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The Genealogy Detectives: A Constitutional Analysis of 'Familial Searching'

David H. Kaye
Penn State Law

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THE GENEALOGY DETECTIVES: A CONSTITUTIONAL ANALYSIS OF “FAMILIAL SEARCHING”

David H. Kaye*

ABSTRACT

“Familial searching” in law enforcement DNA databases has been pilloried as a step “towards eugenics and corruption of blood” and “lifelong genetic surveillance” that is “inconsistent with a basic pillar of American political thought.” Courts have yet to address the issue fully, but several commentators contend the practice is unwise, unjust, or unconstitutional. This Article examines the more significant constitutional claims. It concludes that although kinship matching should not be implemented simply because it is technologically seductive, neither should it be removed from the realm of permissible law enforcement information gathering on constitutional grounds. In reaching this conclusion, the Article describes the logic of kinship analysis; clarifies the nature of partial-match searching; shows how an advanced system of DNA databases could yield additional, accurate leads in the investigation of both routine and high profile crimes; and explains why this system, if properly implemented, is compatible with constitutionally protected interests of both convicted offenders and their close relatives.

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* Distinguished Professor and Weiss Family Scholar, Dickinson School of Law, Graduate Program in Forensic Science, Penn State University. Versions of this Article were presented in 2011 at the 22d International Symposium on Human Identification, the 7th International Society for Applied Biological Sciences Conference in Forensic, Anthropologic and Medical Genetics, and at a faculty workshop at the University of Pittsburgh School of Law. Charles Brenner, Rockne Harmon, David Lazer, Kristin Lewis O'Connor, Jennifer Kristin Wagner, Bruce Weir, Kenneth Weiss, and David Witherspoon commented on part or all of an early draft as did Erin Murphy, who kindly offered especially valuable suggestions and corrections. © 2013, David H. Kaye.

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INTRODUCTION

DNA databases are a darling of the detective’s nursery. They began as a curiosity thought to be useful for solving only a few types of violent crimes.¹ Today, they are dazzling devices for enforcing criminal laws from car theft to murder.² Computerized matching of the DNA identification profiles from crime-scenes and victims³ to profiles from known individuals has produced hundreds of thousands of “cold hits.”⁴

But some people are never satisfied. A number of scientists have concluded the databases could produce many useful investigative leads if a technique known as

1. See COMM. ON DNA TECH. IN FORENSIC SCI., NAT’L RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE 120 (1992) (“[I]t is clear that crimes of most types will not afford the opportunity to recover relevant biological evidence that will allow the police to identify an unknown suspect . . .”).

2. See Edwin Zedlewski & Mary B. Murphy, *DNA Analysis for “Minor” Crimes: A Major Benefit for Law Enforcement*, 2006 NIJ J. 2, 2, 5 (noting expansion of DNA databases to solve property crimes in the United States and the United Kingdom) (2006).

3. For brevity, this Article uses the phrase “crime-scene DNA” to refer to DNA that appears to have come from a criminal, whether found in a location associated with the crime or on or within the body or clothing of an apparent victim.

4. CODIS–NDIS Statistics, FBI, <http://www.fbi.gov/about-us/lab/codis/ndis-statistics> (last visited Nov. 23, 2012).

kinship analysis were routinely employed.⁵ To take their idea to its logical extreme, we can envision a database system constructed to be especially useful for this kind of analysis. Like today's databases, this system would pick out any individuals in the database who are likely sources of crime-scene DNA samples. But the trawling would not stop there. Almost magically, it could lead to identifications of individuals outside the database who left their DNA at crime scenes or on their victims.

Unfortunately, there is a catch. These new leads would point only to very close relatives who are not themselves subject to inclusion in the federal and state databases because they have not been convicted of qualifying crimes. Kinship matching, therefore, has been pilloried as “function creep,”⁶ “mission creep,”⁷ “a major privacy intrusion in the life of families,”⁸ “the worst kind of guilt by association,”⁹ “genetic surveillance for all,”¹⁰ and “lifelong genetic surveillance”¹¹ that is “inconsistent with a basic pillar of American political thought.”¹² And, as if

5. Frederick R. Bieber et al., *Finding Criminals Through DNA of Their Relatives*, 312 *SCIENCE* 1315 (2006). Dr. Bieber and his colleagues reason as follows:

Consider a hypothetical state in which the “cold-hit” rate—the chance of finding a match between a crime scene sample and someone in the offender database—is 10%. Suppose that among criminals who are not (yet) in the database themselves, even 5% of them have a close (parent/child or sibling) relative who is. From our projections that up to 80% (counting the 10 best leads) of those 5% could be indirectly identified, it follows that the kinship analyses we describe could increase a 10% cold-hit rate to 14%—that is, by 40%. There have been 30,000 cold hits in the United States up to now. Kinship searching has the potential for thousands more.

Id. at 1315–16.

6. Barbara Prainsack, *Key Issues in DNA Profiling and Databasing: Implications for Governance*, in *GENETIC SUSPECTS: GLOBAL GOVERNANCE OF FORENSIC DNA PROFILING AND DATABASING* 15, 28 (Richard Hindmarsh & Barbara Prainsack eds., 2010).

7. Sonia M. Suter, *All in the Family: Privacy and DNA Familial Searching*, 23 *HARV. J.L. & TECH.* 309, 317 (2010).

8. Richard Willing, *DNA Database Can Flag Suspects Through Relatives: Critics Fear “Genetic Surveillance” of Innocent*, *USA TODAY*, Aug. 22, 2006, at 2A (quoting Tania Simoncelli).

9. *Id.*

10. Jeffrey Rosen, *Genetic Surveillance for All*, *SLATE* (Mar. 17, 2009), <http://www.slate.com/id/2213958>; cf. Frederick R. Bieber & David Lazer, *Guilt by Association: Should the Law Be Able to Use One Person's DNA to Carry Out Surveillance on Their Family? Not Without a Public Debate Say Frederick Bieber & David Lazer*, *NEW SCI.*, Oct. 23, 2004, at 20 (“[Familial searching] brings with it the indirect lifelong surveillance of citizens simply because they are related to someone whose DNA profile is on record.”); Barbara Goldberg, *Virginia May Nab Serial Rapist Through Blood Relative DNA: Familial DNA Powerful Forensic Tool But Few States Use It Because of Privacy Concerns*, *ABC NEWS* (Aug. 9, 2010), <http://abcnews.go.com/News/TheLaw/familial-dna-expose-east-coast-rapist/story?id=11334748> (quoting Erin Murphy as saying “It’s guilt by association”).

11. SHELDON KRIMSKY & TANIA SIMONCELLI, *GENETIC JUSTICE: DNA DATA BANKS, CRIMINAL INVESTIGATIONS, AND CIVIL LIBERTIES* 175 (2011); Suter, *supra* note 7, at 311; Ellen Nakashima, *From DNA of Family, A Tool to Make Arrests: Privacy Advocates Say the Emerging Practice Turns Relatives Into Genetic Informants*, *WASH. POST*, Apr. 21, 2008, at A1 (quoting “Tania Simoncelli, science adviser to the American Civil Liberties Union”).

12. KRIMSKY & SIMONCELLI, *supra* note 11, at 83 (attributing this view to Professor Jeffrey Rosen).

all that were not enough, it has been tarred as “biological determinism”¹³ and a step “towards eugenics and corruption of blood.”¹⁴

Although early commentators perceived no fundamental legal barriers to kinship matching¹⁵ and most writing continues to focus on policy arguments,¹⁶ some recent commentary displays more sympathy or support for constitutional objections.¹⁷ The most prominent example is an essay by Professor Erin Murphy entitled *Relative Doubt: Familial Searches of DNA Databases*, which contends the technique is counterproductive for police practice, unfair, unjust, and of doubtful constitutionality.¹⁸

This Article provides a more complete examination of the two most significant constitutional issues—the Fourteenth Amendment’s guarantee of equal protection of the laws and the Fourth Amendment’s protection against unreasonable searches

13. Erin Murphy, *Relative Doubt: Familial Searches of DNA Databases*, 109 MICH. L. REV. 291, 304 (2010) (“[F]amilial searches . . . embody . . . biological determinism.”) [hereinafter Murphy, *Relative Doubt*].

14. Adam Schwartz, Senior Staff Counsel, ACLU of Ill., DNA Familial Testing: Civil Liberties and Civil Rights Concerns, Address at the Northwestern Law School Center on Wrongful Convictions Symposium on Familial DNA Searching (Mar. 3, 2011), at 4, <http://www.aclu-il.org/wp-content/uploads/2011/03/Speech-DNA-familial-testing.pdf>. The constitutional limitation on “corruption of blood” obviously has no application to criminal investigative practices. See Henry T. Greely et al., *Family Ties: The Use of DNA Offender Databases to Catch Offenders’ Kin*, 34 J.L., MED. & ETHICS 248, 257 (2006); David H. Kaye, *Associational Privacy, the Presumption of Innocence, and “Corruption of Blood” as Constitutional Metaphors in the Debate on “Familial Searching”*, AMER. CRIM. L. REV. (Nov. 26, 2012), <http://www.americancriminallawreview.com/Drupal/blogs/blog-entry/associational-privacy-presumption-innocence-and-“corruption-blood”-constitutional-m> [hereinafter Kaye, *Associational Privacy*].

15. Jules Epstein, “Genetic Surveillance”—*The Bogyman Response to Familial DNA Investigations*, 2009 U. ILL. J.L. TECH. & POL’Y 141 (2009); Greely et al., *supra* note 14. Professor Greely recently testified in support, “with reservations,” of legislation to facilitate familial searching. *DNA Technology and Cold Cases: Hearing on H.R. 3361 Before the H. Subcomm. On Crime, Terrorism, and Homeland Security of the H. Comm. on the Judiciary*, 112th Cong. 25 (2012) (statement of Henry T. Greely, Professor of Law, Stanford Law School).

16. E.g., KRIMSKY & SIMONCELLI, *supra* note 11; Jessica D. Gabel, *Probable Cause from Probable Bonds: A Genetic Tattle Tale Based on Familial DNA*, 21 HASTINGS WOMEN’S L.J. 3, 57 (2010) (urging “vigilant and uniform” and “rigorous and practical guidelines” to cope with the “certainty” that kinship analysis in databases will become widespread); Joyce Kim et al., *Policy Implications for Familial Searching*, 2 INVESTIGATIVE GENETICS 22 (2011), available at <http://www.investigativegenetics.com/content/2/1/22>; Natalie Ram, *The Mismatch Between Probable Cause and Partial Matching*, 118 YALE L.J. POCKET PART 182 (2009); Natalie Ram & Michael Seringhaus, *O Brother, Where Art Thou?*, SLATE (June 14, 2010), <http://www.slate.com/id/2256966>.

17. Cf. Linda Bartusiak, Comment, *Plea Bargaining for DNA: Implications on the Right to Privacy*, 13 U. PA. J. CONST. L. 1115, 1126–28 (2011) (finding a violation of reasonable expectations of privacy from the involuntarily obtained DNA sample). *But see* Brett Mares, Note, *A Chip off the Old Block: Familial DNA Searches and the African American Community*, 29 LAW & INEQ. 395, 397 (2011) (concluding “familial DNA testing is constitutional under the Fourteenth and Fourth Amendments”); Mary McCarthy, Note, *Am I My Brother’s Keeper?: Familial DNA Searches in the Twenty-first Century*, 86 NOTRE DAME L. REV. 381, 382 (2011) (summarizing the literature and describing the legal arguments as “weak”).

18. Murphy, *Relative Doubt*, *supra* note 13. Her arguments are summarized, with apparent approval, in Natalie Ram, *Fortuity and Forensic Familial Identification*, 63 STAN. L. REV. 751, 789–94 (2011). Similar concerns can be found in Suter, *supra* note 7. The first mention of “ethical and constitutional concerns” may be Michelle Hibbert, *DNA Databanks: Law Enforcement’s Greatest Surveillance Tool?*, 34 WAKE FOREST L. REV. 767, 786 (1999).

and seizures.¹⁹ These constitutional provisions, I maintain, are not show-stoppers. Kinship matching should not be implemented simply because it is technologically seductive, but neither should be it be taken off the legislative table on constitutional grounds. To reach this conclusion, Part I describes the logic of kinship analysis and how it can be applied to state-of-the-art forms of DNA databases that could yield accurate leads in the investigation of both routine and high profile crimes. It introduces a few standard terms from genetics, presents more neutral terminology than the slightly ominous phrase, “familial searching,” and explains how kinship matching differs from the partial matching the FBI allows in the national database (NDIS) that is part of the Combined Offender DNA Index System (CODIS). It also discusses the difficulty of measuring the efficacy of “familial searching.”

Parts II through IV analyze the two main constitutional objections to kinship matching. Part II argues the practice is clearly compatible with the established understanding of the Equal Protection Clause. Parts III and IV analyze the interests of all convicted offenders and their families to show why kinship matching in law enforcement databases can qualify as a reasonable search or seizure under the Fourth Amendment. Like every other investigative technique, it can adversely affect very close relatives, but the actual Fourth Amendment interests of the individuals in the database and their close relatives in keeping the state from finding investigative leads from crime-scene DNA are weak. The government interest in efficiently investigating crimes with a thorough and properly implemented system of kinship matching therefore outweighs these interests.

I. FROM KINSHIP ANALYSIS TO KINSHIP MATCHING

Kinship analysis refers to comparing DNA from different individuals to see if those individuals might be related. It is done frequently in child support²⁰ and immigration²¹ cases and in missing persons and human remains investigations.²² It

19. Other constitutional provisions—involving associational privacy, the presumption of innocence, and corruption of blood—have been invoked, but they are makeweights. David H. Kaye, *Drawing Lines: Unrelated Probable Cause as a Prerequisite to Early DNA Collection*, 91 N.C. L. REV. ADDENDUM 1 (2012); Kaye, *Associational Privacy*, *supra* note 14. Consequently, they are not pursued here.

20. See, e.g., 1 GEORGE E. DIX ET AL., MCCORMICK ON EVIDENCE § 211 (Kenneth S. Broun ed., 6th ed. 2006) [hereinafter MCCORMICK] (describing increased reliance on DNA testing in paternity suits); DAVID H. KAYE ET AL., THE NEW WIGMORE, A TREATISE ON EVIDENCE: EXPERT EVIDENCE § 14.3.2 (2d ed. 2011) (describing the application of DNA databases to paternity cases) [hereinafter KAYE ET AL., WIGMORE].

21. The first well-publicized application of forensic DNA typing occurred in a British immigration case. DAVID H. KAYE, THE DOUBLE HELIX AND THE LAW OF EVIDENCE 55 (2010) [hereinafter KAYE, DOUBLE HELIX].

22. E.g., M. Prinz et al., *DNA Commission of the International Society for Forensic Genetics (ISFG): Recommendations Regarding the Role of Forensic Genetics for Disaster Victim Identification (DVI)*, 1 FORENSIC SCI. INT'L: GENETICS 3 (2007) (recommending further DNA sampling as a method to prepare for identifying victims of disasters).

is done in criminal cases when a rape victim has a child or an aborted fetus.²³ It is one reason to believe U.S. soldiers killed Osama Bin Laden rather than a man who merely resembled him.²⁴ These applications are uncontroversial.

To appreciate the more controversial use of the procedure in criminal database trawls, it is important to understand the scientific and statistical principles behind kinship analysis. These are straightforward, but a few technical details bear heavily on the procedure's efficacy and invasiveness. This Part, therefore, defines and briefly describes the types of chromosomes, alleles, and loci used in forensic DNA identification and how these generate likelihood ratios for specific genetic relationships between individuals that can be used to produce investigative leads.²⁵

Chromosomes. In humans, DNA comes in packages known as chromosomes. Each cell nucleus normally contains twenty-three pairs of chromosomes.²⁶ In twenty-two of these pairs, called autosomes, the two chromosomes are about the same length.²⁷ The twenty-third pair differs between males and females.²⁸ Females have two copies of the X chromosome, while males have one X and one much smaller Y.²⁹

Sex cells (eggs and sperm) are exceptional in that they have a reduced number of chromosomes.³⁰ Each sex cell contains only one chromosome from each homologous pair, chosen at random, giving them a total of twenty-three individual chromosomes.³¹ When a sperm and egg cell combine, a new set of twenty-three pairs is formed.³² The fertilized cell divides, as do its daughter cells, giving rise to trillions of cells in the offspring.³³ All the new cells (except for sex cells) have the same genome of twenty-three homologous chromosomes.³⁴ One member of each pair has been inherited at random from one parent, and the other member was

23. See KAYE ET AL., WIGMORE, *supra* note 20, § 14.3.2 (describing cases); Willing, *supra* note 8 (mentioning Florida's practice of searching its offender database for profiles indicative of the paternity of children born following a rape).

24. David H. Kaye, *Osama Bin Laden's DNA? 99.9% Accuracy and 0.1% Nonsense*, THE DOUBLE HELIX LAW BLOG (May 3, 2011, 12:23 PM), <http://www.personal.psu.edu/dhk3/blogs/DoubleHelixLaw/>; Donald G. McNeil Jr. & Pam Belluck, *Experts Say DNA Match Is Likely a Parent or Child*, N.Y. TIMES, May 3, 2011, at F2.

25. The discussion that follows oversimplifies some facts. For more detail and qualifications, see, for example, FORENSIC DNA EVIDENCE INTERPRETATION (John Buckleton et al. eds., 2005); JOHN M. BUTLER, ADVANCED TOPICS IN FORENSIC DNA TYPING: METHODOLOGY (2011); WILLIAM GOODWIN ET AL., AN INTRODUCTION TO FORENSIC GENETICS (2d ed. 2011); KAYE, DOUBLE HELIX, *supra* note 21; David H. Kaye & George Sensabaugh, *Reference Guide on DNA Evidence*, in NAT'L RESEARCH COUNCIL, FED. JUDICIAL CTR., REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 129 (3d ed. 2011).

26. Kaye & Sensabaugh, *supra* note 25, at 137.

27. *Id.* at 136, 200.

28. *Id.* at 137.

29. *Id.*

30. *Id.*

31. *Id.*

32. *Id.*

33. *Id.*

34. *Id.* at 137–38.

inherited at random from the other parent.³⁵

Loci and alleles. The DNA in a chromosome can be thought of abstractly as a string of four letters (chemical “base pairs”), designated A, T, C, and G.³⁶ The sequence of base pairs in a particular chromosome (number 16, for example) is mostly the same from one individual to another, but at some locations the sequences are different.³⁷ The sequence at each location, or “locus,” is called an “allele.”³⁸ The simplest alleles are a substitution, deletion, or insertion of a letter at a particular locus.³⁹ Such variations in the DNA sequence of the same chromosome in different people (or between the paired chromosomes in the same person) are “single-nucleotide polymorphisms,” or SNPs.⁴⁰ Another kind of polymorphism is a variation in the length of a region of DNA that arises from different numbers of several short, repeated letters.⁴¹ For example, one chromosome number 16 in one individual might have the sequence GATA repeated eight times at a particular locus. Another chromosome 16 might have ten repeats of GATA. Short-tandem repeat, or STR loci, thus resemble trains with different numbers of boxcars. There are other kinds of sequence variations, but STRs currently are the most popular loci for identity and kinship testing, and SNPs are expected to come into widespread use in the near future.⁴²

A. Kinship Analysis with a Suspect

With these terms defined, we can offer a simplified example of kinship analysis that will facilitate later discussion. The hypothetical example involves only two DNA samples and two STR loci, but it illustrates how kinship analysis could supply relevant information in a criminal investigation. A laboratory extracts from one sample, recovered in a rape case, the DNA from sperm cells. The laboratory also extracts DNA from cells obtained by swabbing the inside of Joe Suspect’s cheek pursuant to a court order.⁴³ Analyzing these samples, it finds the DNA profiles listed in Table 1, which also has figures on the frequencies of the alleles in the general U.S. Caucasian population:⁴⁴

35. *Id.*

36. *Id.* at 136.

37. *Id.* at 137.

38. *Id.* at 139.

39. *Id.*

40. *Id.*

41. *Id.* at 139, 141–41.

42. See Manfred Kayser & Peter de Knijff, *Improving Human Forensics Through Advances in Genetics, Genomics and Molecular Biology*, 12 NATURE REV. GENETICS 179 (2011) (detailing current methods of DNA identification and anticipating future developments in the field).

43. Many jurisdictions provide for such orders on a showing of reasonable suspicion rather than the traditional standard of probable cause required for a search and seizure. Edward J. Imwinkelried & D. H. Kaye, *DNA Typing: Emerging or Neglected Issues*, 76 WASH. L. REV. 413, 420–22 (2001).

44. John M. Butler et al., *Allele Frequencies for 15 Autosomal STR Loci on U.S. Caucasian, African American, and Hispanic Populations*, 48 J. FORENSIC SCI. 1, 2 Table 1 (2003); John M. Butler et al., *Allele Frequencies for 27*

Table 1. Hypothetical two-locus STR profiles and allele frequencies from a crime and a suspect. The D16S539 locus is on chromosome 16, and DYS444 is on the Y chromosome. The profile associated with the alleged rapist consists of eight repeats on one chromosome 16 and ten repeats on his other chromosome. Because a man has only one Y chromosome (having inherited it from his father and an X from his mother), there is only one allele at this locus. The percentages are frequencies for these alleles in samples of U.S. Caucasians.

Sample	Locus		
	D16S539		DYS444
Crime (sperm cells)	8 (2%)	10 (6%)	15 (1%)
Suspect (Joe)	8 (2%)	12 (33%)	15 (1%)

The DNA testing apparently has absolved Joe because he does not match the crime sample completely. Joe cannot be the source of the sperm because his allele 12 at the D16S539 locus was not present in the sperm DNA. Suppose, however, that the victim picked Joe out of a lineup, and the police know that he has a brother, Jim, who resembles him. Does the near miss in the profiles of the sperm DNA from the unknown rapist and the cheek DNA from Joe support the surmise that Jim is the rapist?

Kinship analysis offers an answer. It contrasts the probability P_S of observing the STR types when Joe and the unknown source of the crime-scene sample are siblings to the probability P_U of observing these types when they are unrelated. The ratio of these probabilities, P_S/P_U is called the kinship index (or, in this case, the sibship index).⁴⁵ It is an example of a likelihood ratio. Likelihood ratios measure the probative value of evidence.⁴⁶ When the ratio is one, evidence is equally probable under the two hypotheses and thus has no probative value in deciding which hypothesis is true.⁴⁷ The extent to which the ratio exceeds one indicates how much the evidence supports the first hypothesis over the second.⁴⁸ For example, a positive result on a rapid test for the flu (known as the QuickVue

Y-STR Loci with U.S. Caucasian, African American, and Hispanic Samples, 156 FORENSIC SCI. INT'L 250, 253 tbl.2 (2006).

45. Jianye Ge et al., *Comparisons of Familial DNA Database Searching Strategies*, 56 J. FORENSIC SCI. 1448, 1448 (2011).

46. E.g., KAYE ET AL., WIGMORE, *supra* note 20, at § 14.2.1; MCCORMICK, *supra* note 20, at § 185. Contrary to the description in Gabel, *supra* note 16, at 21, taken from NORAH RUDIN & KEITH INMAN, AN INTRODUCTION TO FORENSIC DNA ANALYSIS 149 (2d ed. 2002), the likelihood ratio does not give the relative probability of the hypothesis of relatedness. It gives the relative probability of the observed alleles under different hypotheses. Naively converting the likelihood ratio into the posterior odds is a form of the transposition fallacy. KAYE ET AL., WIGMORE, *supra* note 20, at § 14.2.1–2.

47. KAYE ET AL., WIGMORE, *supra* note 20, at § 14.2.1.

48. *Id.*

Influenza A+B Test) on a patient with flu-like symptoms supports a diagnosis of the disease because the test gives this result more often when the virus is present than when something else is responsible.⁴⁹ But the likelihood ratio is only about nine, indicating that the test, while rapid, is far from definitive.⁵⁰

At the autosomal locus D16S539, the likelihood ratio for full siblingship is 6.5.⁵¹ By itself, the one shared allele proves a little, but not much.⁵² The matching Y-STR is more revealing. If Joe and the rapist are full siblings, both inherited their Y chromosome from the same man, so the probability of the matching DYS444 allele is $P_S = 100\%$. On the other hand, if Joe and the rapist are unrelated, then the probability of a match is roughly the proportion of Caucasian men with Y chromosomes who have this allele.⁵³ This frequency is $P_U = 1\%$. Thus, the likelihood ratio at this locus is $100/1 = 100$. It is 100 times more probable for the matching Y-chromosome evidence to arise when Joe and the rapist are full siblings (or otherwise in the same paternal lineage) than when they are two random men. Combining the two likelihood ratios gives the figure of $6.5 \times 100 = 650$.⁵⁴ The near miss in the STRs is 650 times as probable when the two profiles come from Joe and his (as yet untested) brother Jim than when the profiles come from Joe and an unrelated man.

This information would be quite useful to a magistrate asked to issue a warrant requiring the brother, Jim, to provide a DNA sample. Yet, Jim might object to informing the magistrate of the siblingship index on the ground that the police effectively searched his DNA when—without a new warrant—they reanalyzed Joe's profile to see whether the semen might have come from a possible sibling. He could argue that, up to that point, the police had no reason to suspect *him*—other than his being related to their suspect—and that it was unjust to place him under genetic surveillance because of his involuntary family ties.

However, the Fourth Amendment allows kinship analysis without a warrant. In

49. See Timothy M. Uyeki et al., *Low Sensitivity of Rapid Diagnostic Test for Influenza*, 48 CLINICAL INFECTIOUS DISEASES at E89, E90 (2009) (reporting the probability of a positive result when the virus is present is about 27% compared to a 3% probability of this evidence when something else is responsible).

50. *Id.*

51. The likelihood ratio is given by the expression $(1 + 2p)/8p$, where p is the frequency of the one shared allele. Charles H. Brenner, *Likelihood Ratios for Sibship and Half-sibship*, FORENSIC MATHEMATICS, <http://dna-view.com/sibfmla.htm> (last visited Nov. 25, 2012). Here, $p = 2\%$, so the ratio is $104/16 = 6.5$.

52. The ratio for half-siblingship is $(1 + 4p)/8p = 108/16 = 6.75$. *Id.*

53. For refinements, see David Balding, *Short Tandem Repeats: Interpretation*, in 5 WILEY ENCYCLOPEDIA OF FORENSIC SCIENCE 2365 (Allan Jamieson & Andre Moenssens eds., 2009); J.S. Buckleton et al., *The Interpretation of Lineage Markers in Forensic DNA Testing*, 5 FORENSIC SCI. INT'L: GENETICS 78 (2011).

54. Multiplying the likelihood ratios is appropriate if the alleles on chromosome 16 are uncorrelated with the Y chromosome haplotype. In a large, randomly mating population, the Y haplotype will propagate over many generations (or be extinguished if men with that haplotype have no male offspring), whereas children will inherit one of every pair of autosomal chromosomes at random, and these chromosomes will change as a result of crossing over (the swapping of parts of the homologous chromosomes during meiosis). Kaye & Sensabaugh, *supra* note 25, at 137, 181–82. Over time, this recombination in autosomes will wash out any correlation between the Y haplotype and the autosomal genotype.

this example, the interference with Joe's interests, pursuant to court order, was fully justified, and Jim has no plausible Fourth Amendment claim to immunity from adverse inferences that flow from the legitimately acquired sample—even if it takes a little more investigative effort to draw these inferences. In this context, there is little reason to distinguish between (1) a court order that requires a suspect to surrender his DNA to ascertain whether the suspect matches the crime-scene sample and (2) the same court order issued with the understanding that the police can consider both whether the suspect's DNA matches and, if it does not, whether a close relative's DNA is likely to match. Parts IV and V present the more detailed analysis that underlies these conclusions in the context of a database trawl case. Before engaging in this analysis, however, we should consider how kinship analysis with a database works.

B. Kinship Analysis with a Database: The Two Types of Database Trawls

Using the same principles of genetics, kinship searches can be conducted in a law enforcement database of DNA identification profiles. For brevity, we can call the convicted offenders, whose numerical profiles are recorded, "database inhabitants."⁵⁵ A database is essentially an extended version of Table 1. Instead of a single row for Joe Suspect in our example, the table has rows for the profiles of all the database inhabitants. Moreover, each row is much longer, being based in the United States on thirteen autosomal STR loci (no X- or Y-STR loci).⁵⁶ Whichever loci are in the database, the profile of these loci derived from a crime scene can be compared with all the database profiles to see (1) if a database inhabitant's profile is a match (the usual "cold hit"), indicating that the crime-scene DNA may have come from the database inhabitant, or (2) if a database inhabitant's profile is a close enough partial match to establish that the crime-scene DNA may have come from a very close relative of the database inhabitant. I shall call searches for normal cold hits "inner-directed" trawls and searches for hits indicating a close relationship to someone outside the database "outer-directed" trawls.

55. More than half the states and the federal government now take DNA from mere arrestees. Julie Samuels et al., *Collecting DNA from Arrestees: Implementation Lessons*, NIJ J., June 2012, <http://www.nij.gov/nij/journals/270/arrestee-dna.htm>. The analysis in this Article would apply to these database inhabitants and their first-degree relatives as well, taking into account the lesser interest that the government has in acquiring DNA from individuals not convicted of an offense. See *infra* Part IV.A.3.

Professor Murphy uses the terms "offenders" and "database leads" for "the individuals who, by possessing a databased profile that partially matches a crime-scene sample, point toward suspects, one of whom may be the source." Murphy, *Relative Doubt*, *supra* note 13, at 298. Suter, *supra* note 7, at 342, and KRIMSKY & SIMONCELLI, *supra* note 11, at 84, prefer the more colorful phrase "genetic informant." Gabel, *supra* note 16, at 4, uses the term "genetic snitch." Of course, by the same token, a patient who carries a genetic disease becomes a "genetic informant" or "genetic snitch" when she visits a physician who diagnoses the disease. See, e.g., *Pate v. Threlkel*, 661 So. 2d 278, 280 (Fla. 1995) (concluding a physician had a duty to warn relatives that a patient had a hereditary disease).

56. J. M. Butler & C. R. Hill, *Biology and Genetics of New Autosomal STR Loci Useful for Forensic DNA Analysis*, 24 FORENSIC SCI. REV. 15, 16 (2012).

For example, if the police trawl for a match to a crime-scene sample and Joe's profile is flagged as a full match, he becomes a suspect as a result of the inner-directed trawl. But if neither Joe nor any other database inhabitant matches in full, kinship ratios for all near-misses can be computed, in the hope of finding a database inhabitant (like Joe) with an unusually large kinship ratio to the individual outside the database who left the crime-scene sample (like Jim). With this outer-directed trawl, Jim—who was outside the database—might come to be a suspect.

As we have seen, the likelihood ratio for a particular partial match indicates how strongly the overlap in the profiles supports the inference of a particular relationship.⁵⁷ Even with the standard thirteen CODIS loci, which are not the best for kinship analysis, likelihood ratios for parent-child or sibling-sibling relationships can be quite large. Over ten years ago, the National Commission on the Future of DNA Evidence provided an example of a sibblingship index for these loci of about one million—"that is, the match probability is a million times as great if the DNAs came from siblings [than] if they came from unrelated persons."⁵⁸ If the samples had come from a crime scene and a database inhabitant (like Joe), this analysis would have strongly suggested that the crime-scene profile had come from a full brother or sister of the database inhabitant (like Jim).⁵⁹

Outer-directed trawls popularly are known as "familial searching."⁶⁰ Like that favorite phrase of opponents of estate taxation—"the death tax"⁶¹—"familial search" has a noxious connotation. It gives an impression of searching through an extended family—aunts, uncles, cousins, nephews, and so on. The book *Genetic Justice*, for instance, warns that "[a]nyone who has his or her DNA profiled in a state DNA data bank . . . brings his or her entire family under DNA surveillance."⁶² The current reality is somewhat less threatening. Although likelihood ratios can be produced for any desired relationship, with the limited number of

57. With a reasonable number of loci, the pattern of allele sharing across loci generally makes it easy to distinguish parent-child from sibling-sibling relationships. A child must possess at least one allele in common with each parent at every locus, while two full siblings have only a 25% chance of inheriting the same pair of alleles from their parents and a 50% chance of inheriting one allele in common. The probability of two siblings having at least one allele in common by descent at n loci in a row is therefore $(3/4)^n$. For 10 loci, about $1 - (3/4)^{10} = 94\%$ of siblings will have at least one locus with no shared alleles. The figure will be lower when parents have alleles in common. For 13 loci, the figure is 98%; for 20 loci, 99.7%. In contrast (barring mutations), no parent-child pairs will fail to have at least one matching allele at every locus. Finding at least one allele in common at every locus is thus strong evidence of the parent-child relationship as compared to sibblingship.

58. NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, THE FUTURE OF FORENSIC DNA TESTING: PREDICTIONS OF THE RESEARCH AND DEVELOPMENT WORKING GROUP 25 (2000).

59. The likelihood ratio for the partly matching profiles is essentially zero for a parent-child pair and about 1/500 for half siblings as compared full siblings. *Id.*

60. *E.g.*, Murphy, *Relative Doubt*, *supra* note 13, at 297–98; Suter, *supra* note 7, at 311.

61. See MICHAEL J. GRAETZ & IAN SHAPIRO, DEATH BY A THOUSAND CUTS: THE FIGHT OVER TAXING INHERITED WEALTH 4, 14 (2006) (finding the labeling of the estate tax as the "death tax" to be an effective strategy for its opponents).

62. KRIMSKY & SIMONCELLI, *supra* note 11, at 88.

STR loci used for database profiles, they are not large enough to generate useful leads to most relatives.⁶³ With databases of individuals of unknown pedigrees, kinship analysis with small numbers of loci generally is only effective for first-degree (parent-child and full sibling) relationships.⁶⁴

With more and better loci, police could zero in on the correct first-degree database inhabitant, but even then, ascertaining and making use of more attenuated relationships rarely would be feasible. In a database that includes very specific lineage haplotypes (the genomes of the Y chromosome and the mitochondria), it would be possible to pick out a database inhabitant who is distantly related to a person who deposited DNA while committing a crime. However, these lineage markers only indicate the existence of a common ancestor at some time in history. They would not enable police to infer that a crime-scene sample comes from, say, a second cousin of a database inhabitant as opposed to someone else in a lineage stretching back an unknown number of generations.⁶⁵

To avoid the connotation that kinship analysis in databases typically will go beyond the detection of first-degree relatives, I use the less tendentious terms “near-miss matching” or “kinship matching” for outer-directed trawls.⁶⁶ This terminology also clarifies the FBI’s slightly confusing effort to distinguish between “partial match” searching and “familial searching.”⁶⁷ One would think that partial-match searching simply denotes any method of identifying possible suspects in a criminal investigation short of a full match.⁶⁸ As such, “partial match searching” encompasses both inner- and outer-directed trawls (see Table 2). Existing CODIS software allows trawls for “low” or “moderate stringency” partial

63. See Stefan Wilkening et al., *STR Markers for Kinship Analysis*, 78 HUMAN BIOLOGY 1, 5–7 (2006) (finding current methods and STR markers in use are suitable only in detecting very closely related persons).

64. Steven P. Myers et al., *Searching for First-degree Familial Relationships in California’s Offender DNA Database: Validation of a Likelihood Ratio-based Approach*, 5 FORENSIC SCI. INT’L: GENETICS 493 (2011).

65. If the crime-scene sample was sufficient in quality and quantity, testing to produce high density SNP data would permit an inference as to the degree of the relationship (within one degree of the true relationship). See Chad Huff et al., *Maximum-likelihood Estimation of Recent Shared Ancestry (ERSA)*, 21 GENOME RESEARCH 768 (2011) (demonstrating that the ERSA’s statistical power approached the maximum theoretical limit imposed by the fact that distant relatives frequently share no DNA through a common ancestor). But beyond excluding many of the dataset inhabitant’s relatives as a likely source, how useful would it be to learn that the source probably is, say, a fifth, sixth, or seventh degree relative of the database inhabitant?

66. “Genetic proximity testing” is another phrase used in bioethics literature for outer-directed trawls. Prainsack, *supra* note 6, at 28–29.

67. See *Familial Searching*, FBI, <http://www.fbi.gov/about-us/lab/codis/familial-searching> (last visited Nov. 26, 2012) (defining that partial matching as “the spontaneous product of a regular database search where a candidate offender profile is identified as a possible close relative because of a similarity in the number of alleles shared between the two profiles?”).

68. A full match is a match to every allele at every locus in the crime-scene samples, though not necessarily in the database profiles. Some samples are too degraded to allow successful typing of all 13 core loci adopted for profiles in the U.S. databases. A seven-locus crime-scene profile, for instance, might produce one or more cold hits in a database trawl, making those database inhabitants suspects in the case. *Frequently Asked Questions (FAQs) on the CODIS Program and the National DNA Index System*, FBI, <http://www.fbi.gov/about-us/lab/codis/codis-and-ndis-fact-sheet> (last visited Nov. 26, 2012).

Table 2. Types of trawls in a DNA database

Inner-directed (focuses on database inhabitants)	Outer-directed (focuses on people outside the database)
<i>Full matching:</i> The database inhabitant's profile contains every allele detected in the crime-scene sample. As a result, the database inhabitant becomes a suspect.	
<i>Partial matching:</i> The database inhabitant's profile contains alleles not detected in the crime-scene sample, but these discrepancies might be due to ambiguities in mixed crime-scene samples or differences in the system used to profile the crime-scene sample. Database inhabitants are the only targets of the trawl, although inner-directed partial matches could lead investigators who exclude the database inhabitant as a suspect to consider relatives.	<i>Partial, near miss, kinship, genetic proximity, or familial matching:</i> The database inhabitant's profile differs from the one detected in the crime-scene sample in a way that excludes the inhabitant as a possible source but that is much more probable when a parent, child, brother, or sister outside the database is the source (as compared to an unrelated individual).

matches to deal with ambiguities resulting from mixed samples, technical problems, or variations in STR-typing kits from different manufacturers.⁶⁹ These partial matches are still the product of inner-directed trawls designed to pick out database inhabitants as possible sources. The CODIS partial matches are merely based on counting alleles without considering their frequencies in the population. Such matching does not use kinship analysis and is ill-suited for outer-directed searching for relatives.⁷⁰ For this latter purpose, kinship analysis is more effective (although it can be combined with allele counting rules of the kind used in CODIS partial matching).⁷¹

C. The Efficacy of Kinship Matching

The distinction between near-miss searching for relatives through kinship matching, on the one hand, and partial-match searching for database inhabitants,

69. KRIMSKY & SIMONCELLI, *supra* note 11, at 68.

70. Ge et al., *supra* note 45, at 1448; Scientific Working Group on DNA Analysis Methods Ad Hoc Committee on Partial Matches, SWGDAM Recommendations to the FBI Director on the "Interim Plan for the Release of Information in the Event of a 'Partial Match' at NDIS," *Forensic Sci. Commun.*, Oct. 2009, http://www.fbi.gov/hq/lab/fsc/current/standard_guidelines/swgdam.html.

71. BUTLER, *supra* note 25, at 605–06; Ge et al., *supra* note 45, at 1448; Myers et al., *supra* note 64, at 499. This is not to deny that partial-match searching as now practiced can be used, albeit inefficiently, to trawl for relatives. Many agencies are at sea when it comes to reporting out a reduced stringency search that also strikes an analyst as probative of kinship. For reviews of current, chaotic practices, see Ram, *supra* note 18, at 767; Suter, *supra* note 7, at 324–25.

on the other, is important because only the former holds the promise of generally productive trawls for suspects outside the database.⁷² As noted in the introduction, a number of scientists have estimated kinship matching could generate thousands of useful investigative leads nationally.⁷³ That is a theoretical calculation, however, and direct data on the effectiveness of near-miss searching for relatives through kinship matching (outer-directed trawling) are extremely limited.⁷⁴ Because the technique is almost never used, proponents and opponents tend to rely on their choice of anecdotes about its value and accuracy.⁷⁵ *Relative Doubt* exemplifies this strategy. On the one hand, it acknowledges California's spectacular success in using kinship matching to locate a man alleged to be the Los Angeles "Grim Sleeper" murderer.⁷⁶ On the other hand, *Relative Doubt* emphasizes "one revealing fact: [Denver's District Attorney, Mitch Morrissey's] familial searches did not work. None of the three matches turned out to point toward a relative, much less the source, of the actual crime-scene sample [I]t failed in three separate cases"⁷⁷ However, these searches did not use a matching strategy designed and optimized to detect kinship. When Morrissey experimented with more appropriate software (known as DNA-VIEW) on Denver's local database, he obtained "the first [successful hit] ever [in] a deliberate familial search in the United States."⁷⁸

72. Murphy, *Relative Doubt*, *supra* note 13, at 341–42, asserts that law enforcement personnel will engage in "strategic behavior" to perform inner-directed partial matching to generate leads to relatives; accord Ram, *supra* note 18, at 783–84. To prevent this, they would forbid a laboratory from advising police they should consider the possibility that a particular type of relative from outside the database is the source of a crime-scene sample. Murphy, *Relative Doubt*, *supra* note 13, at 345. Professor Murphy also suggests her proposed policy of silence about plausible leads is comparable to the policy geneticists doing family studies of disease inheritance follow when they discover misattributed paternity. The analogy is unpersuasive, since there is no large social cost to maintaining confidentiality in this research context. In the criminal context, the cost of withholding information exceeds the cost of investigating a potential suspect when kinship clearly is probable. A better argument against "accidental" kinship matching would be that, without formal kinship analysis, the suspicions of laboratory personnel might not be justified.

73. See Bieber et al., *supra* note 5, at 1316 (noting kinship searching has resulted in 30,000 cold hits with the potential for thousands more).

74. See Murphy, *Relative Doubt*, *supra* note 13, at 347 (suggesting procedures that could produce useful statistics on efficacy).

75. One incident that has largely escaped notice involved an ad hoc database, that is, a "DNA dragnet" in a small town in Alberta, Canada. There were no full matches, but two partial matches led police to the son of one of those men, whose DNA did match and who was convicted in 2005. Douglas Quan, *Familial DNA Searches Raise Tough Ethical Questions*, THE STARPHOENIX (Sasjatoon, Can.), May 21, 2011, available at <http://www2.canada.com/saskatoonstarphoenix/news/national/story.html?id=bf5cbe09-392e-4a76-9bdc-b931a18a4605&p=2>.

76. A more recent arrest in the Santa Cruz Coffee Shop rape case makes California's hit rate for its approach to kinship trawling two for thirteen. Stephen Baxter, *Rare, Familial DNA Used in Case of Rape and Robbery at Santa Cruz Coffee Shop*, SANTA CRUZ SENTINEL, Mar. 15, 2011, http://www.santacruzsentinel.com/ci_17618326.

77. Murphy, *Relative Doubt*, *supra* note 13, at 293.

78. Raphaelle Moreau-Horwin, *States Using Familial Searches*, DNA FORENSICS LLC (Aug. 24, 2012), <http://www.dnaforensics.com/StatesAndFamilialSearches.aspx>. For more details on the case, see *Car Vandal Nabbed Thanks To Brother's DNA*, WUSA9 (Nov. 17, 2009), <http://www.wusa9.com/news/local/story.aspx?storyid=93841> (reporting Luis Jaimés-Tinajero's "brother was in the system because of a felony conviction for auto theft" and the "car was one of many at his Denver apartment complex broken into [that] morning").

So, is Morrissey's record 0 for 3 or 1 for 1? It is neither. Surely, there were many cases in which the Denver kinship searches drew blanks or false leads. But the usual, full-match searches do not always produce cold hits either. The latter hit rate depends on the fraction of perpetrators of the crimes who are database inhabitants. The former hit rate is more complicated. It depends on (1) sensitivity—that is, the probability that the kinship matching algorithm registers a hit when it processes the DNA profile of a true relative of the source of the crime-scene DNA; and (2) prevalence—the proportion of relatives of database inhabitants (a) who commit crimes with recovered DNA traces and (b) who are not themselves database inhabitants.⁷⁹ The sensitivity of various algorithms can be estimated,⁸⁰ but the prevalence is more uncertain. In a 1996 study, nearly half of the jail inmates surveyed stated they have close family members who have been incarcerated,⁸¹ but we cannot know how many as yet untested close relatives of those incarcerated individuals have committed crimes for which DNA evidence is on file. Furthermore, with maturing databases, the chance of a criminal's relative being a database inhabitant will grow. When large databases have been in existence long enough, “[a] father's profile could lead to a son's apprehension as the younger man begins a life of crime.”⁸² Nevertheless, until a state implements and tracks the results of a well designed form of kinship matching in a large number of cases, the real-life efficacy of the technique will not be known.⁸³

Neither will its costs. These costs, clearly articulated in *Relative Doubt*, include indignities to innocent suspects and concomitant distress to loved ones, diverting

79. Category (b) reflects the fact that if two database inhabitants are close relatives with slightly different profiles and if one is the source of the crime-scene sample, the latter will emerge as an ordinary cold hit. Kinship matching will not be needed in this case, and the fact that the individual with the full match has a relative with a kinship hit will not be of interest. Erin E. Murphy, *Familial DNA Searches: The Opposing Viewpoint*, 27 CRIM. JUST. 1, 19, 21 (2012) [hereinafter Murphy, *Opposing Viewpoint*]. However, this is not to say that all the kin of database inhabitants who have a “shadow presence” in the database are “law-abiding relatives of offenders” (even as ascertained by the absence of a criminal conviction). *Id.* Some will have criminal records for lesser offenses that do not trigger DNA collection, and others will have completed their sentences.

80. Bieber et al., *supra* note 5; James M. Curran & John S. Buckleton, *Effectiveness of Familial Searches*, 48 SCIENCE & JUSTICE 164 (2008); Ge et al., *supra* note 45; Myers et al., *supra* note 64; Kristen Lewis O'Connor et al., *Evaluating the Effect of Additional Forensic Loci on Likelihood Ratio Values for Complex Kinship Analysis*, PROCEEDINGS OF THE 21ST INTERNATIONAL SYMPOSIUM ON HUMAN IDENTIFICATION (2010), available at <http://www.promega.com/products/pm/genetic-identity/isih-conference-proceedings/proceedings-index-home/>; Thomas M. Reid et al., *Use of Sibling Pairs to Determine the Familial Searching Efficiency of Forensic Databases*, 2 FORENSIC SCI. INT'L: GENETICS 340 (2008).

81. Bieber et al., *supra* note 5, at 1316 (“46% of jail inmates indicated that they had at least one close relative who had been incarcerated.”).

82. BUTLER, *supra* note 25, at 608.

83. Various figures have been quoted. The most recent for the United Kingdom—which uses only 10 loci—is 27% as of 2010. *Id.* at 606–07. See also KRIMSKY & SIMONCELLI, *supra* note 11, at 81 (“Proponents . . . in the United Kingdom boast a 90 percent success rate for those cases where it has been employed.”); *id.* at 175 (“By the beginning of 2008, the United Kingdom analyzed 148 cases using familial searching techniques; only 15 of them had been resolved with 9 convictions.”); Murphy, *Relative Doubt*, *supra* note 13, at 301 n. 49 (quoting statistics from familial searching in the United Kingdom and New Zealand which resulted in eighteen matches and thirteen convictions out of seventy searches since 2004).

police resources to unprofitable leads, and adding more DNA tests to produce better profiles for outside-the-database searches. Deciding whether the game, especially with current technology, is worth the candle is beyond the scope of this article. My primary focus is on the mildly futuristic system of kinship analysis with profiles constructed to be useful in identifying crime-scene sources outside the databases—that is, in outer-directed as well as inner-directed trawls. In this system, there would be more loci in the database. In fact, this enhancement may be on its way, as seven new autosomal STR loci have been proposed for inclusion in the CODIS “core loci.”⁸⁴ Moreover, loci on the sex chromosomes and mitochondria could be part of the profiles.⁸⁵ The additional, digitally searchable data would allow kinship analysis programs (that analyze the pattern of matching alleles within partially matching profiles and the population frequencies of these alleles as in Table 1) to filter out efficiently most database inhabitants who are unrelated to the source of the crime-scene DNA.⁸⁶

This system changes the perspective of current thinking about kinship matching slightly. Because existing databases are confined to autosomal STRs at only 13 loci, near-miss matches require supplemental testing if the DNA itself is to weed out false leads. For example, California’s restrictive trawling rules require laboratory technicians to retain and reanalyze samples in the repositories to verify that the paternally inherited Y-STRs are the same in the crime-scene and the databanked samples of males.⁸⁷ Recording such data at the outset avoids this extra step and, with it, the incentive to retain the physical samples that contain a wealth of personally sensitive information.⁸⁸ Adding mitochondrial sequence data at the same time would enhance detection of maternally related sources. And using carefully chosen SNPs in place of or in addition to existing STRs would improve the resolution of possible kinship.⁸⁹

84. Douglas R. Hares, *Addendum to Expanding the CODIS Core Loci in the United States*, 6 FORENSIC SCI. INT’L: GENETICS e135 (2012); Douglas R. Hares, Letter to the Editor, *Expanding the CODIS Core Loci in the United States*, 6 FORENSIC SCI. INT’L: GENETICS, at e52 (2012).

85. Mitochondria are organelles outside the nucleus that are maternally inherited. Just as Y-STRs (or other Y-chromosome loci) help distinguish paternal lineages, mitochondrial DNA is a maternal lineage marker. KAYE, DOUBLE HELIX, *supra* note 21.

86. See Greely et al., *supra* note 14, at 254 (stating with “roughly twenty more markers . . . similar to the thirteen CODIS markers . . . there would be few, if any, spurious matches to waste an investigator’s time”); O’Connor et al., *supra* note 80 (modeling the effect of using 20 and 40 STR loci in outer-directed trawling). Professor Ram is pessimistic about the current specificity of outer-directed searches. However, she discusses almost none of the relevant research reported. Ram, *supra* note 18, at 764–65.

87. Information Bulletin from Edmund G. Brown, Jr., Attorney General, DNA Partial Match (Crime Scene DNA Profile to Offender) Policy No. 2008-BFS-01 (2008).

88. See David H. Kaye, *Behavioral Genetics Research and Criminal DNA Databases*, 68 LAW & CONTEMP. PROBS. 259 (2006) (outlining arguments for and against sample retention) [hereinafter Kaye, *Behavioral Genetics*]. Professor Murphy maintains, without explanation, that sample retention lacks justification and serves no purpose. Erin Murphy, *Paradigms of Restraint*, 57 DUKE L.J. 1321, 1409 (2008).

89. C. Phillips et al., *Resolving Relationship Tests That Show Ambiguous STR Results Using Autosomal SNPs as Supplementary Markers*, 2 FORENSIC SCI. INT’L: GENETICS 198 (2008).

But even if one concludes these enhancements would produce significant benefits in terms of more accurate leads and reduced supplemental search costs, the constitutional and other questions of legality and political morality of using databases to target outside individuals remain to be addressed. I turn now to the principal constitutional arguments.

II. EQUAL PROTECTION

The Fourteenth Amendment mandates every person receive the equal protection of the law. Arbitrary classifications, which treat similarly situated people differently, or differently situated people equally, are impermissible. But almost all laws rest on imperfect generalizations about people and the problems the laws are designed to address. Even substantial under- or overinclusiveness in a legislative classification is ordinarily constitutionally tolerable, and a mere “rational basis” to draw the line where the legislature chooses will justify the law. Last year, for example, New York expanded the scope of its DNA database law to encompass virtually all convicted criminals.⁹⁰ Arguably, the earlier law was underinclusive; or perhaps the newer one is overinclusive. But neither possibility makes the legislation irrational. A line must be drawn somewhere, and legislatures ordinarily have great latitude in deciding where to draw it and when to move it.

But not always. For example, racial classifications, which have long reflected animosity toward certain groups, are especially likely to constitute unjustifiable disparate treatment. Accordingly, laws establishing overt racial classifications, and laws that are neutral on their face but are “administered . . . with an evil eye and an unequal hand”⁹¹ to benefit one race at the expense of another, are constitutionally suspect. Such state action demands the most compelling justification.

Applying these general principles⁹² to outer-directed trawling demonstrates that the procedure satisfies the Equal Protection Clause. As explained below, uniformly pursuing investigative leads from the genetic data at hand is neither a racial classification nor an irrational one.

A. Racial Discrimination

DNA databases have a greater effect within some racial groups than others. Both full-match and near-miss searching affect a higher proportion of racial minorities (relative to their representation in the general population) simply because these groups are disproportionately arrested and incarcerated, and hence included in law

90. Press Release, Governor Andrew M. Cuomo, Governor Cuomo Signs Law to Expand New York’s DNA Databank, Mar. 19, 2012, <http://www.governor.ny.gov/press/03192012-Dna-Databank>.

91. *Yick Wo v. Hopkins*, 118 U.S. 356, 373–74 (1886).

92. The thumbnail sketch here is incomplete. For additional complications, categories, and nuances, see, for example, Kenji Yoshino, *The New Equal Protection*, 124 HARV. L. REV. 747 (2011).

enforcement DNA databases.⁹³ Since 1976, however, it has been clear that a facially neutral and uniformly applied government policy does not violate equal protection simply because it has a disparate impact on some racial groups.⁹⁴ Thus, it has been said that as long as all database inhabitants are included in database trawls, the procedure does not even raise “a colorable constitutional claim.”⁹⁵

This conclusion could be too hasty. Suppose a municipality were to establish a local database by enforcing facially neutral traffic laws only against African-Americans (and a few white offenders who drive so recklessly that they cannot be ignored).⁹⁶ Would not the “racial profiling” in the construction of the database taint its subsequent use? The formally neutral practice of trawling this database of traffic-offender DNA profiles is no different from picking jurors at random—a facially neutral practice—from a pool of eligible jurors selected by jury commissioners paying careful attention to race. That system of jury selection surely deprives the underrepresented minorities of the equal protection of the law even though the second stage of the selection process is formally neutral.⁹⁷ Similarly, uniformly trawling a database that is itself the product of racially biased enforcement of a generally applicable criminal code does not overcome the argument the system as a whole is infected with impermissible, disparate treatment.

But are existing DNA databases like the hypothetical one I have described? “Racial profiling” or other overtly discriminatory practices contribute in some degree to the skewed demographics of DNA databases (or criminal fingerprint databases, for that matter), but many other factors are at play. Some laws and law enforcement tactics (such as targeting high-crime areas for patrols) could produce disproportionate conviction rates among minorities.⁹⁸ Unless the gross overrepresentation of minorities in the convict population can be proved to be the result of

93. D.H. Kaye & Michael E. Smith, *DNA Identification Databases: Legality, Legitimacy, and the Case for Population-Wide Coverage*, 2003 WIS. L. REV. 413, 452–53 (2003). Blacks outnumber whites in the prison population, but the effects of kinship matching will fall on both groups as well as on other racial and ethnic groups. See TODD D. MINTON, BUREAU OF JUSTICE STATISTICS, JAIL INMATES AT MIDYEAR 2010—STATISTICAL TABLES, NCJ 233431, at 7 tbl.6 (2011), <http://bjs.ojp.usdoj.gov/content/pub/pdf/jim10st.pdf> (reporting that 44%, 38%, and 16% of jail inmates are White, Black, and Hispanic, respectively); HEATHER C. WEST ET AL., BUREAU OF JUSTICE STATISTICS, PRISONERS IN 2009, NCJ 231675, at 27 app. tbl.13 (2010), <http://bjs.ojp.usdoj.gov/content/pub/pdf/p09.pdf> (indicating 31%, 36%, and 20% of sentenced prisoners are White, Black, and Hispanic, respectively).

94. *E.g.*, *McCleskey v. Kemp*, 481 U.S. 279 (1987); *City of Mobile v. Bolden*, 446 U.S. 55 (1980); *Washington v. Davis*, 426 U.S. 229, 230 (1976). On the death of the Fourteenth Amendment disproportionate impact theory, see, for example, Richard Primus, *The Future of Disparate Impact*, 108 MICH. L. REV. 1341, 1342 (2010).

95. Murphy, *Relative Doubt*, *supra* note 13, at 331 (note omitted); *accord*, Greely, *supra* note 14, at 259; Mares, *supra* note 17. More recently, however, Professor Murphy has written that kinship matching “is not even . . . nominally race-blind” because calculation of the kinship index depends on “probabilities generated according to racial and ethnic groupings.” Murphy, *Opposing Viewpoint*, *supra* note 79, at 22. As long as the statistical procedure is applied to all racial groups, however, the nominal use of race does not amount to disparate treatment. See *infra* this Part.

96. John Eligon, *Taking on Police Tactic, Critics Hit Racial Divide*, N.Y. TIMES, Mar. 23, 2012, at A1.

97. See, e.g., *Alexander v. Louisiana*, 405 U.S. 625 (1972).

98. Eligon, *supra* note 96.

intentional discrimination, the established distinction between disparate treatment and disparate impact should insulate the state's decision to exploit all the genetic information in the database from any special scrutiny.

Other discriminatory effects of near-match searching are subject to a similar analysis. Everything else being equal, near-miss trawls will net more suspects within groups such as Catholics, Mormons, or Latinos, which tend to have larger families.⁹⁹ Uncertainty in the estimates of STR allele frequencies is greater in some population groups than others. This could concentrate the rate of false positive conclusions of relatedness in the former groups.¹⁰⁰ African-Americans have more genetic diversity than other groups, making kinship matching more accurate for them. Navajos, having suffered repeated population size reductions, are less variable genetically; a high kinship index will be more common among unrelated individuals in this group.¹⁰¹ The extent to which the differences in the genetic histories and structure of various groups will generate substantially higher rates of false leads in particular populations, especially when a large panel of STRs, X and Y haplotypes, and SNPs are available, is still unclear.¹⁰² But even large differences in the utility of outer-directed trawling by race would not be subject to strict scrutiny. A different ratio of accurate to inaccurate leads in some populations or socially identified races is still disparate impact, not disparate treatment. It would not trigger strict scrutiny. Because both full-match and near-miss searching can generate valid leads for crimes committed by members of every racial group, it is rational to use them for all database inhabitants even if the efficacy and impact will be greater within some groups than others.

B. Arbitrary Discrimination

We have just seen that without a sea change in the law of equal protection, claims of racial discrimination from outer-directed trawling must be rejected. Is there any other basis for regarding outer-directed trawling as violative of equal protection? Professor Murphy proposes “even applying the lowest standard of review, a court might deem irrational a formal policy that effectively divides the population into two groups—those related to convicted offenders and those who are not—and then treats the former population as presumptive suspects in criminal investigations while exempting the latter population from such suspicion.”¹⁰³ “[R]elatives of convicted offenders,” she argues, are indistinguishable from

99. Daniel J. Grimm, Note, *The Demographics of Genetic Surveillance: Familial DNA Testing and the Hispanic Community*, 107 COLUM. L. REV. 1164, 1179 (2007).

100. Rori V. Rohlf et al., *Familial Identification: Population Structure and Relationship Distinguishability*, 8 PLOS GENETICS (Feb. 9, 2012).

101. *Id.* at 8. Population structure also may create more false leads for some groups (such as African-Americans) than others (such as Navajos). *Id.*

102. *Id.* Rohlf et al. focused on the existing 13 CODIS loci. Using Y-STRs and other haplotypes and SNPs should greatly reduce the false positive rate in every population.

103. Murphy, *Relative Doubt*, *supra* note 13, at 331.

“relatives of nonoffenders [when it comes to] generating government suspicion.”¹⁰⁴ Near-miss searches “are, by nature, arbitrary and discriminatory searches . . . in a . . . fundamental way: they unjustly distinguish between innocent persons related to convicted offenders and innocent persons unrelated to convicted offenders.”¹⁰⁵ Only a flat ban on outer-directed trawling—or a universal database—would overcome unjustly burdening those who have “the misfortune of being related to a convicted offender” but lack “some greater inherent criminality.”¹⁰⁶

This is dubious reasoning even as a philosophical or policy argument about fairness. Perversely, it would allow a rapist who could be found through “the misfortune of being related to a convicted offender” to escape punishment solely on the ground that another rapist with the same “inherent criminality” cannot be found through the same “coincidence of biology.”¹⁰⁷ The inability of the state, for reasons beyond its control, to locate the second rapist confers no moral right on the first one. By following all reasonably available investigative leads in all cases, the state treats all persons with equal concern and respect.

The related equal protection claim is at least as implausible as the moral one. It is clearly rational to use a method that is reasonably calculated to produce investigative leads when the opportunity presents itself—and not to use it when it is inapplicable. Doing what can be done with legitimately acquired data to identify criminal actors is not arbitrary—even if it involves family members.¹⁰⁸ Doing so for a broad group as opposed to isolated individuals is also not arbitrary.¹⁰⁹ Given that the rational basis test is “notoriously easy to meet,”¹¹⁰ outer-directed trawling is a constitutionally permissible legislative choice.¹¹¹

To be sure, a population-wide database might be a logically superior legislative response.¹¹² But the life of legislation has not been pure logic. Equal protection

104. *Id.*

105. *Id.* at 304. The term “innocent” here apparently includes all individuals (whether first-degree relatives or not) who have committed crimes for which they have not been previously convicted. *Id.* at 305–06.

106. *Id.* at 308.

107. *Id.*

108. The impact on families is discussed *infra* Part IV.

109. Citing *Davis v. Mississippi*, 394 U.S. 721 (1969), *Relative Doubt* notes “the Court has likewise invalidated broad, dragnet-style acquisition of physical evidence.” Murphy, *Relative Doubt*, *supra* note 13, at 332, 332 n.159. But *Davis* does not suggest it violates the rational basis test to acquire physical evidence from a large number of suspects. It holds only that a custodial arrest of any individual requires probable cause under the Fourth Amendment. *See, e.g., Hayes v. Florida*, 470 U.S. 811, 815 (1985) (reiterating “the holding in *Davis* that transportation to and investigative detention at the station house without probable cause or judicial authorization together violate the Fourth Amendment”); *Cupp v. Murphy*, 412 U.S. 291, 294–95 (1973) (explaining the “vice” in *Davis* was the detention without probable cause, not the act of fingerprinting). For more details on *Davis*, see David H. Kaye, *Two Fallacies About DNA Databanks for Law Enforcement*, 67 BROOK. L. REV. 179, 197–98 n.71 (2001) [hereinafter Kaye, *Fallacies*].

110. Murphy, *Relative Doubt*, *supra* note 13, at 331.

111. Moreover, it may not be constitutionally irrational for the legislature to act on the premise that “crime runs in families” even if this bit of folk wisdom lacks a rigorous empirical foundation.

112. Murphy, *Relative Doubt*, *supra* note 13, at 308. For commentary or arguments favoring the most inclusive DNA databases see, for example, Akil Reed Amar, *A Safe Intrusion*, AM. LAW., June 11, 2001, at 4; David H. Kaye

gives governments breathing space. It allows them to move one step at a time—in the interest of achieving a politically-necessary compromise or for other reasons.¹¹³ If the differences in the treatment of different individuals do not violate fundamental rights, no special showing of legislative necessity is required.

Furthermore, even if a court were to demand a more specific justification for not carrying a policy to its logical conclusion, such a justification is readily available. It is hardly irrational to hesitate to embrace universal databanking in light of the more substantial Fourth Amendment objections to that practice.¹¹⁴ *Reasonable Doubt* itself asserts it is “virtually impossible that a universal database could withstand constitutional scrutiny.”¹¹⁵ If this is so, then legislation implementing both inner-directed and outer-directed DNA database trawling provides for the most expansive form of DNA databanking that the constitution allows. To do more would raise “perplexing questions”¹¹⁶ for legislators who share Professor Murphy’s opinion. Drawing the line at one end of what is constitutionally allowable or drawing it to avoid perceived constitutional challenges is not constitutionally irrational.¹¹⁷

III. ACQUIRING DNA FOR TRAWLING AS A SEARCH

The most substantial constitutional challenge to outer-directed trawling is that it transgresses the Fourth Amendment. The Amendment guarantees “[t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures” and specifies that “no Warrant shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.”¹¹⁸ Blending these two clauses together, the Supreme Court has long held warrantless searches are per

et al., *Is a DNA Identification Database in Your Future?*, 16 CRIM. JUST. 4, 5–9, 19 (2001) [hereinafter Kaye et al., *Identification Database*]; Kaye & Smith, *supra* note 93; Michael E. Smith, *Let’s Make the DNA Identification Database as Inclusive as Possible*, 34 J.L. MED. & ETHICS 385 (2006); Paul M. Monteleoni, Note, *DNA Databases, Universality, and the Fourth Amendment*, 82 N.Y.U. L. REV. 247 (2006).

113. *E.g.*, *Williamson v. Lee Optical Co.*, 348 U.S. 483, 489 (1955) (“The legislature may select one phase of one field and apply a remedy there, neglecting the others,” by “addressing itself to the phase of the problem which seems most acute to the legislative mind.”); *Semler v. Oregon St. Bd. of Dental Exam’rs*, 294 U.S. 608, 610 (1935) (“The State was not bound . . . to strike at all evils at the same time . . .”). *But see* Note, *Reforming the One Step at a Time Justification in Equal Protection Cases*, 90 YALE L. J. 1777 (1981) (proposing narrowing the rationale).

114. Sampling DNA from everyone certainly can be defended as constitutional, but it requires a more radical argument than those most courts have used to uphold offender and arrestee sampling. *See* David H. Kaye, *A Fourth Amendment Theory for Arrestee DNA and Other Biometric Databases*, 15 U. PA. J. CONST. L. 1097 (2013) [hereinafter Kaye, *Fourth Amendment*].

115. Murphy, *Relative Doubt*, *supra* note 13, at 329 n.152.

116. *Id.* at 329.

117. *Cf.* *Whalen v. Roe*, 429 U.S. 589, 597 (1977) (commenting, in response to a due process challenge to a law enforcement database of records of drug prescriptions, that “we have frequently recognized that individual States have broad latitude in experimenting with possible solutions to problems of vital local concern”).

118. U.S. CONST. AMEND. IV.

se unreasonable unless they fall under “a few specially established and well-delineated exceptions”¹¹⁹ to the warrant requirement.¹²⁰ The exceptions cover many situations. The Court has countenanced searches incident to an arrest,¹²¹ searches of movable vehicles,¹²² searches of parolees,¹²³ searches undertaken for reasons other than the discovery of evidence for criminal prosecutions,¹²⁴ and various other searches,¹²⁵ notwithstanding the absence of a warrant. Indeed, the Court even has jettisoned any requirement of individualized suspicion when the warrantless system for searching (that falls within an exception) is not especially intrusive and is applied evenhandedly to broadly defined groups.¹²⁶

Applying this body of law, courts have rebuffed dozens of constitutional challenges to statutes establishing DNA databases for law enforcement.¹²⁷ The courts uniformly uphold acquisition and indefinite retention of DNA from convicted offenders for laboratory analysis, the inclusion of the resulting profiles in databases, and the periodic trawling and retrawling of the compiled profiles.¹²⁸ Two lines of Supreme Court cases have led to these results. One group of opinions invokes the “special needs” exception to the warrant requirement, which allows searches or seizures that advance interests beyond those of ordinary law enforcement when the state’s interests outweigh those of the individual being searched or seized. Another set applies an ad hoc “totality of the circumstances” balancing test the Supreme Court used to justify warrantless searches of parolees’ clothing and residences.¹²⁹ Even the completion of an offender’s sentence does not seem to shift

119. *Coolidge v. New Hampshire*, 403 U.S. 443, 454–55 (1971) (quoting *Katz v. United States*, 389 U.S. 347, 357 (1967)); see also *City of Ontario v. Quon*, 130 S. Ct. 2619, 2630 (2010); *Arizona v. Gant*, 556 U.S. 338 (2009); *Georgia v. Randolph*, 547 U.S. 103, 109 (2006); *Mincey v. Arizona*, 437 U.S. 385, 390 (1978).

120. See generally THOMAS N. MCINNIS, *THE EVOLUTION OF THE FOURTH AMENDMENT* 51–74 (2009). For discussion in the context of DNA database statutes, see D.H. Kaye, *The Constitutionality of DNA Sampling on Arrest*, 10 CORNELL J.L. & PUB. POL’Y 455, 456 (2001) [hereinafter Kaye, *Constitutionality*]; Kaye, *Fourth Amendment*, *supra* note 114.

121. *Whren v. United States*, 517 U.S. 806, 819 (1996) (allowing warrantless searches even when the arrest is pretextual); *Chimel v. California*, 395 U.S. 752, 768 (1969) (limiting the scope of permissible searches incident to arrest).

122. *E.g.*, *California v. Carney*, 471 U.S. 386, 387 (1985) (parked motor home); *Carroll v. United States*, 267 U.S. 132, 134 (1925) (truck on highway).

123. *E.g.*, *Samson v. California*, 547 U.S. 843, 857 (2006).

124. *E.g.*, *United States v. Flores-Montano*, 541 U.S. 149, 155 (2004) (border searches); *Nat’l Treasury Emps. Union v. Von Raab*, 489 U.S. 656, 664 (1989) (drug testing of U.S. Customs Service employees); *Bell v. Wolfish*, 441 U.S. 520, 557 (1979) (jail cells).

125. MCINNIS, *supra* note 120, at 75–118.

126. *E.g.*, *Illinois v. Lidster*, 540 U.S. 419 (2004) (roadblock to question motorists about a hit-and-run accident).

127. *E.g.*, *United States v. Amerson*, 483 F.3d 73, 89 (2d Cir. 2007); *Jones v. Murray*, 962 F.2d 302, 310–11 (4th Cir. 1992); *Landry v. Att’y Gen.*, 709 N.E.2d 1085, 1092 (Mass. 1999).

128. See, *e.g.*, *United States v. Mitchell*, 652 F.3d 387, 397 (3d Cir. 2011) (en banc) (collecting cases); *Amerson*, 483 F.3d at 78 (summarizing case law).

129. *Amerson*, 483 F.3d at 78; Kaye, *Fourth Amendment*, *supra* note 114, at 8; Charles J. Nerko, Note, *Assessing Fourth Amendment Challenges to DNA Extraction Statutes After Samson v. California*, 77 *FORDHAM L. REV.* 917 (2008).

the balance for DNA databases.¹³⁰

Relative Doubt prominently raises the question of whether performing outer-directed trawls changes this constitutional calculus. It brands as nonsensical the established doctrine that allows police to use legitimately acquired information in later cases and in other ways without a warrant, probable cause, or some form of judicial scrutiny at the later time. Instead, it asserts that every step in a DNA database system—taking a sample, analyzing (or reanalyzing) it in the laboratory, storing the sample in case it is needed in the future, and sweeping through the database every week to locate possible matches—is a separate “constitutional moment[.]”¹³¹ And, it analogizes kinship analysis in a database to the “unofficial” creation of a separate databank of the DNA samples and profiles from a vast number of relatives.¹³²

Although I shall show the novel claims about “constitutional moments”¹³³ and “shadow databases”¹³⁴ are untenable, they contain an important insight. Courts should not *assume* that just because acquiring and using a convicted offender’s DNA for inner-directed trawling is permissible, so is acquiring and using it for outer-directed trawling. If outer-directed trawls are part of the process, then reassessing the overall balance in light of these additional interests—in a word, rebalancing—may be required. This Article rebalances. It examines the Fourth Amendment interests implicated by both types of trawling. Taking the conclusion that the balance of interests makes inner-directed trawling constitutional—as every court has said it does—as a given, I ask whether any additional interests implicated by outer-directed trawling alter the balance. The analysis requires us to define the interests the Fourth Amendment protects and the extent to which a system of databases for inner- and outer-directed trawling implicates those specific inter-

130. See *Boroian v. Mueller*, 616 F.3d 60, 62 (1st Cir. 2010) (holding the incremental burden of DNA sample retention and trawling after the sentence is completed is so minimal that these actions cannot be considered new searches); *Amerson*, 483 F.3d at 85. In the Ninth Circuit, a few judges explicitly reserved judgment on the indefinite retention of samples. See *United States v. Pool*, 621 F.3d 1213, 1233 (9th Cir. 2010) (concurring opinion citing earlier concurring opinions), *vacated as moot* 659 F.3d 761. A majority of the judges in the Third Circuit did the same. *Mitchell*, 652 F.3d 387.

131. Murphy, *Relative Doubt*, *supra* note 13, at 334.

132. *Id.* at 337.

133. Litigants recently have contended that every time a database is trawled, a new search, apparently requiring a new warrant, transpires. *Boroian*, 616 F.3d at 62; *Haskell v. Brown*, 677 F. Supp. 2d 1187, 1199 n.10 (N.D. Cal. 2009), *aff’d sub nom. Haskell v. Harris*, 669 F.3d 1049 (9th Cir. 2012). *Boroian* and *Haskell* rejected this definitional move, but the court in *Mitchell*, 652 F.3d 387, had a “constitutional moment” when, without any analysis, it characterized “the processing of the DNA sample and creation of the DNA profile for CODIS” as a “second ‘search.’” *Id.* at 407. The Arizona Supreme Court likewise described the laboratory analysis of a sample as a “second search [that] is, in effect, the analog to opening [a] steamer trunk [or a] purse . . . to see what is inside.” *Mario W. v. Kaipio*, 281 P.3d 476, 481 (Ariz. 2012). The container analogy is questioned in David H. Kaye, *On the “Considered Analysis” of DNA Collection Before Conviction*, 60 UCLA L. REV. DISCOURSE 104 (2013).

134. Murphy, *Relative Doubt*, *supra* note 13, at 338.

ests—as opposed to mere desires for secrecy.¹³⁵ This “rebalancing” analysis suggests kinship matching is a constitutionally acceptable part of a suitably designed DNA database system. The net incremental benefits and burdens of near-miss searching do not greatly change the constitutional calculus already established for full-match trawling.

To reach this conclusion, I proceed through all the phases of generating investigative leads to relatives. I begin with a brief description of the much discussed problem of defining a “search” under the Fourth Amendment since this bears on the question of what is a “constitutional moment.”

A. *The Definition of a Search*

In the watershed case of *Katz v. United States*,¹³⁶ the Supreme Court famously adopted a reasonable-expectation-of-privacy standard, rather than a pure ownership or possession of property test, to mark the boundaries of the Fourth Amendment.¹³⁷ For example, without probable cause and a warrant, the police may not place a hidden microphone and transmitter on a public telephone booth to eavesdrop on calls made inside the booth, but they may send a business associate with the same equipment hidden on his person to talk to a suspect.¹³⁸ The difference, according to this line of cases, is that one can reasonably expect telephone booths to be free of electronic eavesdropping devices, but one cannot reasonably expect that an associate will not be reporting to the authorities.¹³⁹ If an individual has no reasonable expectation that his communications will be unreported or unmonitored, then the Fourth Amendment, with its preference for warrants, does not come into play—the police constitutionally can gather information without any reason to suspect an individual of wrongdoing and without prior judicial approval. If an individual does have a reasonable expectation, then there is a search, and further analysis is required to determine whether the search is permissible.

The reasonable-expectation-of-privacy standard is notoriously underdetermined.¹⁴⁰ Commentators have proposed alternatives to this “doctrinal black hole” lying “[a]t the heart of search and seizure law,”¹⁴¹ and in the past year the Supreme

135. Cf. LEO KATZ, *WHY THE LAW IS SO PERVERSE* 30–31 (2011) (distinguishing between moral claims and mere desires).

136. 389 U.S. 347 (1967).

137. But see Orin S. Kerr, *The Fourth Amendment and New Technologies: Constitutional Myths and the Case for Caution*, 102 MICH. L. REV. 801, 816 (2004) (contending “the Katz ‘reasonable expectation of privacy’ test . . . has not substantially changed the basic property-based contours of Fourth Amendment law”).

138. See *United States v. White*, 401 U.S. 745 (1971).

139. *White*, 401 U.S. at 752.

140. E.g., Tracey Maclin, Katz, Kyllo, and Technology: *Virtual Fourth Amendment Protection in the Twenty-First Century*, 72 MISS. L.J. 51, 75 (2002) (discussing “Katz’s malleability and emptiness”).

141. Jed Rubenfeld, *The End of Privacy*, 61 STAN. L. REV. 101, 103 (2008) (urging renewed emphasis on the interest in personal security rather than privacy); see also CHRISTOPHER SLOBOGIN, *PRIVACY AT RISK: THE NEW GOVERNMENT SURVEILLANCE AND THE FOURTH AMENDMENT* (2007) (proposing balancing the perceived intrusiveness of every form of government data-gathering against the law enforcement value of the practice).

Court has spoken of the test as merely an alternative to an earlier and narrower inquiry into whether the government's information-gathering practice was a trespass or, perhaps more broadly, an unlicensed physical invasion of a protected area. This surprising doctrinal shift began in *United States v. Jones*.¹⁴² There, the Court unanimously held that around-the-clock tracking of a personal vehicle for weeks, accomplished by placing a magnetized GPS tracker to the underside of the car, was a search.¹⁴³ But the Court was divided on the appropriate theory for treating the GPS tracking as a search. A bare majority presented the reasonable-expectation standard of *Katz* as supplementing rather than replacing an earlier definition of a search as a trespass to chattels or land for the purpose of gathering information.¹⁴⁴ For these Justices, a technical trespass (to personal property or to a home or its curtilage) to acquire information constitutes a search regardless of whether it infringes a reasonable expectation of privacy.¹⁴⁵

In *Florida v. Jardines*,¹⁴⁶ police took a dog trained to alert to drugs onto the porch of a house to see if drugs were inside. The Court split 5-4 on the outcome under the *Jones* trespass test. According to four dissenting Justices, this entry on to the curtilage of the house was not a trespass at common law—as shown by the majority's inability to cite a single case to the contrary.¹⁴⁷ Interestingly, Justice Scalia's majority opinion studiously avoided the term "trespass." Rather it stated that under "the traditional property-based understanding of the Fourth Amendment,"¹⁴⁸ "the officers' investigation [was a search because it] took place in a constitutionally protected area [and] was accomplished through an unlicensed physical intrusion."¹⁴⁹ Whether this variation in terminology signals a more complex analysis of property-related interests than a dry inquiry into the elements of a common law trespass is unclear,¹⁵⁰ but *Jones* and *Jardines* establish that "trespass" in the sense of a physical invasion can be a search even in the absence of a reasonable expectation of privacy. Either a *Jones-Jardines*-type physical intru-

142. 132 S. Ct. 945 (2012).

143. *Id.* at 949.

144. *Id.* at 950 ("for most of our history the Fourth Amendment was understood to embody a particular concern for government trespass upon the areas . . . it enumerates. *Katz* did not repudiate that understanding."); *id.* at 951 n.5 ("[t]respass . . . conjoined with . . . an attempt to find something or to obtain information" qualifies as a search); A. E. Dick Howard, *Out of Infancy: The Roberts Court at Seven*, 98 VA. L. REV. IN BRIEF 76, 86 (2012) ("Scalia, for five justices, rediscovered a long forgotten trespass test in Fourth Amendment law"). *But see* Orin S. Kerr, *The Curious History of Fourth Amendment Searches*, 2013 SUP. CT. REV. (forthcoming) (arguing that the pre-*Katz* mode of analysis was much richer than an inquiry into the common-law rules of trespass).

145. *Id.* at 949 (2012) ("our Fourth Amendment jurisprudence was tied to common-law trespass, at least until the latter half of the 20th century");

146. No. 11-564, 2013 WL 1196577 (U.S. Mar. 26, 2013).

147. *Id.* at *9 (Alito, J., dissenting).

148. *Id.* at *6 (Scalia, J.).

149. *Id.* at *4.

150. In a concurring opinion, three Justices who also joined in the majority opinion seemed to agree that the majority analysis turned on what the dissent called "a putative rule of trespass law." *Id.* at *9. They explained that "under a property rubric" the Court had held that "this activity [was] a trespass." *Id.* at *7 (Kagan, J., concurring).

sion or a *Katz* reasonable expectation suffices to demonstrate that state action is a search within the meaning of the Fourth Amendment.

Consequently, we must apply both the physical intrusion and the expectation-of-privacy standard to the steps in building and operating a DNA database. We begin with the acquisition of the DNA sample.

B. Physical Extraction of a DNA Sample as a Search

The very act of collecting a sample of DNA from an individual potentially implicates three interests the Fourth Amendment protects—freedom of movement, bodily integrity, and informational privacy. The first interest is largely beside the point when the individual already is legitimately in custody.¹⁵¹ A statute might authorize the use of force to hold a person still if the individual resists physically,¹⁵² but the principal seizure of the person lies in the detention of the arrested or convicted individual.¹⁵³ This detention is neither more nor less of an infringement of liberty of motion because the state seeks to obtain a DNA sample during the period when it has legal custody of the individual. Relatives of database inhabitants have even less of a claim that acquiring DNA samples infringes the right to be free from arbitrary arrest, for the relatives are not arrested or detained prior to the near-miss trawl.

The interest in bodily integrity offers a firmer foundation for deeming the collection of DNA from individuals in custody a search. The Supreme Court consistently draws on the notion of bodily integrity in holding that extracting material from inside the body, either by entering the body¹⁵⁴ or compelling the individual to expel the material,¹⁵⁵ constitutes a search. As Justice Brennan wrote in *Schmerber v. California*,¹⁵⁶ the “cherished value” that makes extraction of blood for measuring the concentration of alcohol in a driver’s blood a search is the

151. See, e.g., *United States v. Kelly*, 55 F.2d 67, 68 (2d Cir. 1932) (characterizing “[t]he . . . interference with the person involved in finger printing” as slight). When the individual is not in custody, this factor has more bearing on the classification. See *Skinner v. Ry. Labor Execs’ Ass’n*, 489 U.S. 602, 618 (1989).

152. See David H. Kaye, *Forceful DNA Collection from Recalcitrant Prisoners*, DOUBLE HELIX L. (Apr. 17, 2011), <http://www.personal.psu.edu/dhk3/blogs/DoubleHelixLaw/2011/04/forceful-dna-collection-from-recalcitrant-prisoners.html>.

153. Even if resort to reasonable force is a separate Fourth Amendment seizure, it is a permissible means of executing a search. E.g., *Cupp v. Murphy*, 412 U.S. 291, 292 (1973); *Carr v. State*, 728 N.E.2d 125, 129 (Ind. 2000).

154. The easy case, after *Schmerber*, is “physical intrusion, penetrating beneath the skin,” for the physical trespass “infringes an expectation of privacy that society is prepared to recognize as reasonable.” *Skinner*, 489 U.S. at 616. The borderline case with respect to what lies inside the body is *Cupp*, 412 U.S., which applied *Schmerber* to scraping away debris beneath the fingernails of an arrestee. *Id.* at 296.

155. See, e.g., *Skinner*, 489 U.S. at 616–17 (“Subjecting a person to a breathalyzer test, which generally requires the production of alveolar or ‘deep lung’ breath for chemical analysis implicates . . . concerns about bodily integrity and . . . should also be deemed a search.”) (citations omitted).

156. 384 U.S. 757 (1966).

“integrity of an individual’s person.”¹⁵⁷

Because DNA sampling for offender databases involves extracting blood or scraping the inside of the cheek, the lower courts unanimously have treated it as a search of the person.¹⁵⁸ This result is correct under the *Katz* standard used in these cases as well as under the new-old trespass-like standard of *Jones and Jardines*.¹⁵⁹ The physical extraction of DNA via an unprivileged forcible entry into the body would have been tortious in 1787, and it is a physical invasion of a highly protected area.

Finally, the interest in keeping certain kinds of personal information confidential supports this result. This is so even though the Fourth Amendment does not protect information as such. *Schmerber* paid no attention to the value of keeping blood-alcohol content confidential, and later cases involving chemical and microscopic analyses of personal possessions do not recognize a reasonable expectation of privacy in the information these laboratory tests reveal.¹⁶⁰ Yet, some types of information about a person are so socially and personally sensitive that this characteristic of the information militates in favor of treating its acquisition as a search. Thus, the Court has held that although a subpoena to acquire information is not itself a search, a subpoena for truly private documents not disclosed to third parties could infringe a reasonable expectation of privacy under *Katz*.¹⁶¹ Moreover, in *Skinner v. Railway Labor Executives’ Association*,¹⁶² the Court determined a program to test the urine of certain employees involved a search under *Katz* because of two factors—the manner in which the urine samples were acquired and the sensitivity of the information that could be derived from the samples. Specifically, the Court noted the social conventions surrounding the act of urination and the fact that “chemical analysis of urine, like that of blood, can reveal a host of private medical facts about an employee, including whether he or she is epileptic, pregnant, or diabetic.”¹⁶³

No such “host of private medical facts” resides in the particular noncoding STR

157. *Id.* at 772. Having classified the warrantless extraction of bodily material as a search, the majority proceeded to deem it reasonable because “[t]he officer in the present case, however, might reasonably have believed that he was confronted with an emergency . . .” *Id.* at 770.

158. *See* *Friedman v. Boucher*, 580 F.3d 847, 852 (9th Cir. 2009) (holding under existing case law “[t]here is no question that the buccal swab constituted a search under the Fourth Amendment.”).

159. No. 11-564, 2013 WL 1196577 (U.S. Mar. 26, 2013).

160. *See, e.g.*, *United States v. Edwards*, 415 U.S. 800, 803–04 (1974) (“Nor is there any doubt that clothing or other belongings may be . . . later subjected to laboratory analysis . . .”); *cf.* Nita A. Farahany, *Searching Secrets*, 160 U. PA. L. REV. 1239, 1282 (2012) (“[S]eclusion is the only recognized privacy interest that these searches [for biometric data] could implicate. When seclusion is the sole cognizable interest at stake, the physical intrusiveness of the search governs its reasonableness.”).

161. *E.g.*, *United States v. Miller*, 425 U.S. 435, 442–43 (1976); *Couch v. United States*, 409 U.S. 322, 335–36 (1973).

162. 489 U.S. 602, 616–17 (1989).

163. *Id.* at 617.

alleles that comprise the DNA profiles in law enforcement databases.¹⁶⁴ A few minority opinions and some legal commentary deny this¹⁶⁵ or suggest it is about to change,¹⁶⁶ but these writings share a common error—treating the easily abused term “junk DNA” as if it were a unitary biological category.¹⁶⁷ Well established principles of human genetics and statistics make it unlikely the database records of identifying STRs will supply information that insurers, employers, or police could use to make meaningful assessments of present or future health status because of any biological functions these alleles might perform¹⁶⁸ or because they are statistically associated with strongly disease-related regulatory or coding sites.¹⁶⁹ In their potential for revealing “private medical facts,” the identification profiles lie somewhere between taxpayer identification numbers and the common ABO blood groups.¹⁷⁰

164. *E.g.*, *United States v. Mitchell*, 652 F.3d 387, 408 (3d Cir. 2011) (en banc).

165. Schwartz misrepresents the relevant research in human genetics by asserting that four of the original 13 CODIS loci indicate disease status or predisposition and that the discovery of more population-wide associations with substantial predictive value is just around the corner. Schwartz, *supra* note 14, at 2. Among other mistakes, Schwartz cites John Butler as stating three CODIS STRs are associated with kidney disease, cardiovascular disease, neural tube defects, Edward’s syndrome, and Down’s syndrome. *Id.* at 10 n. 9. Butler actually writes “the 13 CODIS core STR loci . . . are not known to have any association with a genetic disease or any other genetic predisposition. Thus, the information in the database is only useful for human identity testing.” JOHN M. BUTLER, *FUNDAMENTALS OF FORENSIC DNA TYPING* 279 (2010); *see also* Frederick R. Bieber, *Turning Base Hits into Earned Runs: Improving the Effectiveness of Forensic DNA Data Bank Programs*, 34 J.L. MED. & ETHICS 222, 223–24 (2006) (“These particular STR markers are not known to be associated with predilection to human disease and therefore the forensic DNA typing results do not predict the present or future health status of the individuals from whom the samples are collected.”); Sara H. Katsanis & Jennifer K. Wagner, *Characterization of the Standard and Recommended CODIS Markers*, 41 J. FORENSIC SCI. (forthcoming 2013) (manuscript at 3) (finding “no evidence that any particular repeat genotypes [among the CODIS loci] are indicative of phenotype”).

166. *Mitchell*, 652 F.3d at 416, 424 (Rendell, J., dissenting); *United States v. Kincade*, 379 F.3d 813, 849–51 (9th Cir. 2004) (en banc) (Reinhardt, J., dissenting); Gabel, *supra* note 16, at 46–47; Elizabeth E. Joh, *Reclaiming “Abandoned” DNA: The Fourth Amendment and Genetic Privacy*, 100 Nw. U. L. REV. 857, 870 (2006); Ram, *supra* note 18, at 759.

167. David H. Kaye, *Science Fiction and Shed DNA*, 101 Nw. U. L. REV. COLLOQUY 62 (2006); Kaye, *Fourth Amendment*, *supra* note 114, at 1155–56; Jennifer K. Wagner, *Out with the “Junk DNA,”* 41 J. FORENSIC SCI. (forthcoming 2013). On the meaning of the phrase “junk DNA” and its relationship to privacy concerns, see Brief of Genetics, Genomics, and Forensic Science Researchers as Amici Curiae in Support of Neither Party, Maryland v. King, No. 12-207, Dec. 28, 2012.

168. One CODIS STR locus may be a part of the genetic system that regulates the level of expression of an enzyme, but no consistent and strong associations between the alleles at this locus and disease states have been observed. Kaye, *Fourth Amendment*, *supra* note 114, at 1154.

169. An STR locus situated close to coding or regulatory elements in the genome would tend to be inherited along with those elements. Kaye, *Fallacies*, *supra* note 109. This phenomenon is known as linkage disequilibrium. *E.g.*, David E. Reich et al., *Linkage Disequilibrium in the Human Genome*, 411 NATURE 199 (2001). But it would take large linkage disequilibrium involving a locus that is, in itself, powerfully predictive of a common disease to permit meaningful prediction of disease status solely from the pair of CODIS STR alleles at the linked locus recorded in a database. These conditions are unlikely to be realized. David H. Kaye, *Please, Let’s Bury the Junk: The CODIS Loci and the Revelation of Private Information*, 102 Nw. U. L. REV. COLLOQUY 70 (2007) [hereinafter Kaye, *Bury the Junk*].

170. Kaye, *Bury the Junk*, *supra* note 169; David H. Kaye, *Mopping Up After Coming Clean About “Junk DNA”*, SOCIAL SCIENCE RESEARCH NETWORK (Nov. 23, 2007), <http://ssrn.com/abstract=1032094>; Kaye, *Fourth*

Of course, the same cannot be said of the DNA *samples*.¹⁷¹ As with the urine in *Skinner*, the blood sample in *Schmerber*, or even a bit of spittle,¹⁷² the DNA sample carries sensitive information about the individual—and, to a lesser extent, about the close relatives of this individual.¹⁷³ One can envision DNA genotyping that differs from the profiling done to establish personal identity in that it reveals private information about the susceptibility to diseases, carrier status for genetic disorders, ancestry,¹⁷⁴ and, more tenuously, psychological states or tendencies.¹⁷⁵ Certain parts of one's genome—those clearly related to otherwise nonobvious disease states or behavioral characteristics—are as much, if not more, a part of “an individual's private life”¹⁷⁶ as are the hormones or other chemicals found in one's urine. Because of this possibility, extracting DNA from individuals in custody to build a database should be considered a search for Fourth Amendment purposes. Indeed, it is easy to argue this would be the proper outcome even if the DNA were

Amendment, *supra* note 114, at 1145–58 (discussing the health-information content of fingerprints and DNA profiles); Kaye, *Fallacies*, *supra* note 109 (arguing the concern about whether DNA sequences are coding is misdirected). However, there is at least one rather roundabout way in which the identification profiles could reveal substantial medical information. In the future, when the full genomes of individuals are recorded in clinical databases of medical records, a police agency possessing the profile and having surreptitious access to the database could locate the entry for the individual's genome and any associated medical records without anyone's knowledge. Although the STRs would be useful only for identification, that use could be the key to locating information in patient records. Furthermore, the patient's records and full genome could lead police to the stored genomes and records of relatives. Although I cannot think of many scenarios in which police would be motivated to engage in this computer hacking and medical snooping, there may be some. To that limited extent, the STR loci fall outside the spectrum indicated above.

Moving outside the zone of medical information, it should be noted that even medically uninformative traits that are inherited could be used for paternity and some other kinship testing. For example, database custodians could test whether two individuals in a database could have the relationship of parent and child. Brief of Genetics, Genomics, and Forensic Science Researchers as Amici Curiae, *supra* note 167.

171. *United States v. Pool*, 621 F.3d 1213, 1229 (9th Cir. 2010) (Lucero, J., concurring), *vacated as moot* 659 F.3d 761 (9th Cir. 2011) (en banc); Kaye, *Constitutionality*, *supra* note 120, at 482.

172. See Susan Gaidos, *A Spitting Image of Health: How Saliva Can Help Doctors Diagnose Disease*, SCI. NEWS, Nov. 19, 2011, at 26, available at http://www.sciencenews.org/view/feature/id/335816/title/A_Spitting_Image_of_Health (describing biomarkers in saliva for “diseases such as breast cancer, type 2 diabetes and Alzheimer's”).

173. The sample also could contain sensitive information about the parents, children or brothers and sisters of the individual whose DNA is acquired for identification, although the inferences regarding such relatives will be less clear. For example, Familial Mediterranean fever (FMF) is an autosomal recessive disorder characterized by recurrent and painful attacks of fever and inflammation in certain tissues. John Hopkins University, *Familial Mediterranean Fever; FMF*, in ONLINE MENDELIAN INHERITANCE IN MAN (1996–2011), <http://www.ncbi.nlm.nih.gov/omim/249100> (last visited Apr. 22, 2011). It is concentrated in (mostly Sephardic) Jewish, Armenian, Arabian, and Turkish populations. Some 29 deleterious mutations (alleles) of the MEFV gene are known. *Id.* If the DNA sample of a database inhabitant tested positive for one or more of these alleles, it would suggest that one or both parents also is at least a carrier of the same mutation.

174. See Kaye, *Fourth Amendment*, *supra* note 114, at 1155–56.

175. See Kaye, *Behavioral Genetics*, *supra* note 88, at 281–82.

176. *Davis v. Mississippi*, 394 U.S. 721, 727 (1969) (suggesting diluting the probable-cause requirement for fingerprinting because the process “involves none of the probing into an individual's private life and thoughts that marks an interrogation or search”).

collected without any bodily invasion,¹⁷⁷ as is technologically possible.¹⁷⁸

IV. THE REASONABLENESS OF INNER-DIRECTED AND OUTER-DIRECTED TRAWLING

Thus far, I have maintained that any extraction of DNA from the body of the individual in custody should be treated as a search.¹⁷⁹ As such, the government must justify the lack of a warrant and probable cause. As noted at the start of Part III, courts have upheld acquisition and profiling of samples along with trawling the resulting databases for inner-directed matches on two alternative theories—direct totality-of-the-circumstances balancing and the special-needs exception to the warrant requirement. The former approach repudiates decades of Fourth Amendment doctrine preventing courts from making ad hoc judgments of the reasonableness of dispensing with warrants and probable cause.

Time and again, the Supreme Court has demanded adherence to a framework of categorical exceptions to the warrant requirement.¹⁸⁰ The special-needs exception, therefore, is more palatable, but it takes considerable effort to conclude that a search to gather information with which to link an individual to a crime implements a government interest distinct from ordinary crime control.¹⁸¹ It would be better to recognize a new exception that permits the government

to acquire, analyze, store, and trawl biometric data without a warrant and without individualized suspicion when five conditions hold: (1) the person legitimately is detained (or the data are acquired without confining the individual); (2) the process of collecting the data is not physically or mentally invasive; (3) collection proceeds according to rules that prevent arbitrary selection of individuals; (4) the biometric data are used only to establish or authenticate the true identity of a given individual or to link individuals to crime scenes; and (5) the authentication or intelligence-gathering system is valid, reliable, and effective.¹⁸²

177. Kaye, *Constitutionality*, *supra* note 120, at 480; Kaye & Smith, *supra* note 93, at 444. *But see* Justin A. Alfano, Note, *Look What Katz Leaves Out: Why DNA Collection Challenges the Scope of the Fourth Amendment*, 33 HOFSTRA L. REV. 1017, 1030–31 (2005).

178. When no bodily invasion occurs—when DNA is shed or deposited naturally, or even acquired by deceit—courts have not perceived any reasonable expectation of privacy. *Williamson v. State*, 993 A.2d 626, 635–36 (Md. 2010); *State v. Athan*, 158 P.3d 27, 33–34 (Wash. 2007); *Imwinkelried & Kaye*, *supra* note 43, at 436–37. This creates the possibility that during a legitimate, custodial detention, police could collect DNA samples by having the arrested suspect spit into a cup, by placing the suspect’s thumb on a sticky pad, or some other sampling procedure that does not require physical entry. Kaye, *Fourth Amendment*, *supra* note 114, at 1108–09.

179. Relying entirely on the interest in informational privacy, one might go still further and argue that even if the government acquires the sample without demanding the individual submit to physical sampling—for example, by collecting DNA from dental floss left in the trash—the acquisition should be considered a search. *See Joh*, *supra* note 166, at 865–69.

180. *See* cases cited, *supra* note 119; Kaye, *Fourth Amendment*, *supra* note 114, at 1104–05, 1112, 1121–22.

181. *See* Kaye, *Fourth Amendment*, *supra* note 114, at 1114–16, 1130–32.

182. *Id.* at 1143.

In these circumstances, the intrusion on liberty and informational privacy interests is relatively minor, and the balance of interests that underlies the normal demand for a warrant does not apply.¹⁸³

For present purposes, however, deciding among these three approaches is not essential. Totality balancing, special-needs balancing, and the balancing required to justify a categorical exception applicable to a DNA database all involve the same weighing of the same interests.¹⁸⁴ This Part demonstrates including the interests of close kin in the balance does not produce a new outcome.

A. *The State's Interests*

Governments have three principal interests in expansive DNA databases: establishing the true identity of known (or suspected) offenders; detecting the perpetrators of crime for the usual purposes (retribution, deterrence, incapacitation, and rehabilitation); and exonerating falsely convicted individuals.¹⁸⁵ The second interest is predominant, but the others contribute a bit more to the government's case. Several comments on these interests are in order.

1. *Authentication: True Identity*

To begin with, before the 19th century, law (and revenue) officials found it difficult to know the true identities of everyone with whom they had contact. Prisoners might escape or use an alias when arrested for other offenses. Consequently, jailers began recording identifying information such as weight, height, and fingerprints of offenders and arrestees,¹⁸⁶ and courts readily upheld collecting

183. For a defense of this conclusion, see *id.* at 1143–44.

184. The biometric exception, if accepted, would permit some systems of population-wide DNA identification profiling. Although Professor Murphy, writes “[i]t seems virtually impossible that a universal database could withstand constitutional scrutiny,” she adds that “[a]t best, such a database might be compiled through a quid pro quo—in order to get a driver’s license, for instance, a person would have to submit a DNA sample, although even then the suspicionless use of that database for criminal justice purposes might raise constitutional problems.” Murphy, *Relative Doubt*, *supra* note 13, at 329 n.152. Another procedure consistent with the exception would use medical personnel, not police,

to extract identification profiles as an adjunct to [the existing] public health programs that for many years have screened [DNA] samples from almost all newborns, to identify infants with treatable genetic diseases. The identification profiles could be transmitted to a single, secure, national database The [genetic] loci . . . would be limited to sequences that have no [implications for] health or other significant physical or mental traits [Furthermore,] [a]ccess to the database would be [strictly] limited to law enforcement personnel investigating specific crimes in which DNA trace evidence already has been found. Law enforcement agencies would not need—and should not be permitted—to handle, much less retain, the samples.

Kaye et al., *Identification Database*, *supra* note 112, at 5. Of course, any such system “might raise constitutional problems.” The question is whether these problems make the system irreconcilable with the Fourth Amendment.

185. The databases also could be useful in identifying remains in missing persons cases or mass disasters.

186. For a more complete history, see Kaye, *Fourth Amendment*, *supra* note 114, at 1124–25; Wayne A. Logan, *Policing Identity*, 92 B.U. L. REV. 1561 (2012)

biometric data on individuals taken into custody.¹⁸⁷ Although it might seem as if adding DNA to the repertoire of measurements that establish identity is superfluous,¹⁸⁸ it can be argued “[u]nless the Fourth Amendment creates a constitutional straightjacket that fits but one biometric identifier, the narrow, ‘true identity’ exception should pertain to DNA genotyping as much as it does to fingerprinting.”¹⁸⁹ Even if this is a sufficient reason to establish an offender DNA database, however, it does not overcome legitimate interests of offenders or relatives in being free from trawls for inner- and outer-directed matches. A database can serve the function of recording true identities without being used for suspicionless trawling for hits to unsolved crimes. Such trawling is useful for criminal intelligence, not for authentication of identity.¹⁹⁰

2. *Intelligence: Investigative Leads and Exonerations*

The dominant reason for law enforcement DNA databases is not to keep track of true identities, but to provide investigative leads in unsolved criminal cases. It is, in other words, to make certain biological trace evidence as useful as possible in crime detection. There is much room for argument about the weight this criminal-intelligence interest deserves. No satisfactory studies have measured the actual effectiveness of ordinary trawling and kinship matching.¹⁹¹ Anecdotal evidence of spectacularly successful trawls abounds. The Green River Killer,¹⁹² the Night Stalker,¹⁹³ the Grim Sleeper,¹⁹⁴ and many other serial killers and sexual predators who had eluded detection for decades finally were identified by database trawls. But ramping up a reliable system for collecting crime-scene evidence and large

187. See Kaye, *Constitutionality*, *supra* note 120, at 485–88 (describing these cases and proposing they establish a “true identity” exception to the warrant and probable-cause requirements); David H. Kaye, *The Judicial Reception of Acquiring Biometric Data on Arrest: Photographing, Sizing, and Fingerprinting Before 1933*, *Forensic Science, Statistics, and the Law*, Dec. 25, 2012, <http://for-sci-law-now.blogspot.com/2012/12/the-judicial-reception-of-acquiring.html>. *But see* Logan, *supra* note, at 186 (arguing the earlier cases were less approving of the dissemination of this information).

188. *King v. State*, 42 A.3d 549, 577 (Md. 2012), *cert. granted*, *Maryland v. King*, 133 S. Ct. 594 (2012).

189. Kaye, *Constitutionality*, *supra* note 120, at 488–89 (explaining “fingerprints already provide an unequivocal, and in some respects, a better record of personal identity than forensic DNA typing. Monozygotic twins can be distinguished by their fingerprints, but not by genotypes. In addition, with current technology, fingerprints can be obtained more easily and more cheaply than DNA profiles. On the other hand, fingerprint patterns cannot be converted into numerical data that can be searched as efficiently as DNA data. Also, an arrestee might be carrying false identification, and searching a database of DNA prints of individuals with outstanding warrants might reveal the arrestee is a fugitive”) (citations omitted). *See also* *Mario W. v. Kaipio*, 281 P.3d 476, 483 (Ariz. 2012).

190. Some courts have blurred this distinction. *See* Kaye, *Fourth Amendment*, *supra* note 114, at 1102–03.

191. *See supra* Part I.C.

192. *E.g.*, ANN RULE, GREEN RIVER, RUNNING RED: THE REAL STORY OF THE GREEN RIVER KILLER—AMERICA’S DEADLIEST SERIAL MURDERER 360 (2004).

193. Ruben Vives, *San Francisco Police Link ‘Night Stalker’ Richard Ramirez to Girl’s 1984 Slaying*, L.A. TIMES, Oct. 23, 2009, <http://articles.latimes.com/2009/oct/23/local/me-richard-ramirez23>.

194. *See supra* Part I.C.

databases has been costly, and the net benefits are hard to estimate.¹⁹⁵

Despite this uncertainty, courts have been quick to give great weight to claims of the crime-fighting power of the databases and slow to examine the specifics of the databases, such as the length of time during which samples and profiles are retained. A less credulous (or less restrained) judicial stance could prompt more narrowly tailored laws.¹⁹⁶ Nevertheless, if the impacts of advanced database systems on deeply rooted Fourth Amendment interests are somewhat modest, the lack of certainty in the government interests may be tolerable. If there is a plausible case that expanding the scope of the system will be at least moderately effective, judgments as to its advisability, with due regard to the wide range of concerns articulated in the literature, can be left to the legislature.

Along with investigative leads come exclusions of innocent suspects or convicts. *Relative Doubt* asks whether “partial match searches are necessary for exculpatory purposes to exonerate suspects” and uses the case of Darryl Hunt, who belatedly was exonerated by a near-miss search, to show they are not.¹⁹⁷ The issue for Fourth Amendment reasonableness, however, is not whether *all* postconviction DNA exonerations necessitate finding the actual criminal. Plainly, they do not. In many situations, there is no reasonable way to explain how the crime-scene DNA

195. See, e.g., DISTRICT ATTORNEY OF ORANGE CNTY, CAL., EFFECTIVELY UTILIZING DNA TECHNOLOGY TO SOLVE CRIME IN ORANGE COUNTY 2009–2010 ANNUAL REPORT, at 17–18 (2010); Kyle I. Jen, *Michigan’s Forensic DNA Database*, FISCAL FORUM: A LEGISLATIVE BRIEFING 7 (Mar. 2003), <http://house.michigan.gov/hfa/PDFs/dna.pdf>; Ray Wickenheiser, *The Business Case for Using Forensic DNA Technology To Solve and Prevent Crime*, 7 J. BIOLAW & BUS. 34, 41 (2004); *Experts Call for DNA Restrictions*, BBC NEWS UK (Sept. 18, 2007), http://news.bbc.co.uk/2/hi/uk_news/6999703.stm; Jennifer L. Doleac, *The Effects of DNA Databases On Crime*, Dec. 2, 2012 (working paper available at http://www.batten.virginia.edu/sites/default/files/fwpapers/Doleac_DNADatabases_0.pdf).

196. Judicial review of this sort would be analogous to the “less drastic means” test sometimes applied in First Amendment litigation. Such judicial analysis is a form of marginal balancing. Note, *Less Drastic Means and the First Amendment*, 78 YALE L.J. 464 (1969). That is, rather than ask whether the constitutionally relevant benefits exceed the costs, a court asks whether the gain in a particular feature of the program (such as retaining profiles indefinitely) advances the government interests very much. Courts in database cases normally apply a total balancing test. See, e.g., *Whalen v. Roe*, 429 U.S. 589, 597 (1977) (“State legislation which has some effect on individual liberty or privacy may not be held unconstitutional simply because a court finds it unnecessary, in whole or in part. For we have frequently recognized that individual States have broad latitude in experimenting with possible solutions to problems of vital local concern.”) (footnotes omitted). Although *Whalen* is a due process case, the Court’s inquiries into reasonableness in Fourth Amendment cases are similarly deferential. See, e.g., Tracey Maclin, *The Central Meaning of the Fourth Amendment*, 35 WM. & MARY L. REV. 197, 199–200 (1993) (describing rational basis standard); William J. Stuntz, *Implicit Bargains, Government Power, and the Fourth Amendment*, 44 STAN. L. REV. 553, 553–54 (1992) (describing reasonableness standard). Indeed, in *City of Ontario v. Quon*, 130 S. Ct. 2619 (2010), the Court “refused to declare that only the ‘least intrusive’ search practicable can be reasonable under the Fourth Amendment . . . because ‘judges engaged in post hoc evaluations of government conduct can almost always imagine some alternative means by which the objectives of the government might have been accomplished . . .’” *Id.* at 2632 (internal citations omitted); see also *Colorado v. Bertine*, 479 U.S. 367, 373 (1987) (“The reasonableness of any particular governmental activity does not necessarily or invariably turn on the existence of alternative ‘less intrusive’ means.”) (quoting *Illinois v. Lafayette*, 462 U.S. 640, 647 (1983)).

197. Murphy, *Relative Doubt*, *supra* note 13, at 308–09.

could fail to match if the convicted defendant were guilty. In these instances, a database trawl is unnecessary for postconviction exoneration.¹⁹⁸

But some cases are more ambiguous. Just as the presence of a defendant's DNA at a crime-scene does not always mean the defendant is a criminal, the exclusive presence of someone else's DNA at the crime-scene does not always mean that the defendant is innocent. In a case of a man "convicted of raping a woman who reported that two men had raped her, and that she had not had consensual sex in the relevant period preceding the rape,"¹⁹⁹ the police could have picked up the wrong man and still found enough other evidence for a conviction. Being innocent, the man would have been unable to say anything about his alleged coconspirator. Postconviction testing will exonerate the petitioner "if the results reveal two separate DNA profiles, neither of which is the petitioner's."²⁰⁰ But what if the postconviction testing reveals only one profile?²⁰¹ The postconviction DNA testing is consistent with the other evidence of guilt. A database trawl, however, could lead to the man whose DNA is associated with the rape, and his statements might lead to the other rapist and ultimately to an exoneration.²⁰²

Although we cannot know how often either inner- or outer-directed trawling will exonerate falsely convicted men and women—or prevent future false convictions—the opportunities an advanced database system affords must count at least slightly in the government's favor. In addition, trawls that lead to the correct suspect early in the investigation avoid blind alleys and unnecessary and disturbing investigations of innocent persons. *Relative Doubt* emphasizes the converse possibility—that the police will waste their resources investigating falsely identified relatives and cause irreparable injury to the lives of these individuals and their families.²⁰³ If investigations are conducted discreetly, however, and if most leads from an advanced database are correct, then the benefits of outer-directed trawling in saving the innocent from becoming suspects may outweigh these costs.²⁰⁴

3. *The Reduced Expectation of Privacy*

My enumeration of the state's interests pretermitted one of the most prominent considerations in most opinions upholding the acquisition and inner-directed use

198. *E.g.*, *Dist. Attorney's Office for Third Judicial Dist. v. Osborne*, 557 U.S. 52, 58 (2009) (noting police failed to use a definitive DNA test on a condom found with the rape victim's clothing in an isolated location described by the victim).

199. Margaret Berger, *Lessons From DNA: Restriking the Balance Between Finality and Justice*, in *DNA AND THE CRIMINAL JUSTICE SYSTEM: THE TECHNOLOGY OF JUSTICE* 109, 116 (David Lazer ed., 2004).

200. *Id.*

201. Or, it might indicate a mixture in which the major contributor's profile is clear but only one or two loci in the minor contributor's DNA can be typed. Such a limited partial profile could be shared by many innocent men, including the petitioner. *See id.* at 116–17.

202. *See id.* at 116–19.

203. *See* Murphy, *Relative Doubt*, *supra* note 13, at 308, 317–18.

204. *But see id.* at 313–14.

of DNA databases against Fourth Amendment challenges—the tarnished status of the person imprisoned or on supervised release. According to *Relative Doubt*, “[t]he rationale justifying such warrantless, suspicionless searches in the case of a direct match—namely, the diminished expectation of privacy and recidivist threat of convicted offenders—is absent when it comes to relatives, who retain the full force of Fourth Amendment protection.”²⁰⁵

It is true that various opinions cite recidivism statistics in describing the strength of the government’s crime-fighting interest.²⁰⁶ But the governmental interest surely is not limited to determining the identities of offenders who are known to have committed past crimes. Database trawls that net first-time offenders or recidivists who previously have escaped detection advance the same interests as trawls that land criminals with an established history of antisocial acts.²⁰⁷ There is no static, precisely defined, criminally active segment of the population. People flow into and out of this category. The more inclusive the database, the more powerful it is as a tool for apprehending the guilty and deterring some potential offenders. To be sure, the probability that a given person will commit or has committed an offense for which a DNA trace might be found is not uniform across the population, and the state’s interest is correspondingly greater for some groups than others. But the interest is not suddenly “absent” when it comes to people without criminal histories.²⁰⁸

What is absent is “the diminished expectation of privacy.”²⁰⁹ But the diminished expectation that results from encounters with the criminal justice system only affects the balancing of public and private interests in using DNA for authentication of personal identity.²¹⁰ It is not a convincing justification for using the profile for criminal investigations.²¹¹ The “diminished expectation” rationale seems to have originated in a 1992 opinion of the Fourth Circuit in *Jones v. Murray*,²¹² the first federal appellate case to address the constitutionality of a law enforcement DNA database.²¹³ Six inmates challenged a Virginia statute that required them, as convicted felons, to submit blood samples for DNA analysis “for the creation of a data bank of the information for future law enforcement purposes.”²¹⁴ The Fourth Court responded as follows:

205. *Id.* at 337.

206. *See, e.g.*, *United States v. Carter*, 325 F. App’x 308, 309–10 (5th Cir. 2009) (analyzing recidivism statistics to rebut defendant’s argument).

207. *See* *Murphy, Relative Doubt, supra* note 13, at 306.

208. And it is not entirely absent for those with criminal histories but not one that would have triggered DNA collection under the laws in place at the time of their offenses. *See supra* note 79 and accompanying text.

209. *Kaye, Fourth Amendment, supra* note 114.

210. *See id.*

211. *See, e.g., id.*; *Kaye & Smith, supra* note 93, at 429–30.

212. 962 F.2d 302 (4th Cir. 1992).

213. *Kaye, Constitutionality, supra* note 120, at 488; *see Jones*, 962 F.2d at 302.

214. *Jones*, 962 F.2d at 302.

With the person's loss of liberty upon arrest comes the loss of at least some, if not all, rights to personal privacy otherwise protected by the Fourth Amendment. Thus, persons lawfully arrested on probable cause and detained lose a right of privacy from routine searches of the cavities of their bodies and their jail cells, as do convicted felons. Even probationers lose the protection of the Fourth Amendment with respect to their right to privacy against searches of their homes pursuant to an established program to ensure rehabilitation and security.

Similarly, when a suspect is arrested upon probable cause, his identification becomes a matter of legitimate state interest and he can hardly claim privacy in it. We accept this proposition because the identification of suspects is relevant not only to solving the crime for which the suspect is arrested, but also for maintaining a permanent record to solve other past and future crimes. This becomes readily apparent when we consider the universal approbation of "booking" procedures that are followed for every suspect arrested for a felony, whether or not the proof of a particular suspect's crime will involve the use of fingerprint identification. Thus a tax evader is fingerprinted just the same as is a burglar. While we do not accept even this small level of intrusion for free persons without Fourth Amendment constraint, the same protections do not hold true for those lawfully confined to the custody of the state. As with fingerprinting, therefore, we find that the Fourth Amendment does not require an additional finding of individualized suspicion before blood can be taken from incarcerated felons for the purpose of identifying them.²¹⁵

The court was correct in observing that some aspects of Fourth Amendment "privacy" could not apply to lawfully detained individuals.²¹⁶ They can hardly claim the same interest in freedom of movement and in withholding definitive proof of their true identity as can most of the population.²¹⁷ To this extent, privacy is diminished. But neither of these two interests supports using the database of true identities for fishing expeditions in the sea of unsolved crimes. The limitation of freedom of movement helps allow the physical sampling, while the identity-authentication exception allows the identification profiling and the recording of the information in a database.²¹⁸ This is the only relevance of these diminutions in privacy. It is the separate interest in linking crimes to criminals that justifies trawling for matches to crime-scene fingerprints or DNA profiles.²¹⁹ The privacy diminution identified in *Jones* and reiterated in later cases neither adds to nor subtracts from that part of the balancing.²²⁰

215. *Id.* at 306–07 (citations omitted).

216. *See id.*

217. *See id.*

218. *See* Kaye, *Constitutionality*, *supra* note 120, at 485–86.

219. *See id.* at 488; *Jones*, 962 F.2d at 307.

220. *See* Kaye, *Fourth Amendment*, *supra* note 114; Kaye & Smith, *supra* note 93, at 447–48 (stating that a population-wide DNA database would not interfere with anonymity).

Against the state's interests we must weigh the individuals' Fourth Amendment interests in being free from the physical intrusion of DNA sampling and the subsequent use of the samples in both inner-directed and outer-directed trawls.²²¹ As previously noted, the courts have uniformly upheld the government's forcing its way into the bodies of convicted offenders under a special-needs balancing test or a similar totality-of-the-circumstances test that allows for searches directed at individuals still under correctional supervision.²²² *Relative Doubt* does not question the determination that the collection process is minimally intrusive and that the invasion of informational privacy is relatively minor in these circumstances.²²³ What changes when we add the effects of kinship matching to the balance? The fundamental insight of *Relative Doubt* is that this question must be confronted for both the database inhabitants and their relatives.²²⁴

B. Database Inhabitants' Interests in Avoiding Outer-directed Trawls

We already have noted the database inhabitant's interests in freedom of movement, bodily integrity, and privacy of medically sensitive information.²²⁵ DNA sampling for inner-directed trawling does not significantly infringe any of these interests. According to *Relative Doubt*, kinship matching invades additional "interests of databased persons."²²⁶ Obviously, these additional interests cannot lie in the process of physically sampling the DNA itself—the factor courts have emphasized in finding DNA sampling for databases to be a search.²²⁷ The physical intrusion remains minimal for the database inhabitant (and nonexistent for the relative).²²⁸ We must look elsewhere.

1. "A Blooming Family Tree"

"First," Professor Murphy announces, "familial searches effectively transform the acquired information from a glorified genetic social security number into a blooming family tree."²²⁹ By this, she seems to mean: (1) police might ask the database inhabitant if he has any parents, children or brothers or sisters, and his answers might inform the police of "abandoned parental bonds, adoptee relation-

221. See *Jones*, 962 F.2d at 307.

222. See *Kaye*, *Fourth Amendment*, *supra* note 114.

223. See generally *Murphy*, *Relative Doubt*, *supra* note 13.

224. See *id.* at 314–19 (analyzing how DNA databases affect database inhabitants and their relatives).

225. See *supra* Section III.B for a general discussion of database inhabitants' Fourth Amendment interests.

226. *Murphy*, *Relative Doubt*, *supra* note 13, at 314.

227. See *United States v. Weikert*, 504 F.3d 1, 10–14 (1st Cir. 2007) (focusing on physical sampling of blood in analysis of reasonableness of search and seizure).

228. See *Murphy*, *Relative Doubt*, *supra* note 13, at 317–18 (stating intrusion into relatives' privacy occurs through the follow-up investigation, not the physical sampling).

229. *Id.* at 315.

ships, children conceived through technology, even family secrets about paternal identity”;²³⁰ or (2) he might eventually learn of biological relationships of which he had been unaware, as when “an offender informed of a partial match . . . later learns that the offense was ultimately attributed to the child of his old flame, or that of his father’s long-time coworker.”²³¹

These unusual scenarios fall short of a fully blossoming family tree, and neither justifies the conclusion that outer-directed trawling renders sample acquisition unreasonable. In bold strokes, the normal doctrinal analysis is as follows. First, with regard to the pressure on the database inhabitant to talk about his biological relations and social family, DNA sampling for the purpose of possible outer-directed trawling, by itself, does not expose “family secrets.”²³² It merely identifies database inhabitants who might have a close relative who might have committed a specific, unsolved crime. The police may locate these relatives for further investigation from public records or from questioning private individuals. In many cases, the police will have no interest in and no need to interrogate the database inhabitant. This could be the case for the two brothers Joe (the database inhabitant) and Jim (the rapist from outside the database) in Part I.B. Even if the police do need to ask Joe if he has a brother, simply posing questions is not a search.²³³ Joe’s interests in being free from unreasonable searches therefore should not prevent the police from asking him to talk about his family members, let alone from finding them through other, legal means.²³⁴

Second, the possibility that Joe will learn things he did not know before the police investigation does not implicate a security interest within the scope of the Fourth Amendment.²³⁵ Many searches can lead to disturbing findings about relatives or other matters, but this possibility does not make them any the less reasonable. Furthermore, even if one were to reject this conception of the interests protected by the Fourth Amendment as too cramped, a system that provides for judicial review of the grounds for interrogation and that minimizes the revelation of unwanted knowledge meets the Fourth Amendment reasonableness standard. The details of and the qualifications to this analysis follow.

230. *See id.*

231. *See id.*

232. *See Kaye, Constitutionality, supra* note 120, at 506.

233. *See, e.g., Florida v. Royer*, 460 U.S. 491, 497 (1983) (plurality opinion explaining that “law enforcement officers do not violate the Fourth Amendment by merely approaching an individual on the street or in another public place, by asking him if he is willing to answer some questions, by putting questions to him if the person is willing to listen, or by offering in evidence in a criminal prosecution his voluntary answers to such questions”); *see also infra* note 238.

234. *See id.*

235. *Cf. Greely et al., supra* note 14, at 255–66.

a. *The desire to keep quiet*

That a database inhabitant “may feel torn [about] identifying relatives, potentially exposing them to intrusive investigation”²³⁶ does not give him a privilege to withhold relevant information.²³⁷ Questioning an individual is not an invasion of a Fourth Amendment right²³⁸—even if the individual is compelled to answer.²³⁹ The evils that motivated the Fourth Amendment were intrusions into the security of the person, interference with the enjoyment of property, and seizing private papers.²⁴⁰ True, a database inhabitant such as Joe may have a strong *desire* to avoid implicating a close relative, but it is not clear that this desire translates into any significant Fourth Amendment interest.²⁴¹

A hypothetical case highlights the problem with the premise that the Amendment protects a bare desire for secrecy in family matters. Bad Sibling is a counterfeiter. Good Sibling does not know this, but she finds a stack of crisp, new \$20 bills in Bad’s room and helps herself to a few of them, fully intending to replace them later. The two siblings go out to a party that spills out onto the streets. The police arrest them for public drunkenness and take them to the station house. There, the police inventory their possessions.²⁴² A perceptive officer sees that Good’s wallet contains crisp, new bills that, on inspection, appear to be counterfeit. She sends them to a fingerprint analyst, who finds Bad’s fingerprints on one of the bills taken from Good’s wallet.²⁴³ The police obtain a warrant to search Bad’s apartment, where they find more of the bills. Good deeply regrets inadvertently leading the police to the now estranged and convicted sib, but Good has no Fourth Amendment claim.²⁴⁴

The example of the brothers, Joe and Jim, in Part I.A is similar. The police had a court order to take Joe’s DNA, and they found that it did not match the rapist’s

236. Murphy, *Relative Doubt*, *supra* note 13, at 315.

237. Cf. Greely et al., *supra* note 14, at 256 (“The argument that the police inappropriately invade a person’s privacy by asking, without any obligation, about his relatives, is very weak.”). The existence of a statutory or common law spousal privilege, together with the absence of a privilege for “family secrets” about genealogy, cuts against a claim of a reasonable expectation in privacy for the latter.

238. *E.g.*, *Hiibel v. Sixth Judicial Dist. Court of Nev., Humboldt Cnty.*, 542 U.S. 177, 178 (2004); *Florida v. Bostick*, 501 U.S. 429, 437 (1991); *INS v. Delgado*, 466 U.S. 210, 215–21 (1984); *Royer*, 460 U.S. at 497. If the database inhabitant is not free to terminate the interrogation, there is a seizure of the person, which requires objective justification. *Delgado*, 466 U.S. at 215–21; *Davis v. Mississippi*, 394 U.S. 721, 728 (1969).

239. *United States v. Calandra*, 414 U.S. 338, 353–54 (1974).

240. *See, e.g.*, *Boyd v. United States*, 116 U.S. 616, 622–30 (1886); cf. *Delgado*, 466 U.S. at 215 (“The Fourth Amendment does not proscribe all contact between the police and citizens, but is designed ‘to prevent arbitrary and oppressive interference by enforcement officials with the privacy and personal security of individuals.’”) (quoting *United States v. Martinez-Fuerte*, 428 U.S. 543, 554 (1976)).

241. On the distinction between desires and interests, see, for example, KATZ, *supra* note 135, at 30–31.

242. As allowed under *Colorado v. Bertine*, 479 U.S. 367, 370–76 (1987).

243. As allowed under *United States v. Edwards*, 415 U.S. 800, 806–08 (1974).

244. *See id.* at 807 (“[O]nce the accused is lawfully arrested and is in custody, the effects in his possession at the place of detention that were subject to search . . . may lawfully be searched and seized without a warrant . . .”).

DNA. But the eyewitness reported Joe Suspect looked like the rapist, and the police computed a sibship likelihood ratio of 10^{10} . Now suppose the police seek an arrest warrant or a warrant to take Jim's DNA. They submit an affidavit relating the genetic and the other evidence pointing to Jim as the rapist. Should the judge issue the warrants?

If there is any hesitancy, it is not because of Joe's bare desire to keep Jim out of trouble. Nor does it seem right to say the police should not have computed the likelihood ratio without a court's permission.²⁴⁵ They had to ascertain the DNA profiles from the semen and from Joe to include or exclude him as a source of the semen. In effect, they performed an inner-directed trawl on a database of size 1. Computing the likelihood ratio constituted an outer-directed trawl, but the only interest of Joe's that the mathematical exercise infringed was his possible desire to shield Jim from suspicion. It did not invade his person or property.²⁴⁶ The only information it revealed about his family was the fact that his brother was worth investigating as a possible source of the semen.²⁴⁷ No matter how honorable or loyal Joe's desire may seem to the two brothers, it should not stand in the way of the warrants.

In opposition to this analysis, one can argue that interrogating a database inhabitant rather than just the database is simply the final step of a search process that starts with the compulsory collection of his DNA and ends with his voluntary (or possibly compulsory) interrogation about family secrets. If a search were defined this expansively, it could be compared to deriving personal information from the hypothetical pregnancy test in *Skinner v. Railway Labor Executives' Association*.²⁴⁸ The risk that the individual will be questioned about this information then should be part of the balancing that determines reasonableness. Nonetheless, this generous definition of the search—never before has the questioning of individuals been considered a search²⁴⁹—does not overcome the fundamental point that the database inhabitant's interest in not having to be questioned about his family is not a weighty Fourth Amendment interest.²⁵⁰ The interest in avoiding embarrassing questions should not tip the balance in a new direction.²⁵¹ Furthermore, this interest would be protected, as much as the Fourth Amendment protects any interest, by having a magistrate review the results of the outer-directed trawl and the other information the police have assembled before allowing any contact

245. For a discussion of likelihood ratios, see Section I.

246. *See id.*

247. *See id.*

248. 489 U.S. 602, 617 (1989) (stating that chemical analysis of urine sample could reveal evidence of pregnancy); *see also supra* note 135 and accompanying text.

249. *See cases cited, supra* note 238.

250. *See infra* text accompanying notes 305–08.

251. *See infra* note 308.

with the database inhabitant.²⁵²

b. The desire not to know

The second concern about the family tree as it relates to the database inhabitant was that the police or the trial might “uncover facts that even the parties do not know.”²⁵³ *Relative Doubt* buttresses this concern with references to the “societal interest in maintaining and promoting intact, healthy family units”²⁵⁴ as manifested “for example, by authorizing spousal privilege”²⁵⁵ and goes so far as to propose “the mere awareness by Good Sibling that Bad Sibling’s conviction now leaves her susceptible to this kind of intrusion may itself generate tension” sufficient to sever family bonds.²⁵⁶

The last suggestion is implausible. That Bad Sibling has earned her name already must be a source of tension in the family. Some families may disown Bad Sibling in response to the damage done to them and others by her criminality and conviction. In these situations, additional anger at “susceptibility” to becoming a suspect in crimes involving DNA evidence is irrelevant, for the family unit would be disrupted anyway. Therefore, the argument must be that Good Sibling would have maintained family ties with Bad Sibling despite the pain caused by Bad Sibling’s transgressions but upon realizing that police can exploit Bad Sibling’s DNA in a way that could make her “susceptible” to suspicion, she suddenly will “sever family bonds.” Yet, how many Good Siblings are likely to feel that much additional remorse or anger toward Bad Sibling just because Bad Sibling not only got herself convicted but also got her DNA into the DNA database in a state that uses outer-directed trawling?

A firmer, but much narrower, basis for the intactness argument uses the following sort of scenario:²⁵⁷ A near miss leads the police to suspect a first-degree relative of the database inhabitant, say, a father named Good Dad. When the police test the Good Dad’s DNA, they discover that his genotype is inconsistent with paternity. They tell Dad he is no longer a suspect because he is not related to the man he thought was his son. The consequence of this disclosure is something other than marital bliss.

Although the scenario is unlikely in an advanced database with Y-markers or a large number of autosomal SNPs and STRs, it could occur if the crime-scene sample was too limited to permit many loci to be tested. Even if it does occur,

252. See, e.g., *Boroian v. Mueller*, 616 F.3d 60, 70–71 (1st Cir. 2010) (holding retention and matching of individual’s DNA sample in computer database did not violate Fourth Amendment).

253. *Murphy, Relative Doubt*, *supra* note 13, at 315.

254. *Id.* at 319.

255. *Id.*

256. *Id.* at 320.

257. See Robin Williams & Paul Johnson, *Inclusiveness, Effectiveness and Intrusiveness: Issues in the Developing Uses of DNA Profiling in Support of Criminal Investigations*, 34 J.L. MED. & ETHICS 234, 244 (2006) (describing scenario).

however, there is no reason to inform Dad of nonpaternity. He need only know that his DNA does not match the crime-scene sample—something that could have happened regardless of paternity.²⁵⁸ If the police gratuitously disclose nonpaternity, and if this is what is unreasonable under the Fourth Amendment, then the police will be liable in a civil action brought by Dad or the illegitimate son.

Given this remedy, prohibiting all outer-directed trawling as unconstitutional is only one way—and an extreme one at that—to protect this interest. A database system in which police are trained properly and which is supplemented by liability for unreasonable disclosures of private, family information should preserve the balance in favor of the state.²⁵⁹ And, if that were not enough, a statute could provide for judicial review to ensure the police have probable cause, based on the likelihood ratio for relatedness and other information about the case, to move the investigation in the direction of particular relatives.

Fourth Amendment reasonableness requires no more than this procedure. Even a search of a dwelling can reveal extremely embarrassing or harmful information about an individual and his family. The result could be “profound social, cultural and physical impacts on that family.”²⁶⁰ With probable cause, in the judgment of a magistrate, the search can proceed despite this risk. Similarly, judicial verification that there is probable cause to suspect that a first-degree relative is the source of a crime-scene sample guarantees that outer-directed trawling combined with a reasonable investigation into who this relative might be satisfies the Fourth Amendment.²⁶¹

Even without judicial supervision of the follow-up investigation, the conclusion that interests of database inhabitants such as Good Dad in avoiding outer-directed trawls do not render sample acquisition unreasonable finds some support in the opinion in *United States v. Pool*.²⁶² In *Pool*, the Ninth Circuit affirmed the district court’s determination that an indicted defendant had to provide a DNA sample before being released on bail.²⁶³ Giving little weight to the interest of relatives who might be implicated by kinship matching, the panel discounted the argument that performing outer-directed trawls would have made arrestee DNA sampling imper-

258. Cf. Greely et al., *supra* note 14, at 255 (describing the police discovery, in the absence of its disclosure to the relative, as “an invasion of privacy with no resulting harm”).

259. See Suter, *supra* note 7, at 393–94 (stating policies promoting training of police and discouraging disclosure of family secrets would help meet privacy concerns associated with familial searching).

260. Murphy, *Relative Doubt*, *supra* note 13, at 319 (quoting Erica Haimes, *Social and Ethical Issues in the Use of Familial Searching in Forensic Investigations: Insights from Family and Kinship Studies*, 34 J.L. MED. & ETHICS 263, 269 (2006)).

261. While familial relationship does not alone constitute probable cause, courts analyze facts other than familial relationship to determine whether probable cause exists. See *Poolaw v. Marcantel*, 565 F.3d 721, 730–31 (10th Cir. 2009) (“A familial relationship to someone suspected of criminal activity, without more, does not constitute probable cause to search or arrest.”).

262. 621 F.3d 1213, 1221, 1228 (9th Cir. 2010), *vacated as moot* 659 F.3d 761 (9th Cir. 2011).

263. *Id.* at 1228.

missible.²⁶⁴ It stated:

This seems somewhat analogous to a witness looking at a photograph of one person and stating that the perpetrator has a similar appearance which leads the police to show the witness photos of similar looking individuals, one of whom the witness identifies as the perpetrator. It is questionable whether the person whose photograph helped focus the inquiry, or whose familial comparison helped focus the inquiry, has suffered any invasion of his or her constitutional right to privacy.²⁶⁵

The court's dicta are not related to the issue of standing.²⁶⁶ As in the examples of Good Sibling and Joe Suspect, the person in the photograph is asserting the collection, profiling, and outer-directed trawling of their DNA is unreasonable as to him. But the Fourth Amendment is not a statute protecting "genetic privacy" or family relations in general.²⁶⁷ Adding the database inhabitant's interests in avoiding outer-directed searches does little to change the balance of all the interests.

2. More Markers

Second, *Relative Doubt* suggests testing "Y-STRs or single nucleotide polymorphisms (SNPs)"²⁶⁸ is a greater threat to informational privacy than merely examining autosomal STRs. Professor Murphy believes "Y-STR testing indisputably reveals biological relationships,"²⁶⁹ and it might be used "for identifying possible surnames."²⁷⁰ The notion that these different loci are more threatening than autosomal STR loci deserves some inspection. I start by clarifying the limited role of Y-STRs in kinship trawling, then discuss SNPs, and conclude with some comments on surname inference.

To begin with, identical or nearly identical Y-STR haplotypes merely imply (to a high probability) a common male ancestor sometime in the past few centuries.²⁷¹ If

264. *See id.* at 1221.

265. *Id.* at 1221. One judge dissented from the result in the case, but she did not discuss the argument about outer-directed trawling. *See id.* at 1234–38 (Schroeder, J., dissenting). A similar analogy appears in D.H. Kaye, *Bioethics, Bench, and Bar: Selected Arguments*, in *Landry v. Attorney General*, 40 *JURIMETRICS J.* 193, 205–06 (2000).

266. *See id.*

267. Treating information about family matters (or anything else) differently because it is disclosed through DNA testing rather than through more conventional investigative methods is a form of "genetic exceptionalism." Prainsack, *supra* note 6, at 29.

268. Murphy, *Relative Doubt*, *supra* note 13, at 315.

269. *Id.*

270. *Id.*

271. Every few centuries, a change in the Y-STR haplotype might occur and propagate in the spermatozoa of an offspring. If this man has a surviving line of male children, the result is a splitting of the paternal line into the old haplotype and a new "clan" of men with the mutated progenitor as the patriarch. But men with different patriarchs also can have the same Y-haplotype. This occurs when a later mutation produces a convergence back to the earlier haplotype. Such convergence is unusual, but even if no two male clans share the same Y-haplotype, two

one searches back far enough in time, all men have such “biological relationships.”²⁷² For example, as many as one in 12 Irishmen may be within the paternal line of the Fifth Century warlord known as Niall of the Nine Hostages.²⁷³ Y-haplotyping thus raises a possibility that police genealogists will notice the database inhabitant has the same haplotype as, for example, a famous person (living or deceased, whose haplotype is published or otherwise discoverable). From this, they might infer (to some probability) that the database inhabitant can count this person as a relative. Placing a prisoner of Irish descent in the same haplogroup as Niall would not seem especially harmful, but a possible relationship to personages such as Hitler and Stalin, whose haplogroups are listed on Wikipedia,²⁷⁴ seems more problematic.

The extent to which police will want to play such genealogy games is open to question. Police laboratories frequently obtain Y-STR profiles of suspects in rape cases aid in the analysis of samples containing the DNA of several individuals, and there is no evidence that police or laboratory workers are using them for such diversions. In any event, the practice does not advance criminal investigations and can be prohibited. The special value of Y-STRs in outer-directed trawling lies in their ability to exclude the possibility the database inhabitant and the crime-scene-sample contributor are both very recent lineal descendants of the same man (or a father-child pair).²⁷⁵ When the Y-STRs do not match, the unidentified crime-scene sample almost certainly does not come from a recent, close male relative of a database inhabitant. This means the kinship index (for patrilineal associations) will be small, and the database inhabitant will not emerge as a likely lead. The failure of the database inhabitant’s name to rise toward the top of the list poses few, if any, threats to anyone’s privacy. Conversely, when the Y-STRs do match, the likelihood ratio usually gets a big boost, just as it does from a series of matching autosomal alleles. No particular harm arises from the use of Y-haplotypes in a well run database.

Next, using single nucleotide polymorphisms instead of, or in addition to, short tandem repeat polymorphisms in kinship analysis does not necessarily produce a greater invasion of privacy. The issue is what the particular SNPs might show above and beyond relatedness. Some SNPs are “noise” rather than meaningful genetic information, just as some STRs are. Other SNPs affect the expression of

men who are lineal descendants of the most recent mutated patriarch can be distant relatives who are unknown to one another. See generally Mark D. Shriver & Rick A. Kittles, Opinion, *Genetic Ancestry and the Search for Personalized Genetic Histories*, 5 NATURE REV. GENETICS 611 (2004).

272. See *id.* at 613–17.

273. L.T. Moore et al., *A Y-chromosome Signature of Hegemony in Gaelic Ireland*, 78 AM. J. HUM. GENETICS 334 (2006).

274. *List of Haplogroups of Historical and Famous Figures*, WIKIPEDIA, http://en.wikipedia.org/wiki/Famous_haplogroup_members.

275. See Murphy, *Relative Doubt*, *supra* note 13, at 315–16 (discussing uncovering relationships and excluding possibilities of relationships).

proteins, but this does not automatically make them medically or socially significant data. Ordinary blood groupings are based on SNPs. Learning that an individual is Group O (as I am) does not seem like a major invasion of privacy. Serologists used this kind of information in case after case in the decades before DNA profiling became part of the forensic scientist's armamentarium—with no apparent ill effects on personal privacy. Modern DNA profiles routinely include the allele of a gene (known as amelogenin) that codes for a major component of the tooth enamel matrix. A shorter version of the allele occurs on the X-chromosome, making it a convenient way to determine the sex of the source of the crime-scene DNA.²⁷⁶ This analysis of coding DNA has not been thought to create a significant privacy issue.

Finally, isonymy (shared surnames) has little to do with outer-directed trawling. It is a conceivable investigative technique for guessing the name of a source of DNA recovered from a crime-scene.²⁷⁷ Like inferring red hair color from SNPs in a semen stain,²⁷⁸ it does not require access to the offender database.²⁷⁹ Moreover, like physical appearance, handwriting, and voice, a recorded family name is not normally a deeply private matter.²⁸⁰

C. Relatives' Interests in Avoiding Outer-directed Trawls

That the proffered interests of the database inhabitant in avoiding outer-directed trawling, do not alter the balance in favor of the state does not exhaust the analysis. What of the first-degree relatives who could become targets of the investigation? As *Relative Doubt* argues, surely their Fourth Amendment interests must be counted and weighed at some point.²⁸¹ In doing so, we must attend again to the nexus between precise interests that can be asserted and the values underlying the

276. GOODWIN ET AL., *supra* note 25, at 69.

277. See, e.g., Peter Gill, *DNA as Evidence—The Technology of Identification*, 352 NEW ENG. J. MED. 2669, 2670 (2005). Professor Murphy has sworn that research demonstrates deducing surnames from Y-STRs works “with alarming accuracy.” Declaration of Erin Murphy in Support of Plaintiffs’ Reply Brief re: Motion for Preliminary Injunction at 3, *Haskell v. Brown*, 677 F. Supp. 2d 1187 (N.D. Cal. 2009). As described in KAYE, DOUBLE HELIX, *supra* note 21, at 210–11, a study in the United Kingdom reported correct predictions of surnames (based on the closest 17-locus STR haplotypes in a table of haplotypes and surnames derived from a random sample of men) in less than one in five instances. Even for less common surnames, prediction was only accurate in one in three instances. Better results should be possible, at least in some societies, but factors such as adoptions, infidelity, and name changes limit accuracy and utility. See Turi E. King & Mark A. Jobling, *Founders, Drift, and Infidelity: The Relationship Between Y Chromosome Diversity and Patrilineal Surnames*, 26 MOLECULAR BIOLOGY & EVOLUTION 1093, 1093 (2009); Alberto Gómez et al., *Correlation Analysis of Surnames and Y-Chromosome Genetic Heritage in 3 Provinces of Southwestern Colombia*, 28 BIOMEDICA 357, 363–65 (2008).

278. On this procedure, see, for example, Wojciech Branicki et al., *Determination of Phenotype Associated SNPs in the MC1R Gene*, 52 J. FORENSIC SCI. 349, 352–54 (2007).

279. To facilitate guessing surnames, the database could be used to create a table of haplotypes and surnames; so could private genealogy databases.

280. See *United States v. Mara*, 410 U.S. 19, 21–22 (1973) (handwriting); *United States v. Dionisio*, 410 U.S. 1, 13–15 (1973) (voice).

281. Murphy, *Relative Doubt*, *supra* note 13, at 317–18.

Fourth Amendment.²⁸² Not all harms to individuals can be brought under the Amendment's protective umbrella. In particular, the interests cited in *Relative Doubt* (as well as other commentary) can find little shelter there.²⁸³ With outer-directed trawling, no relative is detained or asked to submit to a syringe, a swab, or even a touch. The relative's interest in bodily integrity therefore does nothing to change the balance that courts have found to favor the government. Again, we must look elsewhere.

1. Sheltering Evidence of Guilt

Certainly, near-miss searching could reveal things a relative would rather keep private. For one thing, a relative might be concerned that kinship matching will expose him as the perpetrator of an unsolved crime (and incidentally jeopardize the family integrity that *Relative Doubt* characterizes as a constitutional value).²⁸⁴ A trawl with this outcome would harm the relative (and quite possibly the family),²⁸⁵ but this kind of harm cannot count in any Fourth Amendment calculus.²⁸⁶ By itself, the discovery that an individual is responsible for a crime does not infringe a legitimate interest, let alone an interest that the Fourth Amendment respects.²⁸⁷ Thus, *Relative Doubt* wisely dismisses the desire of guilty relatives to escape detection in its catalog of individual interests.²⁸⁸ However, the irrelevance of this harm is not just a matter of a lack of "empathy" and the fact that "[i]t is certainly difficult to get too exercised about the privacy rights of the actual perpetrator."²⁸⁹ One *should* be exercised about violations of those rights—if they are indeed rights under the Fourth Amendment. But they are not. The Fourth Amendment does not protect information per se; it protects individuals against oppressive methods of acquiring that information.²⁹⁰

282. Parts of the analysis of these interests that follows are adapted from David H. Kaye, *DNA Database Trawls and the Definition of a Search* in Boroian v. Mueller, 97 VA. L. REV. IN BRIEF 41, 46–49 (2011) [hereinafter Kaye, *DNA Database Trawls*].

283. See *id.*; Murphy, *Relative Doubt*, *supra* note 13, at 317–18.

284. See *id.*

285. See *id.* at 319.

286. Cf. Kaye, *DNA Database Trawls*, *supra* note 282, at 46–47 (referring to database inhabitant rather than a relative).

287. See, e.g., *Illinois v. Caballes*, 543 U.S. 405, 408–09 (2005); *United States v. Jacobsen*, 466 U.S. 109, 124–25 (1984); *United States v. Place*, 462 U.S. 696, 703–06 (1983); cf. *Oliver v. United States*, 466 U.S. 170 (1984) (holding no-trespassing signs and locked gates on "open fields" are insufficient to create a "legitimate" expectation of privacy against inspection of the land).

288. See generally Murphy, *Relative Doubt*, *supra* note 13 (discussing other interests which could be violated by familial DNA searches).

289. *Id.* at 318–19.

290. Compare *Boyd v. United States*, 116 U.S. 616, 623, 631–32 (1886) (describing the Amendment as protecting private information even against a lawful search), and *Gouled v. United States*, 255 U.S. 298, 309 (1921) ("[Search warrants] may not be used as a means of gaining access to a man's house or office and papers solely for the purpose of [securing] evidence to be used against him . . ."), with *Hale v. Henkel*, 201 U.S. 43, 73 (1906) (limiting the application of the Fourth Amendment to subpoenas), and *Fisher v. United States*, 425 U.S.

2. *Avoiding False Convictions*

Relatives also can be harmed by an outer-directed trawl that calls them to the attention of the police when they are innocent of the crimes to which they apparently are linked. A false alarm could occur if the database inhabitant is not related to the source of the crime-scene DNA but coincidentally shares a profile that has a very large kinship index with respect to the crime-scene sample. Or, the database inhabitant could have the deduced genetic relationship to the criminal, but this discovery leads the police to someone like Good Dad in Part IV.B.1.b, who does not actually stand in that genetic relationship to him. The probability of coincidental partial matches can be controlled by the procedures outlined in Part I, but some false alarms are inevitable. Nevertheless, these false alarms should not lead to false convictions. Before trial, a sample taken from the false lead will have to be compared to the DNA from the crime scene. If the false lead is not the source of the crime-scene DNA, this individual normally will be excluded as a suspect.²⁹¹

Of course, even if there were no false alarms in associating database inhabitants with crime-scene samples left by first-degree relatives, some false convictions could occur. After all, even if all near-miss events were proof perfect of relatedness, a kinship match would not necessarily be conclusive proof of guilt. For one thing, the police or someone else might have planted his DNA at the crime-scene.²⁹² Such possibilities are not special to kinship trawling (or to biological evidence). On occasion, ordinary inner-directed database matches could produce false convictions, if, for example, a laboratory mistypes the crime-scene sample, which then matches that of a database inhabitant.²⁹³ The per capita risk for this outcome seems no higher for outer-directed trawls than for inner-directed trawls, making it hard to discern why a balancing test would come out differently.²⁹⁴

391, 431–32 (1976) (Marshall, J., concurring) (decrying the Court's rejection of *Boyd's* information-centric perspective).

291. KAYE ET AL., WIGMORE, *supra* note 20, at § 13.3.2, 603.

292. *Id.* § 13.3.1, at 600–02 nn.7–9.

293. There are instances in which a laboratory or other organization has swapped crime-scene samples or contaminated a crime-scene sample with DNA from another individual who became a database inhabitant at some point. See Jeremy Gans, *Ozymandias on Trial: Wrongs and Rights in DNA Cases*, in CRIMINAL EVIDENCE AND HUMAN RIGHTS 195, 197–99 (Paul Roberts & Jill Hunter eds., 2012) (discussing the case of Farah Jama). See generally William C. Thompson, *Tarnish On The 'Gold Standard': Recent Problems In Forensic DNA Testing*, THE CHAMPION, Jan.–Feb. 2006, at 10; *DNA Blunder: Man Accused of Rape After Human Error*, BBC NEWS (Mar. 21, 2012), <http://www.bbc.co.uk/news/uk-england-manchester-17460661>. In one case in Australia, this type of error led to a false conviction. Gans, *supra*. These incidents illustrate the need to implement quality control systems that reduce the chance of handling and other error, but even with reasonable precautions in place, the law of large numbers means that low-probability events will occur eventually.

294. Although false convictions due to properly conducted DNA trawls are not high probability events, even if they were, the interest in accurate factfinding at trial does not belong on the individual's side of the ledger. Instead, it diminishes the state's interest in acquiring DNA for database trawls.

3. *Being a Suspect*

The investigative process is not painless for the apparent relative, who must suffer the distress of being the target of a police investigation. As Professor Hank Greely observed, “I don’t think anybody’s going to be falsely convicted It’s the time, hassle and indignity of being interviewed by the police. How much is that worth? How much does that cost a person? I don’t know, but it’s not zero.”²⁹⁵ Professor Murphy vividly describes the possible cost of a prolonged investigation when she asks us to

consider Richard Jewell (the wrongly identified Atlanta bomber) or Stephen Hatfill (the wrongly identified anthrax mailer) or the members of the Duke University lacrosse team (falsely accused of rape). The worst indignity of an investigation can be living under a cloud of suspicion; even mere suspicion, quickly dispelled, has the potential to disrupt a career, destroy a marriage, or ruin a life.²⁹⁶

The individual interest in being free from falsely incriminating trawls surely is legitimate, and the risk of harm to relatives from a false near-match is not zero. But does the risk even count in the Fourth Amendment calculus? The false-incrimination objection to DNA database trawls goes not to the impact of the information-gathering technique on privacy, but to the accuracy of the inferences that can be drawn from the information. For better or worse, beyond the threshold for probable cause, the Fourth Amendment does not protect against mistaken reasoning about evidence.²⁹⁷ In a classic search of a home, police could find planted contraband or ambiguous evidence. It is enough that police, in the informed judgment of a magistrate issuing a warrant, have a sufficient basis to believe that the search will produce potentially useful information.²⁹⁸

The Fourth Amendment protects certain kinds of privacy, such as the undisturbed possession or enjoyment of one’s dwelling.²⁹⁹ It means the police must have a sufficient factual basis or other justification for interfering with that privacy.³⁰⁰ But the Amendment does not protect against mistaken inferences from

295. Nakashima, *supra* note 11, at A1 (internal quotation marks omitted).

296. Murphy, *Relative Doubt*, *supra* note 13, at 314. Other scenarios seem less compelling. *See, e.g.*, Mark Henderson, *DNA Database ‘Puts Innocent Under Suspicion,’* THE TIMES (LONDON), Sept. 18, 2007, available at <http://www.timesonline.co.uk/tol/news/uk/crime/article2477559.ece> (quoting Professor Carole McCartney as posing the following case: “My local off-licence was recently subject to an armed robbery My DNA will be all over the place, but I’m not actually a criminal, I’m just a chocolate-eating wine drinker.”).

297. Kaye, *DNA Database Trawls*, *supra* note 282, at 47.

298. *Id.*

299. *See, e.g.*, *Georgia v. Randolph*, 547 U.S. 103, 120 (2006) (holding warrantless entry of suspect’s home based on permission from his wife was a violation of the Fourth Amendment when the suspect was present and had refused consent to search).

300. *See Illinois v. Gates*, 462 U.S. 213, 238–39 (1983) (applying the test that for a search warrant for a dwelling to issue, the judge must find based on totality of the circumstances set forth in affidavit that there is a fair probability that incriminating evidence will be found in the dwelling).

the fruits of a reasonable search, whether warranted or warrantless.³⁰¹ As with being marched into the grand jury room, the interest in not being a target or even a part of an investigation can be highly meaningful to the individual but quite outside the zone of Fourth Amendment protection.³⁰² Whether it should count in the balancing test therefore is open to question. And, even if it does count, the harm in becoming a suspect when a DNA test can promptly dispel the suspicion may be no more severe for the relative of the database inhabitant than it was for database inhabitant. This factor therefore does not seem to make outer-directed trawling constitutionally unreasonable.

Relative Doubt argues, however, that misdirected investigations will be more common with outer-directed trawls: The same innocent relatives will be approached by the police so often that “a relative would be wise to volunteer a genetic sample (and thus be more readily excluded) rather than run the risk of repeated requests for samples that ultimately prove not to match.”³⁰³ I would not give most relatives such advice. For a relative to be repeatedly implicated, the following conditions would have to hold: (1) The crime-scene profile does not match anyone in the database (no inner-directed match); (2) the crime-scene profile is such a good partial match that it generates a kinship index for at least one type of relationship that exceeds the system’s threshold (an outer-directed hit); (3) outer-directed hits *to the same database inhabitant* occur over and over; and (4) this oddly affected database inhabitant has an innocent relative to whom the police would be attracted in these cases.

Envisioning a scenario that fulfills all these conditions is challenging, but here is one: The database inhabitant (again, we’ll call him Joe) has three brothers, three sisters, two parents, and four sons and four daughters. All are alive, mobile, and within a plausible age range to be criminal suspects at the relevant times. Brother Jim has committed four unsolved crimes, leaving his DNA at all of them. He has no criminal history that would have resulted in the addition of his DNA profile to the database. Everyone else is an innocent relative. That is, no one else in the family has a criminal history that would have led to inclusion in the database, and none of them has committed an undetected crime. An inner-directed trawl for the profile from Crime 1 excludes Joe and all his parents and children (because the Crime 1 profile and Joe’s profile do not share an allele at every locus). Significantly, it produces a full sibship ratio of 10^{10} for Joe (and it shows that Joe and the Crime 1 sample have the same set of Y-STRs). Amelogenin as well as the Y-STR testing establishes that the Crime 1 profile has a Y-chromosome.³⁰⁴ This excludes

301. Kaye, *DNA Database Trawls*, *supra* note 282, at 47.

302. See *United States v. Calandra*, 414 U.S. 338, 353 (1974) (noting a witness has no right of privacy before a grand jury and may not decline to answer questions that evoke embarrassing responses or result in an unwelcome disclosure of his personal affairs).

303. Murphy, *Relative Doubt*, *supra* note 13, at 317.

304. See KAYE, *DOUBLE HELIX*, *supra* note 21, at 220.

the three sisters. Out of this very large family of 15 innocent relatives, only the three brothers are possible suspects in Crime 1. The police ask them for DNA samples, and they comply. Only Jim's profile matches the Crime 1 profile. Neither Joe nor the two innocent brothers (nor anyone else in his family) will become suspects in the other three crimes committed by their errant sibling. Jim's profile will be added to the database, and the profile from Crimes 2–4 will match Jim's, just as the Crime 1 profile did. Joe's many relatives should not feel much pressure to submit their DNA to a database of volunteers.

One might try to modify the details of this example. Perhaps the trace DNA from the other crimes was too degraded to type at many loci, or perhaps the trace DNA was a mixture that left open the possibility that an innocent brother was involved. I cannot prove that no relative at any time in a world of outer-directed trawling will become a suspect more than once. But these kinds of scenarios seem sufficiently rare that this concern has little weight.

Moreover even if the prediction were more than a feather, it bears repeating that it should not matter to the Fourth Amendment calculus. Suppose that Brother Jim always commits his crimes at high noon and always leaves an envelope with the message "Inside this envelope is a card that might (or might not) indicate that the culprit is a relative of a convicted offender." Inside is a printed card reading "One of Joe's brothers did this. Catch me if you can!" To avoid repeated police questioning, the exasperated, innocent brothers might offer to wear a device that transmits their locations at noon of every day. Following *Relative Doubt*, we could say "these innocent persons should not have to make such a strategic election when they are, like all other persons, legally entitled to the full privacy protections of the Fourth Amendment."³⁰⁵ But can it really be that the Fourth Amendment bars the police from opening the envelope and then talking with his brothers? The situation would be no different if Jim did not mean to leave the envelope, but Mother Nature somehow kept delivering the envelope without his knowledge.

Simply put, the Fourth Amendment does not protect people from becoming suspects, persons of interest, and the like. It does not protect them from being questioned³⁰⁶ and being followed if they choose not to answer or if the police do not like their answers.³⁰⁷ "Only when the officer, by means of physical force or show of authority, has in some way restrained the liberty of a citizen may [the Court] conclude that a 'seizure' has occurred."³⁰⁸ Thus, in the absence of reasonable suspicion, the Fourth Amendment *does* protect people from being physically restrained, from being frisked, from custodial arrest, and worse.³⁰⁹ The

305. Murphy, *Relative Doubt*, *supra* note 13, at 317.

306. See cases cited, *supra* note 238.

307. See *United States v. Knotts*, 460 U.S. 276, 281 (1983) (noting a person has no reasonable expectation of privacy in moving on public thoroughfares).

308. *Terry v. Ohio* 392, 1, 19 n.16 (1968).

309. See, e.g., *id.* at 28 (establishing modern "stop-and-frisk" doctrine).

interest *Relative Doubt* invokes is the interest in not being hassled or discussed in public by the authorities. This is a good reason to use all results of database trawls circumspectly, but it is not a factor that alters the Fourth Amendment balance.³¹⁰

4. *Maintaining Spatial Anonymity*

Finally, a database inhabitant's apparent or actual relative could complain that forging the link to the crime scene invades the distinct interest in keeping one's whereabouts secret. An individual's concern with spatial privacy seems to sit more comfortably within the Fourth Amendment than the desire for freedom from prosecution or inferential accuracy.³¹¹ In *United States v. Karo*,³¹² for example, the Supreme Court held that planting a beeper in a container of ether and tracking the container's movements through houses constituted a search.³¹³ A database trawl might produce a kinship match to DNA recovered from the bedroom of a murdered woman, which in turn, might lead to the discovery that the database inhabitant's relative was there (and was having an affair with her).

Nonetheless, the Supreme Court never has viewed the Fourth Amendment as protecting mere information about a person's locations. "Staking out" a suspect's residence and "tailing" him gives the police a record of the individual's movements, but that does not make these time-honored practices "searches" that trigger Fourth Amendment protections. *Karo* and other cases make it clear that tracking movements on public thoroughfares do not constitute a search—no matter how much an individual might desire to keep his movements invisible. Only when the government has entered—physically or technologically—spaces cloaked in a reasonable expectation of privacy has the Court treated the gathering of intelligence about the locations of people or objects as a search.³¹⁴ Just because police investigations establish that individuals visited certain places at certain times does not mean that they implicate a reasonable expectation of privacy.

The sole exception to this rule is *United States v. Jones*.³¹⁵ "[F]or four weeks, law enforcement agents tracked every movement" of a personal automobile by magnetically attaching an electronic device to the underside of the car.³¹⁶ Every

310. Analytically, it fits better into a due process analysis, but the Supreme Court turned away from this path in *Paul v. Davis*, 424 U.S. 693, 712 (1976) (holding the interest in reputation is not a protected interest under the Due Process Clause). *But see generally* Murphy, *Relative Doubt*, *supra* note 13 (advocating more substantial due process protections from government data gathering that would track the locations of individuals).

311. Kaye, *DNA Database Trawls*, *supra* note 282, at 48.

312. 468 U.S. 705 (1984).

313. *Id.* at 712–15 (holding the mere transfer of a can containing an unmonitored beeper was not a search because it conveyed no information, but by monitoring the beeper's location within a private residence, the government performed a search for purposes of the Fourth Amendment).

314. *See, e.g.*, *Kyllo v. United States*, 533 U.S. 27, 34–35 (2001) (finding the use of thermal imaging technology to measure heat emanating from a home to be a search if the technology is not in general public use); *Karo*, 468 U.S. at 712–15 (finding the use of technology to gain information from inside a home to be a search).

315. 132 S. Ct. 945 (2012).

316. *Id.* at 964 (Alito, J., concurring).

ten seconds, they recorded its transmissions of the vehicle's GPS coordinates.³¹⁷ Four Justices concluded "secretly monitor[ing] and catalogu[ing] every single movement of an individual's car for a very long period" constituted a search under *Katz*.³¹⁸ In a separate opinion, Justice Sotomayor explained why: "GPS monitoring generates a precise, comprehensive record of a person's public movements that reflects a wealth of detail about her familial, political, professional, religious, and sexual associations."³¹⁹ To provide examples, Justice Sotomayor quoted the New York Court of Appeals: "[d]isclosed in [GPS] data . . . will be trips the indisputably private nature of which takes little imagination to conjure: trips to the psychiatrist, the plastic surgeon, the abortion clinic, the AIDS treatment center, the strip club, the criminal defense attorney, the by-the-hour motel, the union meeting, the mosque, synagogue or church, the gay bar and on and on."³²⁰ At some point, the sheer quantity of spatial data poses so grave a danger of revealing unusually sensitive information about one's movements that "[a]wareness that the Government may be watching chills associational and expressive freedoms."³²¹

Using trace evidence such as DNA to discover the identity of the individual whose semen, blood, saliva, hairs, or skin cells are in or on a victim's body or other location does not supply the authorities with a "comprehensive record" that would have this chilling effect. It is one thing to trail a suspect every moment of every day. It is another to work backwards from the fact that a murder occurred in a bar to a list of people who might have been there at some time. It is one thing to place a television monitor in a bedroom, as in Orwell's *1984*. It is another to discover trace evidence that might have come from an intruder in the same bedroom. Because of the haphazard and backwards-looking nature of the DNA data, phrases like "lifelong genetic surveillance"³²² are inapposite. If analyzing trace evidence can be called surveillance at all, it is far closer to the "relatively short-term monitoring of a person's movements on public streets" that does not even rise to the level of a search.³²³

This is not to say that the interest in spatial anonymity has *no* weight in a balancing test, but it is no more significant an interest for the relatives implicated by outer-directed trawling than it was for the database inhabitants in the many cases upholding inner-directed trawling. All told, the nature of the interests that

317. Brief for Respondent at 4, *United States v. Jones*, 132 S. Ct. 945 (2012) (10-1259), 2011 WL 4479076, at *4.

318. *Jones*, 132 S. Ct. at 964 (Alito, J., concurring).

319. *Id.* at 955 (Sotomayor, J., concurring).

320. *Id.* (second alteration in original) (quoting *People v. Weaver*, 909 N.E.2d 1195, 1199 (N.Y. 2009)).

321. *Id.* at 956. Combining individual acts of surveillance that are not searches to find a search in the aggregate has been called a "mosaic theory"—and criticized as unworkable. Orin S. Kerr, *The Mosaic Theory of the Fourth Amendment*, 111 MICH. L. REV. 311 (2012).

322. See *supra* Introduction.

323. 132 S. Ct. at 957, 964 (Alito, J., concurring) (citing *United States v. Knotts*, 460 U.S. 276, 281–82 (1983)).

kinship matching implicates and the degree of intrusiveness it produces are not so different from traditional full-match searching as to compel a different result in the balancing tests the courts have used.

D. The Unbearable Lightness of Shadow Databases

At this point, I have described two rationales for an advanced system for generating criminal intelligence from DNA samples, and I have considered the relationship of this system—involving sampling, profiling, and trawling (of both types) of the DNA of convicted offenders—to various countervailing individual interests. I have argued that a system that requires convicted offenders to surrender DNA samples for identification profiling followed by both inner- and outer-directed trawling is sustainable under a balancing test (or a categorical exception) that includes the cognizable interests of both the offenders and their relatives. I have emphasized that the Fourth Amendment embraces certain privacy interests but that it does not protect information *per se*. The violation of the bodily integrity of offenders and their relatives is minimal or nonexistent, the extent to which information about family relationships will be exposed is speculative, and the impact on spatial privacy is intrinsically limited.

Having clarified these matters, we can dispose of Professor Murphy's inventive efforts to "liken familial DNA searches to unofficial, shadow databases."³²⁴ According to *Relative Doubt*, "allowing a familial search is like saying that the sampling, typing, and databasing [of] the innocent relatives of convicted persons is acceptable."³²⁵ Yet, a legislatively approved system specifying the types of trawls that may be done with the profiles of convicted offenders and limiting the disclosure of any unexpected findings about biological relationships is hardly a rogue database created to circumvent statutory requirements and protections.

To this extent, painting outer-directed trawling as a new "shadow database" is misleading. Demanding convicted offenders and all their brothers, sisters, parents, and children—and no one else—appear and submit to DNA sampling, profiling, and inner-directed trawling would be odious. But the system proposed by advocates of "familial searching" does not entail sampling any DNA from any relative. It does not include profiling any samples from relatives. It does not incorporate such profiles into the database. Near-miss trawling certainly *affects* relatives, but so do many other searches. The effects on relatives arise in ways that often lie outside the scope of the Fourth Amendment and are less threatening than the eloquent prose of *Relative Doubt* suggests. Consequently, when it comes to sampling DNA from offenders, the courts, taking cognizance of the Fourth Amendment interests of relatives (and offenders regarding their relatives), can come to the same conclusion they have always reached: rebalancing need not

324. Murphy, *Relative Doubt*, *supra* note 13, at 338.

325. *Id.*

produce different outcomes.

CONCLUSION

The analysis of the constitutional objections to “familial searching” is complete. The call for careful judicial analysis of outer-directed trawls (when the issue finally comes to court) is well taken. Certainly, “the Constitution has something to say about further testing, databasing, and searching of lawfully acquired DNA profiles.”³²⁶ However, the contention “that familial searches should be forbidden because they embody the very presumptions that our constitutional and evidentiary rules have long endeavored to counteract: guilt by association, racial discrimination, propensity, and even biological determinism”³²⁷ is bloated. Notwithstanding these variegated concerns, an advanced database system should survive an analysis that attends, at the outset, to the Fourth Amendment interests of database inhabitants as well as their relatives. The analysis that supports this conclusion began with the process of acquiring DNA samples for an enhanced database and proceeded through genotyping suitable identification loci, storing the resulting profiles in digital form, and repeatedly trawling for identification. It considered the interests of both the convicted offenders and their relatives.³²⁸

326. *Id.* at 336.

327. *Id.* at 304.

328. Professor Murphy cites *Georgia v. Randolph*, 547 U.S. 103, 106 (2006), for the proposition that a “relative has a *protected right* not to have her own genetic information exposed . . . by the fact of her kin’s conviction,” because the relative’s interest is similar “to the joint interest held by property owners who share common space.” Murphy, *Relative Doubt*, *supra* note 13, at 336 (emphasis added). She maintains that “a relative is, in a sense, a ‘joint occupant’ of a genetic profile” who “retains the *right* to keep his or her portion closed from prying eyes.” Murphy, *Opposing Viewpoint*, *supra* note 79, at 24 (emphasis added). But what is the actual source of this “protected right,” and in what sense are two relatives “joint occupants” of anything? Although Professor Murphy may only mean to claim that a relative should have standing to challenge a search, even that conclusion is dubious, and the catalog of interests examined in *Relative Doubt* gives rise to no convincing claim of a legal or moral right. Surely *Randolph* does not indicate that relatives have the right to keep overlapping DNA alleles from police scrutiny. *Randolph* concerns the right to live in a space free from arbitrary physical invasion and inspection. Given this core interest of the Fourth Amendment, *Randolph* allows a cohabitant to veto the consent of the other cohabitant to a police entry. In reaching this result, the Court relied on “widely shared social expectations” to conclude that one co-tenant “has no recognized authority . . . to prevail over a present and objecting co-tenant . . .” *Randolph*, 547 U.S. at 111, 114. But two people with an atypically large number of STR alleles in common are not like two people physically occupying the same dwelling. They are more like two individuals who received similar copies of the same book of commandments from the same ancestors. In what sense do duplications in the texts give relatives a socially recognized right to prevent other people from reading the copy of the book that does not belong to them and that the outside reader legitimately acquired from the other sibling? If anything, legal and social practices show that—in contrast to the true joint occupancy situation in *Randolph*—genetic relatedness *per se* does not create a veto right. For example, a family member has no recognized power to veto a relative’s decision to undergo disease-related genetic testing. At most, a close relative might claim a moral right to have the individual who is contemplating the test not act selfishly by completely disregarding the relative’s views and desires about the testing. Thus, this Article has considered all the interests of the close relatives in evaluating the Fourth Amendment status of obtaining, storing, and trawling DNA profiles for identification and concluded that these interests do not tip the balance. One might argue with this conclusion, but muddled metaphors about “joint occupancy” do not advance the analysis.

I do not doubt a database of expanded profiles of convicted offenders used for full-match and near-miss trawls will cause anguish to family members when it links close relatives to crimes, and if and when it exposes genetic relationships (or their absence) not widely known within the family unit or kept as family secrets. Moreover, scenarios can be constructed in which it might even result in a false conviction.³²⁹ Unfortunately, that much is true of existing databases and inner-directed trawls. A humane system of criminal justice should strive to keep these effects to a minimum, consistent with the objective of convicting the guilty. But foregoing the opportunity to apprehend and prosecute wrongdoers also has grave costs. An advanced database system that includes highly accurate kinship matching is a permissible legislative choice.

At the same time, not all that is permitted is desirable. Would such a system purchase greater individual justice at the expense of comparative justice³³⁰ (because of racially skewed databases and the bad luck that the close kin of database inhabitants suffer through no fault of their own)?³³¹ Would a population-wide database be fairer, affordable, and constitutional? Critiques of kinship matching raise these and other significant questions. I have not even tried to answer most of these outstanding questions of philosophy, policy, practice, and prudence. Nevertheless, I shall be content if my discussion of the nature and potential of near-miss searching and my responses to the constitutional objections to “familial searching” clarify the logic and limitations of these objections.

329. *See supra* Part IV.C.2.

330. On these two facets of justice, see JOEL FEINBERG, *SOCIAL PHILOSOPHY* 98–107 (1973).

331. *Cf.* Daniel Statman, *Introduction*, in *MORAL LUCK* I, 16 (Daniel Statman ed., 1993) (discussing the paradox that whereas we normally profess that individuals are morally assessable only for matters under their control, we frequently make moral judgments of people for things that depend on factors beyond their control).

