ground them in fact.<sup>65</sup> The prong demands that the familiar rule of "adequate foundation"<sup>66</sup> be met. The factors used in the probabilistic analysis must be relevant to "real world" probabilities in order for resulting calculations to be representative of the actual aggregation of those probabilities,<sup>67</sup> and for the jury to evaluate the information intelligently. Therefore, the court insisted that these factors be adequately founded in fact,<sup>68</sup> and that this foundation be laid out for the jury and the record.<sup>69</sup> The prosecutor in *Collins* contended that the probabilistic evidence was merely illustrative and was not intended to represent actual probabilities.<sup>70</sup> As the court correctly noted, this argument is unpersuasive due to the nature of the factors/characteristics chosen by the prosecutor for this "illustration." The characteristics chosen were those possessed by the suspects and, in large part, shared by, the defendants.<sup>71</sup> Such an illustration misleads the jury because it is particular to important matters in issue. Had the prosecutor attempted to illustrate the product rule with characteristics related to, say, the probability of finding a McDonald's employee in a blue uniform in Topeka, Kansas on a Saturday during summer, his argument might well have been more credible.<sup>72</sup>

Prong two simply requires that the mathematician perform her job and illustrate this for the jury.<sup>73</sup> The mathematician is there to apply a theory that is outside the ken of the jury,<sup>74</sup> and she must show them that she is doing so correctly. This involves illustrating not only the soundness of the theory, but also that the mechanics were performed correctly. If not, the jury has no basis for knowing, indeed, even believing, whether application of the theory will result in accurate information on the final probability derived.<sup>75</sup> Prong two, then, involves failure of proof. Incorrect use or application of the theory

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65. *Id.* at 39.

66. *See generally* CHARLES T. MCCORMICK, HANDBOOK OF THE LAW OF EVIDENCE § 14 (1954).

67. *Id.*

68. *See infra* text accompanying notes 104-115.

69. *Collins*, 438 P.2d at 39.

70. *Id.* at 37.

71. *Id.* at 37 n.10.

72. *See id.*

73. *Id.* at 39.

74. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

75. The theory in *Collins* required independent factors. The expert, although acknowledging this, failed to demonstrate the independence of the factors he used to compute the answer. *Collins*, 438 P.2d at 39.

will lead to results that have no tendency to prove or disprove the allegations upon which the theory allegedly bears.

Prong three requires the proponent to show that the parties of interest<sup>76</sup> possess the characteristics of interest in the statistical calculation.<sup>77</sup> That is, there are questions about eyewitness testimony<sup>78</sup> or other pieces of direct evidence<sup>79</sup> that must be answered in order for the circumstantial evidence<sup>80</sup> (the probability calculation) to be relevant. If the direct testimony is incorrect (e.g., if the eyewitness mistakenly identified a redhead as a blond), then the computation based on that evidence will be invalid. This requirement is not new to the realm of proof.<sup>81</sup> Eyewitnesses have always been subject to searching inquiry into the quality of their recollection,<sup>82</sup> their descriptions<sup>83</sup> and their observational capacity.<sup>84</sup> This requirement needs no further rationale for application in this context, as the same concerns are present here.<sup>85</sup> In addition, the probabilistic evidence application does not necessitate a more stringent inquiry into these concerns.<sup>86</sup> Where the direct evidence is sufficiently believable or admissible generally, there is no reason proffered by the *Collins* court for heightened or additional scrutiny of the evidence.<sup>87</sup>

Prong four is a heightened relevancy test, requiring the evidence prove that only one couple could have possessed the characteristics of

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76. This does not necessarily mean the parties at bar, although that is the ultimate question. This prong relates to the perpetrators themselves and whether *they* possessed the characteristics of interest.

77. *Collins*, 438 P.2d at 38.

78. *Id.* at 40.

79. See ANDERSON & TWINING, *supra* note 8, at 56-57.

80. *Id.* at 60-61.

81. See generally Robert Buckhout, *Psychology and Eyewitness Identification*, 2 LAW & PSYCHOL. REV. 75 (1976); NATHAN R. SOBEL, EYEWITNESS IDENTIFICATION: LEGAL AND PRACTICAL PROBLEMS § 6 (Lawrence A. Vogelmann & Barry C. Scheck eds., 2d rev. ed. 1991).

82. See generally, Bernard L. Diamond, *Inherent Problems in the Use of Pretrial Hypnosis on a Prospective Witness*, 68 CAL. L. REV. 313, 332-342 (1980).

83. See ANDERSON & TWINING, *supra* note 8, at 60-61.

84. See *Cruz v. New York*, 481 U.S. 186, 195 (1987) (White, J., dissenting) (citing *Bruton v. United States*, 391 U.S. 123, 139-140 (1968) (White, J., dissenting)).

85. Of course, the probabilistic analysis of the eyewitness evidence does not change the inherent problems of eyewitness testimony.

86. See *infra* notes 125-130 and accompanying text.

87. No policy rationale merits extended discussion. The policy espoused in the Federal Rules of Evidence that relevant evidence is admissible generally announces the general consensus that more information leads to better decisions. See FED. R. EVID. 402 advisory committee's note. See also MCCORMICK, *supra* note 66, at § 184. The possible attack in the probabilistic evidence application, that the perceived certitude of the calculus merits heightened scrutiny of the validity of the underlying evidence, goes to the weight of the evidence and should not be used in an admissibility argument. In addition, errors in the calculation due to necessary imprecision in the underlying assumption are readily available for attack on cross-examination.

interest. Assuring that the calculation does more than just not exclude the couple may, in fact, be important.<sup>88</sup> The court, however, made two errors in the development of this prong. First, the calculation of a forty percent possibility that another couple could be found who possessed the characteristics of interest is factually inaccurate.<sup>89</sup> Second, the court rationalized that the calculus only proved whether a *random* couple could be found with the characteristics of interest, and thus the element of particularity necessary for relevancy was missing.<sup>90</sup> However, the relevance of this calculation is clear. Had the odds of randomness actually been one in thirty trillion, it is more than safe to say that no couple meeting this description would occur randomly. Therefore, any couple meeting the description would be the couple of interest beyond a shadow of a doubt.

The first fundamental problem with the use of *Collins* in the probabilistic evidence admissibility debate stems from the test itself. There are significant consistency problems with the test that make it difficult to apply as precedent and unconvincing as support on either side of this debate. First, the interdependency of the prongs is unclear. That is, it is uncertain from the opinion whether each prong may be satisfied independently, or whether they are intertwined to the extent that meeting any of the prongs will depend on satisfying other prongs.<sup>91</sup> The main problem with this ambiguity is that the test is meant to solve admissibility problems. Without a clear mandate on how to proceed under the *Collins* test, litigators and judges will be hindered in applying it. Normally, the mere difficulty of applying a test may be a reason for contending that the test is unworkable.<sup>92</sup> However, this argument is even stronger regarding evidence admissibility, as rules of admissibility are meant to facilitate efficient trials.<sup>93</sup>

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88. Relevancy requires some tendency to prove or disprove a fact in issue. See FED. R. EVID. 401 advisory committee's note. Although evidence which does not exclude a suspect from guilt may be theoretically relevant because it will exclude *some* members of the general population—and thus reduce the theoretical pool of suspects—such evidence is insufficiently particularized to overcome its prejudicial effect. See FED. R. EVID. 403. This may be even more true where expert testimony and concomitant credibility concerns are involved.

89. Finkelstein & Fairley, *supra* note 5, at 493 n.12; see also Fairley & Mosteller, *supra* note 18; Charrow & Smith, *id.*

90. *Collins*, 438 P.2d at 40.

91. The division of the four specific errors into two groups of "fundamental" errors is not dispositive of any dependency within the groups and appears to be merely a convenient springboard for the court's discussion. See *supra* notes 55-57 and accompanying text; see also *infra* note 119 and accompanying text.

92. See *County of Allegheny v. ACLU*, 492 U.S. 573, 675-77 (1989) (Kennedy, J., dissenting).

93. WILLIAM TWINING, *RETHINKING EVIDENCE* 73 (1990); ANDERSON & TWINING, *supra* note 8, at 100-104.

Ambiguity impedes trials and causes inefficiency.<sup>94</sup> When an admissibility test fails to promote efficiency because of its ambiguity, the test must be found wanting, if not completely insufficient.<sup>95</sup>

Second, this consistency problem gives rise to further difficulties, for when the interdependency of prongs is unclear, courts must inquire into their relationship. Such an inquiry reveals that whether the prongs are assumed to be independent or dependent, the test does not retain any intellectual integrity.<sup>96</sup> If the court thought that the groupings it created helped relate dependent prongs,<sup>97</sup> then its understanding was clearly incomplete, as pragmatic concerns of logical reasoning would have foreclosed discussion of some of the prongs.<sup>98</sup> Given the impressive membership of this court, this rather obvious error is improbable.<sup>99</sup> The prongs within groups almost certainly are meant to be independent of each other. Therefore, apart from the workability in the courtroom, the *Collins* test is unsatisfactory for academic citation in the greater debate on probabilistic evidence.

If the *Collins* court meant the prongs to be independent,<sup>100</sup> that is, that any prong can be satisfied without influencing the outcome of the other prongs, then the rationales that undergird the prongs are inconsistent. Consequently, the test is not helpful in determining admissibility for any variation of the *Collins* fact pattern.<sup>101</sup> Thus, the test is unworkable<sup>102</sup> and academics should not use it as support for generalized propositions. The court set forth the prongs in two groups, each group representing one of the fundamental problems the court believed to exist.<sup>103</sup> The first group of two prongs, the court maintained, is required because the expert's testimony "lacked an ade-

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94. Ambiguity is typically resolved at trial by bench hearings. The issues involved in such hearings require preparation, argument and decision. This process slows down the progression of the trial.

95. See *infra* text accompanying notes 140-146. The difficulty applying the *Collins* prongs may also be evidence that the opinion was not well thought out. Certainly, academics would hesitate to place much faith in the case if it were proven to be improvidently decided.

96. See *infra* notes 144-154 and accompanying text.

97. See *infra* notes 144-152 and accompanying text.

98. See *infra* text accompanying note 152.

99. The 1968 California Supreme Court opinion was written by Justice Sullivan, with Justices Traynor, Peters, Tobriner, Mosk and Burke concurring. Justice McComb dissented. *Collins*, 438 P.2d at 42.

100. There is, of course, the possibility that the prongs are dependent. This dependency could occur *within* the groups or *between* the groups.

101. There will be situations sufficiently similar to *Collins* where such an inquiry is unimportant. However, the academic commentary is concerned with the scope, logic and applicability of *Collins* to other fact patterns and requires a logically compelling argument for general use in the area of probabilistic evidence.

102. See *infra* text accompanying notes 143-146.

103. *Collins*, 438 P.2d at 38, 40.

quate foundation both in evidence and in statistical theory."<sup>104</sup> The first prong forces the litigator to "get her facts straight" and communicate them to the jury. The second prong tells the litigator that she must apply the theory correctly. This group is essentially concerned with the *process* of presenting evidence. Although difficult to discern through the complexity of the opinion, a significant conflict arises when comparing the underlying rationales of the two fundamental errors. If these errors are assumed to be dependent upon one another, then the rationales that support both are ultimately obliterated.

The first group of prongs addresses the sufficiency of the evidentiary foundation. If the foundation is insufficient, as the court found in *Collins*, then the jury cannot function properly because it has been given irrelevant information amounting to "wild conjecture."<sup>105</sup> The second group of prongs addresses the usefulness of the theory in assisting the jury. The *Collins* court found that the mathematical technique used "unduly impressed"<sup>106</sup> the jury and failed to provide them with particularized information of the defendant's guilt, and therefore was unfairly prejudicial. The underlying conflict between these rationales demonstrates that they cannot be dependent and still retain any integrity.<sup>107</sup> The court in prong one noted that there was no evidence relating the probability factors used in the mathematician's computations to actual distributions of the characteristics they were meant to represent.<sup>108</sup> The quality of the evidence used in the prosecutor's probabilistic analysis, then, was not only poor, but was non-existent. That is, the prosecutor failed to give the jury proof that the factors the mathematician employed in his probability analysis were related in any way to actual probabilities. Thus, the jury received irrelevant evidence.<sup>109</sup> The court reasoned that such a complete lack of foundation for the factors used by the prosecutor was a "fatal gap"<sup>110</sup> in the proof and thus made the testimony inadmissi-

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104. *Id.* at 38.

105. *Collins*, 438 P.2d at 40.

106. *Id.* at 41.

107. See *infra* text accompanying notes 147-154.

108. *Id.* at 37 n.10. The factors used by the prosecutor were:

Partly yellow automobile	1/10
Man with mustache	1/4
Girl with ponytail	1/10
Girl with blond hair	1/3
Negro man with beard	1/10
Interracial couple in car	1/1000

109. *Id.* at 38. Irrelevant evidence is defined as "not supporting the issue of fact to be proved." BLACK'S LAW DICTIONARY 829 (6th ed. 1990).

110. *Collins*, 438 P.2d at 39.

ble.<sup>111</sup> This problem inheres, of course, in any expert testimony. Because the expert's specialized knowledge will be "beyond the ken" of the jurors, the court must require that the supporting information be grounded firmly in relevant, accurate facts.

This requirement that a foundation for expert testimony be laid could be satisfied, in theory, by presentation of empirical evidence showing that the factors represented actual frequency distributions.<sup>112</sup> That is, if the foundation for the expert's testimony regarding probability factors showed that empirical data had conclusively and definitively established the actual frequency of a characteristic in a given population, this part of the testimony would satisfy prong one.<sup>113</sup> Not only is this result logical, but the court actually stated that empirical proof of the accuracy of the probability factors would allow satisfaction of this prong of the test.<sup>114</sup> Indeed, this must be the case, since the prong, read independently, is a test of the quality of the factors used in the expert's testimony.<sup>115</sup>

The court found a second fault with the prosecutor's method of proof concerning the mathematician's testimony. The factors, found in prong one to have been without foundation, were found in prong two to have not been shown to be independent. More specifically, the expert witness did not illustrate for the jury that the probability factors were not influenced by the presence of each other.<sup>116</sup> One could erroneously read prong two to be the same as prong one—that both failings resulted in the jury hearing irrelevant information.<sup>117</sup> However, there is a vital difference between the two prongs.<sup>118</sup> The first

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111. *Id.* It seems that the court would have disallowed the evidence on this point alone.

112. See *infra* notes 147-150 and accompanying text.

113. For example, if the prosecution could have shown that every ten cars in Los Angeles were in reality yellow, then this prong of the test would have been satisfied.

114. See *Collins*, 438 P.2d at 39 (citing *State v. Sneed*, 414 P.2d 858 (N.M. 1966)).

115. The court emphasized this point when it cited *Sneed*. In *Sneed*, the court reasoned that the admissibility of mathematical odds depended upon the demonstration of the validity of the estimates of probability factors used for computing the odds. *Sneed*, 414 P.2d at 862. The *Collins* court indicated that validity of the factors was important to the question of admissibility when it argued that the prosecutor's invitation to the jury to formulate its own estimates was a "fatal gap" in the proof. *Collins*, 438 P.2d at 38. This must mean that had the mathematician who computed the final probability been able to prove the validity of the factors he used, thereby foreclosing the jury from inserting its own estimates, he would have satisfied the prong of evidentiary foundation.

116. This is merely the specific problem that is more generally set out in the text accompanying notes 73-75.

117. The "legal" flaw in both prongs rests on irrelevancy. The statistical flaws involved, however, are separate and distinct. Correcting the statistical accuracy problem would not necessarily correct the dependency relationship flaw noted by the court. Likewise, merely defining independent factors would not cure the statistical inaccuracy.

118. It is important to differentiate between the two prongs because this differentiation

prong deals with incomplete information; the second prong deals with improper application of theory. To assure that both are correct requires prongs that separately analyze the aspects of the information and theory to be utilized in the proof.<sup>119</sup>

The second group, also consisting of two prongs, was formulated by the court to keep probabilistic evidence from "distract[ing] the jury from its proper and requisite function of weighing the evidence on the issue of guilt . . . ."<sup>120</sup> The language used by the court is neither unique to expert testimony in general, nor to probabilistic evidence in specific. The concern is one of general application—that juries not be misled in the performance of their duties.<sup>121</sup> The court indicated that prong three, the first prong of the second group, arose because the prosecution did not—indeed, could not—prove that the guilty couple in fact possessed those characteristics described by the eyewitnesses to the crime.<sup>122</sup> That is, the prosecution failed to prove that the *perpetrators* possessed the characteristics ascribed to them by the eyewitnesses. This has nothing to do with whether the couple at bar possessed these characteristics. In fact, it is the correlation between the characteristics and the *couple at bar* that the probabilistic evidence is meant to help prove.<sup>123</sup> The opinion asserted that "no mathematical formula could ever establish beyond a reasonable doubt that the prosecution's witnesses correctly observed and accurately described the distinctive features which were employed to link defendants to the crime."<sup>124</sup> The court was not finding any factual or computational fault with the probabilistic evidence; rather, it was asserting that the mathematical formula failed to quantify eyewitness' error with regard to matters such as observational skills.

Observational and descriptive errors, of course, are present in

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further establishes the applicability of the *Frye* standard. See *infra* notes 215-226 and accompanying text.

119. Prong one, requiring that the data used in the probabilistic analysis be rooted in the real world, cannot assure that prong two, requiring correct application of the theory, will be satisfied. One can have incorrect data, and yet still perform the mathematical mechanics correctly. Conversely, one can misapply the theory to correct data. In either case the answer is erroneous. Neither prong helps determine the outcome of the other, as they address completely different aspects of a similar issue—the foundation of an expert witness's testimony.

120. *Collins*, 438 P.2d at 38.

121. See FED. R. EVID. 403 advisory committee's note.

122. *Collins*, 438 P.2d at 40. For a list of the characteristics involved, see *supra* note 108.

123. The application of probabilistic theory purports to illustrate the chances of a random couple's having the characteristics. If the chances are so slim as to be impossible—that is, "nonexistent" in randomly chosen couples—then any couple with those characteristics must be a highly unique and identifiable couple.

124. *Collins*, 438 P.2d at 40.

any eyewitness situation, and, taken in isolation, the *Collins*' court's statement would defeat any attempt to use eyewitnesses to describe the physical characteristics of assailants. For this reason, the court attempted to soften the sweeping nature of the statement by stating that, although this problem is present in every circumstantial prosecution, the weakness here was fatal because of the non-quantifiable nature of the witness error possibility.<sup>125</sup> The result, the court argued, was that the jury would be confronted with two pieces of evidence: the quantified probability of an individual's possessing the aggregated characteristics<sup>126</sup> and some non-quantified probability of witness error in perception, recall or description.<sup>127</sup> For the court, what distinguished *Collins* from other circumstantial prosecutions is that in all other situations the non-quantified observational error is not confronted with a highly specific quantity.<sup>128</sup> This analysis applies with equal force to the converse situation, where eyewitness testimony will not be confronted with forceful counter-evidence. This is not an insignificant problem. The court maintained that a jury could not "resist the temptation" to give the quantified evidence disproportionate weight. The court did not consider that empirical data might be compiled theoretically so that witness error could be quantified, as it suggested in prong one.<sup>129</sup> This inadequacy may be further evidence that the court did not fully consider its opinion.<sup>130</sup>

The fourth prong, requiring the prosecutor to prove that the couple at bar is "*the guilty couple*,"<sup>131</sup> differs only slightly from the third prong. In prong three the error lay with the theory's perceived inadequacy to deal with non-quantifiable witness error.<sup>132</sup> In prong four the error is also connected to the theory, but is related to the

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125. *Id.*

126. The court calls this quantity a "numerical index of probable guilt." *Id.* However, this characterization assumes the outcome and does not indicate that the number actually represents the possibility that another couple could be the couple present at the time of the robbery. There are other factors bearing on the guilt of the couple at bar that are not subsumed into this "index."

127. This problem is one contemplated by the Federal Rules of Evidence. See FED. R. EVID. 104 and advisory committee's note. The broad nature of this concern is a major motivating factor behind evidence admission rules.

128. *Collins*, 438 P.2d at 40.

129. The court did consider such a possibility in prong (1). See *supra* notes 112-115 and accompanying text. It is just this type of inconsistency that makes the *Collins* test inappropriate for academic citation.

130. See *supra* text accompanying notes 91-98.

131. *Collins*, 438 P.2d at 40.

132. There may be other non-quantifiable errors that would be of similar concern, such as witness credibility. These types of errors are present in all situations involving witness testimony. However, all scientific evidence implicitly, and often explicitly, recognizes such errors.



result, not the process.<sup>133</sup> The court reasoned that the analysis could do no more than show that a randomly chosen couple would possess the characteristics analyzed by the mathematician.<sup>134</sup> This is exactly what the analysis purports to do—analyze the probability that randomly selected units would possess the characteristics of interest.<sup>135</sup> The argument proceeds as follows: (1) certain characteristics exist in the perpetrators; (2) those characteristics exist in a certain ratio in the general public; (3) the chance of finding a *random* couple with those characteristics is vanishingly small; (4) any couple with such characteristics must not be random; (5) any non-random couple with the characteristics must be the couple identified by the eyewitnesses; (6) that couple must be the perpetrators. This argument proceeds under the assumption that no frailties exist in the foundation evidence. The only aspect of the “inference chain”<sup>136</sup> that involves the probabilistic computation is the minute chance that the characteristics exist in random couples. The court, however, failed to appreciate the probative value of such an analysis, and instead attempted to show<sup>137</sup> that, even given the analysis, the chances were very high that the characteristics could be duplicated by at least one other couple capable of having committed the robbery.<sup>138</sup> Rigorous analysis by statistical commentators<sup>139</sup> has shown that the court’s attempt to discredit the analysis’ result is ultimately unsuccessful and undermines this portion of its analysis. Additionally, the court’s rationale is ultimately that there could be a fault with the probabilistic analysis having proved exactly what it was designed to prove—an untenable “fault.”

Among the rationales a court, commentator or litigator are most likely to discover in *Collins* and infer as the motivation for the deci-

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133. Prongs (3) and (4) do not fare much better when assumed to be dependent upon each other. Whether eyewitness accuracy in perception, memory or recall could ever be shown to be quantifiable (prong (3)) would have no bearing on whether the theory could ever show anything more than the probability that a randomly selected couple would possess the aggregated characteristics (prong (4)). Furthermore, showing that the theory necessarily pointed to only one couple would never help ascertain whether the witness had accurately perceived and related the characteristics of the assailants to third persons. Again, as with prongs (1) and (2), assuming dependency of the prongs within each group is simply unhelpful in determining the outcome of any prong.

134. *Collins*, 438 P.2d at 40.

135. It is beyond the scope of this Comment to attempt to prove the intended end result of a probabilistic analysis. However, the court, without realizing the impact of its concession, admitted that identification as a result of uniqueness of random-characteristic-frequency-aggregation is the end result of probabilistic analysis. See *id.* at 40-41.

136. ANDERSON & TWINING, *supra* note 8, at 89-90.

137. *Collins*, 438 P.2d at 42-43.

138. *Id.* at 40.

139. See sources cited *supra* note 18.

sion are: (1) when a statistician testifies, for her testimony to be admissible it must have adequate foundation in empirical data and the theory in use must be properly applied to that data;<sup>140</sup> (2) when a statistical theory provides a quantified value for the jury on an issue closely aligned with the guilt of a suspect *and* some non-quantifiable refutation of that value is all that is available for rebuttal, then the quantified value is inadmissible;<sup>141</sup> (3) when a statistical theory provides probabilistic information whose probative value rests on its tendency to eliminate the remainder of the population rather than directly identify the suspects, it is inadmissible as lacking relevance.<sup>142</sup> These may not be the only rationales a litigator may be able to formulate, and their enumeration is not meant to imply otherwise.

It is not clear from the opinion which, if any, of the three rationales<sup>143</sup> are more important and which rationales, if fulfilled, may override the others, thus allowing admission. Moreover, a lower court faced with novel situations in this area will have no guidance in formulating a test that meets the *Collins* objective, as that objective is unclear from the rationales underlying *Collins* when the prongs are read independently. Therefore, *Collins* is an unsuitable touchstone in the current debate on probabilistic evidence.

If one assumes that the prongs are dependent, the *Collins* test is also unworkable. If the prongs are dependent upon one or more of the other prongs, then they not only have different rationales, but they also directly conflict with each other. The result is not mere ambiguity as to the court's intent, but outright logical conflict. Thus, the argument that ambiguity causes the opinion to be inappropriate for academic citation<sup>144</sup> would be even stronger where the prongs are dependent. Again, the ultimate issue is how the rules of evidence<sup>145</sup> will determine the course of a trial. If the test is unworkable for the courts and practitioners,<sup>146</sup> then there is little use in arguing that the test itself is sound. If one assumes that the prongs are interdependent, then there are additional facial (interdependence within the two groups), as well as more subtle (interdependence between the two groups), difficulties with the *Collins* test.

The court began its opinion by noting that it "discern[ed] no

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140. Derived from prongs (1) and (2).

141. Derived from prong (3).

142. Derived from prong (4).

143. See *supra* text accompanying notes 98-103.

144. See *supra* text accompanying notes 96-102.

145. This does not necessarily include only the statutory rules, but also the common law interpretation thereof.

146. See *supra* text accompanying notes 92-95.

inherent incompatibility between the disciplines of law and mathematics and intend[ed] no disparagement of the latter as an auxiliary in the fact-finding processes of the former."<sup>147</sup> Quite logically, then, the court began an inquiry into the mechanics of the application of the product rule in the case at bar.<sup>148</sup> The first group of two prongs cannot be read as anything else. Finding the application performed incorrectly<sup>149</sup> on erroneous "data,"<sup>150</sup> the court concluded that the evidence was irrelevant and misleading. The court then inquired into the suitability of the product rule for helping triers of fact.<sup>151</sup> This inquiry concerns the second group of two prongs. The court concluded that the "technique . . . so distorted the role of the jury"<sup>152</sup> that it could not be allowed. The two groups need to be discussed *only* when a court concedes the general proposition that probabilistic analysis may be admissible at trial. Otherwise, there is no need to discuss the expert's testimony or application of the theory in any particular situation. To do so indicates that there might be value in allowing such an analysis to stand. Had the court in *Collins* simply restricted its discussion to the last two prongs, the result and the rationale would have been clear: "This type of evidence is incompatible with our system of proof, and so is inadmissible." However, by preceding this analysis with the analysis of the application, the court seemingly and necessarily implied that there was some merit in understanding the accurate application of the product rule.

There is no convincing argument that the court merely meant to edify the general reader or that the court simply enjoyed a brief foray into the realm of mathematics. The foundation analysis<sup>153</sup> was unnecessary to warn counsel that such proof would not be accepted at trial as the complete bar of probabilistic evidence that is effected in the second group of prongs could hardly be a more forceful admonition against its use. Therefore, the court had a notion that there was some utility in the application of probabilistic evidence at trial.<sup>154</sup>

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147. *Collins*, 438 P.2d at 33.

148. *See id.* at 36-39.

149. *See supra* note 116 and accompanying text.

150. *See supra* note 108 and accompanying text.

151. *Collins*, 438 P.2d at 39-41.

152. *Id.* at 41.

153. Prongs (1) and (2).

154. The argument might be made that court gave a full explanation of the incorrect application of the product rule so that the lower courts might distinguish this from other probabilistic theories, so as to allow other theoretical applications into evidence. It is ineffective to attempt to cabin this bar to the product rule alone, due to the incredible simplicity of the product rule as compared to other probabilistic theories. Furthermore the decision has been read both by courts and commentators as a bar to the admission of all forms of probabilistic evidence.

The prongs cannot be read as interdependent *within* their groups because of pragmatic concerns; they cannot be read as interdependent *between* groups because of the conflict of their rationales. Therefore, the prongs could not have been intended to be dependent upon each other. This problem, along with the inconsistencies generated by attempts at reading the prongs as independent of each other, makes the *Collins* test inappropriate as academic support in the debate on probabilistic evidence.

### B. *The Collins Test and Effective Counsel*

In addition to the inconsistencies found in the opinion, the court offers unsound pragmatic reasons to justify its decision. The court was concerned with: (1) the abuse of probabilistic evidence (especially through inaccurate testimony that opposing counsel could not effectively analyze, and therefore, rebut);<sup>155</sup> and (2) the "sorcerer"-like nature of mathematical computations.<sup>156</sup> Neither of these problems, however, merits the court's ultimate decision.

The most egregious abuse of probability analysis by the prosecutor in *Collins* occurred in the assignment of probability factors.<sup>157</sup> While insisting that he was only illustrating the effect of aggregating probabilities, the prosecutor had the expert mathematician *assume* values for computation<sup>158</sup> that were directly related to the personal characteristics of the defendants<sup>159</sup> and not based on any statistical data.<sup>160</sup> Thus, the jury was confronted with an unfamiliar theory, based on unsubstantiated data applied to "illustrate" the effect of multiplying probabilities.<sup>161</sup> The opposing counsel did not possess the expertise to spot these and other flaws in the prosecutor's case.<sup>162</sup> At the conclusion of the expert's testimony, the jury was left with the impression that the chances of these characteristics belonging to any one random couple were one in twelve million.<sup>163</sup> However, this was

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155. "[O]nly a defense attorney schooled in mathematics [] could successfully keep in mind the fact that the probability computed by the prosecution can represent . . . the likelihood that a random couple would share the characteristics. . . . [F]ew defense attorneys . . . could be expected to comprehend this basic flaw in the . . . analysis." *Collins*, 438 P.2d at 40-41.

156. "Mathematics, a *veritable sorcerer* in our computerized society . . . must not *cast a spell* over [the juror]." *Id.* at 33 (emphasis added).

157. *Id.* at 36-37.

158. Because the expert witness stated that he could not assign probability factors for these characteristics, "the prosecutor himself suggested what the various probabilities should be and these became the basis of the witness' testimony." *Id.* at 38.

159. *Id.* at 38.

160. *Id.* at 36-37.

161. *Id.* at 37.

162. *Id.*

163. *Id.*

not the end of the prosecutor's "proof"; he suggested to the jury that his estimates were "conservative," and opined that the probability of the aggregation of these characteristics was actually more like one in a billion.<sup>164</sup> Further, the prosecutor invited the jury to substitute into the calculation its own estimates of the probability factors' magnitude for those of the prosecutor.<sup>165</sup> Finally, the prosecutor failed to have the statistician establish the independence of the probability factors—factors which the court quite clearly shows were not independent.<sup>166</sup> The court was correct that this omission is misleading to the average juror. However, it is not grounds for damning the entire realm of probabilistic evidence. An illustration elucidates this point.

Imagine a trial in which the plaintiff wishes to establish as an element of the claim that AIDS could be transferred via human tears.<sup>167</sup> To help establish this, the plaintiff calls a specialist in the field of virology.<sup>168</sup> The plaintiff's counsel asks the expert to assume that humans transmit viruses exactly as rats do and that rats can transfer hepatitis through teardrops. The expert is then asked to apply his knowledge, given the assumptions about the hepatitis virus' transmissibility, to the question of whether humans can transfer AIDS via tears. If the virologist answers yes, and opposing counsel is insufficiently versed on disease transmission to recognize the rather obvious error in this method of proof, his only opposition to the testimony is likely to be something akin to "doctors have been known to be wrong." In such a case, the court would be faced with the same kind of abuse present in *Collins*. However, it is hard to imagine that anyone even remotely familiar with Anglo-American courts would advocate abolishing expert medical testimony on these grounds.<sup>169</sup>

The possibility of abuse of probabilistic evidence is an insufficient justification for eliminating it altogether. From procedural abuse of

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164. *Id.*

165. *Id.* at 37 n.10. The prosecutor also invited the defense to offer estimates on the probabilities involved. *Id.* This was surely an attempt to get the defense to offer probabilities that were much higher than would be reasonable, but would still result in a calculation that showed only a remote possibility of the random aggregation of the characteristics in any one couple.

166. *Id.* at 39.

167. This hypothetical is used by the University of Florida in its peer-counseling program on AIDS-awareness to illustrate the hysteria surrounding the AIDS crisis. Nothing in this Comment should be interpreted as providing information on actual AIDS transmission modes.

168. Virology is the study of viruses and the transmission of viral diseases.

169. The *Collins* court does not indicate that the abuse alone is dispositive of the issue of admissibility of probabilistic evidence. However, it clearly finds this an important underpinning of the abolition rationale. See *Collins*, 438 P.2d at 38.

"motion practice"<sup>170</sup> to substantive abuse of the jury system,<sup>171</sup> opportunities abound for the unethical attorney. The use of probabilistic evidence, limited as it is to the courtroom, should not be singled out as especially dangerous in this regard. The *Collins* decision itself shows that courts have the ability to ferret out instances of abuse. The record established at trial makes review of the actual evidence admitted possible, and the nature of the evidence requires that only extremely qualified individuals testify.<sup>172</sup> In addition, the time and cost required to do a complete analysis of the data necessary to accurately testify on probability necessarily limits the use of such evidence.<sup>173</sup>

A separate comment on the ability of opposing counsel to effectively rebut plaintiff's use of probabilistic evidence<sup>174</sup> and its influence on admissibility is also appropriate. In the AIDS transmission hypothetical, the same potential danger of opposing counsel's inability to rebut exists. However, the answer most likely given in that situation is: "Get your own expert." Indeed, some commentators contend that the courtroom has become a "battle of the experts."<sup>175</sup> While this result is hardly desirable, the best remedy in such a situation is to fight fire with fire. It is difficult to believe that in a medical malpractice case, for instance, either side would prepare for trial without obtaining an expert to analyze the available data and rebut the testimony of the other side's expert. The "real world" presents issues that

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170. See John F. Cannon, Remarks, *The History and Purpose of Rule 11*, 54 FORDHAM L. REVIEW 10 (1985).

171. See *Hoffa v. United States*, 385 U.S. 293 (1966) (discussing jury tampering).

172. Note that the nature of probabilistic evidence requires that the qualifications of those experts who testify be very high, thus making the pool of potential expert witnesses small. The need to maintain a high reputation in the academic community also works to heighten the credibility of most experts. It is helpful in this argument to recall the academic isolation and unfavorable comment that accompanied Carl Sagan's attempt to make astronomy a pop fad, which eventually resulted in a significant fall from grace in the public eye as well.

173. To adequately analyze even extremely sterile situations requires a great deal of sophisticated and costly work. The expense of expert testimony necessarily limits the use of such testimony to cases of sufficient size and complexity, in which the jury might benefit greatly from an accurate analysis and presentation of this type. Also, opposing counsel will be alert to possible abuse during this extended study. It is arguable that very few cases involve situations that are simple enough to allow for the use of probabilistic evidence in the first place. Moreover, the cost resulting from such stringent requirements will help curb the use of probabilistic evidence in the criminal arena, where critics argue its abuse is more dangerous. See, e.g., Tribe, *supra* note 10, at 1368-1377; Shaviro, *supra* note 21, at 532-533.

174. This inability to rebut was one of the evils feared by the *Collins* court when it addressed the abuse of probabilistic evidence. See *supra* note 155 and accompanying text.

175. See, e.g., Bruce Gardner, *Prosecutors Should Think Twice — Before Using Experts in Child Abuse Cases*, 3 CRIM. JUST. 12 (1988); see also Maury R. Olicker, *The Admissibility of Expert Witness Testimony: Time to Take the Final Leap?*, 42 U. MIAMI L. REV. 831, 848 (1988).

are too complex for an advocate to competently spot flaws in all types of technical testimony. Opposing counsel has the tools of discovery to allow her to seek out her own experts.<sup>176</sup> Beyond this, she may ask the court to appoint an expert.<sup>177</sup> Finally, opposing counsel's inability to effectively argue against technical evidence should not serve as an excuse to exclude the otherwise valid evidence of her opponent. Allowing this excuse would contravene the ideals of zealous advocacy and truth-seeking that underlie the adversary system,<sup>178</sup> and could effectively lead down a "slippery slope"<sup>179</sup> where the least common denominator determines the scope and admissibility of evidence presented at trial. The principle that counsel may use only what her opponent can already rebut or argue effectively prevents new and useful methods of argument from entering the courtroom<sup>180</sup>—an even more undesirable outcome than the circus-of-experts danger already mentioned. Although preventing the development of useful arguments surely cannot be the intention of the *Collins* court, it is the logical end result.

The court's second concern—that mathematics is a "veritable sorcerer"<sup>181</sup> that will rob the jury of its appropriate function—fails on similar grounds. The very use of expert witnesses indicates that the resolution of complex fact situations often requires that triers of fact be given conclusions that they could not draw for themselves.<sup>182</sup> This does not mean, however, that the jury will not determine the outcome of the ultimate issue. Other considerations exist beyond the sorting out of technical facts.<sup>183</sup> For example, the jury has the right to find the explanation offered by the opposing party's expert more convincing or not to believe a witness. Nor is it entirely clear that striking expert testimony on probability will fully resolve the issue. In *Collins*, for example, the jury might have believed, from personal experience or acquaintance, that interracial couples were not as rare as statistics

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176. See, e.g., CAL. CIV. PROC. CODE § 2017 (West 1991).

177. See, e.g., CAL. EVID. CODE § 730 (West 1991).

178. MODERN RULES OF PROFESSIONAL CONDUCT pmbl.

179. Although slippery slope arguments usually fail to withstand academic scrutiny, the theoretical possibility tends to illustrate the point rather forcefully.

180. This principle is contrary not only to the *Downing* test on scientific evidence admissibility, which promotes the admission of novel scientific evidence, but also to the *Frye* test of admissibility, which allows for the continued growth of acceptable types of evidence. See *infra* note 231 and accompanying text.

181. *Collins*, 438 P.2d at 33.

182. *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

183. This situation is easily distinguished from those where the expert testimony is on legal issues. Thus, the argument may be different when legal experts testify on the elements of a claim.

made them seem.<sup>184</sup> The jury might also have found the expert himself unconvincing due, perhaps, to his personal demeanor. Jurors, after all, are not sheep who blindly follow whoever leads them, but independent thinkers with minds of their own. Moreover, there is no reason to believe that mathematics, as compared to other scientific evidence, will be of particularly potent probative force to a trier of fact. For instance, medical doctors are certainly influential in their presentation of detailed physiological evidence, yet courts have no problem allowing its introduction. When deciding issues of fact, a jury is not required to understand all possible intricacies associated with these facts;<sup>185</sup> rather, it is asked to make a logical, reasonable decision based on the information before it.<sup>186</sup> In light of this, the *Collins* court's contention that difficult-to-comprehend theories are improper because of the powerful influence they exert on juries is unpersuasive.

The question of how much weight to assign particular pieces of evidence has long been regarded as strictly within the domain of the jury.<sup>187</sup> In *Collins*, the court noted that the jury could not help but "accord disproportionate weight" to the probabilistic evidence.<sup>188</sup> Yet the same argument would apply in the AIDS transmission hypothetical given above. The testimony of a leading virologist on such a complex issue would certainly be accorded great weight by a jury *who believed the witness credible*, and might very possibly overshadow the opposing counsel's argument that "doctors have been known to be wrong." Yet it is precisely for this reason—to help the jury resolve issues of fact that cannot possibly be within their technical knowledge—that experts are brought into litigation.<sup>189</sup> Where there is no

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184. *Collins*, 438 P.2d at 33. One explanation for this belief may be locale. A reasonable juror may find the testimony incredible based upon a belief that interracial couples in a car in greater Los Angeles are more common than the figures indicate. A juror may believe that the probability factor for interracial couples applies solely to interracial couples who are romantically involved, thereby making the factor smaller than it would be if interracial couples who are merely friends were included in the assessment. Personal experience may also cause a reasonable juror to discredit the expert's testimony.

185. See *Frye*, 293 F. at 1014. The wide adoption by state courts of *Frye* effectively makes this a general evidence principle. But see MCCORMICK, *supra* note 66, at § 203 (criticizing the standard in *Frye*).

186. After all, the law is concerned "with probabilities, not certainties." *Blum v. Airport Terminal Services, Inc.*, 762 S.W.2d 67, 75 (Mo. Ct. App. 1988) (citing *Jackson v. Ray Kruse Construction Co.*, 708 S.W.2d 664 (Mo. 1986) (en banc)).

187. "[T]he weight of the evidence . . . is a matter for the jury, not the court, to decide." *People v. Rhodes*, 258 Cal. Rptr. 71, 74 (Cal. Ct. App. 1989) (citing *People v. Sherren*, 152 Cal. Rptr. 828, 835 (Cal. Ct. App. 1979)); see also *People v. Remiro*, 153 Cal. Rptr. 89, 113 (Cal. Ct. App. 1979).

188. *Collins*, 438 P.2d at 40.

189. See *supra* notes 73-75 and accompanying text.



abuse of the facts or theory involved, the mere strength of an expert's testimony is something to be resolved by the jury, and should not be a consideration in determining whether to admit such evidence.<sup>190</sup>

### III. SUBSEQUENT INTERPRETATION OF *COLLINS*

The second fundamental problem with the use of the *Collins* test to support academic comment on the introduction of probabilistic evidence at trial lies in its interpretation by courts in and outside California. Sometimes examining the rationales behind the decision,<sup>191</sup> sometimes not,<sup>192</sup> courts have applied the *Collins* test in a manner that causes the cases citing it to conflict. This not only makes the test difficult for trial judges to apply, but also weakens any support *Collins* might have provided to academics. If the rationale of the test has been altered in fact, then there is no real present support for the rationale of the original precedent. That is, if the courts have failed to follow the *rationale* of the precedent, then *academic* comment asserting that the decision supports a given view of the case is unconvincing.<sup>193</sup> In the debate on probabilistic evidence, this is an especially dangerous misuse because academic debate is not furthered. In addition, courts that rely on academic discourse in this complex area may be lead to adopt a rationale which has been indiscriminately applied.<sup>194</sup>

At least one court outside California has affirmatively decided not to follow *Collins*. In *Rachals v. State*,<sup>195</sup> the Court of Appeals of

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190. Stephen C. Petrovich, Note, *DNA Typing: A Rush to Judgment*, 24 GA. L. REV. 669 (1990) (alleging forceful evidence needs established guidelines for allowing admissibility, but recognizing the ready admissibility of DNA evidence in the courts); Janet C. Hoeffel, Note, *The Dark Side of DNA Profiling: Unreliable Scientific Evidence Meets the Criminal Defendant*, 42 STAN. L. REV. 465 (1990) (alleging that only recently have courts even begun to inquire into whether DNA is admissible, and that the arguments on DNA may be lost on all but the scientists who are presenting it).

191. See, e.g., *Marks v. Whitney*, 91 Cal. Rptr. 128 (Cal. Ct. App. 1970), *vacated*, 491 P.2d 374 (Cal. 1971); *Bodenshatz v. State Personnel Bd.*, 93 Cal. Rptr. 471 (Cal. Ct. App. 1971).

192. See, e.g., *People v. Slone*, 143 Cal. Rptr. 61 (Cal. Ct. App. 1978); *People v. Law*, 114 Cal. Rptr. 708 (Cal. Ct. App. 1974).

193. I do not mean to suggest that such support is necessary for convincing argument, but rather, that citing outdated precedent does not help further the intellectual debate.

194. This does not assume that the courts who rely on such discourse ultimately apply the *Collins* result. The commentator who relies on *Collins* may cite the case as evidence that an opposite result is favorable, or if she cites it as the desired result, may present such a poor case that a court declines to apply *Collins*. These situations are rare, but there are instances where such citation does not result in the establishment of the *Collins* doctrine. See *infra* text accompanying notes 195-196. The result, however, is unimportant as far as this Comment is concerned. It is merely the lack of *Collins*' probative force in making a decision in this debate that is at issue here.

195. 361 S.E.2d 671 (Ga. Ct. App. 1987).

Georgia cited *Collins* as precedent conflicting with the controlling rule of the state, which it felt constrained to follow.<sup>196</sup> However, that court's use of *Collins* poses significant problems that are symptomatic of the nature of the *Collins* approach. These problems help illustrate the complexity of probabilistic analysis, and the resulting inconsistency in rationales when courts attempt to paint with a broad brush in this area. The Georgia court, without needing to do so—and without actually investigating the rationales involved—effectively barred the use of *Collins* to prevent admission of probabilistic evidence in Georgia.<sup>197</sup>

The precedent cited by the Georgia court in its opinion is not clearly controlling on the issue of the admissibility of probabilistic evidence. The controlling precedent cited by *Rachals* is *Williams v. State*,<sup>198</sup> a forty-page opinion, of which only four sentences are devoted to the admissibility of probabilistic evidence. That court held that “experts are permitted to give their opinions, based upon . . . mathematical computations.”<sup>199</sup> After citing a case for the proposition that counsel are allowed wide latitude on suggestion in closing arguments, the opinion stated that “[s]uch suggestions may include those based upon mathematical probabilities.”<sup>200</sup> The *Rachals* court recognized the cursory treatment of the issue in *Williams*,<sup>201</sup> yet failed to take advantage of the opportunity to invoke the *Collins* doctrine.<sup>202</sup> An outside observer could only infer that the *Rachals* court, no matter its protestations, was not fully convinced of the validity of the *Collins* approach.<sup>203</sup>

It would be foolish to assume that the *Rachals* court invalidated

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196. *Id.* at 675.

197. *Id.* The situation in *Rachals*, although unusual, helps illustrate the thrust of this Comment. Whether the courts and commentators apply *Collins* or discourage the application of its doctrine is irrelevant to the larger debate concerning probabilistic evidence. What matters is that *Collins* is unpersuasive for purposes of critically examining the precedent in the area of probabilistic evidence.

198. 312 S.E.2d 40 (Ga. 1983).

199. *Id.* at 72 (citing *Stewart v. State*, 268 S.E.2d 906, 912 (Ga. 1980) (emphasis added)). The opinion dealt with the appeal of Wayne Williams, an Atlanta man convicted of murdering two young African-American males in the early 1980's and suspected of murdering several others. He had been sentenced to two consecutive life terms. *Id.* at 48.

200. *Id.* at 73.

201. *Rachals*, 361 S.E.2d at 675.

202. *Id.* The opportunity for invoking the doctrine was, in fact, enormous, since *Williams* gave limited consideration to the issue and *Stewart v. State*, from which *Williams* cited, allowed mathematical computation essentially amounting to addition and subtraction. See *Stewart*, 268 S.E.2d at 912. Note, however, that one could very credibly argue that the jurors gave incredible deference to those computations because they expected them to have been performed correctly.

203. *Rachals*, 361 S.E.2d at 675.

another jurisdiction's rule of law solely on the basis of precedent. Nor is it likely that the Georgia court was incapable of adequately assessing the applicability of precedent to the *Rachals* case. The only logical assumption, therefore, is that the court realized what the effect of its decision would be on the use of probabilistic evidence at trial and chose to stand by it, even in the face of doubts about the validity of the controlling precedent's rationale.

Given that the *Rachals* court could have applied the *Collins* test without actually violating the precedent had it so desired,<sup>204</sup> there must be some reason why the court cited *Collins* approvingly without applying its logic. Most likely, the court felt that it could not have applied the logic of *Collins* without doing violence to the controlling rule in Georgia.<sup>205</sup> The court was not looking simply at the mathematical computation, for which a quick cite to the *Collins* test could have done away with probabilistic evidence in Georgia, or at least made its admission dependent upon substantially tougher criteria. Rather, it was focusing on the larger issue of the admissibility of scientific evidence at trial, which by that time had become so pervasive that it guided even when not expressly called into use.

#### IV. THE *FRYE* TEST AND PROBABILISTIC EVIDENCE—CONFLICT WITH *COLLINS*

Science affects our everyday lives as a result of the technology that pervades our society. Yet technological advances are not the only ways in which science permeates the modern world. Indeed, the soul of science lies not in advanced technology, but rather in the method of attaining that technology.

The use of the scientific method has not been limited to university laboratories. It has been applied throughout the social sciences and jurisprudence.<sup>206</sup> The test set forth in the famous case of *Frye v.*

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204. See *supra* note 197 and accompanying text.

205. The controlling rule is that of scientific evidence in general, not the one of admissibility of mathematical computation. Georgia does not follow the *Frye* standard. *Graham v. State*, 308 S.E.2d 413, 415 (Ga. Ct. App. 1983). However, the judge looks to the same type of criteria that other scientists in an expert's field would look to in order to determine if the scientist is credible and the expert's testimony admissible. *Id.* The real difference between the Georgia standard and the *Frye* standard is that the judge applying the former can allow testimony about scientific theories considered by experts to be scientifically sound, even if those theories have not found general acceptance in the scientific community.

206. A growing number of legal journals have used empirical studies to support the hypothetical contentions of scholars. See, e.g., Robert B. Thompson, *Piercing the Corporate Veil: An Empirical Study*, 76 CORNELL L. REV. 1036 (1991); Donald H. Stone, *The Moral Dilemma: Child Custody When One Parent is Homosexual or Lesbian—An Empirical Study*, 23 SUFFOLK L. REV. 711 (1989).

*United States*<sup>207</sup> for the admissibility of scientific evidence is whether “‘the matter of inquiry is such that inexperienced persons are unlikely to prove capable of forming a correct judgment upon it [due to its specialized nature]’ . . . [and the application of that specialized knowledge has] gained general acceptance in the particular field in which it belongs.”<sup>208</sup> Ironically, this principle itself can be “scientifically” applied. That is, counsel observes what methods of proof will benefit her client; she sets forth a hypothesis for the court in the form of offering the proof at trial; the court tests her hypothesis, and if it finds the hypothesis valid in the “particular field” of trial practice, accepts the proof as logically and permissively influencing the outcome of facts in issue.

The *Frye* standard of admissibility has been almost universally accepted by courts.<sup>209</sup> The California Supreme Court expressly adopted it for the first time in 1966,<sup>210</sup> a position reiterated by the California Supreme Court in 1976.<sup>211</sup> The *Frye* standard has been used to allow into evidence results of such scientific methods as ABO blood typing and DNA evidence.<sup>212</sup> Courts have almost universally applied the *Frye* standard to all types of scientific evidence save one—probabilistic evidence.

The use of probabilistic analysis has been disallowed without fully examining how the *Frye* standard would affect the outcome of such an inquiry. There can be no doubt that probabilistic analysis is a member of the scientific evidence world.<sup>213</sup> Because probabilistic analysis is a type of scientific analysis, the standard established in *Frye* would seem to be the appropriate test to apply to the admissibility of probabilistic analyses.<sup>214</sup>

The *Frye* test functions to assure a high level of reliability of scientific evidence in several areas,<sup>215</sup> including the validity of the application of the scientific principle and the qualifications of the experts

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207. 293 F. 1013 (D.C. Cir. 1923).

208. *Id.* at 1014.

209. See, e.g., *Dumond v. State*, 743 S.W.2d 779, 783 (Ark. 1988); *Commonwealth v. Kater*, 477 N.E.2d 1190, 1195 (Mass. 1983).

210. *Huntingdon v. Crowley*, 414 P.2d 382, 388 (Cal. 1966). The first mention of *Frye* in California was in *People v. Wochnick*, 219 P.2d 70, 72 (Cal. Ct. App. 1950). California restatements of the *Frye* test, however, remained “fuzzy” until *Huntingdon*.

211. *People v. Kelly*, 549 P.2d 1240 (Cal. 1976).

212. See *supra* note 27.

213. Indeed, probabilistic evidence underlies statistical analysis, and thus forms the very basis for most of modern scientific testing and analysis.

214. One should recall that Bayesian analysis is the most widely discussed method of probabilistic analysis in the legal arena.

215. See Michael H. Graham, *Relevancy and the Exclusion of Relevant Evidence: Admissibility of Evidence of a Scientific Principle or Technique—Application of the Frye Test*,

interpreting the results of the application. These two areas were of particular concern to the *Collins* court, which most feared incomplete or inaccurate application of the theory<sup>216</sup> and the presentation of overwhelming and irrelevant evidence to the jury.<sup>217</sup>

The *Frye* test protects the validity of the application of the scientific principle primarily by requiring that scientists generally accept the technique at hand.<sup>218</sup> The test provides for critical examination and agreement on the method and results of a scientific inquiry by those who are capable of understanding the processes involved.<sup>219</sup> It is important to note that this "check" on the evidence rests on our modern conception of the universality of scientific principles. That is, the check on science rests in science, and is not independently assailable. It is clear that the *Frye* test "requires the court to find . . . that the scientific test is reliable . . ."<sup>220</sup> This is all that the first fundamental error asserted by the *Collins* court concerns.<sup>221</sup> Because application of the *Frye* standard would have prevented the type of abuse correctly pointed out by the *Collins* court,<sup>222</sup> there was no need for the specific enumeration of such a requirement in *Collins*.

The *Frye* test protects against the use of overwhelming and irrelevant evidence by requiring expert witnesses to be sufficiently qualified<sup>223</sup> and the application of a scientific theory to be generally accepted in the pertinent community of experts.<sup>224</sup> The opposing party has ample opportunity to blunt the impact of the expert's testimony by cross-examining her on the stand<sup>225</sup> or investigating facts not disclosed by the expert on direct examination.<sup>226</sup>

By requiring highly qualified experts, the *Frye* test assures that irrelevant and prejudicial evidence will be kept out of the record.

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19 CRIM. L. BULL. 51, 53 (1983) (arguing that the *Frye* test is conservative and thus insures that admissible scientific evidence is highly reliable).

216. See *Collins*, 438 P.2d at 38.

217. *Id.* at 38, 39. The court found it curious that the prosecutor invited the jurors "to substitute their own 'estimates' should they wish to do so." *Id.* at 38.

218. See Michael H. Graham, *Expert Witness Testimony and the Federal Rules of Evidence: Insuring Adequate Assurance of Trustworthiness*, 1986 U. ILL. L. REV. 43, 52-53.

219. *Id.*

220. *Id.* at 56 (emphasis added).

221. See *supra* notes 105-111 and accompanying text.

222. *Collins*, 438 P.2d at 38, 39.

223. Graham, *supra* note 218.

224. *Id.* at 52; John W. Osborne, *Judicial/Technical Assessment of Novel Scientific Evidence*, 1990 U. ILL. L. REV. 497, 501.

225. Graham, *supra* note 218, at 69-71.

226. See *id.* at 68-69; see also Finkelstein & Fairley, *supra* note 5, at 494-495 (illustrating the ease with which opposing counsel can undermine an expert's testimony by bringing out the inadequacy of the underlying data).

Where the evidence is overwhelming, the expert will be capable, often during cross-examination, of couching the evidence in terms that drain it of its probative value. Of course, this analysis assumes of the expert an ethical stance deeply embracing the truth-seeking value of evidence. Some may find this a Pollyannaish approach to law, given the realities of modern litigation. High ideals, however, seem to befit the rather lofty nature of academic comment.

Finally, *Frye* has been most frequently targeted at criminal trial evidence.<sup>227</sup> This has also been the case in California.<sup>228</sup> The *Collins* court's refusal to apply *Frye* to probability analysis places it at odds with the general, prior approach and requires justification. It also suggests that the court failed to fully consider the available avenues of adjudicating this difficult question.

The conflict between *Collins* and *Frye* has never been harmonized by the courts of California.<sup>229</sup> The two cases have often been cited, however, in the same opinion, and their respective tests applied.<sup>230</sup> The simultaneous application of these tests is more than a mere juxtaposition and results in a weakening of both standards. Where a court applies a higher standard of admissibility to one type of evidence without giving an explanation for the departure from accepted methods of determination, it works a detriment to both standards. When the accepted standard is clearly applicable, yet not followed, it will most likely be seen by courts as arbitrary and lacking universal application. This causes the old standard to lose its probative force in future cases, and within the practicing community in general. The new standard, in turn, is weakened by a similar rationale. The new standard's criteria may seem to have been arbitrarily derived, raising the question of whether it is a unique deviation for which there might be very sound reasons which cannot be determined by the practitioner, or a new trend in the court's jurisprudence. Either way, the conflict between the standards hinders efficient resolution of future scientific theory admissibility questions.

The *Frye* standard, by its own admission, allows for changes of viewpoint within the scientific community. That is, while a particular application of science itself may not change appreciably, if its accepta-

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227. Graham, *supra* note 215, at 54.

228. A survey of California cases available through computer-assisted databases reveals a ratio of criminal to civil applications of *Frye* of approximately 4:1.

229. *But see* *People v. Yorba*, 257 Cal. Rptr. 641 (Cal. Ct. App. 1989) (attempting to illustrate that the *Collins* standard is not in contradiction with admissibility of ABO blood-grouping statistics); *Cramer v. Morrison*, 153 Cal. Rptr. 865 (Cal. Ct. App. 1979) (likewise attempting to rationalize the admissibility of Human Leukocyte Antigen statistics).

230. *See, e.g., Yorba*, 257 Cal. Rptr. 641; *People v. Coleman*, 759 P.2d 1260 (Cal. 1988).

bility within the "community" changes through time, the *Frye* standard allows the rules of admissibility to change accordingly.<sup>231</sup> The *Frye* standard should have been relied upon to argue for the admission of the new scientific evidence.<sup>232</sup>

*Collins* has not been read so generously.<sup>233</sup> It may be argued that the *Collins* court allowed for the future use of probabilistic evidence. In its opening paragraph the court alleges that mathematics and evidentiary proof at trial are not necessarily incompatible, but that the technique employed in the instant case was insufficient to qualify for admission.<sup>234</sup> However, the rather sweeping nature of the decision effectively obliterates the use of such evidence, and subsequent California courts have applied the precedent with vigor.<sup>235</sup> Since the two tests provide for different results with regard to the future admissibility of probability analysis, courts should articulate some valid reason for applying the more stringent *Collins* test over the *Frye* standard.

No such rationale has been proffered. Either both tests can continue to exist side by side, sending inconsistent messages, or one test must be discarded. In the context of probabilistic evidence, the *Collins* test could be discarded, making the *Frye* standard more universal in its application. Probabilistic evidence would still be subject to the same requirements established by the *Collins* court—namely, that the theory be generally accepted by statisticians, that it is of the type that requires expert testimony (since it lies outside the ken of the average juror), and that an adequate foundation be laid and no abuse of the theory be present in the analysis. This level of protection would be consistent with the protection afforded other types of scientific evidence.

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231. See *Frye*, 293 F. at 1014 (stating that scientific application at hand had "not yet gained such standing" (emphasis added)).

232. This assumes, of course, that appellate counsel is on her toes, which was clearly not the case in *Collins*. The court did not even address the application of *Frye* to the case at hand, even though *Frye* had been adopted in California and in other jurisdictions at the time. It is safe to assume that the court would have decided the question had it been brought to its attention, if only to prevent the issue from being raised in future appeals.

233. The *Collins* test may seem to allow for the future admission of probabilistic evidence, but whether this is in fact the case is unclear at this time. The rule in California at present is not clearly stated and does not track the language or logic of *Collins* very closely. The opinions allowing any statistical evidence tend to obfuscate the issues involved rather than addressing them directly and clearly articulating any standards. See, e.g., *People v. Axell*, 1 Cal. Rptr. 2d 411 (Cal. Ct. App. 1991); *Bodenschatz*, 93 Cal. Rptr. 471. The one thing that is clear from the opinions is that the *Collins* test does not lend itself to the type of flexibility and adaptability that the *Frye* test does.

234. *Collins*, 438 P.2d at 33.

235. See *supra* notes 191-192 and accompanying text.

## V. CONCLUSION

The test used by the court in *People v. Collins* to determine the admissibility of probabilistic evidence is inconsistent both internally and in its application to other cases. The test is based in large part upon the unfounded fear that opposing counsel will be unable to defend herself against the imagined onslaught of overwhelmingly powerful, yet misleading, evidence. The *Collins* test has further been shown to be in conflict with the *Frye* standard, which enjoys a rare universality in application and has been thoroughly considered and refined throughout the better part of this century.

It is ineffective to continue to rely on the case of *People v. Collins* to help further the interesting and vigorous debate on the admissibility of probabilistic evidence in general, and Bayesian analysis in particular. The case simply fails to be convincing, or to shed any real light on the question of the validity and probative force of probabilistic evidence.

## APPENDIX—THE BASICS OF PROBABILITY

An "event" is the outcome of a true/false inquiry.<sup>236</sup> That is, the result of inquiring into a given state or condition establishes its truth (the table is green) or falsity (the table is not green), and this outcome is the event. Events are usually denoted by capital letters, such as G (green) or B (not green, say, blue, perhaps).<sup>237</sup> Events may always happen together, sometimes happen together, or never happen together. For example, blue eyes sometimes accompany blond hair; being male never accompanies being female. Terms of art have been developed to describe such relations. The basic relations are conjunction, disjunction and negation.<sup>238</sup> There are mathematical symbols which may be used to denote these relations, or one may use standard grammatical symbols.<sup>239</sup>

Conjunction exists (is "true") when both of any two events are "true."<sup>240</sup> That is, when both events are positive, as positive is defined, then conjunction exists. If green is positive, then a blue table is "false." If a table is positive, then a chair is false. However, if one discovers a green table, then there is conjunction. Conjunction can be

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236. ANDERSON & TWINING, *supra* note 8, at 416.

237. *Id.*

238. *Id.* at 417.

239. For example, the conjunction of blue eyes (event "A") and blond hair (event "B") may be denoted using mathematical symbols as " $A \cap B$ " or " $A \wedge B$ ," or simply denoted using standard grammatical symbols as "A & B." *Id.*

240. *Id.*



symbolized "A & B," for the conjunction of A and B.<sup>241</sup>

Disjunction is not the opposite of conjunction. Disjunction occurs when one or both<sup>242</sup> of two events are true.<sup>243</sup> Thus, if G is true for green, and T is true for a table, then disjunction is true for a green chair, a blue table, or a green table.<sup>244</sup> Disjunction is symbolized by "A or B." Note that the "or" does not exclude the possibility of *both* events being true by definition.

Finally, negation occurs only when one condition is mutually exclusive of another.<sup>245</sup> That is, negation exists when two situations *cannot* exist together. Thus, if event M is true when one is male, then being female, F, is the negation of M.<sup>246</sup> Negation is symbolized "not A."

These relations can be used to compute probabilities of random events. An "ambit" of events is the set of events which are of interest.<sup>247</sup> Before performing any calculations, one assigns<sup>248</sup> probabilities to each event.<sup>249</sup> The resulting symbol is P(X), the probability of X being true. This probability and the probabilities of all other members of the ambit are required for computations of the aggregated characteristics.<sup>250</sup> The assigning of these probabilities must also follow the axioms of probability theory.<sup>251</sup> These axioms are simply defined, and must be accepted as true for our purposes.

There are four axioms. Three of these are fundamental and require no derivation. (1)  $0 \leq P(X) \leq 1$  (any A in the ambit).<sup>252</sup> This axiom says that the probability of any single event in the ambit must be between 0 and 1, inclusive.<sup>253</sup> (2)  $P(\Omega) = 1$ .<sup>254</sup> The symbol  $\Omega$

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241. *Id.*

242. *Id.*

243. *Id.*

244. Note that there are a myriad of furniture pieces and colors which make disjunction true, but only one combination (a green table) which makes conjunction true. Also, when conjunction is true, then disjunction of those same two events is also true, since conjunction is a subset of disjunction. Disjunction, obviously, is not always conjunction.

245. ANDERSON & TWINING, *supra* note 8, at 417.

246. *Id.*

247. *Id.* at 419. In the *Collins* case the six characteristics mentioned *supra* note 108 make up the ambit.

248. One must use an accepted method grounding this assignment in fact if the resulting number is to be relevant. See *supra* notes 108-114 and accompanying text.

249. ANDERSON & TWINING, *supra* note 8, at 419.

250. *Id.*

251. *Id.*

252. *Id.*

253. Note that "inclusive" allows for the possibility of the limiting numbers being equal to the variable quantity, i.e., the probability of any event may equal either 0 or 1.

254. ANDERSON & TWINING, *supra* note 8, at 419.

stands for the "sure" event, that is, an event which is always true.<sup>255</sup> Its probability is 1, which indicates that it is "certain," and must occur.<sup>256</sup> (3) If  $A \& B = \phi$ , then  $P(A \text{ or } B) = P(A) + P(B)$ .<sup>257</sup>  $\phi$  is the "impossible" event, whose probability must be 0.<sup>258</sup> If A and B can never happen together, then their conjunction (A & B) is impossible ( $\phi$ ). When this is true, the probability that (A or B) exists is the sum of the probability of A and the probability of B.<sup>259</sup> These axioms provide for the use of probability theories. The axioms may be used to produce properties of probability distribution.<sup>260</sup> These properties are vital for in-depth study of the probabilistic debate. There is another definition which is necessary to introduce Bayes' Theorem,<sup>261</sup> the most prevalent of the theories in the debate.

The fourth axiom requires some derivation. One can imagine a situation in which (A & B) may or may not exist together,<sup>262</sup> in which the existence of one event is somehow *conditioned* on the existence of some other event. This makes up the fourth basic axiom of probability theory.<sup>263</sup> This axiom states that (4)  $P(A \& B) = P(A|B) \times P(B)$ .<sup>264</sup> This equation says that the probability of the conjunction of A and B is equal to the product of the probability of A, conditioned on B, times the probability of B.

Bayes' Theorem may be derived from using these four basic axioms. This derivation is beyond the scope of this probability "primer," but basically consists of the manipulation of algebraic operators<sup>265</sup> and the substitution of defined relations therein, which are themselves derived from the axioms. Bayes' Theorem may be stated in different ways,<sup>266</sup> but the simplest way for our purpose here is  $P(B|A) = P(A|B)P(B)/P(A)$ .<sup>267</sup> In words, this says that the probability of B, conditioned on A, is equal to the probability of A, conditioned on B, times the probability of B, divided by the probability of A.

The applications and intricacies are more fully set forth in

255. *Id.* at 417.

256. *Id.* at 419.

257. *Id.*

258. *Id.* at 417.

259. Note that although disjunction allows A and B to exist together, this axiom defines this circumstance as impossible for this equation to hold.

260. ANDERSON & TWINING, *supra* note 8, at 419-420.

261. *Id.* at 422.

262. *Id.* at 421.

263. *Id.*

264. *Id.*

265. Algebraic operators are multiplication, addition, etc.

266. McCord, *supra* note 33, at 748 n.22.

267. ANDERSON & TWINING, *supra* note 8, at 422.

Anderson & Twining's text, Appendix I by Philip Dawid.<sup>268</sup> The current appendix, however, should be sufficient to fully ground the reader in an understanding of those properties and axioms which are often glossed over in academic commentary. Using those algebraic functions with which any college graduate should be acquainted along with this appendix, the more intricate and complex properties and theories present in more advanced commentary should be more comprehensible.

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268. *Id.*, at App. I.