Law Enforcement Access to Recreational Genomics Databases

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September 27, 2021

Recreational Genomics

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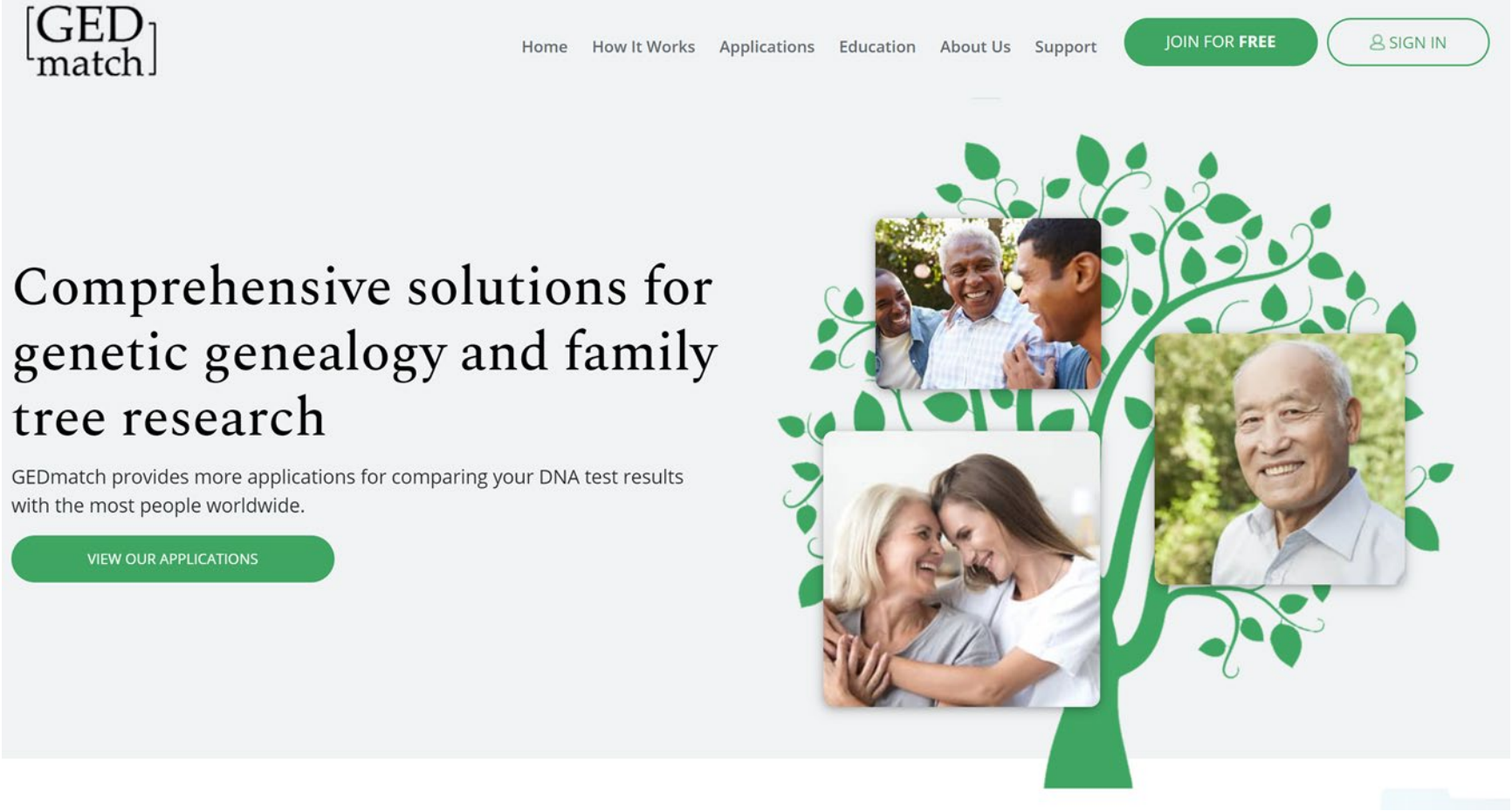


True Crime

The ingenious and 'dystopian' DNA technique police used to hunt the 'Golden State Killer' suspect

Police used DNA information on a genealogy website to track down the Golden State Killer suspect. (Reuters)

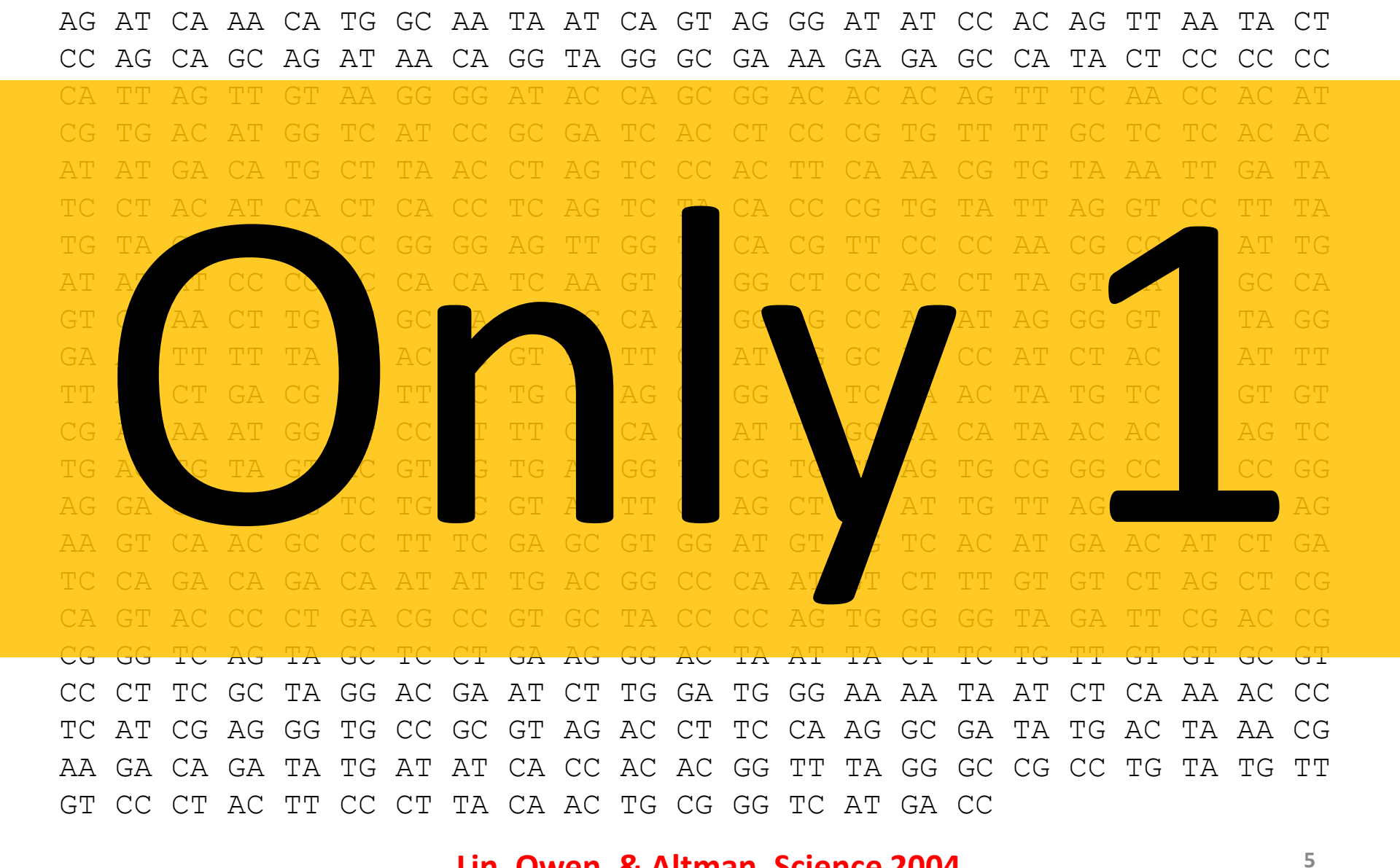
By Avi Selk

April 28, 2018

For decades, police say, the DNA of the "Golden State Killer" sat in evidenc
genetic fingerprint that could identify definitively the man who killed 12 people and raped 45 women across California between 1976 and 1986.

And for decades, those samples were basically useless to investigators, who ran into the same wall that has frustrated police since the invention of DNA forensics: A genetic fingerprint is not much

*omics Data is High-Dimensional!



Lin, Owen, & Altman. Science 2004.

Knocking on the Front Door

AG AT CA AA CA TG GC AA TA AT CA GT AG GG AT AT CC AC AG TT AA TA CT
CC AG CA GC AG AT AA CA GG TA GG GC GA AA GA GC CA TA CT CC CC CC
CA TT AG TT GT AA GG GG AT AC CA GC GG AC AC AC AG TT TC AA CC AC AT
CG TG AC AT GG TC AT CC GC GA TC AC CT CC CG TG TT TT GC TC TC AC AC
AT AT GA CA TG CT TA AC CT AG TC CC AC TT CA AA CG TG TA AA TT GA TA
TC CT AC AT CA CT CA CC TC AG TC TA CA CC CG TG TA TT AG GT CC TT TA
TG TA CC GA GG CC GG GG AG TT GG TT CA CG TT CC CC AA CG CC TC AT TG
AT AT AT CC CC GC CA CA TC AA GT CT GG CT CC AC CT TA GT TA AC GC CA
GT GA AA CT TG GC GC CA TT CC CA AG GG AG CC AC AT AG GG GT GG TA GG
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TT AG CT GA CG CA TT GC TG CG AG GC GG TG TC AA AC TA TG TC CG GT GT
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TG AC TG TA GT AC GT TG TG AA GG TG CG TG CT AG TG CG GG CC AA CC GG
AG GA GG GT CG TC TG CC GT AC TT CC AG CT AT AT TG TT AG GG TA AA AG
AA GT CA AC GC CC TT TC GA GC GT GG AT GT CG TC AC AT GA AC AT CT GA
TC CA GA CA GA CA AT AT TG AC GG CC CA AT GT CT TT GT GT CT AG CT CG
CA GT AC CC CT GA CG CC GT GC TA CC CC AG TG GG GG TA GA TT CG AC CG
CG GG TC AG TA GC TC CT GA AG GG AC TA AT TA CT TC TG TT GT GT GC GT
CC CT TC GC TA GG AC GA AT CT TG GA TG GG AA AA TA AT CT CA AA AC CC
TC AT CG AG GG TG CC GC GT AG AC CT TC CA AG GC GA TA TG AC TA AA CG
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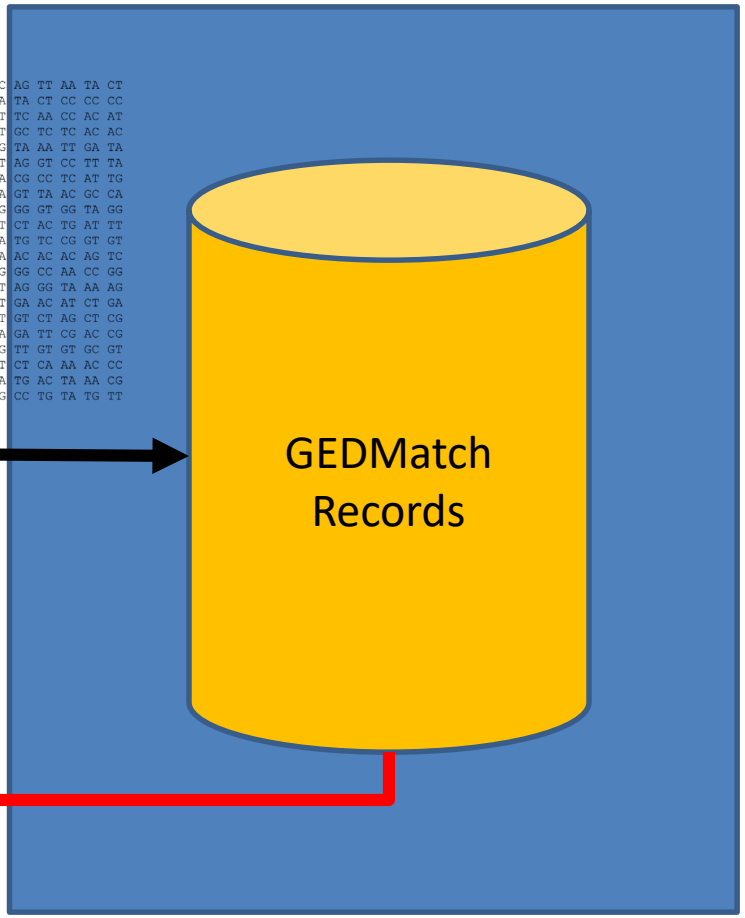
GT CC CT AC TT CC CT TA CA AC TG CG GG TC AT GA CC



John Smith – likely 1st cousin

…

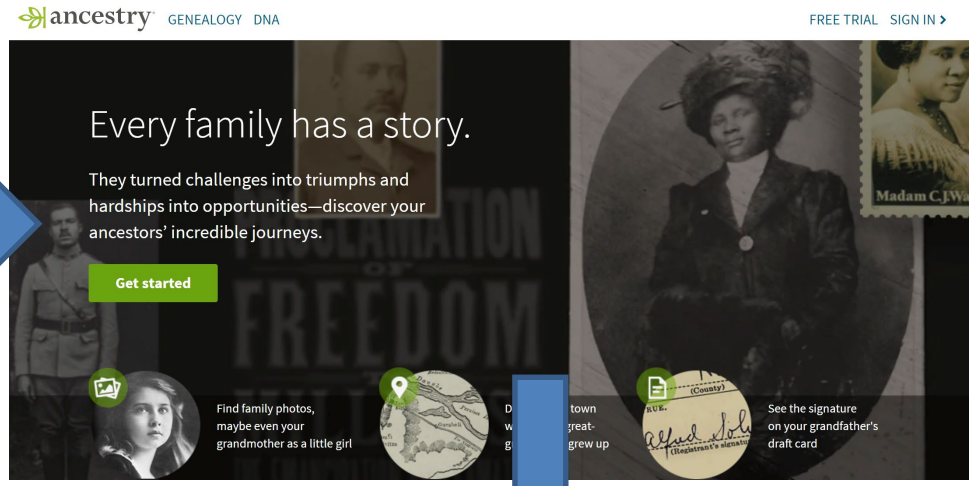
Jane Speith - likely 3rd cousin

The Search is On

John Smith – likely 1st cousin

…

Jane Speith - likely 3rd cousin



Identifying Personal Genomes by Surname Inference

Melissa Gymrek,[1,2,3,4] Amy L. McGuire,[5] David Golan,[6] Eran Halperin,[7,8,9] Yaniv Erlich[1]*

Sharing sequencing data sets without identifiers has become a common practice in genomics. Here, we 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. We show that a combination of a surname with other types of metadata, such as age and state, can be used to triangulate the identity of the target. A key feature of this technique is that it entirely relies on free, publicly accessible Internet resources. We quantitatively analyze the probability of identification for U.S. males. We further demonstrate the feasibility of this technique by tracing back with high probability the identities of multiple participants in public sequencing projects.

Surnames are paternally inherited in most human societies, resulting in their co-segregation with Y-chromosome haplotypes (*1*–*5*). Based on this observation, multiple genetic genealogy companies offer services to reunite distant patrilineal relatives by genotyping a few dozen highly polymorphic short tandem repeats across the Y chromosome (Y-STRs). The association between surnames and haplotypes can be confounded by nonpaternity events, mutations, and adoption of the same surname by multiple founders (*5*). The genetic genealogy community addresses these barriers with massive databases that list the test results of Y-STR haplotypes along with their corresponding surnames. Currently, there are at least eight databases and numerous surname project Web sites that collectively contain hundreds of thousands of surname-haplotype records (table S1).

The ability of genetic genealogy databases to breach anonymity has been demonstrated in the past. In a number of public cases, male adoptees and descendants of anonymous sperm donors used recreational genetic genealogy services to genotype their Y-chromosome haplotypes and to search the companies' databases (*6*–*9*). The genetic matches identified distant patrilineal relatives and pointed to the potential surnames of their biological fathers. By combining other pieces of demographic information, such as date and place of birth, they fully exposed the identity of their biological fathers. Lunshof *et al.* (*10*) were the first to speculate that this technique could expose the full identity of participants in sequencing projects. Gitschier (*11*) empirically approached this hypothesis by testing 30 Y-STR haplotypes of CEU participants in these databases and reported that potential surnames can be detected. [CEU participants are multigenerational families of northern and western European ancestry in Utah who had originally had their samples collected by CEPH (Centre d'Etude du Polymorphisme Humain) and were later reconsented to participate in the HapMap project.] However, these surnames could match thousands of individuals, and the study did not pursue full re-identification at a single-person resolution.

Our goal was to quantitatively approach the question of how readily surname inference might be possible in a more general population, apply this approach to personal genome data sets, and demonstrate end-to-end identification of individuals with only public information. We show that full identities of personal genomes can be exposed via surname inference from recreational genetic genealogy databases followed by Internet searches. In all cases in which individuals were studied who had donated DNA samples, the informed consent statements they had signed stated privacy breach as a potential risk and the data usage terms did not prevent re-identification. Representatives of relevant organizations that funded the original studies were notified and confirmed the compliance of this study with their guidelines (*12*).

As a primary resource for surname inference, we focused on Ysearch (www.ysearch.org) and

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Most White Americans' DNA Can Be Identified Through Genealogy Databases

Only two percent of the population needs to have done a DNA test to identify nearly everyone else, researchers found. Leonard Lessin/Science Source

By **Heather Murphy**

Oct. 11, 2018

The genetic genealogy industry is booming. In recent years, more than 15 million people have offered up their DNA — a cheek swab, some

Right to be Let Alone?

Personal Preference… is clear

- Empirical study with laypeople to gauge societal privacy expectations in use of genetic databases
- Law enforcement access to genetic information considered as, or more, intrusive searches of bedrooms, text messages, or emails
- Regardless of if data is held by health care providers, direct-to-consumer genetic testing companies, or public genealogy websites
- Suggest law enforcement access to non-governmental genetic databases require judicial authorization, although not necessarily a traditional warrant

https://dlj.law.duke.edu/article/a-world-of-difference-law-enforcement-genetic-data-and-the-fourth-amendment-hazel-vol70-iss4/

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SCIENCE

This Genealogy Database Helped Solve Dozens Of Crimes. But Its New Privacy Rules Will Restrict Access By Cops.

GEDmatch’s revamped genetic privacy policy could set off legal battles that go all the way to the US Supreme Court.

Peter Aldhous
BuzzFeed News Reporter

Posted on May 19, 2019, at 3:41 p.m. ET

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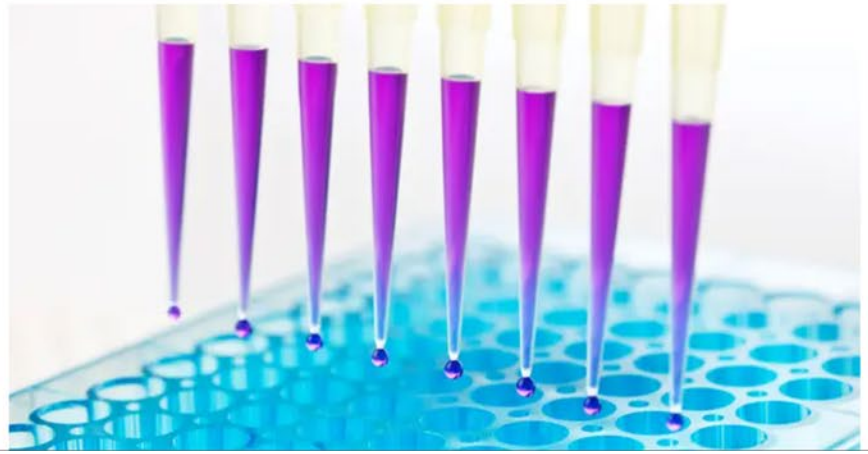


Nice Try

- GEDMatch provided an opportunity to consent to the use of data for violent crimes investigations
- Many failed to consent
- Orlando detective's request for warrant for use of all records was approved

The New York Times

Your DNA Profile is Private? A Florida Judge Just Said Otherwise

Privacy experts say a warrant granted in Florida could set a precedent, opening up all consumer DNA sites to law enforcement agencies across the country.

Dion MBD

By Kashmir Hill and Heather Murphy

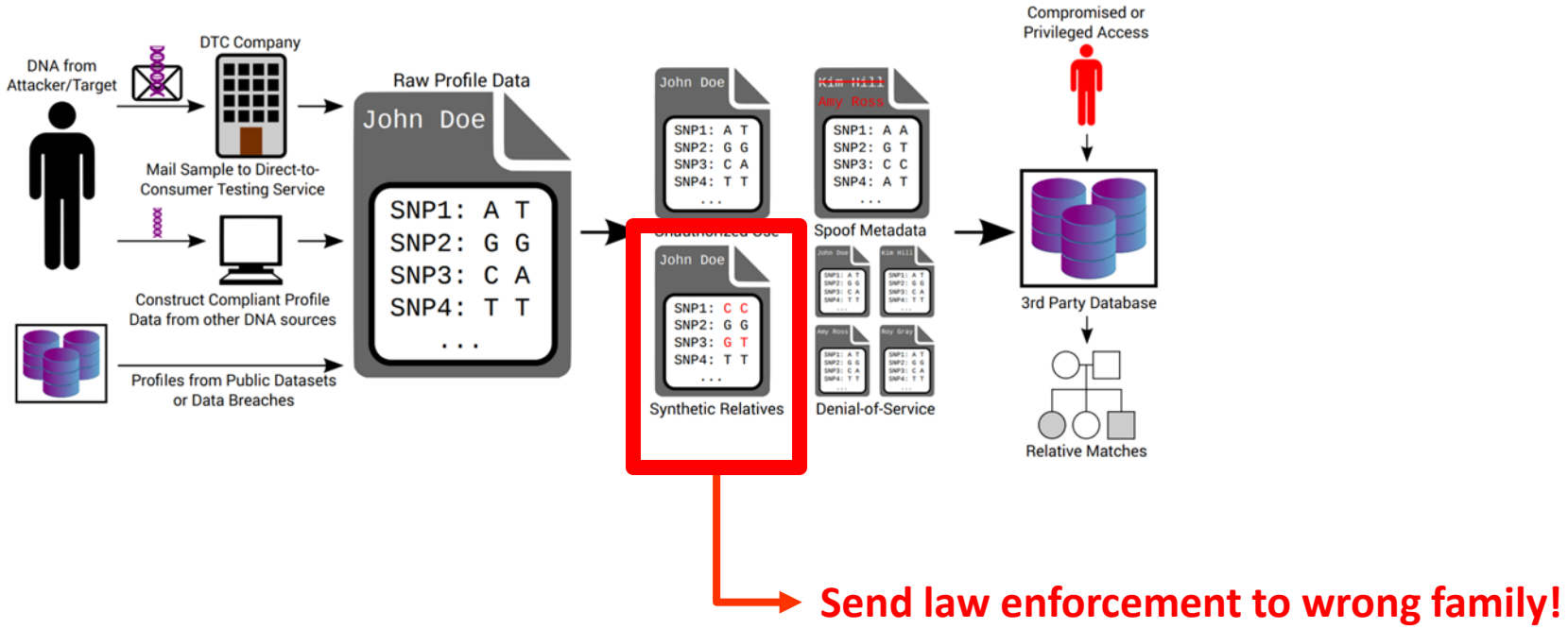
Published Nov. 5, 2019 Updated Dec. 30, 2019

Potential Adversarial Behavior

Computer Security Risks of Distant Relative Matching in Consumer Genetic Databases

Peter M. Ney[1,3,4,5], Luis Ceze[2,4,5], and Tadayoshi Kohno[1,3,4,5]

[1]Security and Privacy Research Lab
[2]Molecular Information Systems Laboratory
[3]Tech Policy Lab



https://arxiv.org/abs/1810.02895

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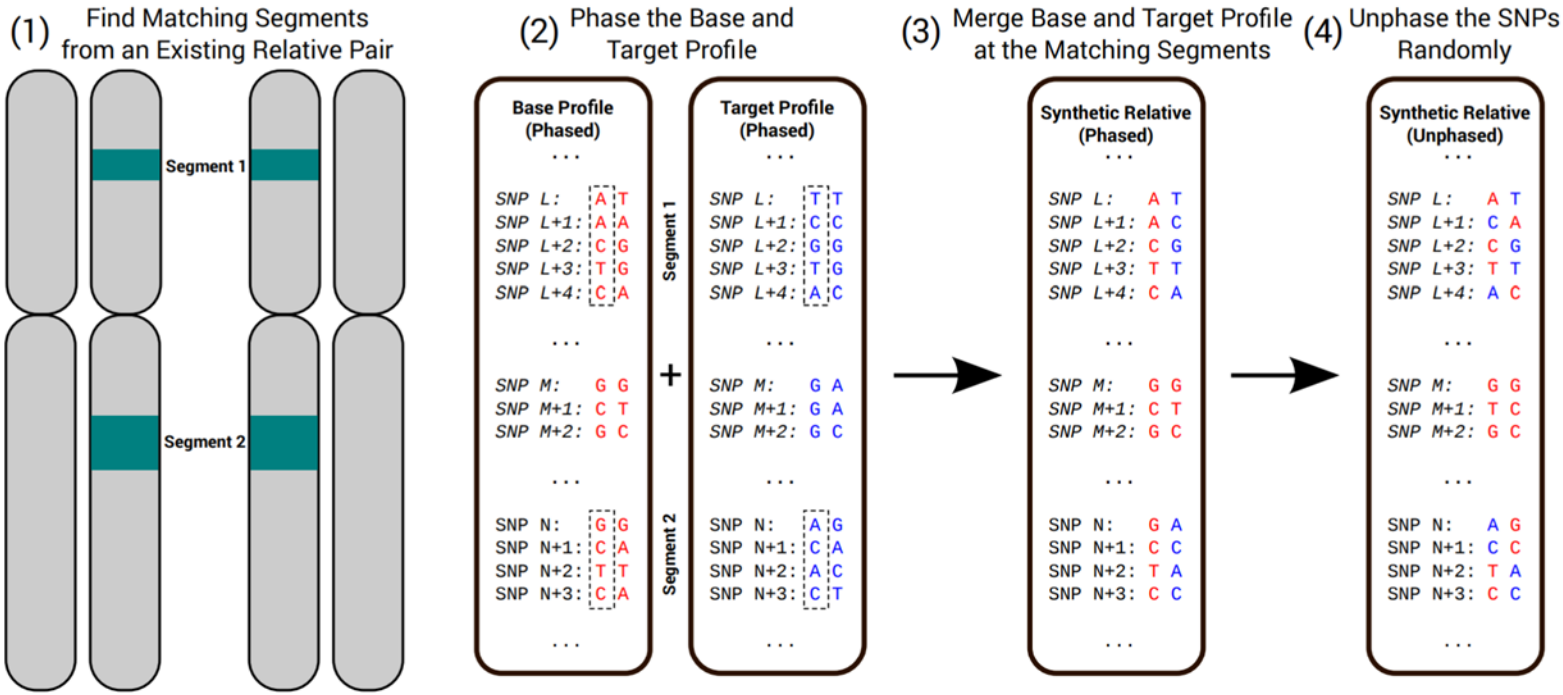

Figure 3: Proposed method to generate synthetic relatives.

https://arxiv.org/abs/1810.02895

So, what do we do?

- States may be leading the way
- MT
  - Requiring government investigators obtain a search warrant before using a consumer DNA database…
  - … unless the consumer has waived the right to privacy
- MD
  - Investigators will need a judge's signoff before using uploading DNA from a crime scene to genealogy websites to find relatives
  - Technique can only for serious crimes (e.g., murder, sexual assault)
  - May only use websites with strict policies around user consent

The New York Times

Two New Laws Restrict Police Use of DNA Search Method

Maryland and Montana have passed the nation's first laws limiting forensic genealogy, the method that found the Golden State Killer.

HudsonAlpha, a genome sequencing lab in Alabama that has worked on more than 1,000 forensic genealogy cases. Wes Frazer for The New York Times

By Virginia Hughes

May 31, 2021

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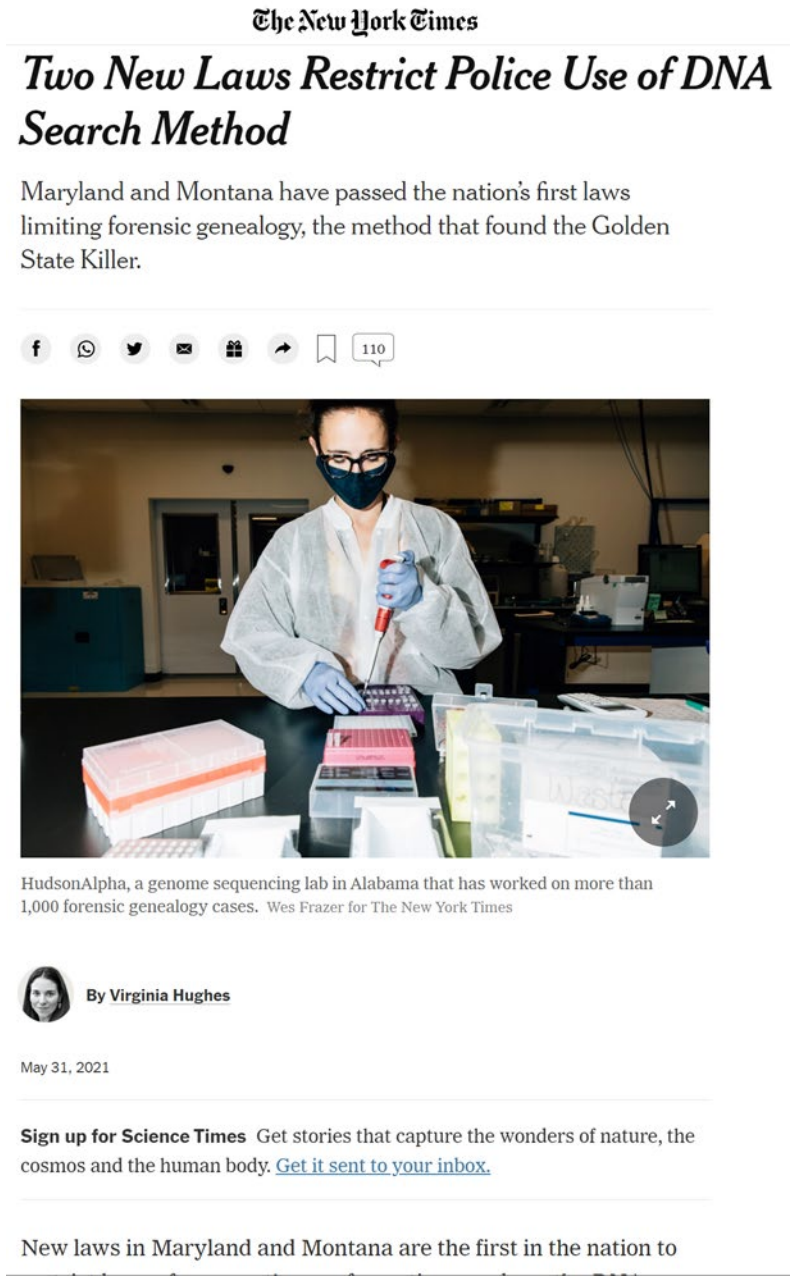
New laws in Maryland and Montana are the first in the nation to

But Consent?

- There's only so much that consent can support

- As Hazel & Slobogin suggest, may be more appropriate to rely upon
  - Judicial approval
  - Warrant
  - Separate database (from DTC)



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By Virginia Hughes

May 31, 2021

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Questions?

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Center for Genetic Privacy & Identity in Community Settings

https://www.vumc.org/getprecise

Vanderbilt Center for Health Data Science

https://www.vumc.org/heads