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Justice as Fairness: Forensic Implications Of DNA and Privacy

Introduction

In the zeal to endorse law enforcement's use of DNA technologies to identify individuals by comparing profiles, the public has overlooked the potential of DNA analyses to reveal information about the individual donors that uncovers far more private information than fingerprint comparisons. DNA analyses have the potential to uncover predispositions to diseases or behaviors in the contributor and similar information about his or her siblings or offspring. A widespread misconception exists that the DNA regions being analyzed are "junk" or do not provide any useful function to the individual, but this is not true. The term "junk DNA," discussed more fully below, refers to DNA with no known function. Advances in understanding have proven it to be inaccurate. Coupled with the rapidly advancing ability to scrutinize DNA in detailed ways that were unthinkable only a few years ago, this lack of understanding is paving the way for intrusive analyses that have the potential to reveal information about one's health, one's family, and one's future health. In this light it is important to take a look at the history of the use of human DNA in forensic laboratories and the potential risks to individual privacy that its use entails today.

In *Maryland v. King*, a slim majority of the Supreme Court upheld the Fourth Amendment constitutionality of DNA profiling of arrestees charged with serious offenses under a Maryland statute.[1] The *King* majority minimized the intrusion of DNA profiling into an accused's genetic history based upon its assumption that the resulting genetic profile was based purely upon the use of non-coding or "junk" DNA which, it said, did not reveal information about the contributor's predisposition for genetic diseases or other traits.[2] The *King* majority concluded that DNA profiling was proper under the Fourth Amendment because law enforcement needed to identify those they had already arrested.[3] Identifying arrestees was also important, according to the majority, to help law enforcement to decide where arrestees should be housed in detention and to help courts decide whether they should be released on bail.[4] The four-justice minority countered that the DNA profiling at issue had nothing to do with identifying an arrestee because comparisons were made against samples from the unsolved crimes database rather than the convict and arrestee database and the gathering of a sample did not occur until roughly the time of arraignment when bail and detention decisions would already have been made.[5] The minority described the DNA profiling regime as a "genetic panopticon" and voiced its "hope that today's incursion upon the Fourth Amendment … will someday be repudiated."[6]

Unfortunately, the *King* majority based its conclusions on the outdated notion that the DNA profiling at issue scrutinized only DNA regions that were "junk." To the contrary, this DNA profiling has the potential to reveal information about the contributor's present and future health, the identity of his or her relatives, and his or her relatives' health as set forth more fully below.

In *People v. Buza*, decided in December 2014, the

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California Court of Appeal refused to apply the *King* majority's holding in its review of California's DNA Act authorizing DNA sampling from adults arrested or charged with felony offenses.[7] The *Buza* court concluded that the California Act "intrudes too quickly and too deeply into the privacy interests of arrestees" and, in doing so, violated the California Constitution's search and seizure provision.[8] Earlier in 2014, the Ninth Circuit Court of Appeals applied the *King* majority's analysis and affirmed the Act's constitutionality under the U.S. Constitution's Fourth Amendment.[9] The *Buza* court criticized the *King* majority for being "too dismissive of scientific knowledge and practical considerations" when it came to the nature of the information exposed by DNA profiling.[10] As in *King*, the *Buza* court unfortunately accepted the erroneous assumption that the DNA profiling at issue involved only junk DNA not associated with genetic diseases or traits.[11] However, the *Buza* court acknowledged the existence of significant debate over the accuracy of the concept of junk DNA.[12] The *Buza* court further recognized that, unlike the statute at issue in *Maryland v. King*, the California Act allowed law enforcement to conduct familial DNA searches — "searches in which a partial match between an individual's DNA profile and a profile in the DNA database is used to implicate a close biological relative of the DNA donor as a possible criminal suspect."[13]

The Statutory Framework

In the DNA Fingerprint Act of 2005,[14] Congress gave the Attorney General discretion to require compulsory DNA collection from individuals "arrested or from non-U.S. persons who are detained under the authority of the United States."[15] Subsequently, the Adam Walsh Child Protection and Safety Act of 2006 expanded this authority to include those "facing charges."[16] Many states have enacted similar provisions. A person who resists the collection of a sample under the federal regime faces prosecution for a class A misdemeanor.[17] The justification for the expansion of the Attorney General's authority was to enhance crime prevention by creating a database of DNA profiles to more easily solve crimes.[18]

The statutory framework at issue requires collecting, analyzing, and storing DNA samples that are converted to DNA profiles, which are then subjected to countless searches by law enforcement nationwide as part of the CODIS system of databases.[19]

CODIS

In 1990 the FBI established the COmbined DNA Index System (CODIS)[20] and, in 1998, the National DNA Index System (NDIS).[21] CODIS combines DNA profiles from evidence recovered at crime scenes; from missing persons and their relatives; from unidentified human remains; and from individuals convicted, arrested, and facing charges.[22] After a DNA sample is extracted from its source, a DNA profile of 13 to 15 locations or *loci* — commonly referred to as "junk DNA" — is generated. It is this profile of an accused that is uploaded to be the subject of searches using the CODIS system. Law enforcement compares target DNA profiles against the DNA profile records contained in the CODIS database.[23]

Whither Junk DNA

The term "junk DNA" was first used by Susumu Ohno in 1972 in reference to portions of the genome, i.e., the total complement of DNA in a human cell, for which we had not yet assigned a function.[24] This notion was later affirmed in 1980 by Leslie Orgen and Sir Francis Crick, the co-discoverer of the structure of DNA, when they wrote that junk DNA "has little specificity and conveys little or no selective advantage to the organism."[25] We now know that this statement is false; it was based on the limited knowledge of the time.

Unfortunately this term was coined at a time when understanding of the human genome was rudimentary. At that time, for example, it was commonly understood that genomes encoded approximately 100,000 genes to account for the approximately 100,000 proteins researchers thought were contained within human cells. Since then, and since the completion of the Human Genome Project, researchers have learned that humans have approximately 20,000 genes.[26] Clearly the understanding has progressed significantly in the intervening years since Ohno's comment. Researchers have also learned that each individual gene has the potential to encode multiple proteins, and thus the commonly accepted belief that one gene encodes one protein was proven false.[27] Most of the remaining DNA regulates, i.e., turns on and off, human genes.[28] Since every cell in the body contains the same complement of DNA, it is crucial for cells to be able to turn on those genes that are needed in a particular cell type and turn off those that are not. The fact that every cell in the body contains the same DNA enables the comparison of DNA from a buccal swab taken from a suspect to DNA from, for example, blood at a crime scene.

Collectively, these and other regulatory functions account for the vast majority of the DNA that used to be termed "junk." Clearly, that term was incorrect; it was simply a term used to describe DNA for which the understanding at that time was restricted. In retrospect, the term "junk" was an unfortunate one that was most likely used to garner notoriety despite its inaccuracy. The term was certainly catchier than a more accurate phrase such as "DNA for which we have not yet discovered a function."

The Five Known Non-Junk CODIS Loci

With regard to the 13 core CODIS loci that are used in forensic DNA profiling, five are located in known genes and are therefore clearly not "junk." Those loci are designated CSF1PO, TPOX, TH01, vWA and FGA and are within the genes that encode the colony stimulating factor 1 (CSF1) receptor,[29] thyroid peroxidase,[30] tyrosine hydroxylase,[31] von Willebrand factor[32] and alpha fibrinogen,[33] respectively. Appropriate genetic testing, beyond the standard forensic profiling currently performed, has the potential to reveal predispositions to diseases in the individuals being profiled as well as their siblings and offspring. Of the remaining eight core CODIS loci, it is unclear whether they fall within any of the important regulatory regions described above, but it is very likely that they do given the current and evolving understanding of the human genome. Therefore, privacy risks are inherent to the analysis of all CODIS loci, whether they are currently deemed junk or not.

History of the Forensic Use of DNA

Nearly 40 years ago, in 1980, Ray White, a scientist at the University of Utah, discovered a polymorphic or variable region of DNA that was detectable with a "restriction enzyme digestion" laboratory technique that was common at the time.[34] This technique, combined with the Southern blot technique, gave technicians the ability to distinguish among individuals.[35] Small differences in individuals' DNA suddenly became visible. Five years later this first identified restriction fragment length polymorphism, or RFLP, led Alec Jeffreys to propose using DNA as a tool to solve crimes because it provided the ability to distinguish among individuals by virtue of subtle differences in their DNA sequences.[36] In fact, one year later Dr.

Jeffreys used this technique to exonerate a 17-year-old accused of two rapes and murders in Leicestershire, England.[37] This opened the door to the now common use of DNA technologies in criminal cases. It is important to note that the DNA profiles developed in forensic laboratories do not, by themselves, identify individuals. Instead, they must be compared among individuals and to profiles in databases in order to find matches.

In 1986, Cell Mark Diagnostics and Life Codes became the first companies to offer forensic DNA typing. This was the same year that Dr. Kary B. Mullis invented a laboratory technique that was destined to revolutionize the ability to analyze scant quantities of DNA — the polymerase chain reaction (PCR). Not only is it easy to execute in the laboratory, but this technique provides the ability to analyze as little as one molecule of DNA. Prior to this invention, a DNA quantity equivalent to that in a tube of blood was necessary for forensic RFLP analyses. Of course, this exquisite sensitivity has its pitfalls. The ability to detect extremely small quantities of DNA amplifies the risk of confusion caused by contamination. Since this powerful technique can amplify and render suitable for analysis as little as one molecule of DNA, very small amounts of contamination can be problematic. Evidence technicians and forensic laboratories have had to increase their diligence and exercise greater care to avoid contaminating precious evidence. When laboratories detect mixtures, it is challenging to dissect out the profiles of the individual contributors.

DNA evidence was used for the first time in the United States in 1987; Tommie Lee Andrews was convicted of rape in a Florida state court.[38] Thomas Caskey and his co-workers published a paper in 1991 proposing the use of short tandem repeat (STR) technology for DNA typing.[39] That same year researchers identified a gene on the human sex chromosomes (i.e., the X and Y chromosomes) as a useful marker for gender.[40] Since then, forensic laboratories have routinely used the amelogenin gene to distinguish between male and female DNA.

Researchers developed a very simple and reproducible method for extracting DNA from biological samples in 1991.[41] This method was coupled with the use of fluorescent dyes to label PCR-amplified STR loci.[42] This concurrence of technological developments led Promega to release a commercially available and easy-to-use STR profiling kit the following year, and to this day Promega remains a market leader in that space.

In 1995 the public became aware, some would say painfully aware, of the use of DNA in criminal cases as the O.J. Simpson trial was relentlessly transmitted to television sets. That awareness was followed by misinformation provided by a number of television series. As a result of popular media, people and prospective jurors became aware of the power of DNA to solve crimes yet were wrongly led to believe that it could do impossible things in impossibly short periods of time. This misconception prevails even today and presents a challenge in any courtroom.

Today the use of STR analyses in the forensic laboratory has not changed much since the mid-1990s, except laboratories now use two additional locations in their analyses and are getting better at analyzing smaller samples. However, another technology has been emerging in research laboratories throughout the world that has the potential to vastly increase the amount of information technicians can extract from new and archived forensic samples. The ability to determine the sequence of the entire human genome, all three billion nucleotides of it, has improved and the price to do so has fallen dramatically. Beginning in 1980, it took approximately 15 years and nearly $100,000,000 to sequence a single human genome. In 2014, that time had been reduced to about two days and the cost was approximately $1,000. Scientists estimate that the time and cost will continue to drop so that in several years they will be able to sequence a human genome in less than one day for less than $100. As of this writing, the time needed to generate a DNA profile in a forensic laboratory is less than one day and the time to determine the sequence of all three billion nucleotides in the human genome has fallen to less than one day, albeit for more than $100.[43]

What does this mean for forensic investigations? It means that laboratories will have the ability to learn everything about an individual's DNA easily, cheaply, and rapidly. Technicians already have the capability to identify siblings, offspring, and ancestors of individuals from whom they isolate DNA. In addition, researchers are able to identify asymptomatic diseases, predispositions to future diseases and, in time, predispositions to behavioral traits. The *Buza* court recognized the existence of ongoing and potential research designed to associate a variety of behaviors with a genetic cause, including addiction, violence, and delinquency.[44]

Evolving Technologies Enable the Extension Of DNA Profiles

Concerns are growing about other uses of the DNA that is collected from suspects.[45] Technological developments are enabling DNA to be analyzed in ways that were unimaginable only 10 years ago.[46] Many in the scientific community fully expect that each individual will have his or her DNA sequenced as a matter of course in much the same way that physicians analyze a patient's blood for glucose levels, cholesterol levels, and a number of other chemicals.

When the cost — in terms of both time and money — reaches a point where the DNA currently held in forensic laboratory freezers around the country can be completely sequenced, society will be in a position to learn a great deal about the individuals from whom the DNA was derived as well as about their families. The *Buza* court cautioned that, because the federal DNA laws and the laws of most states are silent regarding what is to be done with the physical samples containing the entire genome, a "far greater danger to privacy lies in the DNA samples from which the CODIS profiles are developed, which … contain the entire genome."[47]

It will be interesting to follow legislation that addresses those physical samples, their use, and their potential destruction after the forensic DNA profile is added to the local and national databases.

Familial/Partial Match DNA Searches

Another concern raised by the *Buza* court was the use of DNA profile information in the database to conduct "familial" or "partial match" DNA searches.[48] Partial match searches are also referred to as moderate stringency searches. These searches use CODIS profiles to associate family members of a profile donor to a crime scene or to other crimes for which DNA was analyzed. In *King*, the Supreme Court acknowledged the existence of such searches only in the context of noting that the Maryland DNA statute under review prohibited such searches.[49] The *Buza* court, however, acknowledged that law enforcement in California had "engaged in such deliberate familial searching for many years. …"[50]

A familial search is a deliberate search for biological relatives of a contributor of a DNA profile to determine possible familial involvement in a crime.[51] The search relies upon inexact matches between DNA evidence profiles and

offender and arrestee DNA profiles. Upon the identification of one or more partial match profiles, law enforcement may investigate purported family members of the partial matches as suspects.[52] Familial searching is indistinguishable from "partial match" or moderate stringency searching but for the claim that, with partial match searching, the search is not deliberately aimed at the contributor's biological relatives.[53] Familial searching of the CODIS database is widespread in the United States, with many states authorizing partial DNA match reporting for the purpose of familial investigation.[54]

Put another way, familial — and partial match — searches flag those in the DNA database whose profiles are significantly similar, but not identical, to profiles from crime scene samples. The NACDL Board of Directors recognized the potential of this procedure to compromise the privacy of innocent individuals and proposed safeguards to mitigate those incursions in a February 2013 resolution.[55] In contrast, the standard used in forensic laboratories throughout the country requires matches at every location analyzed. Familial searching necessarily increases the size of the DNA database by including the contributor's family members.[56] A Rand Corporation report explained how the process works:

> [In practice,] a crime-scene sample is found to have at least one allele at each locus in common, suggesting a filial relationship to the offender. Y-STR or mitochondrial testing confirms that the offender and the source of the crime-scene profile are at least distantly related. Detectives track down the offender's children and obtain DNA samples in the hopes of finding an exact match.[57]

The effect is to draw in contributors' relatives unbeknownst to them.[58] It also carries the risk of identifying unrelated individuals. In both cases the risk of exposing information about innocent individuals exists.

The FBI apparently does perform moderate stringency searching of CODIS.[59] Although the FBI insists that its purpose in doing so is not to identify family members, identifying family members is an inevitable outcome of such searches. In addition, several states (California, Colorado, Texas, and Virginia) have passed legislation authorizing familial searching.[60] In fact, in 2010 the Los Angeles police arrested a murder suspect based on a moderate stringency search of the California state DNA database.[61] Several states permit the disclosure of partial matches, including Arizona, Connecticut, Florida, Missouri, Nebraska, New York, Oregon, Washington, and Wyoming.[62] However, to date, Maryland and Washington, D.C., have banned so called familial searching.[63]

Whether called partial DNA matching or familial DNA searching, by engaging in this conduct, law enforcement aggravates the racial and ethnic disparity already present within the CODIS offender-based DNA databases due to overrepresentation.[64] By expanding its reach to contributors' relatives, law enforcement expands the pre-existing bias.[65]

The FBI initially prohibited the release of a contributor's personal information when a partial match resulted.[66] In 2009, however, the CODIS Interim Plan announced that not only would the CODIS databases continue to be used for purposes of familial and partial match searches by participant states, but CODIS administrators would now actively assist.[67] In particular, the 2009 interim plan recommended that, when CODIS administrators report partial match results, they "state explicitly the possible family relationships."[68] In the context of discussing appropriate comparison thresholds for purposes of partial matches, the interim plan concludes that "they do set useful thresholds for the partial match to identify a true relative, if one exists in the database."[69] The interim plan also offers advice to CODIS administrators as to the most desirable type of familial searching: "Because most perpetrators are male, and in this discussion of partial matches we are typically looking for father-son or full-sibling pairs, YSTR information can winnow relatives from false-positive partial DNA matches."[70]

DNA Analyses Differ From Urine Drug Screens And From Fingerprints

The genetic information obtained from a urine screen, assuming that DNA is not extracted from cells found in the urine and analyzed separately, reveals only metabolic disorders present in the individual at the time of the analysis. For example, if the individual's glucose level is high, it may indicate the presence of diabetes.[71]

DNA analyses, on the other hand, may reveal existing disorders that the individual is unaware of such as an early stage cancer or late onset disorders for which no known treatment is available.[72] Taken together, DNA analyses have the ability to detect and predict a variety of diseases that are otherwise unseen by a urine drug screen.

A key — and perhaps the most worrisome — property of DNA analyses is that they have the potential to reveal information about disease predispositions in an individual's siblings and children. This potential raises questions about genetic privacy for those who do not know that the tests are being performed (e.g., siblings), individuals who are too young to understand the tests or have yet to be born at the time the tests are performed, or offspring of the individual being tested. For example, if the defective gene for Huntington's disease is found in an individual, that individual's offspring have a 50 percent chance of inheriting it. Once inherited, developing the disease is a certainty, only the time of onset is a question. This finding may affect the individual's ability to gain employment or to purchase life and health insurance despite the fact that the genetic test was performed on a relative.

Predictably, this uncertainty regarding the age of onset is the source of much anxiety and can influence decisions about one's life commitments. For example, is it responsible for a person to have children if the person knows that he or she is guaranteed to experience a prolonged period of infirmity followed by a premature death? Similarly, is it worth the investment to attend college, and perhaps graduate or professional school, when one's productive

years are sure to be cut short? These decisions not only weigh on the individuals facing them but also impact their potential contributions to society.

Added to this concern about the detection of impending disease is the possibility that the government or a company contracted by the government may sell genetic information, which would affect an individual's ability to obtain life or health insurance, employment, or perhaps a mate. While the prospect of the government selling private information seems unlikely, it has been done in Florida[73] and Minnesota,[74] among other jurisdictions, so the risk is real. In 2010, the Ohio Department of Motor Vehicles sold personal information to various companies, other municipalities, and a host of other customers. Reportedly the entities paid more than $42 million for that information.[75] In that same year, Texas did something similar.[76] Florida made as much as $63 million in the previous year alone.[77] In fact, the Federal Trade Commission reported that 33 states were selling hospital discharge data — including sources of payment and diagnostic information — about their patients.[78]

Conclusion

The acceptable use of DNA in criminal cases has improved the ability to associate individuals with crime scenes and to associate individuals with each other. However, advancing technologies have the real potential to threaten privacy; law enforcement is gaining the ability to learn everything about individuals' genetics from relatively simple and inexpensive laboratory analyses. In this light, and given the *King* majority opinion and the *Buza* court's misconceptions about "junk DNA," statutes mandating the gathering of DNA from individuals merely arrested but not convicted are ripe for the challenge.

Notes

1. *Maryland v. King*, 133 S. Ct. 1958 (2013).
2. *Id.* at 1966-1968.
3. *Id.* at 1970-1972.
4. *Id.* at 1972-1974.
5. *Id.* at 1983-1987 (Scalia, J., dissenting).
6. *Id.* at 1989-1990.
7. *People v. Buza*, 180 Cal. Rptr. 3d 753, 785 (Cal. Ct. App. 2014). In 2014, the Supreme Court of Vermont also rejected the *Maryland v. King* holding in its state constitutional review of a DNA statute requiring sampling from individuals arraigned on a felony charge. *State v. Medina*, 102 A.3d 661 (Vt. 2014).
8. *Buza*, 180 Cal. Rptr. 3d at 785, 793, 795-796.
9. *Haskell v. Harris*, 745 F.3d 1269 (9th Cir. 2014) (en banc).
10. *Buza*, 180 Cal. Rptr. 3d at 771.
11. *Id.* at 760, 779.
12. *Id.* at 772, n.9.
13. *Id.* at 767.
14. Tit. X, P.L. 109-162, 119 Stat. 2960.
15. *Id.* (codified at 42 U.S.C. § 14135a(a)(1)).
16. P.L. 109-248, 120 Stat. 587 (2006) (codified at 42 U.S.C. § 14135a(a)(1)).
17. 42 U.S.C. § 14135a(a)(5). The 2005 and 2006 expansions of compulsory DNA collection followed earlier legislation that required, *inter alia*, DNA collection from convicts (Violent Crime Control and Law Enforcement Act of 1994, Pub. L. No. 103–322, 108 Stat. 1796 (1994)) and other individuals convicted of certain federal offenses (DNA Analysis Backlog Elimination Act of 2000, Pub. L. No. 106–546, 114 Stat. 2726 (2000)).
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22. 42 U.S.C. § 14135a(a)(4), (b) and (c), note 34.
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50. *Buza*, 180 Cal. Rptr. 3d at 779.

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60. SWGDAM, *supra* note 59.

61. *Id.*

62. *Id.* Kim, *et al.*, *supra* note 52.

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Address: _____

City: _____ State: _____ Zip: _____

Date of Birth: _____ Gender: _____

Phone: _____

Fax: _____

E-mail: _____

State Bar(s) & Admission Date(s): _____

Bar Number(s): _____

☐ I certify that I meet the criteria for the membership category to which I am applying.

☐ **Attorneys:** I am a member of the bar in good standing and I am not subject to suspension or disbarment in any jurisdiction. I understand that prosecutors are not eligible to be NACDL members.

Signature: _____ Date: _____

I qualify for the following membership category (Please check one)

Membership Categories:	Annual Dues:
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☐ New Lawyer*	$179
☐ Law Professor	$165
☐ Fedl. or State Public Defender**	$135
☐ Judge	$189
☐ Military	$165
☐ Law Student	$65
☐ Associate	$189
☐ International	$179
☐ Sustaining	$465
☐ President's Club	$689
☐ Life Member***	$5,000

* New Lawyer Membership – for members of the bar for less than 5 years
** Public Defender Membership – for full-time, salaried employees of non-profit or government agency
*** Life Membership – a one-time contribution; or 5 installments of $1000 each over 5 consecutive years

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Return by FAX to: (202) 872-8690, Attn: NACDL® Membership Director
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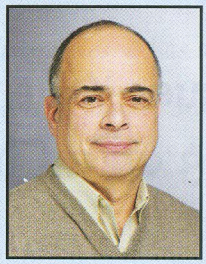

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