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DNA by the Entirety

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The law fails to accommodate the inconvenient fact that an individual's identifiable genetic information is involuntarily and immutably shared with her close genetic relatives. Legal institutions have established that individuals have a cognizable interest in controlling genetic information that is identifying to them. The Supreme Court recognized in Maryland v. King *that the Fourth Amendment is implicated when arrestees' DNA is analyzed, and the Genetic Information Nondiscrimination Act protects individuals from genetic discrimination in the employment and health-insurance markets. But genetic information is not like other forms of private or personal information because it is shared—immutably and involuntarily—in ways that are identifying of both the source and that person's close genetic relatives. Standard approaches to addressing interests in genetic information have largely failed to recognize this characteristic, treating such information as individualistic.*

While many legal frames may be brought to bear on this problem, this Article focuses on the law of property. Specifically, looking to the law of tenancy by the entirety, this Article proposes one possible framework for grappling with the overlapping interests implicated in genetic identification and analysis. Tenancy by the entirety, like interests in shared identifiable genetic information, calls for the difficult task of conceptualizing two persons as one. The law of tenancy by the entirety thus provides a useful analytical framework for considering how legal institutions might take interests in shared identifiable genetic information into account. This Article examines how this framework may shape policy approaches in three domains: forensic identification, genetic research, and personal genetic testing. In some of these domains, experts are already advocating for policies consistent with this framework.

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INTRODUCTION

In August 2013, the National Institutes of Health (NIH) announced that it had reached an agreement with Henrietta Lacks's family members governing access to Lacks's genetic information.[1] Lacks, who died of cervical cancer in 1951 and whose cells were used in research without her knowledge or consent, was the progenitor of the first immortal cell line—HeLa cells.[2] Those famous cells "contributed to the development of a polio vaccine, the discovery of human telomerase and countless other advances."[3] But for decades, no one consulted with Lacks's family about the use and commercial exploitation of those cells, even as some researchers continued to approach family members for more genetic samples.[4] Events came to a head in March 2013, when researchers at the European Molecular Biology Laboratory published the full HeLa genome.[5] Family members were concerned "that personal medical information about their family could be deduced by anyone who had the full genome map in their possession."[6] Under the new agreement, HeLa's full

1. Ewen Callaway, Deal Done Over HeLa Cell Line, 500 Nature 132, 132 (2013) [hereinafter Callaway, Deal Done].

2. Id. See generally Rebecca Skloot, The Immortal Life of Henrietta Lacks (2010) (discussing Lacks's life, illness, and subsequent use of her cells).

3. Callaway, Deal Done, supra note 1, at 132.

4. Id.

5. Art Caplan, NIH Finally Makes Good with Henrietta Lacks' Family, CNBC (Aug. 8, 2013, 8:12 AM), http://pp.pub.cnbc.com/id/100946766 (on file with the *Columbia Law Review*).

6. Id.

genomic data will be available on a case-by-case basis, two members of Lacks's family will serve on the NIH board responsible for evaluating requests for access, and researchers using that data will be asked to acknowledge the Lacks family in resulting publications.[7]

Separately, in February 2014, the Commonwealth of Virginia secured its first conviction borne from familial searching—a new use of existing DNA forensic technology.[8] Police knew that the same man had committed three serious crimes, including a 2001 rape, as the DNA recovered from each crime scene matched.[9] But for more than a decade, investigators could not identify the perpetrator of those serious offenses; that man's DNA was not in the state or national forensic databases.[10] After Virginia's governor authorized familial searches, however, investigators got a break in the case. Though the culprit's DNA was not in the state database, the state's forensic lab identified a partial DNA match—a match that definitively excluded from suspicion the person whose DNA provided the match, but implicated his close genetic relatives as possible suspects.[11] The match came from Kenneth Holloway, who had a criminal record but had been out of prison for the last ten years.[12] Police identified each of Kenneth's close male relatives—his father and any brothers or sons—as the possible perpetrator of the unsolved crimes. By process of elimination, the police zeroed in on Kenneth's younger brother, Tyrone, who was by then living in South Carolina.[13] After surreptitiously following Tyrone, police tracked down a take-out bag Tyrone had discarded in a public trashcan. DNA left on the contents of that bag finally matched the unsolved crime-scene DNA.[14] Tyrone was charged and convicted of the 2001 rape.[15] Though Kenneth Holloway "understands that because he is a felon, authorities have a right to his DNA should he ever reoffend," he nonetheless explained that "he feels it was wrong to use [his DNA] to go after his brother."[16]

These two events may seem far removed, but they are two sides of the same genetic coin. Both the concerns voiced by the Lacks family and the legal consequences for members of the Holloway family implicate the same essential principles of genetic inheritance and genetic control.

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7. Id.

8. Frank Green, Brother's DNA Leads to Rape Conviction in Williamsburg, Richmond Times-Dispatch (Feb. 22, 2014, 12:00 AM), http://www.richmond.com/news/local/crime/brother-s-dna-leads-to-rape-conviction-in-williamsburg/article_90431ad3-5989-5122-b274-05805ea30a77.html (on file with the *Columbia Law Review*).

9. Id.

10. Id.

11. Id.

12. Id.

13. Id.

14. Id.

15. Id.

16. Id.

Individuals frequently provide their cells for genetic analysis, whether knowingly or not (and whether voluntarily or not). When they do, they are not the only ones whose identifiable genetic information they reveal. Rather, those individuals' close genetic relatives also have identifiable genetic information at stake. Through the DNA of another, those relatives may be targeted for criminal investigation (like Tyrone Holloway), and their medical, behavioral, or other traits may be revealed or implied (as concerned the Lacks family). In other words, genetic information about one individual can be used to identify or learn about that individual's close genetic relatives—with clinical, research, and criminal consequences.

That is so because genetic information is inherited in specific and predictable ways, such that close genetic relatives are more genetically similar than unrelated individuals. An individual inherits 50% of her genetic material from each parent and is expected to have roughly 50% of her genes in common with any full sibling.[17] In humans, that genetic material is organized into twenty-three pairs of chromosomes. In each generation, different portions of the DNA sequence in the chromosomes from each parent are passed on to each child.[18] As a result, each child is unique, though she shares some parts of her sequence with her parents and also with her siblings, who likewise inherited parental DNA—but in a different combination.

The fact that identifiable genetic information is shared among close genetic relatives is relevant in at least three distinct domains: forensic familial identification, genetic research, and personal genetic testing. In each of these arenas, certain individuals provide their cells for genetic analysis, whether involuntarily (as in forensic identification and de-identified genetic research) or voluntarily (as in nonanonymized biomedical research and personal genetic testing). When they do, however, some identifiable genetic information of their close genetic relatives is also revealed. But even as legal institutions have recognized that individuals have some cognizable interest in what happens to their identifiable genetic information,[19] these legal actors have not accounted for the interests close genetic relatives have in each other's genetic infor-

17. Bruce R. Korf, Human Genetics and Genomics 36 (3d ed. 2007) (defining Mendelian patterns of genetic inheritance).

18. See William Goodwin, Adrian Linacre & Sibte Hadi, An Introduction to Forensic Genetics 11 (2d ed. 2011) ("Humans contain two sets of chromosomes—one version of each chromosome from each parent . . . ."). Twenty-two of these pairs are autosomal, meaning that they are inherited identically by both sexes. The last pair is the sex chromosomes, in which human males inherit XY chromosomes, while human females inherit XX. Erin Murphy, Relative Doubt: Familial Searches of DNA Databases, 109 Mich. L. Rev. 291, 294 n.13 (2010).

19. See infra Part II (summarizing case law and statutes governing individual interests in genetic material).

mation, which contains some identifiable information for each individual.

This state of affairs cannot persist. If identifiable genetic information is worthy of protection, then legal institutions must take its inherently shared nature seriously. Accounting for those shared interests in identifiable genetic information is not straightforward, but it can be done. And failing to act subverts the very legal interest at stake. Absent a shift, individuals who have never been arrested—and whose DNA could not lawfully be placed in a forensic DNA database directly—may nonetheless be identified, surveiled, and arrested based on a partial DNA match to a close genetic relative. That is precisely what happened in the Holloway case. Similarly, individuals who consciously have declined to participate in genetic research may have that choice effectively negated by the participation of a parent, child, or sibling. That is one aspect of the Lacks family's concern about widespread access to and genetic research involving Henrietta Lacks's DNA. A legal interest in genetic information impacts each of these domains.

This Article lays bare the shared nature of identifiable genetic information and offers one account of how the law might approach that shared nature, as typified in these three domains. In so doing, this Article systematically identifies how DNA's shared nature complicates the usual individualistic rules that have characterized the law governing DNA.[20] Genetic information is shared, and it is shared immutably and nonvolitionally. Moreover, recognizing that efforts to account for the shared nature of identifiable genetic information could draw on a number of legal frameworks and general principles, this Article focuses on one of these: the law of property generally and the law of tenancy by the entirety in particular. Like interests in shared identifiable genetic information, tenancy by the entirety is grounded on unity of identity and on family. Finally, the Article explores how the law of tenancy by the entirety might help policymakers take proper account of the shared nature of identifying genetic information in the three identified domains. While tenancy by the entirety is not the only relevant analogy on which policymakers may draw, its similar foundations, transformations, and features render it an illuminating place to start.

I. THE BIOLOGY OF INHERITANCE

Some background about the biology of genetic similarity and variability is necessary for an informed exploration of the ways in which that biology is relevant in forensic identification, genetic research, and personal genetic testing. Part I.A describes the basic biology. Part I.B

20. See infra Part III (discussing shortcomings of traditional privacy and property approaches to interests in DNA, in light of overlapping and shared nature of those interests).

then provides a brief description of how each of the identified domains uses genetic information.

A. Biological Structures of Genetic Information

Most of an individual's genetic information is inherited in equal parts from each parent's DNA. The result is that, as set forth above, individuals are 50% genetically identical to each parent and roughly 50% genetically identical to each full sibling,[21] though the mix of parental DNA each child inherits will be distinct.[22] In addition, a child inherits some portions of DNA in full from just one parent. The Y chromosome is only present in males, and it is inherited in full from father to each son.[23] As a result, a Y-chromosome profile is not specific to an individual, although it may identify a particular male line. Similarly, the small amount of additional genetic material in mitochondria outside the nucleus is inherited exclusively from the mother.[24] Therefore, all individuals descended from the same mother will share the same (or nearly identical) mitochondrial DNA sequence, and such sequences will identify families, not individuals.[25] To say that close genetic relatives "share" genetic information is to recognize that some of the information encoded in those relatives' DNA is the same and that it springs from a common source. The physical cells are distinct, but the informational content is shared.

Of course, describing parents and children as 50% genetically identical is an oversimplification. After all, genetic information is composed of just four different "chemical constituents," or bases.[26] These four bases pair up in set patterns, and a "base pair" represents one "rung" in the

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21. Korf, supra note 17, at 36. Mutation rates in humans are comparatively low, and so "the vast majority of the differences . . . within an individual are inherited, rather than resulting from *de novo* mutation." T. Strachan & Andrew P. Read, Human Molecular Genetics 316 (3d ed. 2004).

22. The exception, of course, is identical twins, who are expected to have identical (or nearly identical) genetic sequences. See Daniel L. Hartl, Essential Genetics: A Genomics Perspective 477 (6th ed. 2014) (noting identical twins are genetically identical because they arise from splitting of single fertilized egg).

23. Edward S. Tobias, Michael Connor & Malcolm Ferguson Smith, Essential Medical Genetics 61 (2011). Y-chromosome and other genetic sequences may display additional variation among genetic relatives arising from mutation occurring during gamete formation and subsequent cell division. See Strachan & Read, supra note 21, at 316 (discussing genetic mutations).

24. John M. Butler, Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers 247–49 (2d ed. 2005) [hereinafter Butler, Forensic DNA Typing] (explaining mitochondrial DNA is passed from original egg cell "directly to all offspring independent of any male influence").

25. Id. at 248–49.

26. Hartl, supra note 22, at 7 (listing adenine, guanine, thymine, and cytosine as four bases).

ladder-like form of DNA's famous "double helix."[27] A human genome—the total nuclear DNA sequence of an individual—contains roughly three billion base pairs of DNA.[28] Even unrelated individuals differ only by hundredths of a percent at a genomic level.[29] But while this may seem like a very small difference, it in fact represents more than three million base-pair differences between those unrelated individuals.[30] Closely related individuals, meanwhile, will have fewer base-pair differences between them. Thus, when we say that parents and children are 50% genetically identical, we mean that children inherit roughly 50% of each parent's share of genetic variations.

The heritability of genetic variations has two consequences relevant for purposes of this Article. First, patterns of relatedness and heritability result in many fewer base-pair differences between two closely related individuals than between two randomly selected strangers. Second, those patterns make the portion of shared genetic variation more predictable, with medical, research-related, and forensic implications.[31]

Even information about a single base pair can be revealing about an individual and, in some instances, her close genetic relatives. A difference in a single base pair is known as a single nucleotide polymorphism (SNP).[32] While most SNPs do not have any known appreciable effect, some can give rise to observed characteristics or increase the likelihood of developing a particular trait.[33] Sickle-cell anemia, for instance, is a genetic disorder resulting from an SNP.[34]

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27. Id. at 7–8.

28. The Human Genome Project Completion: Frequently Asked Questions, Nat'l Human Genome Res. Inst. (Oct. 30, 2010), http://www.genome.gov/11006943 (on file with the *Columbia Law Review*).

29. Id.

30. Id.

31. See infra Part III (discussing shared nature of identifiable genetic information).

32. Benjamin Pierce, Genetics Essentials: Concepts and Connections 374 (2009).

33. Id.

34. Tobias, Connor & Smith, supra note 23, at 152–53 (describing sickle-cell inheritance). Sickle-cell anemia is a recessive genetic disorder, meaning that an individual will only manifest the disorder if she inherits from both parents the gene variant, or allele, linked to the disease. See Pierce, supra note 32, at 60 (defining recessive traits). In such circumstances, both parents will necessarily have at least one copy of the disease-linked variant, which he or she passed along to the child. Other genetic disorders associated with SNPs are dominant, meaning that an individual will manifest the disorder even if she only inherits a single copy of the disease-linked variant. See id. at 61 (defining dominant traits). Dominant traits do not skip generations because, in nearly all cases, each person with a dominant trait will have inherited it from at least one parent—who likewise would have displayed that dominant trait. Id. In addition, there is a very small probability that a particular SNP could arise by mutation, giving rise to a genetic disorder other than by inheritance. See Strachan & Read, supra note 21, at 316 (explaining processes of genetic mutation).

Human genetic variation may also be found in stretches of DNA, called "microsatellites."[35] At microsatellites, the genetic sequence "appears to 'stutter,' resulting in different numbers of copies of repeated sequences" of base pairs.[36] Forensic analysis currently examines variations in the lengths of these short tandem repeats (STRs) to construct DNA profiles.[37] STRs also can have medical implications.[38] For instance, Huntington's disease, a dominantly inherited, degenerative neurological disorder leading to dementia, is linked to an STR on chromosome four.[39]

These forms of genetic variation occur in both coding and noncoding portions of the genome.[40] Coding DNA contains the information required to make proteins.[41] Conversely, noncoding DNA does not encode for proteins and until recently was considered to have no biological function.[42] The great majority of human DNA is noncoding.[43] The STRs that American forensics labs typically examine are located in noncoding portions of the genome.[44] Forensic genetics vests the distinction between coding and noncoding DNA with significance. Indeed, some states explicitly prohibit forensic analysis that could predict genetic

35. Henry T. Greely et al., Family Ties: The Use of DNA Offender Databases to Catch Offenders' Kin, 34 J.L. Med. & Ethics 248, 249 (2006).

36. Id.

37. Butler, Forensic DNA Typing, supra note 24, at 85–86; Greely et al., supra note 35, at 249–50.

38. See, e.g., Karen Usdin, The Biological Effects of Simple Tandem Repeats: Lesson From the Repeat Expansion Diseases, 18 Genome Res. 1011, 1011 (2008) (observing tandem repeats are "associate[ed] with human disease[s]" including Huntington's disease, spinobulbar muscular atrophy, myotonic dystrophy, and Fragile X syndrome); Tong Liang et al., Detection of Dispersed Short Tandem Repeats Using Reversible Jump Markov Chain Monte Carlo, Nucleic Acids Res. 1 (June 29, 2012), http://nar.oxfordjournals.org/content/40/19/e147.full-text-lowres.pdf (on file with the *Columbia Law Review*) ("There is also an increasing amount of researches [sic] showing that tandem repeats are related to many human diseases, such as Huntington's disease and cancer." (internal citations omitted)).

39. Nat'l Ctr. for Biotechnology Info., Huntington Disease, Genes and Disease, https://www.ncbi.nlm.nih.gov/books/NBK22226/ (on file with the *Columbia Law Review*) (last visited Mar. 23, 2015).

40. Usdin, supra note 38, at 1011.

41. John M. Butler, Fundamentals of Forensic DNA Typing 25 (2009) [hereinafter Butler, Fundamentals]. Proteins perform essential cell functions or serve as building blocks for larger molecules. See Eldra Solomon, Linda Berg & Diana Martin, Biology 274 (10th ed. 2015) (explaining relationship between DNA, RNA, and proteins in basic biology). Thus human variation, manifesting phenotypically as unique physical or medical characteristics, derives from the small variations in the coding DNA contained in each individual's cells.

42. Butler, Fundamentals, supra note 41, at 25.

43. Id. Butler states that the portion of noncoding DNA in humans is roughly 95% of the human genome. Id.

44. Id.

disease or predisposition to illness.[45] But new research casts doubt on the notion that noncoding DNA is simply "junk." Researchers have linked genetic disorders to STRs in noncoding regions of genes, including certain neurodegenerative disorders and mental retardation syndromes.[46] This suggests that the distinction between coding and noncoding DNA is less rigid than previously believed.

B. *Uses of Genetic Information*

1. *Forensic Identification.* — Forensic DNA typing in the United States typically analyzes STRs at thirteen genomic locations.[47] Each location (or "locus"; plural "loci") reveals two alleles, or variants of repeat lengths, one inherited from each genetic parent. Thus, twenty-six data points are examined in all, and these constitute an individual's genetic profile for purposes of forensic investigation.

Local, state, and federal DNA laboratories may enter lawfully obtained genetic profiles into a central database known as the Combined DNA Index System (CODIS).[48] Today, all fifty states and a variety of federal agencies collect, store, and share genetic information through CODIS.[49] The genetic profiles of known felons, misdemeanants, and arrestees are stored in CODIS's "offender database," while crime scene DNA profiles are stored in a separate ("forensic") CODIS index.[50] A complete match between an offender profile and a forensic profile is probative evidence that the matching offender committed the crime.

The CODIS software may also be used to search for less than exact matches.[51] Such searches may be necessary where a crime scene sample is incomplete or degraded.[52] But partial matches between an offender pro-

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45. See, e.g., R.I. Gen. Laws § 12-1.5-10(5) (2013) (forbidding use of DNA samples for purposes of obtaining information about "physical characteristics, traits or predispositions for disease"); Utah Code Ann. § 53-10-406(1)(f) (LexisNexis 2010) (requiring bureau to "ensure that the DNA identification system does not provide information allowing prediction of genetic disease or predisposition to illness").

46. See Usdin, supra note 38, at 1012–13 (concluding many repeat-expansion diseases "involve a repeat that is in a noncoding region of the gene" and providing examples).

47. Murphy, supra note 18, at 295 (describing process for uploading data to Combined DNA Index System (CODIS) and data contained in CODIS profiles).

48. See id. at 296 (describing CODIS use by multiple jurisdictions).

49. Maryland v. King, 133 S. Ct. 1958, 1968 (2013).

50. See 42 U.S.C. § 14132(a) (2012) (authorizing Director of FBI to "establish an index of . . . DNA identification records of . . . persons convicted of crimes," as well as indices of "analyses of DNA samples recovered from crime scenes," "recovered from unidentified human remains," and "voluntarily contributed from relatives of missing persons").

51. See Murphy, supra note 18, at 297 (explaining low-stringency CODIS search "returns matches in which at least one allele is present").

52. See Jessica D. Gabel, Probable Cause from Probable Bonds: A Genetic Tattle Tale Based on Familial DNA, 21 Hastings Women's L.J. 3, 17–18 (2010) ("A partial match can

file and a crime scene sample generated by such searches may exclude the offender whose CODIS profile provides the match. This may occur where, though matching in part, the known offender's DNA profile also is demonstrably different from the crime scene sample. These source-excluding partial matches may instead inculpate the offender's close genetic relatives as possible perpetrators of a crime.[53] Like the crime scene sample, these relatives share some, but not all, of the examined loci with the individual whose CODIS profile provided the partial match.

This is precisely what occurred in the investigations leading to Tyrone Holloway's arrest and conviction in Virginia. When the Virginia state forensics laboratory identified a partial DNA match between Kenneth Holloway's DNA and the DNA collected from as-yet-unsolved crime scenes, that match definitively excluded Kenneth as a suspect.[54] Kenneth's DNA matched the crime scene DNA only in part, and the portions that did not match indicated that Kenneth did not commit the crimes in question. But the match cast doubt on someone else—Kenneth's male relatives, and ultimately, on his brother Tyrone.[55]

Because DNA is inherited in established patterns, there is a strong probability that close genetic relatives will share a significant number of STR alleles. Two unrelated, randomly selected individuals will have, on average, 8.59 alleles in common.[56] By contrast, children will share at least thirteen alleles with each parent.[57] Siblings will share on average 16.5 to 17 alleles.[58] Moreover, relatedness is more likely where two DNA samples share rare genetic markers.[59]

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occur . . . [when] running a *degraded* crime scene sample against the offender index . . . . [T]he complete offender profile is identified as the possible source of the DNA . . . and law enforcement will seek a fresh sample from that person.").

53. See id. at 20–21 (providing example of "routine[]" familial searching in United Kingdom).

54. Green, supra note 8 ("The laboratory made it clear that the person whose DNA was in the database was eliminated as the suspect, but he could be the father, son or brother of the perpetrator.").

55. Id.

56. David R. Paoletti et al., Empirical Analysis of the STR Profiles Resulting from Conceptual Mixtures, 50 J. Forensic Sci. 1361, 1364 (2005) (reporting hypothetical shared allele counts among thirteen CODIS loci as 8.59 between random individuals, 10.95 between cousins, and 16.94 between siblings).

57. Murphy, supra note 18, at 295.

58. Paoletti et al., supra note 56, at 3; see also Greely et al., supra note 35, at 253 (reporting average of 16.7 alleles shared between full genetic siblings).

59. See Greely et al., supra note 35, at 252 (stating rare genotypes yield few CODIS matches); Marjan Sjerps & Ate D. Kloosterman, On the Consequences of DNA Profile Mismatches for Close Relatives of an Excluded Suspect, 112 Int'l J. Legal Med. 176, 176 (1999) ("[T]here can be situations in which the two non-matching DNA profiles suggest that a close relative of the suspect might match the crime stain. This holds in particular for cases in which the two non-matching DNA profiles share several very rare alleles.").

Under an "interim policy" instituted by the FBI in July 2006, states now may share information about partial matches uncovered in CODIS.[60] Today, most states have no formal policy in place regarding this practice.[61] Yet at least nineteen states permit or have permitted the use of a partial DNA match for purposes of familial investigation.[62] At least one state permits such use based solely on the similarity between crime scene sample and offender CODIS profile alone, with no additional confirmatory genetic analysis required.[63] This is so even though partial matching methods presently have a significant rate of false positives—supposed relatives who, upon further analysis, turn out not to be related.[64]

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60. Combined DNA Index Sys., Bull. No. BT072006, Interim Plan for the Release of Information in the Event of a "Partial Match" at NDIS (2006).

61. Natalie Ram, Fortuity and Forensic Familial Identification, 63 Stan. L. Rev. 751, 776 & fig.3 (2011) [hereinafter Ram, Fortuity].

62. Id. at 767.

63. See id. at 782 (reporting, in North Carolina, lab analysts may "informally discuss partial matches with investigators," and while "state laboratory handles Y-STR analysis, a partial match would not constitute a trigger for such analysis. Mere similarity at a majority of standard CODIS loci is sufficient"). Of course, most states that permit or have permitted use of a source-excluding partial match attempt to confirm relatedness by means of additional genetic testing, including analysis of STRs on the Y chromosome. See id. (reporting at least twelve states "require additional genetic testing—usually Y-STR analysis").

64. See Frederick R. Bieber, Charles H. Brenner & David Lazer, Finding Criminals Through DNA of Their Relatives, 312 Science 1315, 1315 (2006) (finding, in 50,000 profile database, relative is top match about half of time and "has a 99% chance of appearing among the 100 largest" likelihood ratios); James M. Curran & John S. Buckleton, Effectiveness of Familial Searches, 84 Sci. & Just. 164, 166 (2008) (using allele counting and likelihood ratio analysis methods and finding 72–78% probability true sibling will be among top 100 matches); 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, 342 (2008) (concluding partial matching yields too many false positives to be recommended at this time); Rori V. Rohlfs, Stephanie Malia Fullerton & Bruce S. Weir, Familial Identification: Population Structure and Relationship Distinguishability, 8 PLoS Genetics (Feb. 2012), at 1, 9, [hereinafter Rohlfs et al., Familial Identification] available at http://www.plosgenetics.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pgen.1002469&representation=PDF (on file with the *Columbia Law Review*) (concluding familial searching in structured populations "may result in law distinguishability and potentially high false positive rates among certain groups"); Rori V. Rohlfs et al., The Influence of Relatives on the Efficiency and Error Rate of Familial Searching, 8 PLOS ONE (Aug. 2013), at 1, 7–8, available at http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0070495&representation=PDF (on file with the *Columbia Law Review*) (concluding California familial search policy was likely to correctly identify first-degree relative if one was already in database and was unlikely to return false leads, but had high likelihood of falsely identifying more distant relative if one was in database).

False positives in partial matching have already resulted in false identifications and investigations. In March 2015, New Orleans filmmaker Michael Usry found himself the target of a police investigation stemming from a partial match between DNA left at a 1996 murder scene and Usry's father's DNA, which was stored in a commercial DNA database searched by forensic investigators. The partial match excluded Usry's father as a suspect but suggested a close relative might have committed the crime. Based on the partial

2. *Genetic Research.* — More than 500 million specimens of human biological material are stored in hundreds of biobanks throughout the United States, and that number continues to grow by at least twenty million per year.[65] Genetic material may be used for research into how the genome functions,[66] as well as how genetic variations contribute or give rise to medical conditions,[67] behavioral differences,[68] and even "'recreational'"[69] traits (like curly hair[70] or a preference for cilantro[71]). Advanced research methods, like those employed in whole-genome and genome-wide research, raise new complications for legal and ethical research standards. Whole-genome research involves sequencing the full genome, followed by "various levels of data analysis, and, possibly, the use

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match, police began to investigate Usry, eventually securing a warrant for Usry's DNA. Usry's DNA was not a match for the crime scene DNA, exculpating Usry as a suspect. Jim Mustian, New Orleans Filmmaker Cleared in Cold-Case Murder; False Positive Highlights Limitations of Familial DNA Searching, New Orleans Advoc. (Mar. 12, 2015), http://www.theneworleansadvocate.com/news/11707192-123/new-orleans-filmmaker-cleared-in (on file with the *Columbia Law Review*).

65. Mark A. Rothstein, Protecting Privacy in Genetic Research on Alcohol Dependence and Other Addictions, *in* Genetic Research on Addiction 84, 84 (Audrey R. Chapman ed., 2012); see also 1 Nat'l Bioethics Advisory Comm'n, Research Involving Human Biological Materials: Ethical Issues and Policy Guidance 13 (1999) (reporting "as of 1998, more than 282 million specimens of human biological materials were stored in the United States, accumulating at a rate of more than 20 million cases per year").

66. See, e.g., Elizabeth Pennisi, DNA Study Forces Rethink of What It Means to Be a Gene, 316 Science 1556, 1556 (2007) (reporting "pain-staking new analysis of 1% of the human genome" found, contrary to conventional wisdom, genes "are neither compact nor uniquely important" and "can be sprawling, with far-flung protein-coding and regulatory regions that overlap with other genes"); Frequently Asked Questions About Genetic Research, Nat'l Human Genome Res. Inst. (June 2, 2014), https://www.genome.gov/19516792 (on file with the *Columbia Law Review*) (explaining "[g]enetic researchers are now learning more about how each gene works and what it does").

67. Nat'l Human Genome Res. Inst., supra note 66 ("[Genetic researchers] also study the role that variations in genes play in disease.").

68. See, e.g., Dean Hamer & Peter Copeland, The Science of Desire: The Search for the Gay Gene and the Biology of Behavior 13–15 (1994) (introducing research on genetics of sexual orientation); Marc D. Schwartz et al., Consent to the Use of Stored DNA for Genetics Research: A Survey of Attitudes in the Jewish Population, 98 Am. J. Med. Genetics 336, 341 (2001) (finding "small, but statistically significant, reduction in willingness to participate in studies involving homosexuality or frugality . . . both of which are potentially stigmatizing").

69. Eline M. Bunnik et al., Informed Consent in Direct-to-Consumer Personal Genome Testing, 28 Bioethics 343, 344 (2012) [hereinafter Bunnik et al., Informed Consent] (quoting J.P. Evans, Recreational Genomics: What's in It for You?, 10 Genetic Med. 709, 709–10 (2008)).

70. Nicholas Eriksson et al., Web-Based, Participant-Driven Studies Yield Novel Genetic Associations for Common Traits, 6 PLoS Genetics (June 2010), at 1, 8, available at http://www.plosgenetics.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pgen.1000993&representation=PDF (on file with the *Columbia Law Review*).

71. Nicholas Eriksson et al., A Genetic Variant Near Olfactory Receptor Genes Influences Cilantro Preference (Sept. 11, 2012) (unpublished manuscript), available at http://arxiv.org/pdf/1209.2096v1.pdf (on file with the *Columbia Law Review*).

of the sample and/or data for a wide variety of future research projects."[72] Genome-wide association studies may examine thousands of SNPs.[73]

> [E]very time one of these genome-wide association studies is conducted, the researcher theoretically has the opportunity to look in each individual's DNA not only for SNPs that correlate with the disorder in which she is interested, but also for any other SNPs that other investigators have identified as correlated with other disorders.[74]

Traditionally, research specimens have been collected for one purpose (like medical treatment) but subsequently used for another.[75] Such use has often occurred without consent from the tissue source, "either because the [Institutional Review Board] waives that requirement or because identifiers are removed so that the samples are no longer deemed to involve 'human subjects.'"[76] American standards for legal and ethical research require informed consent only from persons whose "[i]dentifiable private information" is at issue.[77] Researchers have attempted to avoid these stringent requirements by de-identifying or anonymizing genetic information.[78]

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72. Timothy Caulfield et al., Research Ethics Recommendations for Whole-Genome Research: Consensus Statement, 6 PLoS Biology (Mar. 2008), at 430, 431, available at http://www.plosbiology.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pbio.0060073&representation=PDF (on file with the *Columbia Law Review*).

73. See Ellen Wright Clayton, Incidental Findings in Genetics Research Using Archived DNA, 36 J.L. Med. & Ethics 286, 287–88 (2008) (discussing spread of chips that can examine thousands of SNPs at once, enabling genome-wide association studies).

74. Id. at 288.

75. Id. at 287; see Moore v. Regents of the Univ. of Cal., 793 P.2d 479, 480–83 (Cal. 1990) (discussing removal of patient's spleen to combat hairy-cell leukemia and subsequent use of spleen cells for commercial production of cell line to produce lymphokines); Amy L. McGuire, Timothy Caulfield & Mildred K. Cho, Research Ethics and the Challenge of Whole-Genome Sequencing, 9 Nature Revs. Genetics 152, 155 (2008) [hereinafter McGuire et al., Research Ethics] (discussing ethical difficulties and recommendations regarding secondary use in context of whole-genome research).

76. Clayton, supra note 73, at 287 (citation omitted).

77. See 45 C.F.R. § 46.102(f) (2014) (defining "human subject" for purposes of Common Rule, which governs research involving human subjects conducted using federal monies, to include "living individual about whom an investigator (whether professional or student) conducting research obtains . . . [i]dentifiable private information"). The Common Rule requires federally funded researchers to provide "human subjects" with extensive information in the course of obtaining informed consent, including information about the expected risks and benefits of the research and confidentiality procedures to be followed. Id. § 46.116(a)(2)–(3), (5). The regulations go on to specify that protected "[p]rivate information" is information that is "individually identifiable (i.e., the identity of the subject is or may readily be ascertained by the investigator or associated with the information)." Id. § 46.102(f). The FDA imposes similar requirements on all studies submitted for its review in 21 C.F.R. §§ 50, 56, 812 (2012).

78. See 45 C.F.R. § 164.514(b)(2)(i) (enumerating eighteen identifiers, removal of which renders what would otherwise be protected health information "de-identifi[ed]" and outside scope of Privacy Rule of Health Insurance Portability and Accountability Act

Direct-to-consumer companies offering genetic analysis for personal and research uses, such as 23andMe, similarly distinguish the research use of "individual-level information" from research involving only "anonymized and aggregate information," which 23andMe shares more freely with third parties.[79] 23andMe defines "individual-level information" as "information about a single individual's genotypes, diseases or other traits/characteristics" and attempts to distinguish this from the "anonymized and aggregate information," which is, principally, "any information that has been stripped of your name and contact information and aggregated with information of others."[80] In January 2015, 23andMe announced high-profile data sharing arrangements through which several pharmaceutical companies will gain access to the full genetic profiles of thousands—and in some instances, hundreds of thousands—of 23andMe's customers.[81]

Yet a number of recent studies have demonstrated that such "anonymization" may not be as sound as previously believed.[82] In one demonstration, researchers showed that "an individual can be uniquely identified with access to just 75 single-nucleotide polymorphisms (SNPs) from that person," while "[g]enomewide association studies routinely use more than 100,000 SNPs to genotype individuals."[83] Re-identification is

(HIPAA)); Office of Human Research Prots., Guidance on Research Involving Coded Private Information or Biological Specimens, U.S. Dep't of Health & Human Servs. (Oct. 16, 2008), www.hhs.gov/ohrp/policy/cdebiol.html (on file with the *Columbia Law Review*) (reaffirming review and consent obligations ordinarily applicable to federally funded research do not apply to research using biological specimens that are not "individually identifiable").

79. Privacy Highlights, 23andMe, https://www.23andme.com/about/privacy/ (on file with the *Columbia Law Review*) (last visited Mar. 23, 2015).

80. Id.

81. See Press Release, 23andMe and Genentech to Analyze Genomic Data for Parkinson's Disease, 23andMeMedia (Jan. 6, 2015), http://mediacenter.23andme.com/blog/2015/01/06/23andme-genentech-pd/ [hereinafter 23andMe, Genentech Press Release] (on file with the *Columbia Law Review*) (announcing "multi-year collaboration" with Genentech based on 23andMe's "Parkinson disease community"); Press Release, 23andMe Announces Collaboration with Pfizer Inc. to Conduct Genetic Research Through 23andMe's Research Platform, 23andMeMedia (Jan. 12, 2015), http://mediacenter.23andme.com/blog/2015/01/12/23andme-pfizer-research-platform/ [hereinafter 23andMe, Pfizer Press Release] (on file with the *Columbia Law Review*) (detailing agreement providing Pfizer researchers with access to "genotyped population of over 800,000 individuals").

82. See Jeantine E. Lunshof et al., From Genetic Privacy to Open Consent, 9 Nature Revs. Genetics 406, 406 (2008) ("Developments in both medical informatics and bioinformatics show that the guarantee of absolute privacy and confidentiality is not a promise that medical and scientific researchers can deliver any longer."); Robert Mitchell et al., Genomics, Biobanks, and the Trade-Secret Model, 332 Science 309, 309 (2011) ("Although traditional research promised confidentiality and/or anonymity to participants, advances in DNA technology may render these safeguards meaningless." (internal citation omitted)).

83. Amy L. McGuire & Richard A. Gibbs, No Longer De-Identified, 312 Science 370, 370 (2006); see also Melissa Gymrek et al., Identifying Personal Genomes by Surname

possible even from pooled or aggregated DNA data.[84] Individual informed consent to genome-wide or whole-genome research may therefore be necessary.

Where re-identification occurs, it often yields information about both the specific individual from whom the genetic material came and her close genetic relatives.[85] Generating "whole-genome data significantly increases the ability to match the DNA of close relatives, and to reveal predictive information about relatives' present and future health risks."[86] When the Lacks family expressed concerns about researchers compromising their genetic interests through research on HeLa cells, the familial consequences of large-scale genetic research are what they had in mind.[87] Some in the bioethics community are already sorting out whether, even outside of a special case like that involving HeLa cells,

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Inference, 339 Science 321, 321 (2013) ("[W]e report that surnames can be recovered from personal genomes by profiling short tandem repeats on the Y chromosome (Y-STRs) and querying recreational genetic genealogy databases."). See generally Angela L. Morrison, Note, A Research Revolution: Genetic Testing Consumers Become Research (and Privacy) Guinea Pigs, 9 J. on Telecomm. & High Tech. L. 573, 590–91 (2011) (identifying studies demonstrating that anonymity cannot be preserved simply by "removing certain pieces of information from data" drawn from individuals).

84. See Nils Homer et al., Resolving Individuals Contributing Trace Amounts of DNA to Highly Complex Mixtures Using High-Density SNP Genotyping Microarrays, 4 PLoS Genetics (Aug. 2008), at 1, 2–6, available at http://www.plosgenetics.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pgen.1000167&representation=PDF (on file with the *Columbia Law Review*) (explaining methodology of study showing possibility of extracting information from pooled DNA); see also P3G Consortium et al., Public Access to Genome-Wide Data: Five Views on Balancing Research with Privacy and Protection, 5 PLoS Genetics (Oct. 2009), at 1, 1, available at http://www.plosgenetics.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pgen.1000665&representation=PDF (on file with the *Columbia Law Review*) (discussing Homer et al. as demonstrating, "given genome-wide genotype data from an individual, it is, in principle, possible to ascertain whether that individual is a member of a larger group defined solely by aggregate genotype frequencies").

85. See, e.g., Wylie Burke, Genetic Testing, 347 New Eng. J. Med. 1867, 1867–68 (2002) (identifying range of medical conditions for which genetic analysis currently is available and observing "[a] genetic diagnosis often indicates that other family members are at risk for the same condition"); Kathy Hudson, The Human Genome Project, DNA Science and the Law: The American Legal System's Response to Breakthroughs in Genetic Science, 51 Am. U. L. Rev. 431, 445 (2002) ("[M]y DNA is not just my DNA. It's my family's DNA. It's related to my sons. It's related to my mom. It's related to my sister . . . . There's a National Human Subjects Research Protection Advisory Committee who is struggling with . . . whether third parties constitute human subjects.").

86. McGuire et al., Research Ethics, supra note 75, at 154; see also Eline M. Bunnik et al., The New Genetics and Informed Consent: Differentiating Choice To Preserve Autonomy, 27 Bioethics 348, 350 (2013) [hereinafter Bunnik et al., New Genetics] ("[W]hole-genome tests *routinely* reveal such findings."); Burke, supra note 85, at 1867–68 (noting genetic diagnosis for one individual "often indicates that other family members are at risk for the same condition").

87. See Caplan, supra note 5 (noting Lacks's family members were "concerned that personal medical information about their family could be deduced by anyone who had the full genome map in their possession").

these close relatives also have a role to play in the informed consent process.[88]

3. *Personal Genetic Testing*. — Genetic analysis for personal use typically falls into one of two domains: ancestral and medical. Several commercial firms market ancestral genetic analysis directly to consumers.[89] This analysis is designed to enable consumers to "[f]ind relatives across continents or across the street."[90] As one such service advertises, "[t]he matches you'll get can range from close family to distant cousins"—some of whom may be previously unknown.[91]

Medical genetic analysis typically may be obtained through a physician. Falling costs and improving sequencing technology have rapidly

88. See, e.g., Bunnik et al., New Genetics, supra note 86, at 351 (discussing ethical issues arising from prenatal screening, such as respecting autonomy of future child); Caulfield et al., supra note 72, at 434 (suggesting release of genomic data into restricted-access databases to enhance privacy protection); Lunshof et al., supra note 82, at 410 ("The genetic and medical information that is posted on [a] study website . . . could also have relevance to participants' family members. Individuals could be traced and identified by any DNA-containing sample from their relatives who might not even be aware of its storage and its possible implications."); McGuire et al., Research Ethics, supra note 75, at 154 (observing "[a]s the risks to relatives increase, the ethical obligations towards them intensify" but concluding, for now, "additional informed consent from close genetic relatives should not be required"); Bahrad A. Sokhansanj, Note, Beyond Protecting Genetic Privacy: Understanding Genetic Discrimination Through Its Disparate Impact on Racial Minorities, 2 Colum. J. Race & L. 279, 302 (2012) (discussing proposals for increased rigor in consent procedures used in genetic studies); infra notes 335–338 and accompanying text (discussing consensus among bioethicists that obligations to close relatives of genomic-sequencing subjects increase as risks to them increase).

89. Morrison, supra note 83, at 579 (discussing various kinds of direct-to-consumer genetic testing). Although the profile of direct-to-consumer genetic testing has risen, the number of competitors in this market has fallen. Of the three most prominent companies—23andMe, Navigenics, and DeCodeMe—one (Navigenics) was acquired in 2012 by another company that does not appear to provide testing directly to consumers and another (DeCodeMe) has stopped providing direct-to-consumer testing itself. See Andrew Pollack, Consumers Slow to Embrace the Age of Genomics, N.Y. Times (Mar. 19, 2010), http://www.nytimes.com/2010/03/20/business/20consumergene.html?_r=0 (on file with the *Columbia Law Review*) (noting 23andMe was "most prominent of a trio of companies that in 2007 began using the Web to market personal genomics services" and other two competitors had moved away from direct-to-consumer personal testing); Acquisition FAQs, Navigenics, https://www.navigenics.com/visitor/about_us/acquisition_faqs/ (on file with the *Columbia Law Review*) (last visited Mar. 23, 2015) (discussing Navigenics's acquisition by Life Technologies in August 2012). Accordingly, this Article's discussion of personal genetic testing relies primarily on the services that 23andMe has offered and continues to offer directly to consumers.

90. Ancestry, 23andMe, https://www.23andme.com/ancestry/ [hereinafter Ancestry, 23andMe] (on file with the *Columbia Law Review*) (last visited Mar. 23, 2015).

91. Id.; see also Trevor Woodage, Note, Relative Futility: Limits to Genetic Privacy Protection Because of the Inability to Prevent Disclosure of Genetic Information by Relatives, 95 Minn. L. Rev. 682, 703 & n.137 (2010) (discussing 23andMe's similar Relative Finder service).

expanded the scope of such genetic analysis available to individuals.[92] Building on existing genetic research, clinical tests are available to screen for a variety of medical diseases and disorders, including genes linked to Alzheimer's disease, bipolar disorder, breast cancer, coronary heart disease, obsessive-compulsive disorder, and pancreatic cancer.[93]

In addition, direct-to-consumer companies previously offered a range of genetic services screening for a wide range of medical[94] and nonmedical markers.[95] Indeed, "[f]or a few hundred dollars," direct-to-consumer services provided consumers with "'personal genome tests' that map hundreds of thousands of genetic variants across the genome and estimate disease risks for dozens of diseases and other phenotypic traits."[96] In November 2013, however, the Food and Drug Administration (FDA) ordered the most prominent of these services—23andMe, Inc.—to stop marketing genetic tests "intended for use in the diagnosis of disease or other conditions or in the cure, mitigation, treatment, or prevention of disease, or . . . intended to affect the structure or function of the body."[97] The FDA concluded that many of 23andMe's tests and services constituted a medical device and that 23andMe had not assured the agency "that the firm has analytically or clinically validated the [personal genome service] for its intended uses."[98] Today, 23andMe offers only "ancestry-related genetic reports and uninterpreted raw genetic data."[99] The company, however, recently received FDA approval for its first

92. Avak Kahvejian, John Quackenbush & John F. Thompson, What Would You Do If You Could Sequence Everything?, 26 Nature Biotechnology 1125, 1125 (2008) (discussing implications of falling costs and improving sequencing technology).

93. See Genetic Testing Registry, Nat'l Ctr. for Biotech. Info., http://www.ncbi.nlm.nih.gov/gtr/ (on file with the *Columbia Law Review*) (last visited Mar. 23, 2015) (providing searchable database for clinical tests available to screen for diseases and disorders). To see the clinical tests available for a specific disease, search for the medical condition under "Conditions/Phenotypes" and view "Clinical tests" for each disorder. Id.

94. See Bunnik et al., Informed Consent, supra note 69, at 347 (identifying direct-to-consumer screening for "complex diseases" including "type 2 diabetes, osteoporosis, cardio-vascular diseases or schizophrenia," as well as for "some pharmacogenomic markers and carrier screening for monogenic diseases").

95. See, e.g., id. (listing tests including "alcohol flush reaction, freckling, memory or muscle performance").

96. Bunnik et al., New Genetics, supra note 86, at 352.

97. Warning Letter from Alberto Gutierrez, Dir., Office of In vitro Diagnostics & Radiological Health, Ctr. for Devices and Radiological Health, Food & Drug Admin., to Ann Wojcicki, CEO, 23andMe, Inc. (Nov. 22, 2013), http://www.fda.gov/ICECI/EnforcementActions/WarningLetters/2013/ucm376296.htm [hereinafter Warning Letter] (on file with the *Columbia Law Review*).

98. Id.

99. 23andMe, https://www.23andme.com/ (on file with the *Columbia Law Review*) (last visited Mar. 23, 2015).

diagnostic test and has committed to working with the FDA to obtain clearance for other medical genetic tests.[100]

Each of these sources of personal genetic information requires only the authorization of the individual whose cells are used for analysis.[101] Yet, the information disclosed through this testing may be significant for that individual's close genetic relatives. Genes for medical traits, if present in a child, disclose that at least one parent similarly carries the gene in question because, as mentioned above, children inherit half of their genetic material from each parent.[102] Moreover, if a parent or sibling carries a particular gene variant, then that indicates an increased probability that the variant is also present in another family member.[103] And where facilitating identification of genetic relatives is the aim of genetic analysis, the interests of those relatives—both known and unknown—are implicated. Such analysis can reveal heretofore-unknown or -unrevealed infidelity, disrupting existing familial relationships and forging new ones.[104]

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100. See Anne Wojcicki, A Note to Our Customers Regarding the FDA, 23andMe (Feb. 19, 2015), http://blog.23andme.com/news/a-note-to-our-customers-regarding-the-fda/ (on file with the *Columbia Law Review*) (announcing FDA's approval of genetic test for Bloom syndrome and explaining "[w]e will continue to work with the FDA to ensure that all future health submissions meet the agency's standards"). For now, 23andMe will continue to provide new customers with only "ancestry-related information and uninterpreted raw genetic data." About Genetic Data & Health Reports, 23andMe, https://www.23andme.com/health/ (on file with the *Columbia Law Review*) (last visited Mar. 24, 2015).

101. See, e.g., How It Works, 23andMe, https://www.23andme.com/howitworks/ [hereinafter How It Works, 23andMe] (on file with the *Columbia Law Review*) (last visited Mar. 24, 2015) (explaining individual seeking genetic analysis must order DNA kit and "register your specific bar code number" prior to submitting saliva sample). The terms governing this genetic analysis are embodied in the Terms of Service, and participation in 23andMe Research also requires completion of a "Consent Document." See Terms of Service, 23andMe, https://www.23andme.com/about/tos/ (on file with the *Columbia Law Review*) (last visited Mar. 24, 2015). Whether the authorization sought for direct-to-consumer genetic testing should conform to informed consent requirements remains an open question. See Bunnik et al., Informed Consent, supra note 69, at 348–49 (arguing traditional approaches to informed consent fail in context of personal genome testing).

102. Korf, supra note 17, at 36.

103. See Burke, supra note 85, at 1867–68 ("A genetic diagnosis often indicates that other family members are at risk for the same condition."); Sonia M. Suter, Note, Whose Genes Are These Anyway? Familial Conflicts over Access to Genetic Information, 91 Mich. L. Rev. 1854, 1861 (1993) ("Therefore, whenever a disease gene is detected, there is a good probability that some siblings, parents, aunts, uncles, or other relatives may also carry the gene, particularly if it is recessive and lies unexpressed for many generations.").

104. See Daniel Engber, Who's Your Daddy? The Perils of Personal Genomics, Slate (May 21, 2013, 5:45 AM), http://www.slate.com/articles/health_and_science/science/2013/05/paternity_testing_personal_genomics_companies_will_reveal_dna_secrets.html (on file with the *Columbia Law Review*) (recounting woman's discovery of nonpaternity using 23andMe genetic testing); Kashmir Hill, Whoops. How DNA Site 23andMe Outed Parents Who Gave Their Baby up for Adoption, Forbes (May 16, 2012, 12:48 PM), http://www.forbes.com/sites/kashmirhill/2012/05/16/dna-site-23andme-outed-parents-who-gave-their-first-baby-up-for-adoption/ (on file with the *Columbia Law Review*)

II. THE LEGAL INTEREST IN IDENTIFIABLE GENETIC INFORMATION

A necessary predicate to considering how the law ought to take into account the shared nature of identifiable genetic information is that there first be a cognizable interest in controlling identifiable genetic information at all. This initial question must be answered in the affirmative in order for the question about a collateral interest in the genetic information of close genetic relatives to be relevant. This antecedent question has not been free from doubt. In the research context, courts often have demonstrated little concern for whatever legal interest individuals may assert in their physical cells.[105] And in the forensic arena, scholars often have maintained that, for better or worse, the Constitution regulates the government's initial collection, but not subsequent analysis, of evidence.[106]

(discussing discovery of full genetic siblings using 23andMe, where one sibling had been placed for adoption and his existence had been previously unknown to other sibling); see also What Can 23andMe Do for Me If I Am Adopted?, 23andMe, https://customercare.23andme.com/entries/21734228-What-can-23andMe-do-for-me-if-I-am-adopted- [hereinafter 23andMe, If I Am Adopted] (on file with the *Columbia Law Review*) (last visited Mar. 24, 2015) ("There is . . . the possibility of finding a much closer relative—including a parent or sibling.").

105. See Moore v. Regents of the Univ. of Cal., 793 P.2d 479, 480 (Cal. 1990) (holding undisclosed use of cells in medical research does not constitute conversion); see also Wash. Univ. v. Catalona, 490 F.3d 667, 670 (8th Cir. 2007) (recognizing Washington University as exclusive owner of tissues provided by patients seeing urological specialist at University); Greenberg v. Miami Children's Hosp. Research Inst., Inc., 264 F. Supp. 2d 1064, 1074 (S.D. Fla. 2003) (dismissing conversion claim for unauthorized use of tissue samples). Both *Catalona* and *Greenberg* emphasized that the tissues at issue were *donated*. *Catalona*, 490 F.3d at 676 (concluding research participants "donated their biological materials to [Washington University] as valid inter vivos gifts"); *Greenberg*, 264 F. Supp. 2d at 1074 (finding individuals providing tissue samples for research on Canavan disease made "donations to research without any contemporaneous expectations of return of the body tissue and genetic samples, and thus conversion does not lie as a cause of action"). These cases suggest that individuals may have a property interest to assert in their cells but that any such interest was waived or gifted away in these cases.

Moreover, even *Moore* did not hold that human biological material could never be the subject of personal property rights. See 793 P.2d at 491–92 (describing California law as limiting individual property rights over excised cells but acknowledging "some limited right to control the use of excised cells" may remain). Indeed, only a few years after *Moore*, the California Court of Appeals held that a sperm donor may have a property-like interest in his stored semen. Hecht v. Superior Court, 20 Cal. Rptr. 2d 275, 281 (Ct. App. 1993) (explaining donor's right was not "governed by the general law of personal property" but was "an interest, in the nature of ownership, to the extent that he had decision making authority as to the sperm within the scope of the policy set by law"); see also Natalie Logan, Note, Questions of Time, Place, and Mo(o)re: Personal Property Rights and Continued Seizure Under the DNA Act, 92 B.U. L. Rev. 733, 753 (2012) (discussing *Moore* and *Hecht*).

106. See, e.g., Orin S. Kerr, The Mosaic Theory of the Fourth Amendment, 111 Mich. L. Rev. 311, 331–32 (2012) ("Fourth Amendment law traditionally has focused only on the first step [of surveillance regimes]—the acquisition of information. The subsequent analysis and use of information has been considered beyond the scope of Fourth

But genetic information is different. Courts, regulators, and legislatures—as well as ordinary citizens—have indicated that genetic information is something over which one ought to have some measure of control, at least where that information can be traced back to an individual.[107] In other words, lawmaking institutions have recognized that people do have a cognizable legal interest in their identifiable genetic information.

To be sure, existing legal rules and doctrines addressing genetic information have largely considered only the interest an individual has in identifiable genetic information drawn from her own cells. While those accounts are underinclusive for the reasons set forth in Part III, claims to the genetic information in one's own cells provide a basis for considering interests in identifiable genetic information more broadly.

Identifiable genetic information may be analyzed through multiple legal lenses, as implicating interests in property,[108] privacy,[109] confidentiality,[110] dignity,[111] comparative justice,[112] and family cohesion,[113] among

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Amendment protection." (internal citations omitted)); Tal Z. Zarsky, Governmental Data Mining and Its Alternatives, 116 Penn St. L. Rev. 285, 315 (2011) ("Fourth Amendment jurisprudence has focused on the gathering of information as opposed to its subsequent analysis.").

107. See infra notes 114–138 and accompanying text (providing examples of articles, cases, and statutes supporting individual's right to control her genetic information).

108. See infra notes 193–198 and accompanying text (discussing judicial and legislative interpretations of genetic information as property of individual to whom information pertains).

109. See, e.g., Murphy, supra note 18, at 313–19 (examining privacy implications of familial searches of DNA databases); Sonia M. Suter, Disentangling Privacy from Property: Toward a Deeper Understanding of Genetic Privacy, 72 Geo. Wash. L. Rev. 737, 773–74 (2004) (arguing personhood conception of privacy applies to protecting genetic information).

110. Pate v. Threlkel, 661 So. 2d 278, 282 (Fla. 1995) (weighing patient's right in medical confidentiality against physician's duty to warn patient's family members about genetic risk and holding any such duty "will be satisfied by warning the patient"); Safer v. Estate of Pack, 677 A.2d 1188, 1192 (N.J. Super. Ct. App. Div. 1996) (weighing patient's right in medical confidentiality against physician's duty to warn patient's family members about genetic risk and declining "to hold . . . that, in all circumstances, the duty to warn will be satisfied by informing the patient"). On the distinction between privacy and confidentiality, see Neil M. Richards & Daniel J. Solove, Privacy's Other Path: Recovering the Law of Confidentiality, 96 Geo. L.J. 123, 127 (2007) (arguing "divergent paths of privacy and confidentiality law [exist] in America and England").

111. See, e.g., Natalie Ram, Assigning Rights and Protecting Interests: Constructing Ethical and Efficient Legal Rights in Human Tissue Research, 23 Harv. J.L. & Tech. 119, 125 (2009) [hereinafter Ram, Assigning Rights] ("Respect for the interests of tissue providers in controlling the ways in which their tissues, and the information contained in their cells, are used flows in part from respect for human dignity.").

112. See, e.g., David H. Kaye, The Genealogy Detectives: A Constitutional Analysis of "Familial Searching," 50 Am. Crim. L. Rev. 109, 163 (2013) (questioning whether widespread partial match reporting and investigation would "purchase greater individual justice at the expense of comparative justice (because of racially skewed databases and the bad luck that the close kin of database inhabitants suffer through no fault of their own)"

others. Two legal lenses have proven most significant in assessing claims touching on identifiable genetic information: privacy and property.

Ordinary citizens manifest a desire to control what is done with their identifiable genetic information, framed in both property and privacy terms. For instance, research on public attitudes regarding consent to the research use of genetic material reveals that, while most potential research participants are happy to grant broad consent for future use of their genetic information, a large majority also believe that their consent should be required before researchers can use clinically derived samples retaining personal identifiers.[114] "Personal control over [one's genetic information] is central to individual autonomy in making basic life decisions."[115] This notion of control—and control most basically about excluding others from accessing one's information—invokes the framing of property, and its core right to exclude. Similarly sounding a property theme are the medical rights to know and not to know: In the medical context, individuals retain both a right to know what their genetic information reveals about them and the right *not* to know certain genetic information.[116]

Yet, citizens also express privacy-related concerns about their genetic information. In the context of genome-wide research, one study reported that "84% of participants chose public data release, with anonymization, prior to learning about re-identification risks. After receiving such education, only 53% chose public release, 33% chose restricted access in a

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(footnote omitted)); Daniel J. Grimm, Note, The Demographics of Genetic Surveillance: Familial DNA Testing and the Hispanic Community, 107 Colum. L. Rev. 1164, 1175–85 (2007) (arguing impact of partial matching may be greater for Hispanics than for other ethnic populations because individuals in Hispanic community tend to have larger family structures).

113. See, e.g., Murphy, supra note 18, at 319–21 (discussing impact of forensic familial identification and investigation on "societal interest in intact families").

114. See Dave Wendler & Ezekiel Emanuel, The Debate over Research on Stored Biological Samples, 162 Archives Internal Med. 1457, 1459–60 (2002) (reporting survey results and finding two-thirds of respondents believe consent should be required for research using clinically derived samples retaining personal identifiers). Moreover, one out of eight respondents indicated that they believed consent should be required even for additional research using research-derived samples that have been stripped of personally identifying information. Id. at 1460.

115. Elizabeth E. Joh, DNA Theft: Recognizing the Crime of Nonconsensual Genetic Collection and Testing, 91 B.U. L. Rev. 665, 679 (2011) [hereinafter Joh, DNA Theft].

116. See Bunnik et al., New Genetics, supra note 86, at 349 ("The testee has a right to know, but also a right *not* to know genetic information."); Caulfield et al., supra note 72, at 433 (recommending personal genome research projects should "acknowledge the participants' right not to know certain results"); Bert-Jaap Koops & Maurice Schellekens, Forensic DNA Phenotyping: Regulatory Issues, 9 Colum. Sci. & Tech. L. Rev. 158, 175 (2008) ("The right not to know is uniformly recognized as an important principle."). See generally The Right to Know and the Right Not to Know: Genetic Privacy and Responsibility (Ruth Chadwick, Mairi Levit & Darren Shickle eds., 2d ed. 2014) (collecting works analyzing privacy-related topics in field of genetic research).

password-protected database, and 14% opted out of data sharing."[117] These findings underscore that the identifiability of genetic information—the possibility of attributing certain genetic information to a particular individual—matters to a significant portion of the population. In the language of privacy and disclosure, experts warn that "[i]n theory, whole genome sequence information could be used to deny financial backing or loan approval, educational opportunities, sports eligibility, military accession, or adoption eligibility. Disclosing genomic information could affect the opportunities available to individuals, subject them to social stigma, and cause psychological harm."[118]

Policymakers across legal institutions have utilized the same two frames, property and privacy, in attempting to operationalize this interest in controlling one's identifiable genetic information. This not only underscores the centrality of the property and privacy frames, but also indicates that the interest in identifiable genetic information is one society is prepared to take seriously. Most directly, a number of states have enacted legislation declaring that genetic information is the property of the individual from whom it derives.[119] Congress, in turn, has legislated genetic information through privacy protections. The Genetic Information Nondiscrimination Act (GINA) demonstrates Congress's understanding of the importance of genetic information. GINA aims to protect individuals from discrimination on the basis of genetic information in the employment and health insurance markets.[120] Its express intent is to "protect the public from discrimination and allay their concerns about the potential for discrimination, thereby allowing individuals to take advantage of genetic testing, technologies, research, and new

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117. Sokhansanj, supra note 88, at 303 (discussing Amy L. McGuire et al., To Share or Not to Share: A Randomized Trial of Consent for Data Sharing in Genome Research, 13 Genetics Med. 948, 952 (2011)).

118. Presidential Comm'n for the Study of Bioethical Issues, Privacy and Progress in Whole Genome Sequencing 24–25 (Oct. 2012) (footnote omitted) [hereinafter Privacy and Progress], available at http://bioethics.gov/sites/default/files/PrivacyProgress508_1.pdf (on file with the *Columbia Law Review*).

119. See, e.g., Colo. Rev. Stat. Ann. § 10-3-1104.7(1)(a) (West 2014) ("Genetic information is the unique property of the individual to whom the information pertains . . . ."); Fla. Stat. Ann. § 760.40(2)(a) (West 2010) (declaring results of genetic testing "exclusive property of the person tested"); Ga. Code Ann. § 33-54-1(1) (2013) ("Genetic information is the unique property of the individual tested . . . ."); La. Rev. Stat. Ann. § 22:1023(E) (2014) ("An insured's or enrollee's genetic information is the property of the insured or enrollee."); Or. Rev. Stat. § 192.537(1) (2013) ("[A]n individual's genetic information and DNA sample are private and must be protected, and an individual has a right to the protection of that privacy."). This list of statutes and the accompanying descriptions were first compiled in Elizabeth E. Joh, Reclaiming "Abandoned" DNA: The Fourth Amendment and Genetic Privacy, 100 Nw. U. L. Rev. 857, 868 n.61 (2006) [hereinafter Joh, Reclaiming].

120. Genetic Information Nondiscrimination Act of 2008, Pub. L. No. 110-233, 122 Stat. 881.

therapies."[121] Significantly, GINA defines "genetic information" to include not only an individual's own genetic tests, but also the tests of genetic relatives.[122] GINA clarifies that "genetic information" is "health information" under the Health Insurance Portability and Accountability Act of 1996 (HIPAA).[123]

HIPAA, in turn, emphasizes the need for control where "individually identifiable" information is at issue.[124] The Privacy Rule promulgated under HIPAA generally requires that a covered entity obtain authorization from an individual for the disclosure or research use of her protected health information (including individually identifiable genetic information), unless a regulatory exception applies.[125] These disclosure restrictions, however, are inapplicable to health information that has been de-identified, which the regulations exclude from the definition of "protected health information."[126] Other federal regulations governing research similarly condition protection on "[i]dentifiable private information."[127] The regulations make clear that the identifiability of information is crucial for legal protection. Once again, however, repeated demonstrations of re-identification of genetic information raise doubts that such information can truly be said to be "de-identified."[128]

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121. Id. § 2(5), 122 Stat. at 882–83 (codified as amended in scattered titles of U.S.C.).

122. See 42 U.S.C. § 300gg-91(d)(16) (2012) (defining "Genetic Information"); see also id. § 1320d-9(b)(1) (incorporating this definition by reference); infra text accompanying notes 245–246 (discussing GINA's definition of genetic relatedness).

123. Id. § 1320d-9(a)(1).

124. See 45 C.F.R. § 164.502(d)(2) (2014) (specifying HIPAA's disclosure restrictions apply only to "individually identifiable" information).

125. Id. § 164.512(i) (setting forth regulatory exceptions to rule of required authorization).

126. See id. §§ 164.502(d)(2), 164.514(a) ("Health information that does not identify an individual and with respect to which there is no reasonable basis to believe that the information can be used to identify an individual is not individually identifiable health information."). The Privacy Rule also permits protected health information to be disclosed without authorization in some instances, including for research purposes. Id. § 164.514(e) (specifying protected health information may be disclosed for, inter alia, research purposes, so long as information released contains only limited data set and is released pursuant to data use agreement between researcher and covered entity (but not individual whose information is at issue)).

127. See id. § 46.102(f) (setting forth Department of Health and Human Services policy on protection of identifiable private information); see also supra note 77 and accompanying text (noting American legal and ethical standards require informed consent only when identifiable personal information is at stake).

128. See supra notes 82–84 and accompanying text (questioning soundness of "anonymization" procedures). The Privacy Rule permits de-identification to be accomplished by removing eighteen categories of information, but only if "[t]he covered entity does not have actual knowledge that the information could be used alone or in combination with other information to identify an individual who is a subject of the information." 45 C.F.R. § 164.514(b)(2). Alternatively, de-identification may be found where "the risk is very small that the information could be used, alone or in combination with other reasonably available information, by an anticipated recipient to identify an

Moreover, the Supreme Court recently recognized that the analysis of identifiable genetic information, and not only its collection, calls for constitutional scrutiny—and thus that identifiable genetic information is information in which individuals may have a legitimate expectation of privacy. In *Maryland v. King*, the Court considered the analysis of a compelled genetic sample to be a separate Fourth Amendment event from the acquisition of the sample itself.[129] The Court concluded that neither collection nor analysis is impermissible under the Fourth Amendment where an individual has been validly arrested for a serious offense.[130] But it is significant that the Court considered the genetic analysis independently, as it implies that genetic analysis itself implicates a privacy interest of constitutional magnitude.[131] Such interests, the Court has repeatedly explained, are ones that involve an "expectation of privacy . . . that society is prepared to recognize as 'reasonable.'"[132] In other words, *King* implies that individuals have a reasonable expectation of privacy in their identifiable genetic information that is distinct from their interest in the physical cells. The privacy interest in that information will not necessarily prevent the government or other actors from making use of genetic information without authorization; indeed, *King* held just the opposite. But the existence of that interest demands more searching scrutiny where unauthorized or compelled genetic analysis is at issue. In *King*, the Court found the diminished expectation of privacy that arrestees retain to be critical to its holding that compelled DNA collection and analysis passes constitutional muster.[133]

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individual who is a subject of the information." Id. § 164.514(b)(1). Re-identification demonstrations indicate that neither assurance may be available where large swaths of genetic information are at issue.

129. See 133 S. Ct. 1958, 1979–80 (2013) (noting analysis may present additional privacy concerns).

130. See id. at 1980 ("When officers make an arrest supported by probable cause to hold for a serious offense . . . taking and analyzing . . . the arrestee's DNA is . . . reasonable under the Fourth Amendment.").

131. See id. at 1979 (considering whether "processing of respondent's DNA sample's 13 CODIS loci" intruded "on respondent's privacy in a way that would make his DNA identification unconstitutional"). Some courts of appeals have similarly discussed genetic analysis as a "search" separate from the collection of genetic material. See, e.g., United States v. Mitchell, 652 F.3d 387, 407 (3d Cir. 2011) (recognizing "processing of the DNA sample and creation of the DNA profile for CODIS" is search with "potential to infringe upon privacy interests"); United States v. Amerson, 483 F.3d 73, 85 (2d Cir. 2007) (reiterating "'analysis and maintenance of [offenders'] information' in CODIS, the federal database is, in itself, a significant intrusion," which constitutes "a second and potentially much more serious invasion of privacy" (alteration in original) (quoting Nicholas v. Goord, 430 F.3d 652, 670 (2d Cir. 2005))); United States v. Sczubelek, 402 F.3d 175, 182 (3d Cir. 2005) ("'The ensuing chemical analysis of the sample to obtain physiological data' is also a search covered by the Fourth Amendment." (quoting Skinner v. Ry. Labor Execs.' Ass'n, 489 U.S. 602, 616 (1989))).

132. Katz v. United States, 389 U.S. 347, 361 (1967) (Harlan, J., concurring).

133. 133 S. Ct. at 1978–80 ("[U]nlike the search of a citizen who has not been suspected of wrong, a detainee has a reduced expectation of privacy.").

At a minimum, *King* strongly suggests that there is a constitutionally relevant interest in identifiable, medically relevant genetic information. The Court emphasized that "the CODIS loci come from noncoding parts of the DNA that do not reveal the genetic traits of the arrestee."[134] The Court also deemed the collection and analysis of genetic information analogous to the collection and analysis of fingerprints.[135] And the Court warned that analysis going beyond identification and "determin[ing], for instance, an arrestee's predisposition for a particular disease or other hereditary factors not relevant to identity . . . would present additional privacy concerns not present here."[136] Like the separate discussion of DNA analysis generally, the Court's comments in this regard imply that information analysis implicates constitutional concerns. And the Court recognized a line between "junk" and more private information that echoes nearly every appellate court decision assessing the constitutionality of various aspects of forensic identification.[137] Thus, the government's use of genetic information for more than merely fingerprint-like identification of the individual whose cells are involved likely implicates weightier interests not addressed thus far.[138]

In sum, policymakers, courts, and ordinary citizens agree: Enabling individuals to control the dissemination of their identifiable genetic information—whether in the language of privacy or property—is worthy of pursuit.

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134. Id. at 1979. But see Usdin, supra note 38, at 1012–13 (identifying genetic diseases involving "noncoding region of the gene").

135. See *King*, 133 S. Ct. at 1972 ("[T]he only difference between DNA analysis and the accepted use of fingerprint databases is the unparalleled accuracy DNA provides.").

136. Id. at 1979.

137. See United States v. Mitchell, 652 F.3d 387, 407 (3d Cir. 2011) (agreeing with "every one of our sister circuits" that concerns about "scope of information that can be obtained from a DNA sample" are unpersuasive "given their speculative nature and the safeguards attendant to DNA collection and analysis" (internal quotation marks omitted)); see also United States v. Kriesel, 720 F.3d 1137, 1140 (9th Cir. 2013) (reiterating "government may extract junk DNA from samples, and use it to generate profiles for inclusion in CODIS, because present scientific understanding indicates that junk DNA reveals no sensitive, private genetic or medical information"); United States v. Weikert, 504 F.3d 1, 3–4 (1st Cir. 2007) ("Profiling . . . [uses] only so-called 'junk DNA,'" which "differs from one individual to the next and . . . can be used for . . . identification but which was 'purposely selected because [it is] not associated with any known physical or medical characteristics' and 'do[es] not control or influence the expression of any trait.'" (quoting H.R. Rep. No. 106-900(I), at 27 (2000))); Nicholas v. Goord, 430 F.3d 652, 670 (2d Cir. 2005) ("The junk DNA that is extracted has, at present, no known function, except to accurately and uniquely establish identity.").

138. Cf. Boroian v. Mueller, 616 F.3d 60, 69–70 (1st Cir. 2010) (concluding partial matching for familial investigation remains "speculative" but acknowledging "[a]rguably, the government's use of CODIS to discover partial matches could raise privacy concerns not raised by a traditional fingerprint database").

III. DNA IS SHARED, IMMUTABLY AND INVOLUNTARILY

Although individuals have a cognizable interest in controlling their identifiable genetic information, existing rules governing the dissemination and use of this information are inadequate to protect the full range of this interest. As *King* demonstrates, forensic genetic profiles have been likened to fingerprints.[139] Courts also have approved both research and forensic uses of genetic information based on an individual's supposed abandonment of that information.[140] Even state statutes that recognize that an individual has a property right in her genetic information ordinarily limit that right to the genetic information in her own cells.[141]

More broadly, the most commonly deployed legal protections for genetic information—privacy and property—often are individualistic in scope. Privacy and its associated rights are frequently thought of as unitary in nature; namely, as rights of the individual "against the world."[142] As one commentator has observed, American privacy law is "structured over a strictly individualistic concept of private information."[143] Consistent with that approach, doctrines of informed consent are "meant to respect individual autonomy."[144]

With respect to property, Blackstone described that right as "that sole and despotic dominion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe."[145] The Supreme Court similarly has recognized that the right to exclude is "one of the most essential sticks in the bundle of rights that are commonly characterized as property."[146] Consistent with that approach, property theory presently applied to identifiable genetic information has treated that information atomistically.[147]

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139. See *King*, 133 S. Ct. at 1972 (comparing use of forensic genetic profiles to matching suspect's fingerprints to fingerprint evidence deriving from scene of crime).

140. See infra notes 182–185 and accompanying text (discussing courts' application of doctrine of abandonment to permit DNA use in research and forensic contexts).

141. See, e.g., Fla. Stat. Ann. § 760.40(2)(a) (West 2010) (declaring results of genetic testing "exclusive property of the person tested"); Ga. Code Ann. § 33-54-1(1) (2013) ("Genetic information is the unique property of the individual tested.").

142. Samuel D. Warren & Louis D. Brandeis, The Right to Privacy, 4 Harv. L. Rev. 193, 213 (1890).

143. Laura Maria Franciosi & Attilio Guarneri, The Protection of Genetic Identity, 1 J. Civ. L. Stud. 139, 186 (2008); see also Richards & Solove, supra note 110, at 126–27 (identifying American privacy law's individualistic focus).

144. Caulfield et al., supra note 72, at 432.

145. 2 William Blackstone, Commentaries *2.

146. Kaiser Aetna v. United States, 444 U.S. 164, 176 (1979). For an overview of the scholarly debate as to whether the "bundle of rights" or "bundle of sticks" metaphor is appropriate for private property, see generally Symposium, Property: A Bundle of Rights?, 8 Econ. J. Watch 193 (2011).

147. See supra Part II (discussing property theory's treatment of identifiable genetic information). As discussed at infra Parts IV and V, an atomistic property approach is not inevitable.

Existing rules—whether statutory, regulatory, or judicial in nature—cannot hope to address the more numerous stakeholders that have an interest in a single cell's genetic information as a matter of biological fact. As this Part explains, that is so because identifiable genetic information is shared, immutably and involuntarily, and that shared nature renders existing rules a poor fit for adjudicating claims to genetic information. If we are to take seriously the multiple and competing interests in identifiable genetic information, these kinds of traditional rules and approaches are inadequate.

A. *Identifiable Genetic Information Is Shared*

As I have suggested elsewhere, genetic information is decidedly not atomistic.[148] Children and parents share roughly 50% of their genetic variations due to relatedness, while the mix of genetic variation full siblings inherit from their parents, taken together, is also roughly 50% similar.[149] Identical twins, of course, are very nearly genetically identical.[150]

This substantial genetic similarity among closely related individuals occurs in the thirteen regions of noncoding DNA analyzed to create CODIS profiles. Indeed, it is the predictable patterns of that similarity that makes forensic familial identification possible. The fact that genetic information is shared also means that medical or other information revealed through genetic analysis may affect close genetic relatives as well. A child's genetic information discloses that at least one parent carries the same sequence, and the presence of a particular gene variant in a parent or sibling indicates an increased likelihood that that variant is also present in another family member. Accordingly, the shared nature of identifiable genetic information means that individuals' authority to control their "own" identifiable genetic information may be affected by how the government, research entities, or genetic testing firms make use of genetic information drawn from close genetic relatives. As one expert put it: "[T]he fact of the matter is that my DNA is not just my DNA. It's my family's DNA. It's related to my sons. It's related to my mom. It's related to my sister."[151]

At a minimum, the shared nature of identifiable genetic information means that the popular analogy between genetic profiles and finger-

148. See Ram, Assigning Rights, supra note 111, at 132 ("More problematic still for current approaches to protecting relevant interests is the fact that genetic material is identifying not only to the person who provides it, but also to her close family members."); Ram, Fortuity, supra note 61, at 791–93 (discussing unsuitability of current Fourth Amendment doctrine for addressing constitutionality of source-excluding partial matching because that doctrine fails to account for ways identifying genetic information is shared).

149. See supra notes 21–22 and accompanying text (discussing patterns of genetic inheritance).

150. See Hartl, supra note 22, at 546 (defining identical twins as "[t]wins developed from a single fertilized egg that splits into two embryos at an early division").

151. Hudson, supra note 85, at 445.

prints is inapt when partial matching is at issue. That is so because, "unlike DNA, fingerprints have a limited identification value. By themselves, fingerprints cannot reveal any more information about the person from whom they have been collected (other than a prior criminal record)."[152] Whether as a matter of science or of social policy, fingerprints are identifying only to the person from whom they come.[153]

Moreover, the agreement between the Lacks family and the NIH governing access to HeLa genome data is built in part on real and present concerns about the genetic interests of Lacks's family members arising out of the shared nature of that genome data.[154] As bioethicist Bartha Knoppers observed, "The family is saying, having sequenced her, [researchers have] sequenced them."[155] While the NIH agreement was an important vindication of a long-lapsed ethical obligation to Lacks herself,[156] it also was an important vindication of the interest Lacks's family members have in their identifiable genetic information.

At least one court has grounded a claim of control over the genetic information of another on the shared nature of identifiable genetic information. In *Guðmundsdóttir v. Iceland*, the Icelandic Supreme Court determined that an individual exercising the right to opt out of a genetic database may require the exclusion not only of her own genetic sequence, but also that of her deceased father.[157] Iceland boasts the world's most comprehensive genetic database: "a national database—DeCode—to maintain healthcare records and store genetic information . . . intended to give Iceland a global edge in medical research."[158]

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152. Joh, Reclaiming, supra note 119, at 870.

153. Ram, Assigning Rights, supra note 111, at 132. Simon Cole has argued that "the widespread view of fingerprints as devoid of information stems from a social decision not to invest in research exploring correlations between fingerprint patterns and race, ethnicity, disease, and behavioral propensities, not from a biological absence of such correlations." Simon A. Cole, Is the "Junk" DNA Designation Bunk?, 102 Nw. U. L. Rev. 54, 61 (2007). But whether it is a matter of biology or social policy, the fact remains that fingerprints have not been plumbed for information about the close relatives of fingerprint sources. DNA has. Accordingly, it is incorrect to suggest that fingerprints and DNA are similar because both might give rise to identification of close genetic relatives—only the latter, and not the former, has been exploited for that identification information. See Boroian v. Mueller, 616 F.3d 60, 69–70 (1st Cir. 2010) (acknowledging "[a]rguably, the government's use of CODIS to discover partial matches could raise privacy concerns not raised by a traditional fingerprint database," but declining to consider issue).

154. See Caplan, supra note 5 (noting tension between scientific interest of retaining cells and privacy interests of Lacks's family).

155. Ewen Callaway, HeLa Publication Brews Bioethical Storm, Nature (Mar. 27, 2013), http://www.nature.com/news/hela-publication-brews-bioethical-storm-1.12689 (on file with the *Columbia Law Review*).

156. Caplan, supra note 5 (describing settlement as "ethical victory").

157. Guðmundsdóttir v. Iceland [Supreme Court] Nov. 27, 2003, No. 151/2003, (Ice.), available at https://epic.org/privacy/genetic/iceland_decision.pdf (on file with the *Columbia Law Review*).

158. See Gabel, supra note 52, at 51.

Pursuant to Icelandic law, participation in DeCode is assumed, and "persons who do not want information on them to be entered into the database can prevent this by a notification to the Medical Director of Health."[159] Since 2000, more than 20,000 people have exercised that option.[160]

In *Guðmundsdóttir*, the appellant, a minor, requested that "the genealogical or genetic information on the appellant's father should not be transferred into the database."[161] The Medical Director of Health refused this request on the basis that the statute does not permit descendants to refuse the transfer of information about their deceased parents into the database.[162] The Icelandic Supreme Court agreed that the appellant could not exercise the statutory opt-out "as her deceased father's substitute."[163] But the court went on to find that the appellant "has a personal interest in preventing the transfer of data from her father's medical records to the Health Sector database, as it is possible to infer, from the data, information relating to her father's hereditary characteristics which could also apply to herself."[164] In view of the extensive information included in the database, the court found that the appellant's personal privacy could not be assured.[165] The court therefore recognized the appellant's right to request exclusion of her deceased father's information from the database—a right grounded on the appellant's own personal privacy interest, not her father's.[166] The Icelandic Supreme Court's analysis indicates that the shared nature of identifiable genetic information may have serious legal implications.

Nonetheless, not all genetic relatives share so substantial a portion of their genetic variation. While it is difficult to draw bright lines in the genetic family tree demarcating "strong" versus "weak" genetic commonality, as one moves out along the family tree, the statistical portion of common genetic information due to relatedness diminishes rapidly. Half-siblings are likely to be roughly 25% genetically similar, as are genetically related grandparents and grandchildren. First cousins are expected to be 12.5% genetically similar due to relatedness, while first cousins once-removed will be roughly 6.25% genetically similar. Genetic relatedness in second cousins drops to 3.125% and to less than 1% for

159. *Guðmundsdóttir*, No. 151/2003, at 3.

160. Gabel, supra note 52, at 51.

161. *Guðmundsdóttir*, No. 151/2003, at 4.

162. Id.

163. Id.

164. Id. at 4–5.

165. See id. at 9 (holding constitutionally assured protection of privacy "cannot be replaced by various forms of monitoring" nor by "leav[ing] it in the hands of the Minister" or other officials to establish operating rules or procedures).

166. See id. at 10 ("[T]aking into account the principles of Icelandic legislation concerning protection of privacy, the Court recognises the right of the Appellant in this respect.").

third cousins. As a result, forensic familial identification focuses almost exclusively on immediate-family relations; that is, on parents, siblings, and children.[167] While in some circumstances, whole families or communities may share common genetic interests,[168] most of the time

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167. See, e.g., Green, supra note 8 (reporting Virginia forensic laboratory involved in Holloway case, in reporting partial DNA match to investigators, "made it clear that the person whose DNA was in the database was eliminated as the suspect, but he could be the *father, son or brother* of the perpetrator" (emphasis added)).

168. For example, multigenerational male lines within families share a common Y-chromosome, which may have criminal and other consequences beyond the immediate family. Investigators in Boston took advantage of patterns of Y-chromosome inheritance in 2013 in confirming the identity of the so-called Boston Strangler, who committed eleven murders between 1962 and 1964. Jess Bidgood, 50 Years Later, a Break in a Boston Strangler Case, N.Y. Times (July 11, 2013), http://www.nytimes.com/2013/07/12/us/dna-evidence-identified-in-boston-strangler-case.html?_r=0 (on file with the *Columbia Law Review*). Investigators had long suspected that Albert DeSalvo was the Boston Strangler, but they had been unable to confirm the link before DeSalvo's death in 1973. Id. When investigators revisited the case armed with modern forensic technology, however, they turned to DeSalvo's relatives for a genetic link to old crime-scene evidence. The link came in the form of DeSalvo's nephew, whose discarded water bottle the police surreptitiously collected and analyzed. Carolyn Y. Johnson, How DNA Evidence Points to Albert DeSalvo, Bos. Globe (July 12, 2013), http://www.bostonglobe.com/metro/2013/07/11/how-dna-evidence-linked-desalvo-last-boston-strangler-murder/s7Wi0L8cgwP4JKfwX5WZSK/story.html (on file with the *Columbia Law Review*). DeSalvo and his nephew (the son of DeSalvo's brother) share nearly identical DNA profiles of their Y-chromosomes—a portion of DNA that sons inherit in full from their fathers. Id. The DNA profile obtained from the discarded water bottle was sufficiently similar to genetic material found on the body of the Boston Strangler's last victim that a judge authorized exhumation of DeSalvo's body for confirmatory testing. Bidgood, supra. That testing established that DeSalvo's DNA did indeed match the crime scene evidence, providing what Suffolk County District Attorney Daniel Conley called an "'unprecedented level of certainty'" that DeSalvo committed the crime in question. Doug Stanglin, DNA Test Ties Albert DeSalvo to Boston Strangler Victim, USA Today (July 19, 2013, 2:15 PM), http://www.usatoday.com/story/news/nation/2013/07/19/boston-strangler-albert-desalvo-dna-tests/2568599/ (on file with the *Columbia Law Review*).

Beyond the family, in rare circumstances, communities may share common genetic interests. For instance, the Havasupai, a small, isolated Native American tribe living in the Grand Canyon, won a settlement from Arizona State University related to research that implicated the genetic interests of the whole tribe. See Amy Harmon, Indian Tribe Wins Fight to Limit Research of Its DNA, N.Y. Times (Apr. 21, 2010), http://www.nytimes.com/2010/04/22/us/22dna.html?_r=0 (on file with the *Columbia Law Review*) (describing settlement as "significant because it implied that the rights of research subjects can be violated when they are not fully informed about how their DNA might be used"). A fraction of the Havasupai tribe's members provided tissue to University researchers for genetic research related to diabetes. Id. They later learned that the researchers had used their genetic information for other studies, including some that directly undermined the tribe's core religious beliefs about their origins. Id. Such research, the tribe's members explained, inflicted an injury on the whole community: "It hurts the elders who have been telling these [origin] stories to our grandchildren." Id. (internal quotation marks omitted).

genetic relatedness must be close for genetic information drawn from one individual's cells to be legitimately informative about others.[169]

B. *Identifiable Genetic Information Is Immutably Shared*

Genetic connections cannot be broken. Short of large-scale gene therapy,[170] the genetic information an individual inherits from her parents is the genetic information she will always have. And her genetic information will always, to some degree, also contain some identifiable information for her parents, siblings, children, and other genetic relatives. As one commentator has recognized in another context, "unlike a stolen credit card or bank account number, once your genetic information is exposed without your consent, nothing can be done to sever your connections to that information."[171]

The immutable nature of genetic information further complicates attempts to account for individuals' interests in their identifiable genetic information. Exit, an ordinarily crucial element in mediating relationships between multiple parties, is unavailable where genetic information is concerned.[172] An individual cannot simply sell or otherwise alienate her interest in her genetic information and thereby no longer be genetically similar to her close genetic relatives. Thus, frameworks that depend on the ability to easily sever one's relationships with co-owners or confidants are inapt. Consider, for instance, the case of civil forfeiture of co-occupied properties involved in criminal activity. Under federal law, "When a non-owner uses another's property as the site for a drug offense, the owners must, to prevent forfeiture of the property, prove to a federal court either that they had no knowledge of any wrongdoing or that they did all they reasonably could have done to prevent the illegal conduct."[173] Courts have sometimes applied this rule to permit forfeiture of property where an owner or co-owner could have removed the offender—even if a close family member—from the home and failed to

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169. As discussed infra, both GINA and current practices of familial forensic identification draw lines about how much genetic similarity due to relatedness is enough to be exploited by third parties—the former embracing extended relations who may have as little as 6.25% genetic similarity on average arising from relatedness, and the latter focusing almost exclusively on the immediate family (an individual's parents, siblings, and children). See infra notes 244–250 and accompanying text (describing two methods of line-drawing for individual genetic interests).

These sources of law provide guidance about how much (or rather, how little) genetic similarity is necessary in the ordinary course to make an individual sufficiently identifiable through the genetic material of a relative, thus giving rise to the kinds of interests and protections set out in this Article.

170. At present, large-scale gene therapy remains possible only in science fiction.

171. Joh, DNA Theft, supra note 115, at 681.

172. See Ram, Assigning Rights, supra note 111, at 129 (emphasizing importance of threat of exit as means for ensuring respect for one's choices).

173. Sandra Guerra, Family Values?: The Family as an Innocent Victim of Civil Drug Asset Forfeiture, 81 Cornell L. Rev. 343, 343 (1996).

do so.[174] Contrary to the shared nature of a co-occupied home, the shared nature of identifiable genetic information is not subject to severance. Accordingly, analogies to forms of shared interests that are easy to break or easy to exit will not suffice.

C. *Identifiable Genetic Information Is Non-Volitionally Shared*

Individuals do not voluntarily share identifying genetic information in common with their close genetic relatives.[175] Genetic similarity is a product of biology, not choice. "[W]e all well know that we do not choose the families into which we are born."[176] Parents might be said to share their identifiable genetic material volitionally by choosing to procreate, but even that notion of voluntariness is open to question.[177] At a minimum, there is no sense in which children may be said to have chosen their genetic parents, and siblings likewise do not control whether their parents have additional children. Thus, the number and identity of one's close genetic relatives is most often out of one's control.

Here again, this feature complicates the ordinary frameworks applied to genetic information. Most saliently, "[i]n light of the involuntariness and intractability of the genetic link, . . . it seems indefensible to claim a voluntary relinquishment of privacy by the relative on account of mere biology."[178]

Voluntariness shapes the scope of many legal rights. As set forth above, civil forfeiture sometimes turns on the voluntary decision of an

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174. See, e.g., United States v. 19 & 25 Castle St., 31 F.3d 35, 40 (2d Cir. 1994) (permitting forfeiture of family home where adult children possessed narcotics on premises and "Mr. and Mrs. Gonzalez could have given their adult children an ultimatum: Comply with the law or move out"); United States v. 4.14 Acres, 801 F. Supp. 737, 742–43 (S.D. Ga. 1992) (ordering forfeiture of defendant's property due to defendant's failure to remove drug-selling daughters from home, despite other actions by defendant to oppose daughters' drug activities). Property owners in these kinds of cases are deemed not to be "innocent" within the meaning of the forfeiture statute.

Demands for exit or removal of an offending party are different where the wrongdoer owns the property in question with a possible "innocent owner" as tenants by the entirety. At least one court has rejected a requirement that a spouse must seek divorce or partition in order to prevail as an "innocent owner." See United States v. 6109 Grubb Rd., 886 F.2d 618, 627 (3d Cir. 1989) ("Certainly the government's suggestion that an innocent spouse should seek partition of the entireties property not only lacks legal substance but, in any event, defies marital reality."); Guerra, supra note 173, at 377 (discussing cases involving jointly owned property, including *6109 Grubb Road*); see also infra notes 295–301 and accompanying text (discussing application of federal civil forfeiture statute to entireties properties).

175. Ram, Fortuity, supra note 61, at 793.

176. Murphy, supra note 18, at 336.

177. See generally I. Glenn Cohen, The Right Not to Be a Genetic Parent?, 81 S. Cal. L. Rev. 1115 (2008) (considering whether law should recognize right not to be genetic parent and what scope that right might have).

178. Murphy, supra note 18, at 337.

owner or co-owner to continue to share property with a criminal.[179] The tort of public disclosure of private facts has been held to turn on one's voluntary public appearance.[180] And courts have deemed the Fourth Amendment inapplicable to information individuals voluntarily share with others.[181]

Notions of abandonment, which play a key role in both research and forensic uses of genetic information, similarly turn on some notion of volition—the "knowing exposure" of material or information to the public.[182] In the research context, "the principle most commonly applied seems to be that of 'finders keepers' where pathologists, physicians, and researchers who have access to patient tissue feel no qualms about keep-

179. See supra notes 173–174 and accompanying text (discussing role of occupancy choice in civil forfeiture context).

180. See, e.g., Cefalu v. Globe Newspaper Co., 391 N.E.2d 935, 939 (Mass. App. Ct. 1979) ("The appearance of a person in a public place necessarily involves doffing the cloak of privacy which the law protects."); Nader v. Gen. Motors Corp., 255 N.E.2d 765, 769 (N.Y. 1970) ("[T]here can be no invasion of privacy where the information sought is open to public view or has been *voluntarily* revealed to others." (emphasis added)); McNamara v. Freedom Newspapers, Inc., 802 S.W.2d 901, 905 (Tex. Ct. App. 1991) (finding newspaper immune from tort liability for publishing photo of high school athlete's inadvertently exposed genitalia during game and explaining "[a]t the time the photograph was taken, McNamara was *voluntarily* participating in a spectator sport at a public place" (emphasis added)). But see *Nader*, 255 N.E.2d at 771 ("A person does not automatically make public everything he does merely by being in a public place, and the mere fact that Nader was in a bank did not give anyone the right to try to discover the amount of money he was withdrawing.").

181. See Smith v. Maryland, 442 U.S. 735, 744 (1979) (holding installing pen register without warrant does not violate Fourth Amendment because, "[w]hen he used his phone, petitioner *voluntarily* conveyed numerical information to the telephone company and 'exposed' that information to its equipment in the ordinary course of business" (emphasis added)); United States v. Miller, 425 U.S. 435, 442 (1976) ("All of the documents obtained, including financial statements and deposit slips, contain only information *voluntarily* conveyed to the banks and exposed to their employees in the ordinary course of business." (emphasis added)); In re Application of the U.S. for Historical Cell Site Data, 724 F.3d 600, 614 (5th Cir. 2013) ("Because a cell phone user *makes a choice* . . . to make a call, and because he knows that the call conveys cell site information . . . he *voluntarily* conveys his cell site data each time he makes a call." (emphasis added)). But see United States v. Jones, 132 S. Ct. 945, 957 (2012) (Sotomayor, J., concurring) ("More fundamentally, it may be necessary to reconsider the premise that an individual has no reasonable expectation of privacy in information voluntarily disclosed to third parties."). On the view that the third-party doctrine is a functional consent test, see Orin S. Kerr, The Case for the Third-Party Doctrine, 107 Mich. L. Rev. 561, 588–90 (2009).

182. See Joh, Reclaiming, supra note 119, at 865 (noting Fourth Amendment does not apply in cases where DNA is recovered from abandoned objects "'knowingly exposed' to the public"); see also United States v. Thomas, 864 F.2d 843, 846 (D.C. Cir. 1989) ("To determine whether there is abandonment in the fourth amendment sense, the . . . court must focus on the intent of the person who is alleged to have abandoned the place or object."); United States v. Colbert, 474 F.2d 174, 176 (5th Cir. 1973) ("The issue is not abandonment in the strict property-right sense, but whether the person prejudiced by the search had voluntarily discarded, left behind, or otherwise relinquished his interest in the property in question so that he could no longer retain a reasonable expectation of privacy with regard to it . . . .").

ing it for their own use, beyond the purposes for which the tissue was collected."[183] The rule of "finders keepers" at work here stems from the doctrine of abandonment, in which the former title-holder surrenders all rights to the object in question, and title is assigned to the first person who takes possession.[184] In the forensic context, individuals have been held to have "abandoned" genetic material left on cigarette butts, coffee cups, and envelopes, such that analysis of that material did not implicate the Fourth Amendment.[185]

None of these legal limitations is appropriate in the context of shared identifiable genetic information. That information is not voluntarily shared or exposed by the close genetic relative of one whose cells are used for genetic analysis. We do not "voluntarily participate," "knowingly expose," or otherwise "abandon" our identifiable genetic information in another person's cells. We can be identified, at least partially, through those cells as a matter of biology, not choice. The project of respecting one's interest in identifiable genetic information thus is complicated still further.

IV. LOOKING TO TENANCY BY THE ENTIRETY

Accounting for the embedded relationships that identifiable genetic information embodies requires a legal framework familiar with similarly fixed features. Such a framework may be found in many spheres of law. Just as a variety of legal interests touch on identifiable genetic information,[186] an array of legal analogies are available for thinking about that information in all its complexity. Possible frameworks may be drawn from property,[187] intellectual property,[188] tort,[189] and business administration,[190] among others. And general principles also may guide decision-

183. Lori B. Andrews, Harnessing the Benefits of Biobanks, 33 J.L. Med. & Ethics 22, 23 (2005); see also Ram, Assigning Rights, supra note 111, at 171–72 (discussing abandonment in context of human tissue research).

184. Dukeminier et al., Property 112 (8th ed. 2014).

185. See Joh, Reclaiming, supra note 119, at 860–62 (collecting and discussing cases).

186. See supra notes 105–138 and accompanying text (analyzing legal interest in genetic information).

187. See infra notes 202–204 (identifying sources describing property-based analogies for shared identifiable genetic information); infra notes 205–212 and accompanying text (identifying variety of property forms involving shared interests).

188. See, e.g., 1 Chisum on Patents § 2.02 (joint inventorship); 1 Nimmer on Copyright §§ 6.01–.12 (joint authorship); see also Ram, Assigning Rights, supra note 111, at 141–55 (introducing "informational property" model for addressing interests of tissue providers in cells and genetic information they contribute to research and explaining model "adopts the contours of American intellectual property").

189. See, e.g., Richards & Solove, supra note 110, at 156–59 (describing American tort of breach of confidence for unconsented-to disclosures).

190. See, e.g., 7 Richard R. Powell, Powell on Real Property § 50.08 (Michael Allen Wolf, ed., 2000) (identifying "tenancy in partnership" as one of several forms of concurrent ownership).

making in approaching this difficult problem, including principles of efficiency[191] or fairness.[192]

This Article focuses on a property framework, and more specifically on the law of tenancy by the entirety. The use of the word "framework" here is deliberate. This Article is not intended to suggest that interests in genetic information are or should be thought of strictly as property interests or that courts should invoke the law of tenancy by the entirety in adjudicating cases involving claims to DNA. Rather, this Article's aims are more limited: Legal institutions, in grappling to make policy regarding shared identifiable genetic information, would do well to look to other areas of the law—including property law, and more specifically the law surrounding tenancy by the entirety—as a guide for how to deal seriously with fundamentally shared interests. In other words, discussion of property interests and tenancy by the entirety can serve as a useful starting point in thinking about how identifiable genetic information can best be regulated to take its shared nature into account.

While the law of property is just one possible framework among many, it is a logical one with which to begin. As identified earlier, several states have declared that genetic information is property—property of the individual "to whom the information pertains."[193] Moreover, at least one court has expressly treated genetic information, apart from the cells from which that information was derived, as property.[194] In *United States v. Kriesel*, the Ninth Circuit concluded that a convicted offender who had completed his period of supervised release had standing to seek return of the blood sample taken from him for forensic analysis as a condition of that release.[195] The court affirmed that Kriesel was "seeking the return of 'property.' . . . [T]he blood sample itself is a tangible object, and the genetic code contained within the blood sample is information."[196] To be sure, property claims related to human biological materials have not always fared well; for instance, in the famous *Moore v. Regents* suit, the California Supreme Court rejected a conversion claim.[197] But cases like

191. See, e.g., Michael E. Smith, Let's Make the DNA Identification Database as Inclusive as Possible, 34 J.L. Med. & Ethics 385, 386 (2006) (invoking efficiency in arguing for expanding forensic DNA databases).

192. See, e.g., Greely et al., supra note 35, at 258–59 (concluding African Americans, overrepresented in CODIS, "are likely to oppose family forensic DNA" as "racist action by the American criminal justice system" and suggesting this unfairness "deserves attention in the context of America's historical and current problems with race").

193. Colo. Rev. Stat. § 10-3-1104.7(1)(a) (2014); see also Fla. Stat. § 760.40(2)(a) (2010); Ga. Code Ann. § 33-54-1(1) (2013); La. Rev. Stat. Ann. § 22:1023(E) (2014).

194. United States v. Kriesel, 720 F.3d 1137, 1144–45 (9th Cir. 2013).

195. Id. at 1147.

196. Id. at 1144–45.

197. See Moore v. Regents of the Univ. of Cal., 793 P.2d 479, 480 (Cal. 1990); see also Wash. Univ. v. Catalona, 490 F.3d 667, 673–74 (8th Cir. 2007) (recognizing Washington University as exclusive owner of tissues provided by patients seeing urological specialist at University); Greenberg v. Miami Children's Hosp. Research Inst., Inc., 264 F. Supp. 2d

Moore have usually focused on the physical cells at issue, rather than the identifiable genetic information those cells contain.[198] Accordingly, property offers a useful lens through which to consider how individuals may effectuate their interests in identifiable genetic information. Moreover, while property-based rules related to genetic information to date may have focused only on an individual's relationship to the genetic information drawn from her own cells, those rules nonetheless provide a legal basis for considering an individual's interest in her identifiable genetic information more broadly.

In particular, property offers a more advantageous lens for addressing shared interests in identifiable genetic information than its chief competitor, the law of privacy. As discussed above, the law of privacy is unitary in nature, "centered around the individual's inviolate personality."[199] "American privacy law has never fully embraced privacy within relationships; it typically views information exposed to others as no longer private."[200] While privacy law has much to recommend it when we ask about the interests of individual stakeholders against outsiders, it is less helpful when we ask how such interests should work in the context of relationships and overlapping, shared interests. Property law is more suited to guide our efforts in the latter circumstance. American property law is rich with forms of shared property interests, including the tenancy by the entirety that is the focus of this Article.[201]

Indeed, others similarly have identified the usefulness of the property lens in addressing the shared nature of identifiable genetic information precisely because shared property interests, unlike shared privacy interests, are well known in the law. Thus, Laura Maria Franciosi and Attilio Guarneri have observed that, rather than privacy, "property laws may better serve as a paradigm to ensure that a greater level of protection is provided for information that belongs to all of the individuals involved."[202] These authors specifically identified that "the theme of joint ownership (joint tenancy, co-ownership) could be applied. These norms in fact would allow disciplining potential conflicts among individuals that

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1064, 1074 (S.D. Fla. 2003) (dismissing conversion claim). But see supra note 105 (explaining these cases do not necessarily require rejection of all property rights in human biological materials).

198. See supra Part II (explaining genetic information often is treated differently).

199. Richards & Solove, supra note 110, at 127.

200. Id. at 126.

201. See 7 Powell, supra note 190, § 49.01 (noting tenancies by the entirety are one of four categories of concurrent ownership). To date, and as discussed above, those forms largely have not come to the fore in current policy governing identifiable genetic information.

202. Franciosi & Guarneri, supra note 143, at 186. Franciosi and Guarneri critique the privacy paradigm because "the current configuration of American privacy law provisions" is "structured over a strictly individualistic concept of private information," while "the nature of genetic information is common to a group and not merely to a single individual." Id.

hold the same right."[203] Erin Murphy similarly has remarked that "a relatives' [sic] protectable interest in the privacy of their half of the database kin's genetic code . . . could be likened to the joint interest held by property owners who share common space."[204] But these scholars have not explored these analogues in depth.

As these scholars indicate, the law of property, like the law more generally, offers a multitude of possibilities that may serve as a basis for analogy. One property treatise has commented that "[t]he idea of two or more people being simultaneously the owners of the same [thing] is very old."[205] Shared ownership interests include:

> four categories of substantial antiquity, tenancies in coparcenary, joint tenancies, tenancies in common, tenancies by the entireties; one category imported since 1800 from the civil law, community property; another borrowed from the civil law as late as 1961, the condominium; and three categories invented to meet recently realized business and economic needs, the tenancy in partnership, the cooperative, and time-sharing.[206]

Moreover, shared property interests may include leaseholds in which "two or more persons have interests in property, but at least one of them is not in possession."[207]

Each of these property forms has developed law governing what each owner or interested party may do with the shared property and what actions co-owners or co-tenants may take to prevent or profit from each other's conduct. Thus, co-tenants in common generally are entitled to use and enjoy the whole property and unilaterally to encumber their own shares of the property, giving access or ownership in the property to others even without their co-owners' consent.[208] Condominium associations, which "join[] separate ownership of one's unit with an undivided interest in the common elements,"[209] ordinarily establish voting rules by agreement for addressing issues in common elements.[210] These property associations may require majority, super-majority, or unanimous consent to take certain actions with respect to shared elements or even individually owned portions of the property.[211] And leaseholds require, among

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203. Id.

204. Murphy, supra note 18, at 336. But see Kaye, supra note 112, at 162 n.328 (rejecting Murphy's co-occupancy argument).

205. 7 Powell, supra note 190, § 49.01.

206. Id.

207. Thomas W. Merrill, *Melms v. Pabst Brewing Co.* and the Doctrine of Waste in American Property Law, 94 Marq. L. Rev. 1055, 1056 (2011).

208. 7 Powell, supra note 190, §§ 50.03–.06.

209. Id. § 49.01.

210. Id. § 54.03.

211. Id.

other things, that a tenant in possession not engage in conduct that "injur[es] the absent owner's interest in the property."[212]

Among these, tenancy by the entirety is the most useful place to start. Although the details of tenancy by the entirety differ from state to state, a substantial number of states still retain this property form, with many retaining it in a form conducive to the discussion that follows.[213] Tenancy by the entirety and interests in shared identifiable genetic information are similar in foundational, descriptive, and historical ways. As set forth in more detail below, these two are foundationally similar because both implicate a unity of identity as an essential attribute and both derive from certain close familial relationships. These shared essential features give rise to similar descriptive features, including the ways in which interests in both tenancy by the entirety and shared identifiable genetic information are overlapping and difficult, or impossible, to break. Tenancy by the entirety offers historical kinship for interests in shared identifiable genetic information, in that tenancy by the entirety has developed from a one-relevant-decisionmaker model into a largely egalitarian property framework, a transformation sorely needed in accounting for interests in shared identifiable genetic information.

Other shared property arrangements offer much less by way of similarity to interests in shared identifiable genetic information. Tenancies in common and leaseholds purposely create easily terminable relationships among interest-holders, and so are unlike the unbreakable bond of genetic relatedness. Even joint tenancies with a right of survivorship usually are unilaterally severable.[214] None of these property forms is limited, like tenancy by the entirety, to already-established familial relations. As such, though they offer models of shared property, they share neither foundational nor structural kinship with interests in shared identifiable genetic information. The law of tenancy by the entirety does both.

A. *Foundational Kinship*

Both tenancy by the entirety and shared identifiable genetic information involve at least partial unity of identity—one a legal fiction, the other a biological fact. Tenancy by the entirety is a property form traditionally available only to married persons.[215] It is built on a legal fiction that spouses are "one person at law," such that neither spouse

212. Merrill, supra note 207, at 1056.

213. Dukeminier et al., supra note 184, at 345 (observing "tenancy by the entirety exists today in fewer than half the states"); 7 Powell, supra note 190, § 52.01(3) (identifying each state's approach to tenancy by the entirety).

214. Dukeminier et al., supra note 184, at 208; see also Abraham Bell & Gideon Parchomovsky, Of Property and Federalism, 115 Yale L.J. 72, 77 (2005) ("Some states allow unilateral conversion of a joint tenancy into a tenancy in common; others do not." (footnotes omitted)).

215. United States v. Craft, 535 U.S. 274, 280 (2002).

"own[s] any individual interest in the estate; rather it belong[s] to the couple."[216] This unity persists in order to give each spouse authority and responsibility with respect to their shared property.[217] Genetic information among closely related individuals also exhibits a unity of identity, in this instance, a biological one. As discussed above, genetic information among closely related persons is inextricably shared. Some portion of that information, probabilistically calculated and biologically determined, is the same, springing from a common source. If legal institutions hope to take seriously individuals' interests in their identifiable genetic information, then there is a need to create shared authority and responsibility for those portions of identifiable genetic information that each individual shares with her close genetic relatives.

Moreover, both tenancy by the entirety and shared identifiable genetic information are focused on the family. Again, tenancy by the entirety ordinarily is available only to married persons,[218] and so it necessarily contemplates organizing shared property interests within the family. As the Hawaii Supreme Court observed in embracing modern tenancy by the entirety, "'The interest in family solidarity retains some influence upon the institution of tenancy by the entirety.'"[219] In affirming the continued use of tenancy by the entirety, that court described itself as protecting "the interests of the family unit."[220] Interests in shared identifiable genetic information are also necessarily about family, as that information is shared more closely among close genetic relatives. To be sure, families are social constructs.[221] But they also often reflect genetic relationships.[222] The family thus is a core feature of both tenancy by the entirety and shared identifiable genetic information. Workable governance for shared identifiable genetic information, like the tenancy by the entirety, must take seriously "the interests of the family unit," specifically those borne of genetic relatedness.

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216. Id. at 281.

217. See Gregory S. Alexander, Governance Property, 160 U. Pa. L. Rev. 1853, 1885 (2012) ("This institution encourages both parties to keep each other informed regarding use of their jointly owned property because the exercise of property rights depends upon the other's consent.").

218. But see Haw. Rev. Stat. Ann. § 509-2 (LexisNexis 2007) (permitting any two "reciprocal beneficiaries," including siblings and parent-child pairs, to hold real property in any type of concurrent estate, including as tenants by the entirety).

219. Sawada v. Endo, 561 P.2d 1291, 1297 (Haw. 1977) (quoting Fairclaw v. Forrest, 130 F.2d 829, 833 (D.C. Cir. 1942)) (alterations omitted).

220. Id.

221. 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, 270 (2006) (explaining relationships are more likely to be built up between "individuals who had assumed that the link existed, for example, as parent-child or brother-sister"); Murphy, supra note 18, at 315 ("In our society, families are largely social, not biological, constructs.").

222. Murphy, supra note 18, at 315.

B. *Structural Kinship*

This focus on family drives "[t]he structure of the tenancy by the entirety," which in its modern form "envisions a particular kind of relationship that depends on communication between cotenants."[223] Tenancy by the entirety considers neither spouse to "own any individual interest in the estate; rather it belong[s] to the couple,"[224] and therefore the estate may be severed only by divorce, joint conveyance, or conveyance from one co-owner to the other.[225] Indeed, a key feature of tenancy by the entirety is that typically "[n]either spouse may unilaterally alienate or encumber the property."[226] An encumbrance includes any right or claim to property other than an ownership interest.[227] In the context of tenancy by the entirety, rights held by individuals or institutions external to the married pair are likely to be encumbrances on the property.

This feature of tenancy by the entirety makes it quite unlike most joint tenancies, in which "any one joint tenant can convert a joint tenancy into a tenancy in common unilaterally by conveying his interest to a third party."[228] Owners who hold as tenants by the entirety are bound together much more firmly. Unilateral conveyances of an entireties property do not sever the tenancy; they are simply void.[229] In most states,

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223. Alexander, supra note 217, at 1885.

224. United States v. Craft, 535 U.S. 274, 281 (2002).

225. See, e.g., Mich. Comp. Laws Ann. § 552.102 (West 2005) (stating divorce creates tenancy in common "unless the ownership thereof is otherwise determined by the decree of divorce"); id. § 557.101 ("[T]enancy by the entirety may be terminated by a conveyance from either one to the other of his or her interest in the land so held."); United States v. 2525 Leroy Lane, 910 F.2d 343, 351 (6th Cir. 1990) ("The entireties estate may also be destroyed through a joint conveyance of the property by husband and wife . . . ."); United States v. 15621 S.W. 209th Ave., 894 F.2d 1511, 1514 n.2 (11th Cir. 1990) (describing how tenancy by the entirety can terminate pursuant to Florida law); see also John V. Orth, Tenancy by the Entirety: The Strange Career of the Common-Law Marital Estate, 1997 BYU L. Rev. 35, 39 ("Not having a share at all, it necessarily followed that neither had an alienable share.").

226. *Craft*, 535 U.S. at 282; see also Dukeminier et al., supra note 184, at 245 (linking survival of tenancy by the entirety to inability to unilaterally assign one's interest in property so held); Damaris Rosich-Schwartz, Tenancy by the Entirety: The Traditional Version of the Tenancy Is the Best Alternative for Married Couples, Common Law Marriages, and Same-Sex Partnerships, 84 N.D. L. Rev. 23, 34–35 n.77 (2008) (categorizing forms of tenancy by the entirety in states retaining that property form and indicating protection of entireties property from unilateral creditors is rule in plurality of those states).

227. Black's Law Dictionary 644 (Bryan Garner ed., 10th ed. 2014) (defining "encumbrance" as "claim or liability that is attached to property or some other right and that may lessen its value, such as a lien or mortgage; any property right that is not an ownership interest").

228. Dukeminier et al., supra note 184, at 224; see also Bell & Parchomovsky, supra note 214, at 77 ("Some states allow unilateral conversion of a joint tenancy into a tenancy in common; others do not.").

229. See, e.g., Tkachik v. Mandeville, 790 N.W.2d 260, 265 (Mich. 2010) ("[W]hen title to real estate is vested in a husband and wife by the entirety, separate alienation by

creditors of a single owner cannot reach a tenancy by the entirety as a result of this rule.[230] And upon the death of one spouse, "'the whole must remain to the survivor.'"[231]

Tenancy by the entirety thus "encourages both parties to keep each other informed regarding use of their jointly-owned property because the exercise of property rights depends upon the other's consent."[232] Like modern tenancy by the entirety, shared decisionmaking should be prized where shared interests, like those in identifiable genetic information, implicate individual identity and autonomy. Thoughtful governance of identifiable genetic information, in other words, also should "envision[] a particular kind of relationship" in which its members are in some ways accountable to one another.[233]

Indeed, the restraints that tenancy by the entirety imposes commend this framework for yet another reason. The tenancy by the entirety framework not only protects the core of the property interest in shared identifiable genetic information; it also modifies some of the other sticks in the traditional bundle of rights—for instance, the right of alienation—in ways that are privacy-protecting. Thus, while GINA and the HIPAA Privacy Rule seek to protect privacy by requiring an individual's authorization before her identifiable genetic information is disclosed or used in research, so too does the tenancy by the entirety framework.[234] That framework renders unilateral conveyances void and therefore requires an individual's authorization before her identifiable genetic

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one spouse only is barred."); Ethridge v. TierOne Bank, 226 S.W.3d 127, 132 (Mo. 2007) ("A deed by only one of two tenants by the entirety conveys nothing."); Bellows Falls Trust Co. v. Gibbs, 534 A.2d 210, 211 (Vt. 1987) (voiding mortgage note executed by only one spouse).

230. See Rosich-Schwartz, supra note 226, at 34–35 n.77 (indicating protection of entireties property from unilateral creditors is rule in plurality of states retaining tenancy by the entirety); see also Dukeminier et al., supra note 184, at 250 ("In a majority of states, a creditor of one spouse cannot reach a tenancy by the entirety because one spouse cannot assign his or her interest."); 7 Powell, supra note 190, § 52.01(3) (identifying each state's approach to tenancy by the entirety).

This rule is subject to at least one exception. In *Craft*, the Supreme Court held that a "husband's interest in the entireties property constituted 'property' or 'rights to property'" to which a federal tax lien could attach. 535 U.S. at 288. The Court recognized that "Michigan makes a different choice with respect to state law creditors." Id. But the Court explained that "exempt status under state law does not bind the federal collector." Id. (internal quotation marks omitted). *Craft*'s exception to the state law rule has not spread throughout federal law. See, e.g., In re Brannon, 476 F.3d 170, 175 & n.6 (3d Cir. 2007) (observing "joint filing in bankruptcy does not sever a tenancy by the entireties so as to make the property available to creditors of either husband or wife individually" and collecting cases in agreement).

231. Orth, supra note 225, at 39 (quoting 2 Blackstone, Commentaries 182 (photo. reprint 1978) (R. Burn ed., 1783)).

232. Alexander, supra note 217, at 1885.

233. Id.

234. 45 C.F.R. § 1320d-9(a)(1) (2014) (defining "genetic information" as "health information" under HIPAA).

information is disclosed to or used by third parties, whether that information resides in her own cells or those of her close genetic relative. In so doing, the tenancy by the entirety model achieves the interests undergirding modern policy governing the protection of identifiable genetic information, whether voiced in the language of property or of privacy.

At bottom, the key to the structural kinship between tenancy by the entirety and interests in shared identifiable genetic information is that both demand "a particularly difficult form of doublethink: to think about two persons as though they were one."[235] While the source of this "doublethink" may be different, the purposes served by the former may be instructive as to the latter. Tenancy by the entirety imposes a legal fiction in order to support and encourage shared governance within the family. Respecting interests in shared identifiable genetic information could do the same.

Tenancy by the entirety is not, however, a perfect structural fit for shared identifiable genetic information. For one thing, unlike genetic information, tenancy by the entirety is a shared relationship that is voluntarily undertaken. In addition to being limited to two individuals, marriage is legally a voluntary arrangement in this country. Indeed, tenancies by the entirety often require deliberate action, as a tenancy by the entirety is not a default rule in most states.[236] And tenancies by the entirety may be burdensome to create, as they require five "unities": time, title, interest, possession, and marriage.[237] Nonetheless, the law surrounding tenancies by the entirety indicates that the law is capable of responding to circumstances in which property is shared without consent—that is, involuntarily.[238]

For another, tenancy by the entirety only ever requires mutual consent among two individuals, while those with interests in shared identifiable genetic information will inevitably be more numerous. Again, tenancy by the entirety is ordinarily available only to married persons, and in the United States, legal marriage is limited to two individuals.[239] By

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235. Orth, supra note 225, at 40.

236. Hanoch Dagan, The Craft of Property, 91 Calif. L. Rev. 1517, 1541–42 (2003). But see Beal Bank v. Almand & Assocs., 780 So. 2d 45, 54 (Fla. 2001) (explaining, as to real property, "[a] conveyance to spouses as husband and wife creates an estate by the entirety in the absence of express language showing a contrary intent," while as to personal property, "the intention of the parties must be proven" (alteration in original) (quoting In re Estate of Suggs, 405 So. 2d 1360, 1361 (Fla. Dist. Ct. App. 1981); First Nat'l Bank v. Hector Supply Co., 254 So. 2d 777, 780 (Fla. 1971)) (internal quotation marks omitted)).

237. See, e.g., *Beal Bank*, 780 So. 2d at 52 (identifying these five unities and adding also characteristic of survivorship).

238. See infra Part V.A (demonstrating how tenancy by the entirety framework can apply to forensic familial identification, which involves sharing genetic information without consent).

239. See, e.g., United States v. Windsor, 133 S. Ct. 2675, 2692 (2013) (explaining lawful status of marriage "is a far-reaching legal acknowledgment of the intimate

contrast, children typically each have two genetic parents,[240] yielding at least three individuals who must agree before the child may encumber the identifiable genetic material she shares with her parents. In many instances, the number of interested parties will be even greater, as individuals may have multiple siblings and children of their own, in addition to genetic parents.[241]

We might exploit this multiplicity of relevant actors to limit the impact of tenancy by the entirety's requirement of mutual consent, envisioning that requirement as breaking a tie against encumbrance. Under such an understanding, decisionmaking involving more than two stakeholders would allow a majority to prevail over a less numerous opposition. But that result seems inconsistent with the foundational commitment of tenancy by the entirety to unity and with the right tenancy by the entirety gives to each spouse "to protect [the property] against outsiders."[242] Such an interpretation of the tenancy by the entirety framework, while more manageable, would undermine the usefulness of that framework by betraying its fundamental attributes.[243]

Nonetheless, the scope and number of genetic relatives with whom one shares a tenancy-by-the-entirety-like interest is not without limit. Indeed, existing practices suggest two possible lines on which policymakers may draw to capture the great majority of relevant interests.[244] First, GINA, which extends medical privacy protection to "genetic infor-

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relationship between *two people*, a relationship deemed by the State worthy of dignity in the community equal with all other marriages." (emphasis added)). In some states, tenancy by the entirety is also available to domestic partners, individuals joined through civil union, or other kinds of "reciprocal beneficiaries." See Haw. Rev. Stat. § 509-2 (2006) (stating "reciprocal beneficiaries" may hold property as tenants by the entirety). Even where this is so, however, the maximum number of individuals who may be part of such a relationship is two. See id. § 572C-3 (defining "reciprocal beneficiaries" as "two adults who are parties to a valid reciprocal beneficiary relationship").

240. Korf, supra note 17, at 36. Three genetic parents are possible in assisted human reproduction involving cytoplasmic transfer or mitochondrial DNA replacement therapy, in which cytoplasm from one egg is transferred to another, yielding a mix of mitochondrial genetic material. See Jason A. Barritt et al., Cytoplasmic Transfer in Assisted Reproduction, 7 Hum. Reprod. Update 428, 430 (2001) (discussing possibility of "mixing mitochondria from one oocyte with another during ooplasmic donation"); Gretchen Vogel & Erik Stokstad, U.K. Parliament Approves Controversial Three-Parent Mitochondrial Gene Therapy, Science (Feb. 3, 2015, 2:00 PM), available at http://news.sciencemag.org/biology/2015/02/u-k-parliament-approves-controversial-three-parent-mitochondrial-gene-therapy (reporting U.K. House of Commons approved mitochondrial DNA replacement therapy, which yields embryo with "nuclear DNA from the mother and father and mitochondrial DNA from the egg donor").

241. Korf, supra note 17, at 36.

242. 7 Powell, supra note 190, § 52.03(4).

243. As discussed at infra notes 345–348 and accompanying text, however, an action for waste may provide a measure of protection against unreasonable holdouts or refusals to respond in the context of securing familial consent for genetic research.

244. But see supra note 168 and accompanying text (discussing instances in which broader interests in shared identifiable genetic information may be relevant).

mation," defines an individual's "genetic information" to include information about "the genetic tests of family members of such individual."[245] Further provisions and regulations explain that "family members" include up to "an individual's great-great-grandparents, great-great-grandchildren, and first cousins once-removed (i.e., the children of the individual's first cousins)," or such relatives of an individual's dependent.[246] Such relatives may have as little as 6.25% genetic similarity on average arising from relatedness, and this group of "family members" may, and often will be, substantial in number.[247]

Alternatively, other practices and research suggest a more manageable line, at least for now, around the immediate family (parents, siblings, and children). As set forth above, to date, forensic familial identification focuses almost exclusively on immediate-family relations in deriving useful leads for investigation.[248] The result in *Guðmundsdóttir*[249] is also consistent with drawing a presumptive line around immediate family members. Certain social science research reinforces an immediate-family line as well, documenting that parents' concerns about genetic relatedness for their children extends much more strongly to full siblings than even half siblings.[250]

C. *Historical Kinship*

The foregoing is relevant only to the modern form of tenancy by the entirety. As a historical matter, tenancy by the entirety managed the difficulties of treating "two persons as though they were one" by render-

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245. 42 U.S.C. § 300gg-91(d)(16) (2012) (defining "Genetic Information").

246. 29 C.F.R. § 1635.3(a) (2014).

247. See Rohlfs et al., Familial Identification, supra note 64, at 8 ("The kinship coefficient for parent-offspring, sibling, half-sibling, first cousin, and second cousin relationships are 0.25, 0.25, 0.125, 0.0625, and 0.015625, respectively . . . . [A]s the kinship coefficient of the tested relationship approaches the population background relatedness . . . it will become increasingly difficult to discern relatives from unrelated individuals.").

248. See, e.g., Green, supra note 8 (reporting Virginia forensic laboratory involved in Holloway case, in reporting partial DNA match to investigators, "made it clear that the person whose DNA was in the database was eliminated as the suspect, but he could be the *father, son or brother* of the perpetrator" (emphasis added)).

249. See Guðmundsdóttir v. Iceland [Supreme Court] Nov. 27, 2003, No. 151/2003, at 9–10 (Ice.), available at https://epic.org/privacy/genetic/iceland_decision.pdf (on file with the *Columbia Law Review*) (finding individual privacy grounds for allowing appellant to block release of her deceased father's genetic information, which could be used to infer her own genome).

250. See Heather Widdows, Ethical Issues in Biobanking Oocytes and Embryos 9–10 (Dec. 5, 2014) (unpublished manuscript) (on file with the *Columbia Law Review*) (noting interview subject "distinguished between full and half siblings," deeming latter not problematic); see also Giulia Zanini, Neither Gametes nor Children, 4 Tecnoscienza 87, 104 (2013) (reporting one respondent who expressed serious concerns about genetic relatedness using donor embryos where other, full-sibling embryos exist, while expressing little concern about half-sibling embryos for her child).

ing the wife's authority a virtual nullity.[251] At common law, husbands, but not wives, enjoyed rights of use even to the exclusion of their spouses, and husbands were entitled to all of the rents and profits from entireties properties.[252] Indeed, "[t]he husband's control of the property was so extensive that, despite the rules on alienation, the common law eventually provided that he could unilaterally alienate entireties property without severance subject only to the wife's survivorship interest."[253] A few courts even permitted creditors of the husband alone to secure liens against entireties property.[254]

Beginning with Mississippi in 1839, however, states began to enact Married Women's Property Acts.[255] By the end of the nineteenth century, all common law property states had enacted similar statutes.[256] These statutes abolished the historical rule of coverture and recognized that wives, like husbands, retained legal existence in marriage.[257] Some states subsequently did away with tenancy by the entirety;[258] others reshaped tenancy by the entirety to preserve the legal fiction that married spouses are one while recognizing the equality of its participants.[259] In this latter group of states, legal equality between spouses with respect to entireties property often required additional legislative action and modernization, "a process not completed until late in the twentieth century."[260] For many of these states, it remains the case that "'one tenant by the entirety has no interest separable from that of the other,'"[261] "each tenant by the entirety possesses the right of survivorship," and "[n]either spouse may unilater-

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251. Orth, supra note 225, at 40–41; see also United States v. Craft, 535 U.S. 274, 281 (2002) (explaining, at common law, the "one person at law . . . practically speaking, was the husband").

252. Orth, supra note 225, at 40.

253. *Craft*, 535 U.S. at 281.

254. See, e.g., Raptes v. Cheros, 155 N.E. 787, 787 (Mass. 1927) ("A tenancy by the entirety may be taken on an execution issued against the husband, and the purchaser at the sale on execution may maintain a writ of entry against him for possession and title."); Lewis v. Pate, 193 S.E. 20, 20 (N.C. 1937) (holding husband's judgment creditor could force sale of crops grown on land owned by husband and wife as tenants by the entirety).

255. Dukeminier et al., supra note 184, at 385 ("Beginning with Mississippi in 1839, all common law property states had, by the end of the nineteenth century, enacted Married Women's Property Acts.").

256. Id.; see also Reva B. Siegel, The Modernization of Marital Status Law: Adjudicating Wives' Rights to Earnings, 1860–1930, 82 Geo. L.J. 2127, 2141–49 (1994) (describing history of coverture-reform statutes' passage).

257. Dukeminier et al., supra note 184, at 385 (explaining "statutes removed the disabilities of coverture and gave a married woman, like a single woman, control over all her property"); Orth, supra note 225, at 41 (discussing statutes' impact on tenancy by the entirety).

258. Orth, supra note 225, at 41.

259. United States v. Craft, 535 U.S. 274, 281–82 (2002) (citing Michigan as example of state retaining modified tenancy by the entirety).

260. Orth, supra note 225, at 42–44.

261. *Craft*, 535 U.S. at 282 (quoting Long v. Earle, 269 N.W. 577, 581 (Mich. 1936)).

ally alienate or encumber the property, although this may be accomplished with mutual consent."[262] But contrary to its historical iteration, modern tenancy by the entirety gives each spouse rights to "use the property, exclude third parties from it, and receive an equal share of the income produced by it."[263]

This arduous and ongoing process of ameliorating the role of women as tenants by the entirety may serve as a model for a similar and much-needed shift in the law governing interests in shared identifiable genetic information. The law of tenancy by the entirety for centuries occluded women's control completely in order to resolve the difficulty of "think[ing] about two persons as though they were one."[264] Current legal rules governing the use of identifiable genetic information similarly have failed to acknowledge the identifiable genetic information about an individual that is carried in the cells of her close relatives.[265] Instead, with rare exceptions, policymakers and courts have located any interests in identifiable genetic information only in the individual whose cells are analyzed.[266] Taking interests in shared identifiable genetic information seriously, however, requires recognizing that other stakeholders matter. The modern shift toward egalitarian control of property held in tenancy by the entirety may provide a model for a similar shift in the law governing DNA.[267]

V. APPLYING DNA BY THE ENTIRETY

The essential features that often make tenancy by the entirety difficult to accommodate in law and policy complement the essential and difficult features of identifiable genetic information. Taking an individual's interest in her identifiable genetic information seriously requires accounting for the identifiable genetic information about that individual that is carried in the cells of her close relatives—as well as the identifiable genetic information she carries in her cells about those relatives. This Part maps how the law of tenancy by the entirety may illuminate what that accounting demands and considers how the law of tenancy by the

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262. Id. at 281–82 (discussing Michigan's modern law governing tenancy by the entirety and describing this as "typical of the modern tenancy by the entirety"); see also United States v. 15621 S.W. 209th Ave., 894 F.2d 1511, 1514–15 (11th Cir. 1990) (describing similar features in Florida's law of tenancy by the entirety).

263. *Craft*, 535 U.S. at 282.

264. Orth, supra note 225, at 40.

265. See supra Part III (explaining how concept of individual autonomy has led courts to treat DNA as belonging only to individual from whom sample derives).

266. See supra Part II ("[E]xisting legal rules and doctrines addressing genetic information largely have considered only the interest an individual has in identifiable genetic information drawn from her own cells.").

267. See Dagan, supra note 236, at 1542 (discussing tenancy by the entirety as "closer to the ideal of marriage as an egalitarian liberal community than the alternatives in these common law jurisdictions").

entirety may inform legal governance in three domains: forensic familial identification, genetic research, and personal genetic testing.

In each domain, it falls to state and federal policymakers to abrogate the unilateral control that the law ordinarily vests in an individual over all the identifiable genetic information in her cells. As set forth above, although tenancy by the entirety developed as a common law doctrine, it required modernization through statutory enactments like Married Women's Property Acts to recognize the interests of both spouses in marital property and marital life.[268] Similarly, in most instances, a statutory or regulatory break from the past likely would be necessary for the law to recognize the interests that close genetic relatives may have in the genetic information encoded in one another's cells. This Part identifies one way for shaping such recognition.

A. *Forensic Familial Identification*

As explained at the outset, and as typified by the Holloway case, source-excluding partial matches between known-offender profiles and crime-scene samples may be useful because they can direct law enforcement to investigate the close genetic relatives of the partially matching offender. Identifiable genetic information is shared in specific and predictable ways, such that close genetic relatives have more similar genetic profiles than unrelated individuals. Source-excluding partial matches have been successful in some cases.[269] But these matches often are false positives, which limits their informative power.[270] Partial matches may arise fortuitously during a database search intended to identify an exact match, or they may be deliberately sought. As I have explained else-

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268. See supra notes 255–263 and accompanying text (describing development and purpose of Married Women's Property Acts).

269. See, e.g., Greely et al., supra note 35, at 248–49 (describing "bloody brick" case in which British police used partial match in DNA database to locate perpetrator's brother and, ultimately, perpetrator himself); Ram, Fortuity, supra note 61, at 753–54 (describing case of "Grim Sleeper," in which genetic profile of murderer's son led to suspect's arrest); id. at 781 (describing Colorado's use of source-excluding partial matching to identify and prosecute perpetrator of "car break-in where the burglar 'left a drop of blood on a passenger seat when he broke a car window and stole $1.40 in change'" (quoting P. Solomon Banda, Police Debate Use of Family DNA to ID Suspects, Associated Press (Feb. 9, 2010, 4:50 PM), http://www.nbcnews.com/id/35317812/ns/technology_and_science%20-science#.VNFLI8aprzJ (on file with the *Columbia Law Review*))); Familial Searching, FBI, http://www.fbi.gov/about-us/lab/biometric-analysis/codis/familial-searching (on file with the *Columbia Law Review*) (last visited Mar. 7, 2015) ("Since 2003, the UK has conducted approximately 200 familial searches resulting in investigative information used to help solve approximately 40 serious crimes (as of May 2011)."); see also supra text accompanying notes 8–16 (describing Tyrone Holloway's identification following source-excluding partial match).

270. See supra note 64 and accompanying text (discussing significant rate of false positives); see also Mustian, supra note 64 (discussing false identification and investigation of Usry resulting from partial match search of commercial genetic database containing Usry's father's DNA).

where, however, there is no sound basis for distinguishing between the two.[271] Significantly, both types of matches typically prompt additional, intentionally undertaken genetic or other analysis, and so the use of either should be considered intentional.[272]

Forensic familial identification constitutes an unlawful effort by the government to encumber not only an offender's interest in her identifiable genetic information, but also the interest of the offender's closest kin. The ordinary rules of tenancy by the entirety forbid a single spouse from encumbering the shared property without the consent of her partner.[273] As an encumbrance describes rights held by those external to the married pair,[274] a government's right to use DNA for forensic investigation and identification constitutes an encumbrance on the interest of any individual whose identifiable genetic information is exploited by this use. A rule allowing use of source-excluding partial matches would encumber the portions of identifiable genetic information shared between known offenders and their close genetic relatives. Accordingly, under the framework of tenancy by the entirety, courts should not sanction forensic use of source-excluding partial matches, absent independent justification as to the known offender's kin. Similarly, state forensics laboratories should reject expansions of their roles to include developing and relaying information about source-excluding partial matches.[275]

The rule barring unilateral encumbrances has legal consequences even as against the federal government. Consider federal forfeiture law. Although courts typically have analyzed forensic genetic identification under the Fourth Amendment,[276] the notion of forfeiture is not foreign to the Fourth Amendment.[277] Courts frequently speak of defendants

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271. See Ram, Fortuity, supra note 61, at 783–807 (describing and rejecting justifications distinguishing fortuitous and deliberate partial matches).

272. Id. at 795–98 (emphasizing "differentiating between an intended result and an unintended one . . . is difficult" due to ever-present possibility of inadvertent match).

273. See United States v. Craft, 535 U.S. 274, 282 (2002) ("Neither spouse may unilaterally alienate or encumber the property, although this may be accomplished with mutual consent." (citations omitted)); see also United States v. 15621 S.W. 209th Ave., 894 F.2d 1511, 1514 (11th Cir. 1990) ("[N]either spouse can sell, forfeit or encumber any part of the estate without the consent of the other, nor can one spouse alone lease it or contract for its disposition." (alteration in original) (quoting Parrish v. Swearington, 379 So. 2d 185, 186 (Fla. Dist. Ct. App. 1980) (per curiam)) (internal quotation marks omitted)).

274. See Black's Law Dictionary, supra note 227, at 644 (defining "encumbrance").

275. As I have explained elsewhere, most policies governing forensic familial identification exist, if at all, in state forensics lab manuals. Ram, Fortuity, supra note 61, at 776–78.

276. See, e.g., Maryland v. King, 133 S. Ct. 1958, 1965–69 (2013) (classifying collection of DNA by way of buccal swab as search under Fourth Amendment).

277. The Supreme Court's recent reinvigoration of Fourth Amendment doctrine tied to common law trespass further supports the invocation of property doctrines in discussing Fourth Amendment protections. See United States v. Jones, 132 S. Ct. 945, 949–50 (2012) (noting property doctrine has figured in search and seizure protections since at least

whose actions have thereby "forfeited" any reasonable expectation of privacy in objects or information.[278] Moreover, courts have addressed criminal and civil forfeitures of entireties property directly in determining whether and in what forms the government may forfeit property.[279] The legal burdens applicable to forfeitures also are largely similar to those giving rise to the legal authority to take and analyze genetic material—criminal conviction or at least probable cause.[280] The law of criminal and civil forfeitures and the concept of tenancy by the entirety thus provide an instructive framework for considering the appropriateness of forensic familial identification.

Pursuant to the federal criminal forfeiture statute, the government may forfeit property used in or derived from a statutory violation.[281] As criminal forfeiture requires a nexus to the defendant's illegal conduct, however, "only the defendant's interest in property may be forfeited."[282] The interests of third parties are beyond the scope of forfeiture, "even if the third party was fully aware of the criminal acts and the way the prop-

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Entick v. Carrington, (1765) 95 Eng. Rep. 807 (K.B.), and arguing "text of the Fourth Amendment reflects its close connection to property").

278. See, e.g., Reedy v. Evanson, 615 F.3d 197, 230 (3d Cir. 2010) ("She indisputably had a reasonable expectation of privacy in her blood when it was drawn, and she did nothing to forfeit that expectation."); McClish v. Nugent, 483 F.3d 1231, 1247 (11th Cir. 2007) ("McClish did not completely surrender or forfeit every reasonable expectation of privacy when he opened the door, including, most notably, the right to be secure within his home from a warrantless arrest."); United States v. Redmon, 138 F.3d 1109, 1120 (7th Cir. 1998) (en banc) (Flaum, J., concurring) ("In the context of trash searches, a person is considered to have knowingly exposed any trash that is 'readily accessible' to the public (and thereby to have forfeited any reasonable expectation of privacy in the trash)."); see also Sherry F. Colb, Innocence, Privacy, and Targeting in Fourth Amendment Jurisprudence, 96 Colum. L. Rev. 1456, 1459 (1996) ("All of us begin with an entitlement to privacy, but some seem by their actions to forfeit part of that entitlement. The idea of forfeiture captures the intuition that guilty people really do not deserve the right when its exercise consists of the concealment of incriminating evidence.").

279. See infra notes 281–289, 293–301 and accompanying text (discussing statutory conditions for forfeiture in criminal and civil contexts, and judicial interpretations thereof).

280. See *King*, 133 S. Ct. at 1980 (concluding DNA analysis does not violate Fourth Amendment where it accompanies "arrest supported by probable cause to hold for a serious offense"); Stefan D. Cassella, Criminal Forfeiture Procedure: An Analysis of Developments in the Law Regarding the Inclusion of a Forfeiture Judgment in the Sentence Imposed in a Criminal Case, 32 Am. J. Crim. L. 55, 57 (2004) [hereinafter Cassella, Criminal Forfeiture Procedure] (explaining criminal forfeitures require conviction); Guerra, supra note 173, at 369 (explaining in civil forfeiture actions, government "need only establish probable cause to believe that the property is subject to forfeiture, *i.e.*, that someone has illegally used the property, be it the owner or another" (internal citation omitted)).

281. See 21 U.S.C. § 853 (2012) (establishing conditions and procedures for criminal forfeiture).

282. Heather J. Garretson, Federal Criminal Forfeiture: A Royal Pain in the Assets, 18 S. Cal. Rev. L. & Soc. Just. 45, 59 (2008).

erty was used to facilitate them."[283] More than one court has cautioned that failure to exclude third-party interests from forfeiture where multiple individuals have interests in a single parcel of real property "raises serious constitutional concerns."[284] "If partial forfeitures are forbidden, then a criminal's activity may result in the forfeiture of an innocent third party's interest in property," which "may thus constitute an unconstitutional taking of a third party's interest or a deprivation of that party's property without due process."[285]

Courts considering criminal forfeitures where tenancies by the entirety are at issue have often worked contortions in the law in order to permit the government to forfeit its due while not encroaching on the interest of a nondefendant spouse. Where a criminal defendant is a joint tenant with an innocent party, the federal government's forfeiture authority takes the defendant's interest in the property, presumably severing the joint tenancy, destroying rights of survivorship, and creating a tenancy in common with the innocent co-owner.[286] But where a tenancy by the entirety is at issue, the result is often quite different. For instance, in *United States v. 2525 Leroy Lane*, the Sixth Circuit held that, because "entireties property may not be attached to satisfy the personal tax liability of a single spouse," "[w]hile the federal forfeiture scheme permits the Government to assume Mr. Marks' interest in the property, it may not by virtue of the forfeiture alter the essential characteristics of the entireties estate."[287] The court concluded that "the government could not execute on a defendant's interest in a tenancy by the entireties while the interest was still intact, even if such interest was subject to forfeiture. To do so would burden the interests of . . . third party owners in the criminal for-

283. Stefan D. Cassella, The Uniform Innocent Owner Defense to Civil Asset Forfeiture: The Civil Asset Forfeiture Reform Act of 2000 Creates a Uniform Innocent Owner Defense to Most Civil Forfeiture Cases Filed by the Federal Government, 89 Ky. L.J. 653, 705–06 (2000–2001); see also Garretson, supra note 282, at 59 ("[O]nly the defendant's interest in property may be forfeited.").

284. Pacheco v. Serendensky, 393 F.3d 348, 354 (2d Cir. 2004); accord United States v. Totaro, 345 F.3d 989, 997 (8th Cir. 2003) ("If this court were to deem forfeited the entire estate despite a valid claim of partial ownership by a third party, . . . [i]t would . . . punish the third party, against whom no jury has returned a verdict of guilt, and may therefore raise constitutional questions of a whole different order." (citation omitted)); see also *Pacheco*, 393 F.3d at 354–55 (collecting and discussing cases).

285. *Pacheco*, 393 F.3d at 354.

286. Dukeminier et al., supra note 184, at 392. The cases discussed herein consider properties that were not purchased with the proceeds of the defendant's crime. Where criminal proceeds are used to purchase property, courts have sometimes found the property forfeitable in full, notwithstanding a nondefendant spouse's assertion of legal interest in property held by the entireties or as community property. See United States v. Martinez, 228 F.3d 587, 590 (5th Cir. 2000) ("Because the 'relation back doctrine' operates to vest title in the Government to the proceeds of Martinez' RICO activities as of the time Martinez engaged in those illegal activities, these proceeds, and any property purchased with the proceeds, never became community property.").

287. 910 F.2d 343, 350 (6th Cir. 1990).

feiture context."[288] Some courts have gone further still, holding that a property held in tenancy by the entirety is not subject to federal forfeiture at all.[289]

Applied to identifiable genetic information, this framework suggests that courts should constrain the government to using genetic information it has lawfully obtained only to search for matches implicating the matching offender—but not to search for matches implicating a matching offender's close genetic relatives. Where an individual has engaged in conduct triggering the collection, analysis, and use of her DNA, she has in effect forfeited her interest in keeping the limited information used for forensic identification out of the hands of law enforcement. Using that information to identify an exact match to a crime scene sample intrudes only on that individual's interest in identifiable genetic information. Developing a source-excluding partial match using that same genetic profile, by contrast, also invades the interests of close genetic relatives in the shared portions of identifiable genetic information. In effect, such matches forfeit the interests of close genetic relatives in some portion of their identifiable genetic information. The criminal forfeiture cases suggest that this constitutes an unlawful exercise of government power—perhaps even one of constitutional magnitude.

The criminal forfeiture cases do not, however, fully resolve the issue of forensic familial identification. Recall that *Maryland v. King* sustained the taking of genetic information from individuals arrested for, but not yet convicted of, serious offenses.[290] The criminal forfeiture context, which requires a criminal conviction, may therefore be underinclusive.[291] Looking to the civil forfeiture context, however, yields the same result. Civil forfeitures result from in rem proceedings against the property itself.[292] Unlike criminal forfeitures, civil forfeitures do not require proof of an owner's guilt; rather, they require the government to establish only probable cause to believe that the property in question was involved in unlawful conduct.[293]

Nonetheless, at least with respect to federal law, "[a]n innocent owner's interest in property shall not be forfeited under any civil forfei-

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288. United States v. Kennedy, 201 F.3d 1324, 1332 (11th Cir. 2000) (describing *2525 Leroy Lane*); see also United States v. Jimerson, 5 F.3d 1453, 1454 (11th Cir. 1993) (explaining forfeiture against guilty husband did not affect his wife's interest in their property owned by tenancy by the entirety because she "continues to hold an indivisible one-half interest in the entire residence property").

289. See United States v. Lee, 232 F.3d 556, 560–62 (7th Cir. 2000) (adopting this rule with respect to criminal forfeiture of substitute asset).

290. 133 S. Ct. 1958, 1980 (2013).

291. See Cassella, Criminal Forfeiture Procedure, supra note 280, at 57 ("[I]t is fundamental that there can be no forfeiture order in a criminal case unless the defendant is convicted of an offense . . . .").

292. Guerra, supra note 173, at 362.

293. Id. at 369.

ture statute."[294] In considering the innocent owner defense to civil forfeiture, courts sometimes have tangled with contortions similar to those in the criminal forfeiture context. Indeed, *2525 Leroy Lane* held that the result under the civil forfeiture law was the same as under the criminal forfeiture statute.[295] In *United States v. 1500 Lincoln Avenue*, the Third Circuit similarly held that an innocent spouse who holds otherwise forfeitable property as a tenant by the entirety is entitled to retain the "right to full and exclusive use and possession of the property during her life, her protection against conveyance of or execution by third parties upon her husband's former interest, and her survivorship right."[296] And as in the criminal forfeiture context, some courts have found entireties properties beyond the scope of federal civil forfeiture where there is an innocent spouse.[297]

Moreover, courts in the civil forfeiture context have implied, and sometimes held, that forfeiture of property used in criminal activity without any voluntary action by an innocent owner raises constitutional con-

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294. 18 U.S.C. § 983(d)(1) (2012).

295. 910 F.2d 343, 350–51 (6th Cir. 1990); see also United States v. Kennedy, 201 F.3d 1324, 1332 (11th Cir. 2000) (describing *2525 Leroy Lane* as concluding that executing on entireties property "would burden the interests of 'innocent owners' in the civil forfeiture context, and of third party owners in the criminal forfeiture context" (internal citation omitted)).

296. 949 F.2d 73, 78 (3d Cir. 1991); see also United States v. $16,920.00 in U.S. Currency, No. 1:06CV265, 2008 U.S. Dist. LEXIS 31697, at *11–*17 (W.D.N.C. Apr. 17, 2008).

297. See United States v. 15621 S.W. 209th Ave., 894 F.2d 1511, 1518 (11th Cir. 1990) ("We simply find that the federal law protects an innocent owner's interest, and when that innocent owner's interest comprises the whole of a property, nothing can be forfeited to the government.").

Congress's enactment of a uniform severance provision in the Civil Asset Forfeiture Reform Act of 2000 has not rendered the role of tenancy by the entirety moot. See 18 U.S.C. § 983(d)(5) (enabling court, when innocent owner has partial interest in tenancy by the entirety, to order severance, transfer to government with compensation, or retainment subject to government lien). Of the few cases considering this provision with regard to property held as a tenancy by the entirety, at least three have concluded that the property's status as a tenancy by the entirety affects how forfeiture is accomplished. See United States v. Coffman, No. 5:09-CR-181-KKC, 2014 WL 6750603, at *5–*6 (E.D. Ky. Dec. 1, 2014) (denying government's motion for "order awarding it half of the rental income from the rental properties" held by tenancy by the entirety because government could not acquire defendant spouse's interest in properties without "diminishing" nondefendant spouse's interest); *$16,920.00 in U.S. Currency*, 2008 U.S. Dist. LEXIS 31697, at *7–*9 (concluding wholesale severance of property is inappropriate and granting innocent spouse's Rule 59(e) motion to permit that spouse to "retain the property subject to a lien in favor of the Government to the extent of the forfeitable interest in the property"); United States v. 8 Curtis Ave., No. 01-10995-RWZ, 2003 U.S. Dist. LEXIS 2585, at *3–*4 (D. Mass. Feb. 25, 2003) (concluding, as Section 983(d)(5) "does not override the interests in a tenancy by the entirety as defined by the state," innocent spouse should be "entitled to retain the property in question subject to a lien on Mr. Smith's right of survivorship in favor of the government"). These holdings accord roughly with the results reached in *2525 Leroy Lane* and *1500 Lincoln Ave.*

cerns.[298] In *Calero-Toledo v. Pearson Yacht Leasing Co.*, the Supreme Court reiterated that its cases have "implied that it would be difficult to reject the constitutional claim of an owner whose property subjected to forfeiture had been taken from him without his privity or consent."[299] The Court has consistently distinguished between forfeitures in which property was used without the owner's consent and forfeitures in which, after the owner "entrusted" the property to another user, the property was used in a manner to which the owner did not consent.[300] The Supreme Court has implied, and other courts have held, that forfeitures of the latter type are constitutionally permissible, while forfeitures of the former type are not.[301]

Relatedness to one arrested for a crime is more akin to the former than the latter. Indeed, the distinction drawn in the civil forfeiture cases tracks the involuntariness that typifies shared identifiable genetic information. As previously discussed, close genetic relatives do not ordinarily "consent" or "entrust" one another with their identifiable genetic information for any purpose.[302] Identifiable genetic information is shared among these relatives as an involuntary product of biology, not consent. While probable cause may exist as to an arrestee, thereby giving rise to lawful use of that individual's identifiable genetic information, no such cause exists as to that individual's close genetic relatives. And the fact that the genetic profile of an arrestee contains at least some identifiable

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298. One example of this reasoning can be found in a Michigan Supreme Court decision, which the Supreme Court later affirmed:

> We note the distinction between the situation in which a vehicle is used without the owner's consent and, although the owner consented to the use, it is used in a manner to which the owner did not consent. In the former, the innocent owner's interest could not be abated. In the latter, as in the present case, the innocent owner's interest may be abated.

Michigan ex rel. Wayne Cnty. Prosecutor v. Bennis (*Bennis I*), 527 N.W.2d 483, 495 n.36 (Mich. 1994) (emphasis omitted) (citations omitted), aff'd sub nom. Bennis v. Michigan (*Bennis II*), 516 U.S. 442, 446 (1996).

299. 416 U.S. 663, 689 (1974).

300. See, e.g., *Bennis II*, 516 U.S. at 444–46 (1996) (affirming abatement of jointly-owned vehicle where owner "entrusted" vehicle to her husband, who used it to meet with prostitute, and observing Michigan Supreme Court "noted that, in its view, an owner's interest may not be abated when 'a vehicle is used without the owner's consent'"); *Calero-Toledo*, 416 U.S. at 689–90 (finding forfeiture appropriate because defendant company "voluntarily entrusted" its yacht but noting possibility of different outcome if yacht were taken without defendant's privity or consent); Van Oster v. Kansas, 272 U.S. 465, 467 (1926) ("It is unnecessary . . . to inquire whether the police power . . . extends to the confiscation of the property of innocent persons appropriated and used by the law breaker without the owner's consent, for here the offense . . . was committed by one entrusted by the owner with the possession and use of the . . . vehicle.").

301. See supra notes 298–300 and accompanying text (providing cases to illustrate forfeiture implications of distinction between property voluntarily entrusted and property taken without consent or privity).

302. See supra notes 175–177 and accompanying text (describing phenomenon of shared genetic information as result of biology, rather than consent).

genetic information for her close genetic relatives should not permit the government effectively to forfeit those relatives' interests in that portion of their identifiable genetic information; after all, the sharing involved is involuntary. Accordingly, the law of government encumbrances once again indicates that courts should refuse to bless the fruits of forensic familial identification. Courts instead should hold that there is no lawful basis for encroaching on the interests in identifiable genetic information held by the close genetic relatives of arrestees. And state forensics laboratories should consider carefully these constitutional and other dimensions of approving disclosure of source-excluding partial matches.

In considering such questions, courts (and decisionmakers in state forensics laboratories) might exclude from this rule parents identified through genetic analysis of their children's cells. Parents might be said to have "entrusted" their offspring with their shared identifiable genetic information by choosing to procreate and raise their biological children.[303] If so, then the tenancy by the entirety framework and the civil forfeiture case law would indicate that parents have no cognizable constitutional claim against the use of their children's genetic profiles to point a finger at them. But taking advantage of this tenuous loophole would pose a significant risk to general use of source-excluding partial matches. After all, were an investigation growing out of a partial match to lead to a sibling or a child of the partially matching offender profile, that

303. See supra text accompanying note 177 (discussing parental procreation-as-entrustment argument). An argument about volitional procreation would depend on parents' choice to raise their biological children, as developing source-excluding partial matches requires not only a partial genetic match, but also identification of which individuals might be the partially matching relative. See Murphy, supra note 18, at 315 (explaining process of investigators asking subjects about existence and identities of subject's children and parents). This second requirement turns on the degree to which the social family reflects a genetic one.

In addition to parental procreation-as-entrustment, a second exception might be argued as to children vis-à-vis their parents, based on parents' authority to consent for their minor children. See, e.g., United States v. Peterson, 524 F.2d 167, 180–81 (4th Cir. 1975) (holding parents with control over entire premises of home may consent to search of minor's bedroom); Heather Boonstra & Elizabeth Nash, Minors and the Right to Consent to Health Care, 3 Guttmacher Rep. on Pub. Pol'y, Aug. 2000, at 4, 4, available at http://www.guttmacher.org/pubs/tgr/03/4/gr030404.html (on file with the *Columbia Law Review*) ("States have traditionally recognized the right of parents to make health care decisions on their children's behalf, on the presumption that before reaching the age of majority (18 in all but four states), young people lack the experience and judgment to make fully informed decisions."). This potential exception would be time-limited. It would exist only so long as the child remained incapable of independent consent. In the medical context, parents would lose the right to make decisions for their children once those children became mature enough to decide for themselves. See id. at 4 ("[C]ourts in some states have adopted the so-called mature minor rule, which allows a minor who is sufficiently intelligent and mature to understand the nature and consequences of a proposed treatment to consent to medical treatment without consulting his or her parents or obtaining their permission.").

match, and all that flowed from it, might well be deemed "fruit of the poisonous tree" subject to suppression.[304]

Whatever the legal standard for invading an individual's interest in her identifiable genetic information—and *King* suggests that that standard is probable cause, at least for some types of infractions[305]—that standard is not met with respect to individuals targeted through a source-excluding partial match. No basis for database inclusion or database search of their genetic information exists until after a partial match has been discovered, investigated, and found to be informative. But the Constitution does not permit intrusion of protected interests to be justified with information discovered after the fact.[306]

Moreover, in the course of investigating a partial match, law enforcement officers will inevitably have intruded on the privacy of innocent persons. By conducting searches that may turn up source-excluding partial matches, whether fortuitously or deliberately, the government implicitly searches the identifiable genetic information that each close genetic relative of every databased individual shares with her databased kin.[307] This would be so even if every source-excluding partial match were a true match, rather than a false positive—a dubious proposition indeed.[308] Accordingly, the tenancy by the entirety framework indicates that, even where an individual's identifiable genetic information is lawfully stored in CODIS, courts should not bless the use of that information to target close genetic relatives. Nor should state forensics laboratories enable such use. Using source-excluding partial matches constitutes an unlawful encumbrance of individuals' identifiable genetic information that is shared with their databased kin.[309]

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304. See Hudson v. Michigan, 547 U.S. 586, 592 (2006) (describing suppressible "fruit of the poisonous tree" as evidence that "has been come at by exploitation of" "illegal actions of the police" (internal quotation marks omitted)).

305. Maryland v. King, 133 S. Ct. 1958, 1980 (2013) ("In light of the context of a valid arrest supported by probable cause respondent's expectations of privacy were not offended by the minor intrusion of a brief swab of his cheeks.").

306. See Florida v. J.L., 529 U.S. 266, 271 (2000) ("The reasonableness of official suspicion must be measured by what the officers knew before they conducted their search."); United States v. Ienco, 182 F.3d 517, 524 (7th Cir. 1999) ("[R]easonable suspicion must exist at the time the officer stops an individual; it cannot come after the fact." (internal citation omitted)).

307. See Ram, Fortuity, supra note 61, at 794 ("[E]very database search raises the possibility of discovering a partial match, and so every database search accomplishes implicit inclusion regardless of whether, how often, or how deliberately such matches are found.").

308. See supra note 64 and accompanying text (discussing rates of false positives).

309. Looking only to Fourth Amendment precedent would likely yield the same result. In *Georgia v. Randolph*, for instance, the Supreme Court held that "a physically present co-occupant's stated refusal to permit entry prevails" over another co-occupant's consent to a search of the shared premises. 547 U.S. 103, 106 (2006). But the Court explained that the permissibility of a search premised on co-occupant consent is grounded on co-occupants having "assumed the risk that one of their number might permit the

The answers that flow from the tenancy by the entirety framework, however, are not free from doubt. As set forth above, partial matches have proven pivotal in solving some serious crimes.[310] A complete prohibition on their use may deprive investigators of an important tool—yielding inefficiencies in criminal investigation.[311] After all, "[t]he chief justification given for embracing partial match reporting is that it enables investigators to solve more crimes. All else being equal, increasing the scope of coverage in CODIS will enable more genetic identifications, which will likely solve more crimes."[312]

But that is not the only way to view efficiency in the realm of partial match reporting. As Erin Murphy has argued, "[t]he use of effective familial search methods to identify crime suspects . . . has the potential to harm, rather than aid, police investigations."[313] Partial match reporting may "cause investigators to rely on genetic leads at the expense of more traditional lines of investigation—essentially a fear of overreliance."[314] Moreover, "genetic dependence can also be an issue when a source is found, because in those cases the genetic evidence may so dominate and shape the course of any subsequent investigation that it inevitably taints the results."[315] These concerns are especially likely to manifest with respect to source-excluding partial matches due to the significant rate of false-positives.[316] As one recent study warned**,** "some groups may have

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common area to be searched." Id. at 110 (internal quotation marks omitted). A close genetic relative, as explained, has "assumed" no such risk. Moreover, the link between close genetic relatives, unlike the link between co-occupants, cannot be severed. Accordingly, like the forfeiture cases, the Fourth Amendment cases governing shared living spaces suggest that forensic familial identification may be constitutionally problematic. See Murphy, supra note 18, at 336–37 (discussing forensic familial identification in light of co-occupant cases). But see Kaye, supra note 112, at 162 n.328 (rejecting argument that occupants' rights to challenge police searches of shared spaces legitimate familial rights to challenge policy scrutiny of overlapping DNA).

310. See supra note 269 (collecting reports of successful criminal investigations).

311. See Kaye, supra note 112, at 140–42 (noting searches avoid costs of "blind alleys and unnecessary and disturbing investigations of innocent persons"); Kimberly A. Wah, Note, A New Investigative Lead: Familial Searching as an Effective Crime-Fighting Tool, 29 Whittier L. Rev. 909, 920–23, 929–31 (2008) (discussing potential of familial DNA searching to narrow suspect list); cf. Jules Epstein, "Genetic Surveillance"—The *Bogeyman* Response to Familial DNA Investigations, 2009 U. Ill. J.L. Tech. & Pol'y 141, 170–73 (describing benefits of familial DNA investigations to innocent individuals).

312. Ram, Fortuity, supra note 61, at 788.

313. Murphy, supra note 18, at 309; see also Ram, Fortuity, supra note 61, at 802–03 (discussing this argument).

314. Murphy, supra note 18, at 309.

315. Id.

316. See, e.g., Mustian, supra note 64 (discussing instance of false positive identification and investigation of Usry through partial matching); Ram, Fortuity, supra note 61, at 764–65 (discussing "significant rate" of false positives presented by partial matching); Murphy, supra note 18, at 317 (describing impact of false positives generated by partial match searches); supra note 64 and accompanying text (collecting sources analyzing error rates in forensic familial identification).

higher rates of false identification . . . raising questions about the practicality of familial searching."[317] On this view, prohibiting the use of source-excluding partial matches may in fact enhance investigative efficiency, by limiting the effect of genetic dependence and encouraging a more efficient deployment of limited investigative resources.[318]

B. *Genetic Research*

Genetic research can expose intensely private medical details, including details not previously known to the person whose genome is under examination.[319] Moreover, with the rise of whole-genome and genome-wide research, "[d]ata obtained from genome sequencing reveal information not only about the individual who is the source of the DNA, but also probabilistic information about the DNA sequence of close genetic relatives."[320] The benefits and risks associated with these new frontiers in genetic research are thus open to and imposed on close genetic relatives of research participants.[321] The question then becomes whose informed consent to participation in research is required.

This is a domain in which federal regulators are well positioned to act. In the United States, research involving human subjects conducted using federal monies must comply with federal research regulations known as the Common Rule.[322] The scope of human subjects research extends to genetic research in which DNA sources are "individually identifiable (i.e., the identity of the subject is or may readily be ascertained by the investigator or associated with the information)."[323] The Common Rule imposes significant requirements for informed consent to participation in research.[324] The FDA imposes similar requirements for

317. Rohlfs et al., Familial Identification, supra note 64, at 9.

318. More bluntly, the Fourth Amendment itself envisions inefficiencies in criminal investigation. See, e.g., Georgia v. Randolph, 547 U.S. 103, 115 n.5 (2006) ("A generalized interest in expedient law enforcement cannot, without more, justify a warrantless search.").

319. See Privacy and Progress, supra note 118, at 25 ("[H]aving one's whole genome sequenced today could reveal genetic variants that increase the risk for certain conditions such as Alzheimer's disease, which many people either do not want to know about themselves or others to know about them.").

320. McGuire et al., Research Ethics, supra note 75, at 154.

321. See Privacy and Progress, supra note 118, at 24 ("[A] decision to learn about our own genomic makeup might inadvertently tell us something about our relatives or tell them something about their own genomic makeup that they did not already know and perhaps do not want to know.").

322. 45 C.F.R. §§ 46.101–.409 (2013); see also Federal Policy for the Protection of Human Subjects ('Common Rule'), U.S. Dep't Health & Hum. Servs., http://www.hhs.gov/ohrp/humansubjects/commonrule/ (on file with the *Columbia Law Review*) (last visited Mar. 24, 2015) (describing Common Rule).

323. 45 C.F.R. § 46.102(f).

324. See id. § 46.116(a) (stating each research subject will receive significant information, including "description of any reasonably foreseeable risks" and benefits of research and statement of confidentiality policy).

all studies submitted for its review.[325] Accordingly, these actors are primed to consider appropriate regulation of informed consent to genetic research in view of the shared nature of identifiable genetic information.

As in the forensic context, the relevant rule of tenancy by the entirety that carries force here mandates that "'neither spouse can sell, forfeit or encumber any part of the estate without the consent of the other, nor can one spouse alone lease it or contract for its disposition.'"[326] Where one family member consents to the use of wide swaths of her genome for research purposes, this may amount to an encumbrance or contract for the disposition of the identifiable genetic information that that individual shares with her close genetic relatives. Both constitute unilateral actions by an individual that impact the shared interests of all involved. Moreover, consent to genetic research is consent to the use and exploitation of one's genetic information by individuals and institutions external to the family, indicating that such use constitutes an external encumbrance rather than an internal use.[327]

On this view, consent to the research use of identifiable genetic information should require the agreement of each close genetic relative whose identifiable genetic information also will be exposed. Obtaining this agreement will be easier some times than others. Empirical research indicates that most people will freely grant broad consent for the use of their genetic information in research.[328] But obtaining agreement may be considerably more difficult in large families where one must secure agreement from many individuals. Agreement may be impossible to come by where family members are unknown to or estranged from one another. And a strict requirement of mutual consent gives each family member a unilateral veto on participation by anyone in the family—a harsh result if there is one naysayer in a family otherwise interested in research participation. Ultimately, the burden of securing consent may be so great as to dissuade many potential research participants.

Such a result raises serious concerns about the justice and efficiency of a mutual-consent requirement. Potential research participants, researchers, and society at large benefit from the progress of science

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325. See 21 C.F.R. § 50 (2014) (providing rules protecting human subjects during clinical tests regulated by FDA).

326. United States v. 15621 S.W. 209th Ave., 894 F.2d 1511, 1514 (11th Cir. 1990) (alteration omitted) (quoting Parrish v. Swearington, 379 So. 2d 185, 185 (Fla. Dist. Ct. App. 1980) (per curiam)).

327. See Black's Law Dictionary, supra note 227, at 644 (defining "encumbrance"); cf. 7 Powell, supra note 190, § 52.03(4) ("Each tenant by the entirety is entitled . . . to protect [the entire property] against outsiders . . . .").

328. Cf. Wendler & Emanuel, supra note 114, at 1459–60 (concluding most individuals will generally consent to research without hearing particular details as to type of research).

through research.[329] Courts have consistently refused to recognize legal claims that might "chill" or "cripple" medical research.[330] The mutual consent demanded by the tenancy by the entirety framework might well invite such "chill[ing]." Indeed, the potential for hold-up in the research context is even greater than in the law of tenancy by the entirety itself, in light of the more numerous interested parties to genetic research.[331] It is not clear that the benefits of control and consent over one's shared identifiable genetic information would be worth such costs to research and research stakeholders.

Yet, there is good reason to believe such concerns are overstated and the burdens associated with mutual consent are not prohibitive.

For one thing, the mutual consent model suggested by the tenancy by the entirety framework has some explanatory force for policies already in place or recommended by experts. The agreement between the Lacks family and the NIH governing access to HeLa genome data demonstrates that something approaching shared decisionmaking is possible. And while experts have agreed that the Lacks agreement responded to unique circumstances,[332] the notion of joint decisionmaking on a broader scale is not so outlandish a proposition. Consent processes approaching joint decisionmaking are already being put into place. For instance, the Personal Genome Project, which "is dedicated to creating public genome, health, and trait data,"[333] "tries to involve the community as broadly as possible, recognizing that individualized consent is limited by the risk posed to relatives who do not consent."[334] More broadly, bioethicists have recognized that joint decisionmaking in this arena is not prohibitive; in fact, it may be ethically obligatory. Bioethicists writing in scientific journals have acknowledged that, as a general matter, "[a]s the risks to relatives increase, the ethical obligations towards them intensify."[335] These scholars recommend that "investigators should take a

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329. Ram, Assigning Rights, supra note 111, at 135–38 (discussing impact of broad interest in obtaining information about diseases and other health conditions).

330. Greenberg v. Miami Children's Hosp. Research Inst., Inc., 264 F. Supp. 2d 1064, 1070, 1076 (S.D. Fla. 2003) (dismissing both claim of failure to obtain informed consent and claim of conversion due in part to concerns about "chill[ing]" or "crippl[ing]" medical research); see also Moore v. Regents of the Univ. of Cal., 793 P.2d 479, 493 (Cal. 1990) (emphasizing need not to threaten "innocent parties who are engaged in socially useful activities" with "disabling civil liability").

331. See supra text accompanying notes 239–241 (noting maximum of two interested parties in tenancy-by-the-entirety context compared with multiplicity of interested parties in genetic-material context).

332. See Callaway, Deal Done, supra note 1, at 133 ("In discussing HeLa cells and the agreement forged with the family, Collins and others often use the word 'unique' . . . . The NIH does not see the deal with the family as a guide to handling other human samples.").

333 . Sharing Personal Genomes, Pers. Genome Project, http://www.personalgenomes.org/ (on file with the *Columbia Law Review*) (last visited Mar. 24, 2015).

334. Sokhansanj, supra note 88, at 302.

335. McGuire et al., Research Ethics, supra note 75, at 154.

family-centered approach to informed consent (an approach that has already been embraced in many research ethics guidelines)."[336] And these recommendations contemplate an "obligation to include at-risk relatives" that "increases with the degree of relatedness to the primary research subject."[337] An "interdisciplinary consensus workshop" including twenty-three prominent bioethicists from the United States, United Kingdom, and Canada similarly concluded that, "[a]s part of the consent and ethics review process, the issues associated with family members and relevant groups and populations should be considered (this may, for example, involve encouraging/requiring discussions with family members)."[338] The framework of tenancy by the entirety generally accords with these views.

The law of tenancy by the entirety also indicates that the Icelandic Supreme Court appropriately honored a young woman's request that "the genealogical or genetic information on [her] father should not be transferred into the database."[339] Tenancy by the entirety provides for rights of survivorship—upon the death of one spouse, "the whole must remain to the survivor."[340] That is effectively what the Icelandic Supreme Court granted to the appellant in *Guðmundsdóttir*. As the Icelandic Supreme Court explained, Guðmundsdóttir could not exercise on her father's behalf her father's right to exclude his information from the database.[341] Rather, after her father died, Guðmundsdóttir was able to exercise the right to control her own identifiable genetic information that was present in her father's cells.[342] That looks considerably like a survivorship right.

For another, three caveats may blunt the difficulty of what the tenancy by the entirety framework might demand in the context of genetic research. First, the approach suggested by the law of tenancy by the entirety may not require mutual consent where close genetic relatives are missing or unknown. Under Massachusetts's law of tenancy by the entirety, for instance, a single owner of an entireties property may obtain authorization to dispose of the property unilaterally where her spouse has "left . . . and does not intend to return."[343] Lack of knowledge of a spouse's whereabouts for a year or more constitutes "prima facie evidence" supporting unilateral disposition of the entireties property.[344] For

336. Id.

337. Id.

338. Caulfield et al., supra note 72, at 430, 434.

339. Guðmundsdóttir v. Iceland [Supreme Court] Nov. 27, 2003, No. 151/2003, at 4 (Ice.), available at https://epic.org/privacy/genetic/iceland_decision.pdf (on file with the *Columbia Law Review*).

340. Orth, supra note 225, at 39 (internal quotation marks omitted).

341. *Guðmundsdóttir*, No. 151/2003, at 4.

342. Id. at 10.

343. Mass. Gen. Laws ch. 209, § 30 (2013).

344. Id.

individuals who are adopted, mutual consent from genetic parents and siblings might not be required to participate in genetic research for similar reasons. Where such individuals do not know the whereabouts of their genetic relatives (and cannot easily obtain that information), unilateral disposition may be appropriate. The same result likely would obtain with respect to parents who have not been actively involved in the lives of their genetic children.

Second, the doctrine of waste may provide a tool for limiting the ability of one or more unreasonable naysayers to prevent participation in research. The doctrine of waste becomes relevant "whenever two or more persons . . . have rights to possess property at the same time."[345] While states have varied in their application of the doctrine of waste to property held by the entireties,[346] applying the doctrine of waste in the context of interests in shared identifiable genetic information seems sensible. This doctrine limits each owner's ability to use the property in a manner "that *unreasonably* interferes with the expectations of" other owners.[347] The doctrine gained purchase both because interest-holders might include children or the unborn and because co-owners were "locked into dealing with each other"—a relatively fixed, and sometimes involuntary, arrangement.[348] Limiting the impact of unreasonable refusals to consent (or unreasonable consents and unreasonable refusals to respond at all), akin to a doctrine of waste, would temper the impact of the mutual consent requirement otherwise suggested under the tenancy by the entirety framework. Moreover, as the doctrine of waste has applied to restrain unreasonable conduct between co-owners bound together involuntarily, that doctrine can assist us more broadly in accommodating the tenancy by the entirety framework to the involuntary nature of interests in shared identifiable genetic information.

Third, mutual consent may be necessary only in the context of whole-genome and genome-wide research. The law of tenancy by the entirety is concerned with property in which multiple individuals have cognizable interests.[349] That law can help inform the regulation of

345. Dukeminier et al., supra note 184, at 241.

346. See, e.g., In re Hamilton's Estate, 260 A.2d 232, 234 (N.J. App. Div. 1969) (discussing "nature of an estate by the entirety" and observing "each spouse is protected against waste by the other"); Kawalis v. Kawalis, 53 N.Y.S.2d 162, 166 (Sup. Ct. 1945) ("If . . . a tenant by the entirety may alone sue a third party for damages . . . then by analogy or parity of reasoning it is difficult to see why such suits may not be maintained by one tenant by the entirety against the other . . . ."). See generally 7 Powell, supra note 190, § 52.03(4) ("Each tenant by the entirety is entitled . . . to be protected against waste by the other spouse."). But see Stuckey v. Keefe's Executor, 26 Pa. 397, 401 (1856) ("These incidents cannot exist in an estate held by husband and wife. No action of partition, or waste, or account, or ejectment, can be maintained by one against the other.").

347. Dukeminier et al., supra note 184, at 241.

348. Id. (describing Richard A. Posner, Economic Analysis of Law 92 (8th ed. 2011)).

349. See United States v. Craft, 535 U.S. 274, 280–82 (2002) (discussing tenancy by entirety as relating specifically to married individuals, who are jointly interested).

research only for research that in fact exposes the identifiable genetic information of multiple individuals. Consistent with current federal regulations governing human genetic research, therefore, consent is unnecessary where genetic information is successfully de-identified or anonymized.[350] If anonymity is preserved as to whose DNA is on display, genetic information is by definition no longer identifiable. Research using such genetic information does not trigger the tenancy by the entirety framework at all, as no identifiable genetic information is at issue.[351] Re-identification and de-anonymization are most likely to occur, and to have informational consequences for an individual's genetic relatives, in the context of whole-genome and genome-wide research. Researchers have demonstrated repeatedly that genomes sequenced in whole-genome or genome-wide research can be traced back to identifiable individuals despite de-identification efforts.[352] While "traditional research promised confidentiality and/or anonymity to participants, advances in DNA technology may render these safeguards meaningless."[353] Moreover, where re-identification occurs, whole-genome and genome-wide research are likely to involve sufficiently large troves of data from which significant information can be gleaned about both the individual whose cells were used and her close genetic relatives.[354] Genetic information used in research concentrating on small (or universally shared) portions of the genome, conversely, is less likely be to re-identified or sufficiently individually informative as to require mutual consent consistent with the tenancy by the entirety framework.

C. *Personal Genetic Testing*

Personal genetic testing stands on significantly different ground from forensic familial identification and large-scale genetic research. While forensic and research uses of identifiable genetic information give individuals and institutions outside the family access to that information,

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350. See 45 C.F.R. § 164.514(b)(2)(i) (2002) (enumerating eighteen identifiers, removal of which renders what would otherwise be protected health information "de-identifi[ed]" and outside scope of Privacy Rule of HIPAA); Office of Human Research Prots., supra note 78 (reaffirming review and consent obligations ordinarily applicable to federally funded research do not apply to research using biological specimens that are not "individually identifiable").

351. But see Wendler & Emanuel, supra note 114, at 1460 (reporting more than 10% of survey respondents indicated they believed consent should be required for additional research using research-derived samples that have been stripped of personally identifying information).

352. See Lunshof et al., supra note 82, at 409 ("Developments in both medical informatics and bioinformatics show that the guarantee of absolute privacy and confidentiality is not a promise that medical and scientific researchers can deliver any longer."); see also supra notes 82–84 and accompanying text (identifying difficulty of maintaining privacy in DNA research).

353. Mitchell et al., supra note 82, at 309.

354. McGuire et al., Research Ethics, supra note 75, at 154.

personal genetic testing enables individual use of identifiable genetic information. Genetic testing typically is undertaken for one's own enrichment rather than for the enrichment of non-family members.[355] Such testing generally also is protected from prying eyes by existing doctrines of doctor–patient confidentiality[356] or contractual assurances of security.[357] As such, personal genetic testing is more akin to an exercise of "the right to use the property" than an effort to encumber the property.[358]

The framework of tenancy by the entirety suggests that, unlike participating in genetic research, individuals are entitled to pursue personal genetic testing without familial consent. Modern tenancy by the entirety gives each spouse "equal right to the control, use, possession, rents, income, and profits of real property held by them in tenancy by the entirety."[359] Each owner of an entireties property generally retains the full and unilateral right to use the property as she sees fit.[360] With respect to identifiable genetic information, this approach suggests that each family member retains a unilateral right to learn about the genetic information in her cells—even if that information is germane to others of her kin. An individual who pursues such testing, however, may be obligated to share the "profits" of that testing—giving those close genetic relatives who ask access to her test results.

These are policies that federal regulators again may best be suited to implement. Disclosure of identifiable health information, including identifiable genetic information, is already regulated at the federal level through HIPAA.[361] The FDA has already acted to curtail certain aspects unverified medical genetic test marketing direct to consumers.[362] And insofar as personal genetic testing constitutes commercial rather than

355. See 23andMe, supra note 99, (inviting users to "[f]ind out what your DNA says about you and your family").

356. See, e.g., Alberts v. Devine, 479 N.E.2d 113, 120 (Mass. 1985) ("We hold today that a duty of confidentiality arises from the physician–patient relationship and that a violation of that duty, resulting in damages, gives rise to a cause of action sounding in tort against the physician."). But see infra note 367 and accompanying text (discussing possible exception to doctor–patient confidentiality requiring physician to warn patient's family members of serious genetic risk).

357. See How It Works, 23andMe, supra note 101 ("Your personalized 23andMe web account provides secure and easy access to your information, with multiple levels of encryption and security protocols protecting your personal information.").

358. See Black's Law Dictionary, supra note 227, at 644 (defining "encumbrance").

359. Orth, supra note 225, at 43 (internal quotation marks omitted).

360. 7 Powell, supra note 190, § 52.03(4) ("Each tenant by the entirety is entitled to possess the entire property.").

361. See 45 C.F.R. § 164.502(d)(2) (2014) (detailing permitted uses and disclosures for certain de-identified health information).

362. Warning Letter, supra note 97 (ordering company to cease marketing its Saliva Collection Kit and Personal Genome Service because of failure to comply with Food, Drug and Cosmetic Act).

medical activity, it is subject to a modicum of oversight by the Federal Trade Commission.[363]

Existing legal and bioethical rules generally accord with the requirements flowing from the tenancy by the entirety framework. That is not altogether surprising, given that existing rules generally treat genetic information individualistically,[364] while the tenancy by the entirety framework would allow individuals generally to act unilaterally notwithstanding the shared interests involved. Thus, medical personnel and commercial enterprises engaged in personal genetic testing typically seek authorization for testing only from the individual whose cells the company analyzes.[365] More interestingly, bioethical norms and even some case law have indicated that an obligation to share the results of genetic testing may exist. At least one court has expressly recognized that physicians involved in genetic testing are legally obligated to take "reasonable steps . . . to assure that the [genetic testing] information reaches those likely to be affected or is made available for their benefit."[366] Biomedical ethicists similarly have concluded that individuals seeking genetic testing, or their physicians, may in some instances be expected to disclose genetic testing results to at-risk family members.[367]

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363. See 15 U.S.C. § 46(a) (2012) (granting Federal Trade Commission power to investigate any corporation engaged in commerce). The Federal Trade Commission "has asserted that it has jurisdiction over genetic testing advertising," although "it appears to have taken no action against any genetic test advertisements." Genetics & Pub. Pol'y Ctr., Direct-to-Consumer Genetic Testing: Empowering or Endangering the Public? 2 (2008), available at http://www.dnapolicy.org/images/issuebriefpdfs/2006_DTC_Issue_Brief.pdf (on file with the *Columbia Law Review*).

364. See supra Part II (describing individualistic nature of recognized legal interests in DNA).

365. See, e.g., How It Works, 23andMe, supra note 101 (explaining individual seeking genetic analysis must order DNA kit and "register your specific bar code number" prior to submitting saliva sample).

366. Safer v. Estate of Pack, 677 A.2d 1188, 1192 (N.J. Super. Ct. App. Div. 1996). Courts have given conflicting responses as to whether a duty to warn at-risk family members exists at all, and whether any such duty may be discharged simply by warning the patient. Compare Pate v. Threlkel, 661 So. 2d 278, 282 (Fla. 1995) (holding any duty physician might bear to warn patient's family members about genetic risk "will be satisfied by warning the patient"), with *Safer*, 677 A.2d at 1192 ("We decline to hold . . . that, in all circumstances, the duty to warn will be satisfied by informing the patient.").

367. Inst. of Med., Assessing Genetic Risks: Implications for Health and Social Policy 278 (Lori B. Andrews et al. eds., 1994) (recommending disclosure of genetic risk to relatives "only when elicit[ing] voluntary disclosure fail[s]," "high probability of irreversible or fatal harm [exists]," "disclosure of information will prevent harm . . . [and] is limited to the information necessary for diagnosis or treatment of the relative," and "there is no other reasonable way to avert . . . harm"); Opinion 2.131—Disclosure of Familial Risk in Genetic Testing, Am. Med. Ass'n (Dec. 2003), http://www.ama-assn.org/ama/pub/physician-resources/medical-ethics/code-medical-ethics/opinion2131.page (on file with the *Columbia Law Review*) ("Physicians also should identify circumstances under which they would expect patients to notify biological relatives of the availability of information related to risk of disease.").

Insofar as such a result seems inadequately protective of the interests of close genetic relatives in their identifiable genetic information, the doctrine of waste may once again provide a limiting principle as to what individuals may do with their cells.[368] The tenancy by the entirety framework may be underprotective because it gives an individual no role in the decision of any of her close genetic relatives to pursue genetic testing, even though that testing may reveal information with a profound impact on her. Personal genetic testing may deliver information about an array of medical traits and familial connections.[369] At least one direct-to-consumer genetic testing firm, 23andMe, also invites its users to "[f]ind relatives across continents."[370] The company explains, "[y]ou'll likely discover dozens or even hundreds of relatives who share DNA and ancestors [with you]."[371] This information clearly implicates the identifiable genetic information of close genetic relatives, even if they do not participate in genetic testing themselves. Revelation of medical or other markers in one family member reflects an increased risk or certainty that another close family member has the same marker.[372] And features like 23andMe's ancestry-related genetic reports have exposed mistaken paternity and siblings given up for adoption—again, even where crucial

368. See 7 Powell, supra note 190, § 52.03(4), at 52-24 ("Each tenant by the entirety is entitled to possess the entire property . . . and to be protected against waste by the other spouse." (footnotes omitted)); see also Stratton v. Stratton, No. 4615-09, 2013 WL 2249155, at *4–*5 (N.Y. Sup. Ct. May 20, 2013) (explaining under New York's law of tenancy by the entirety, action for receivership may be appropriate where one owner's interest in entireties property is "in danger of being lost, damaged or destroyed" (citing N.Y. C.P.L.R. § 6401(a))); supra note 346 and accompanying text (discussing state application of doctrine of waste to property held in tenancy by the entirety).

In addition, it is not clear how frequently personal genetic testing takes place without future research use also playing a role. As 23andMe has indicated in announcing new research arrangements with Genentech and Pfizer, "of 23andMe's genotyped population of over 800,000 individuals, . . . more than 80 percent have consented to participate in research." 23andMe, Pfizer Press Release, supra note 81 (announcing collaboration with Pfizer); see also 23andMe, Genentech Press Release, supra note 81 (announcing collaboration with Genentech). Accordingly, as many as 80% of individuals seeking personal genetic testing may in addition be bound by policies governing genetic research. Insofar as commercial genetic databases come to be used for purposes of forensic investigation as well, such use complicates individual consent for personal genetic testing still further. See Mustian, supra note 64 (discussing investigation of Usry stemming from false positive partial match identified in search of commercial genetic database containing Usry's father's DNA).

369. See supra notes 94–96 and accompanying text (providing examples of available clinical tests for diseases and genetic markers).

370. Ancestry, 23andMe, supra note 90.

371. Id.

372. See supra notes 102–103 and accompanying text (explaining gene inheritance and possible consequences).

participants in those social events (like the parents) are not 23andMe customers and may well have preferred to keep those facts hidden.[373]

The tenancy by the entirety framework, in combination with the doctrine of waste, may suggest differing responses to different types of personal genetic testing. This framework would provide the greatest protection for unilateral genetic testing for genetic markers associated with medical information, particularly medical information susceptible to environmental or behavioral responses. Such information is the most personal, relevant, and likely to spur changes in one's behavior for medical benefit. The framework would, by contrast, provide the least protection for unilateral genetic testing for familial connections. Such testing has the possibility of disrupting core familial relationships, perhaps without significant countervailing benefit (especially where curiosity alone drives such testing or it occurs over familial objections). Indeed, where previously undisclosed infidelity is revealed, personal genetic testing for familial connections may be said to have destroyed or irreparably damaged the shared interest at stake, by revealing that it is not shared at all. Accordingly, while personal genetic testing may continue to be handled on an individual basis, the tenancy by the entirety framework may call for more familial involvement—at least by an individual's (putative) parents—where ancestral information is the aim of testing.

CONCLUSION

Courts, agencies, and legislatures have accepted that individuals have significant and cognizable interests in their identifiable genetic information. Many individuals appear similarly interested in protecting their identifiable genetic information from prying eyes. But the rules that these institutions embrace are largely underinclusive because they fail to take seriously the inconvenient fact that identifiable genetic information is involuntarily and immutably shared with close genetic relatives. As this Article has demonstrated, accounting for shared interests in identifiable genetic information is not simple.

The law of tenancy by the entirety suggests one possible approach to accommodating the interest each close genetic relative has in that portion of identifiable genetic information that she shares with the others. Both kinds of interests call for the difficult task of thinking about multiple persons "as though they were one."[374] The tenancy by the entirety framework gives rise to concrete proposals for taking shared interests in

373. See Engber, supra note 104 (explaining possibility of discovering new or unsuspected relations via genetic reports); Hill, supra note 104 (discussing discovery of full genetic siblings using 23andMe, where one sibling had been placed for adoption and his existence had been previously unknown to other sibling); 23andMe, If I Am Adopted, supra note 104 ("There is . . . the possibility of finding a much closer relative—including a parent or sibling.").

374. Orth, supra note 225, at 40.

identifiable genetic information into account in forensic identification, genetic research, and personal genetic testing. In some of these domains, experts are already advocating policies consistent with this framework. The tenancy by the entirety framework thus illuminates how decisionmakers might approach the difficult problem of accounting for interests in shared identifiable genetic information. This framework is consistent with a vision of justice that grants each individual some right to control when and how her identifiable genetic information becomes available to outsiders. It may also, in some contexts, bring about efficient results. If courts, agencies, and legislatures mean what they say—that an individual's interest in her identifiable genetic information is worthy of legal protection—then these legal institutions must do more to accommodate the full scope of this interest. A framework drawing on tenancy by the entirety provides a good place to start.