MEMO

To: Professor McMurrey

From: Kassie King

Date: March 20, 2021

Subject: Final Assignment for the Technical Reports for Industry, Government, and Business course

I am submitting the final assignment of the second class in the certificate program. The attached report is entitled *Use of Genetic Genealogy by Law Enforcement.*

The purpose of this report is to convey an understanding of what genetic genealogy is, how it can be utilized by law enforcement as an investigative tool, and the potential risks of its use. It will cover the specific type of DNA testing involved and its benefits, the genealogical resources utilized in the process, and include data related to solved crimes and public opinion.

After consideration of these points, law enforcement agencies should be able to make an informed decision about implementing genetic genealogy as part of their own investigations.

Looking forward to your feedback!

Encl.: Technical report on Use of Genetic Genealogy by Law Enforcement

USE OF GENETIC GENEALOGY BY LAW ENFORCEMENT

submitted to

Professor David McMurrey

Technical Reports for Industry, Government, and Business

March 20, 2021

by

Kassie King

This report will explain what genetic genealogy is, how its process works, how it can be utilized by law enforcement as an investigative tool, and the potential risks of its use.

ABSTRACT

Genetic genealogy is the combination of traditional methods of genealogical study with forensic DNA testing, which together can determine the level and type of genetic relationship between two or more individuals. Genetic genealogy was originally created by direct-to-consumer (DTC) genealogy sites such as Ancestry and 23andMe to assist users in learning more about their genes and their families. Genetic Genealogy was first used by law enforcement as an investigative tool in 2018 with the capture of the Golden State Killer.

Law enforcement currently use the Combined DNA Index System (CODIS) to match DNA samples to potential suspects. The CODIS system requires that DNA is analyzed at 20 core loci for the presence of short tandem repeats (STRs), which are repetitive tracts of DNA. Alternatively, the DTC companies analyze over 700,000 loci in the DNA and thus can provide significantly more genetic information. Rather than STRs, the DTC companies analyze the samples for single nucleotide polymorphisms (SNPs), which are single points of mutation in the DNA, through the automated use of DNA chips.

Genetic genealogy requires the use of a database called GEDmatch, a forensic technology company called Parabon NanoLabs, and genetic genealogy researchers. GEDmatch is a database in which the public can upload their genetic information obtained from DTC testing sites and find potential familial matches. The GEDmatch system is preferred over CODIS because the search pool is different and much greater, and the ability to find a match is increased. Parabon NanoLabs employs genetic genealogy experts who assist law enforcement with testing DNA, finding matches in the GEDmatch system, and building family trees. Researchers use any genetic matches to construct a family tree that can lead law enforcement to potential suspects.

Genetic genealogy can be used by law enforcement to help solve cold cases in which all other methods of investigation have been exhausted. Between April 2018 and January 2019, Parabon assisted in 28 violent crimes that were solved by using of genetic genealogy, the majority of which were committed over a decade previously. Genetic genealogy can also be used to help identify human remains. The DNA Doe Project (DDP) is a group of genetic genealogy professionals who volunteer their time to help both the public and law enforcement identify John and Jane Does. As of 2021, DDP has helped identify 39 individuals and has 70 ongoing cases.

Due to the attention that the Golden State Killer case brought upon law enforcement's use of genetic genealogy, several issues regarding privacy were raised. In response to these concerns, GEDmatch changed its policies to allow users to "opt-in" to allowing law enforcement access to their information or not. Currently, a GEDmatch Pro database is being created specifically for use by law enforcement that includes information from users who have "opted in." The DTC testing companies such as Ancestry have strict privacy regulations and decline to cooperate with authorities whenever possible, highlighting the need for a database such as GEDmatch. The Department of Justice (DOJ) created a set of interim policies in 2019 to help regulate the use of genetic genealogy by law enforcement. These regulations detail the situations in which using genetic genealogy is appropriate and permitted, the internal steps required to initiate the process, and the limitations regarding data control and privacy. In 2019 a Florida Judge set a potentially dangerous precedent by allowing a detective a search warrant for full access to the GEDmatch system regardless of whether users had opted-in or not. However, the public response to law enforcement's use of genetic genealogy to solve violent crime or identify remains was overwhelmingly positive based on two 2018 surveys. In addition to privacy, there were also concerns raised about the potential misuse of genetic genealogy technology by law enforcement, most of which can be mitigated if agencies are diligent about their investigations and following regulations.

Genetic genealogy has the potential to be an unparalleled investigative tool if used properly. It is necessary to garner the public's support in order to grow the search pool and further legislation will be required to streamline the process of using genetic genealogy. If these points are followed through on, genetic genealogy can help decrease the number of unsolved cold cases and violent crimes, the number of unidentified bodies, and the number of dangerous perpetrators on the streets.

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What is Genetic Genealogy?

Genetic Genealogy consists of the combination of traditional methods of genealogical study with forensic DNA testing, which together can help determine the level and type of genetic relationship between two or more individuals. Both DNA testing and genealogical study have existed as their own science and social science respectively for decades, but their relationship with each other didn't begin until much more recently.

History of Use

Traditional genealogy is the study of one's family history by building a family tree, which is typically done by utilizing public records and historical documents. Since the early 2010s genealogical sites such as Ancestry and 23andMe have made this process much easier and more popular with their vast database of digitized records and tree-building interfaces. It was these sites that first began to introduce the idea of using genetic testing in partnership with genealogical research by producing and commercializing direct-to-consumer (DTC) DNA test kits. At-home DNA testing skyrocketed in popularity as the public suddenly had access to their personal genetic history at an affordable price and without the involvement of a doctor. By 2018 over 12 million tests collectively had been processed by these companies.

Adaptation for Law Enforcement

The first instance that genetic genealogy was used by law enforcement to help solve a major crime was in 2018 with the capture of Joseph James DeAngelo, otherwise known as the Golden State Killer. DeAngelo ravaged a southern California community throughout the 70s and 80s and was proven to be responsible for a number of rapes and murders in the area.

In taking a renewed look at the case, law enforcement utilized a public online database called GEDmatch in which users can upload their DNA information obtained from sites like Ancestry or 23andMe to find genetic matches. Detectives used a sample of the perpetrator's DNA from one of the crime scenes and uploaded the genetic profile to GEDmatch and were able to identify the great-great-great grandparents of the suspect. Then, working with professional genetic genealogists, a team of investigators established a family tree consisting of thousands of descendants until they narrowed the search to a living individual that fit the appropriate criteria. After further investigation, police were able to identify DeAngelo as their suspect, and he was later proven to be the Golden State Killer. However, this arrest and conviction brought scrutiny upon genetic genealogy as an investigative tool and raised significant ethical concerns.

Scope of Report

The four sections of this report include (1) DNA testing, (2) genealogical research, (3) applications for use, and (4) ethical concerns. The first section will detail the type of DNA testing used by genetic genealogists, the process by which the tests are completed, and the benefits of these methods over traditional law enforcement DNA testing. The second section will describe the resources needed in order to complete the genealogical research portion of this technique, including the matching database GEDmatch and the genetic genealogy company Parabon. The third section will explain the two major applications for law enforcement to use genetic genealogy, including solving cold cases and identifying human remains. The fourth section will highlight the major concerns posed by using genetic genealogy, which are related to the public's right to privacy and potential misuse of genetic genealogy by law enforcement.

I. DNA TESTING

Genetic genealogy utilizes the type of DNA testing done by DTC genealogical sites, which differ greatly from the type of DNA testing done by law enforcement for use in databases such as the Combined DNA Index System (CODIS). The DTC sites analyze a completely different type of DNA than law enforcement does and the methods they use provide significantly more genetic information.

CODIS

Currently, for the purposes of forensic identification, the CODIS system requires that DNA samples be analyzed at 20 core loci, which are specific physical locations of a gene on a chromosome [1]. These loci are located in the autosomal DNA (atDNA) which is found in all chromosomes except for the sex chromosomes and consists of genetic information inherited through all ancestral lines.

For use in the missing persons databases, the Y chromosome DNA (Y-DNA) and mitochondrial DNA (mtDNA) are analyzed [1]. The Y-DNA is genetic material located in the Y chromosome of a male individual and is only inherited through the paternal line, and the mtDNA is genetic material located in the mitochondria in each cell of the body and is only inherited through the maternal line.

Short tandem repeats. All loci are analyzed for the presence of short tandem repeats (STRs), which is a tract of repetitive nucleotides in the DNA that is specific to every individual. If the STRs of two samples are identical, they have come from the same individual. If the STRs are similar but not exact, it is likely the samples have come from two genetically related individuals—the more STRs they share, the closer the familial relationship.

Although analyzing 20 loci for STRs is plenty of information for law enforcement to make a definitive match between sample DNA and a specific individual (in which the STRs would be identical), the companies that created the DTC kits analyze several hundred thousand locations in the DNA and provide significantly more genetic information.

Direct-to-Consumer DNA Kits

Rather than analyzing only 20 loci, the DTC testing companies are able to study upwards of 700,000 loci in the autosome (where the atDNA is located). The extensiveness of this research can provide information to their consumers regarding their ethnic make-up and potential health risks but is also extremely helpful in terms of genetic matching and identification.

Single nucleotide polymorphisms. Rather than STRs, these companies analyze their samples by looking for single nucleotide polymorphisms (SNPs). An STR and SNP are similar in that they are both changes in the DNA that occur at a specific locus, but the type of change differs. An SNP is a single change, addition, deletion of a nucleotide (represented by the letters A, C, G, and T) in a specific sequence of DNA.

Figure 1 below shows an example of the difference between an SNP and an STR within the same strand of DNA:

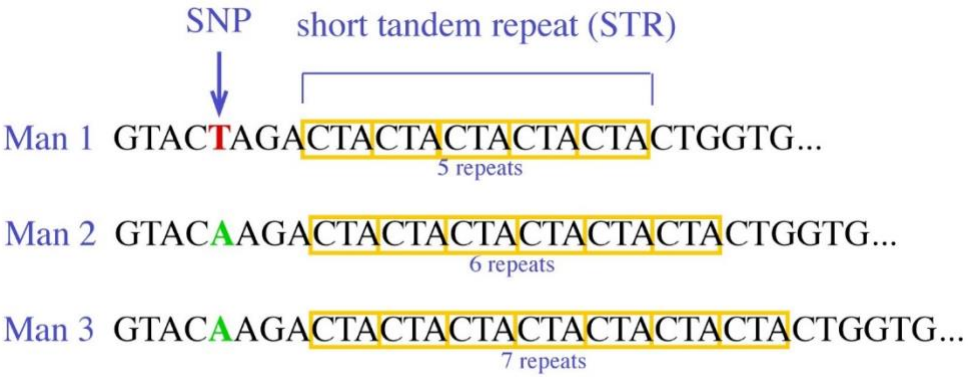

Figure 1: Example of SNPs and STRs in DNA sequence.

Source: "Surnames, Genes and the History of Britain," Mark A. Gobling, University of Leicester Department of Genetics, 2009.

DNA chips. Since there are hundreds of thousands of points in the DNA where SNPs can occur, the process for detecting them has become automated through the use of DNA microarrays, also called DNA chips or SNP chips. These chips are made out of a piece of silicon glass or other solid surface to which specific strands of synthetic DNA have been chemically bonded, creating microscopic spots. When the sample DNA is introduced to the chip, the molecules "stick" to the spots of synthetic DNA that are

complementary. This creates a pattern that a computer program can “read” and identify any single point mutations, such as an SNP.

Figure 2 below shows how the sample DNA appears on an DNA Chip, which is then analyzed for SNPs:

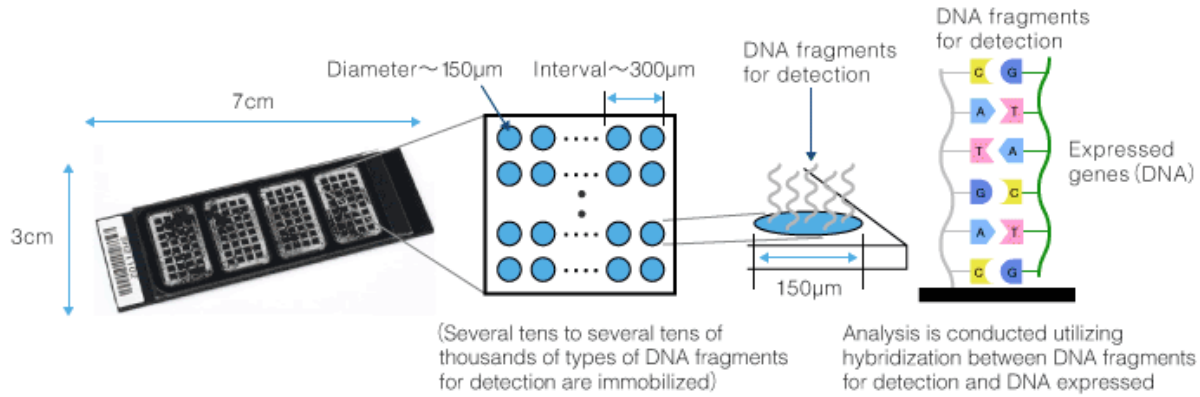

Figure 2: How DNA Chip is used.

Source: “Outline of DNA microarrays,” Toray Industries, Inc., 2021.

II. GENEALOGICAL RESEARCH

Genetic genealogy differs from traditional DNA testing not only in the ways in which the DNA is analyzed, but more specifically, what is done with the results. Rather than comparing a DNA sample to the limited CODIS database, it can be compared to a much larger search pool through sites like GEDmatch. Databases like GEDmatch, as well as forensic technology companies such as Parabon NanoLabs and their genealogical researchers, are imperative resources for law enforcement to use when deciding to implement genetic genealogy in an investigation.

GEDmatch

GEDmatch is a database in which the public can upload their genetic information obtained from DTC testing sites and find potential familial matches who have also been tested through an array of different companies and laboratories. This site was originally created simply for genealogical study, and it wasn't until after the capture of the Golden State Killer was the full magnitude of its potential understood. Now, GEDmatch is a tool more regularly utilized by both law enforcement and genetic genealogists.

The benefits of the GEDmatch database over the CODIS database are threefold: (1) the DNA results that are uploaded to GEDmatch come from an SNP analysis of a DNA chip, which provides greater genetic information and increases the probability of a match, (2) the GEDmatch system allows for distant familial matches between samples rather than just a direct match, and (3) GEDmatch consists of an entirely different search pool comprised of members of the public rather than suspects, arrestees, victims, or missing persons.

Parabon NanoLabs

Parabon NanoLabs is a DNA technology company that develops therapeutic and forensic products related to DNA sequencing, analysis, and manufacturing. Parabon is one of the only companies who have begun using genetic genealogy technology to work directly with law enforcement, through their Snapshot Investigative Genetic Genealogy Unit™. The Snapshot unit is spearheaded by researcher and genealogy expert Cece Moore who has been involved in many high-profile investigations.

DNA testing. Autosomal SNPs can be difficult to obtain from forensic samples and Parabon laboratories are able to optimize that process and gather more information from a smaller sample size that you would get with a traditional STR test [2]. Parabon uses similar, and sometimes the exact, DNA chips utilized by the DTC companies, allowing for much easier comparison between samples later. Once a sample is obtained, the Snapshot team is able to upload the data into the GEDmatch database and find any potential matches.

Matching. Once the GEDmatch system alerts to a potential match, the genetic genealogists can compare the samples and determine the lengths and chromosomal locations of the shared segments of DNA. Measures of genetic distance are called centimorgans (cMs) and the total number of cMs shared across all chromosomes of two samples determines the level of genetic relatedness between them.

There are many biological relationships that share the same “degree of relatedness” and thus it is important to utilize the expertise of genealogists who can help determine the probable connection between samples through further research into the subject’s family. For example, a half-brother or sister, niece or nephew, aunt or uncle, grandson or granddaughter, or great-grandfather or grandmother, would all be considered 2nd degree of relatedness. This means an individual shares approximately the same amount of DNA with each of these relatives. If a 2nd degree match was found in GEDmatch, it would be up to the genetic genealogist to narrow down which familial relationship to the suspect is the most likely, through further analysis of the shared DNA and genealogical research.

Figure 3 below details the degree of relatedness of different family members:

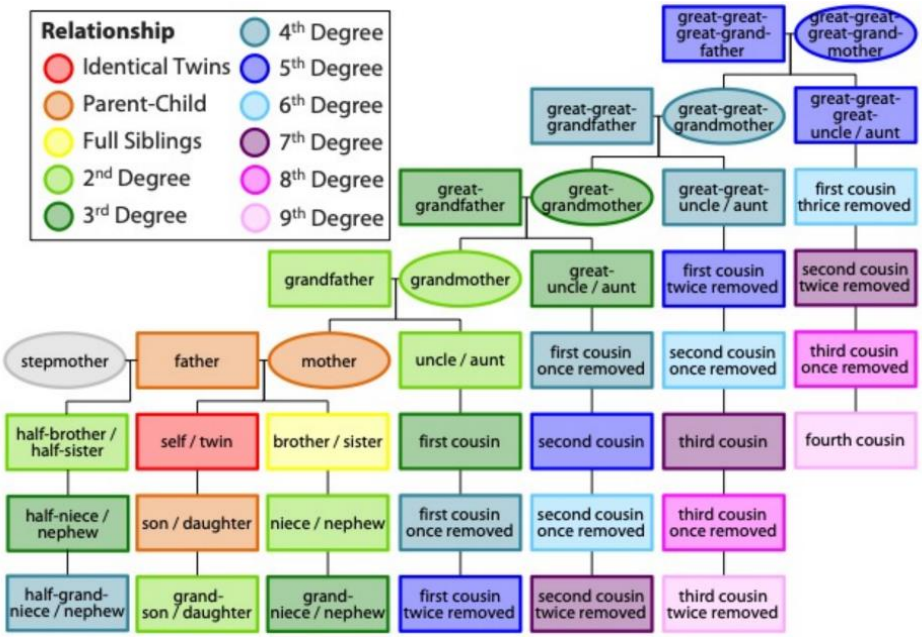

Figure 3: Degree of relatedness chart.

Source: "Genetic genealogy for cold case and active investigations," Greytak, Ellen M., Cece Moore, Steven L. Armentrout. *Forensic Science International*. 2019.

Tree-building. During the tree-building process the genetic genealogist searches for any common ancestors between the matches. From there, descendancy research is employed using traditional genealogical search tools such as public records and historical documents, in order to map the descendants of the common ancestor to the present day. This research can narrow down a suspect pool to a particular branch of a family, a set of names, or even a specific individual. This is a similar process often undergone by adopted individuals in search of biological family, but in the case of a criminal investigation the sample would be a suspect rather than an adoptee.

In 2018 Cece Moore assisted Snohomish County, WA detectives with a double homicide case that had been cold since 1987. Figure 4 below is a representation of the family tree Moore created during her investigation. When the suspect's DNA was uploaded into GEDmatch there were two distant relative matches—one from the maternal side and one from the paternal side. She was then able to build a family tree backwards from those two individuals until she found the point where the families intersected by marriage. That couple had four children and only one was male - leading investigators to their prime suspect. After 31 years, William Talbott II was convicted of

this crime and sentenced to two life terms.

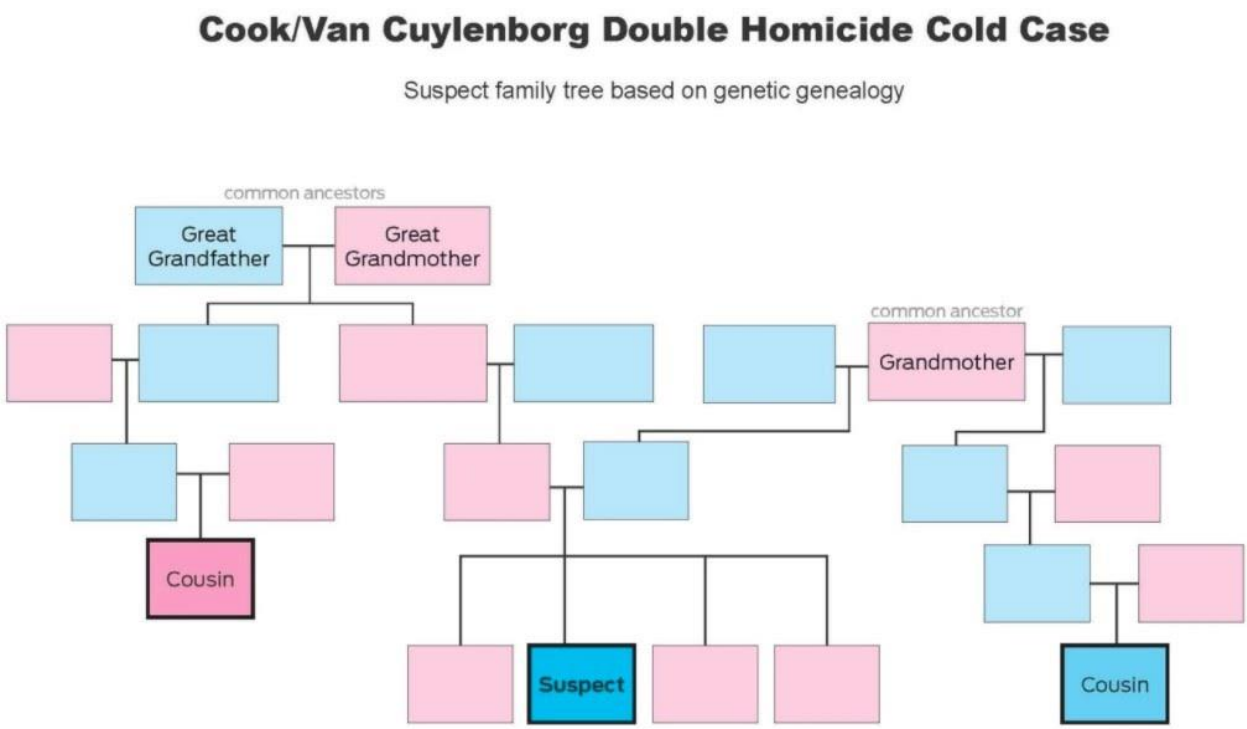

Figure 4: Criminal suspect family tree in Snohomish, WA double homicide cold case.

Source: "Genetic genealogy for cold case and active investigations," Greytak, Ellen M., Cece Moore, Steven L. Armentrout. *Forensic Science International*. 2019.

III. APPLICATIONS FOR USE

There are several instances in which genetic genealogy can be beneficial to a criminal investigation. Primarily, it can assist with cold cases in which no new leads can be generated through traditional methods, and often the crime has been committed in the years before DNA testing or genetic genealogy was available. Genetic genealogy can also assist with identifying remains and giving closure to the families of missing persons.

Cold Cases

The types of investigations in which genetic genealogy can be particularly useful are cold cases. Typically, cases have gone cold after all possible avenues of investigation have been exhausted and genetic genealogy is an approach that can be used to generate new leads or suspects. There have been significant improvements made in

DNA technologies in the past few decades and new information can now be gleaned from old forensic evidence, especially now that SNP testing is a viable option.

Solved crimes. Based on information gathered by Parabon NanoLabs, there were 28 violent crimes solved across the United States with the assistance of genetic genealogy between April 2018 and January 2019 [2]. All 28 of these crimes were instances of homicide, sexual assault, or both. From the graph below you can see that the majority of the crimes, a combined 64.2%, were committed in the year 2000 or prior. In total, 25 of these 28 cases were able to be solved a decade or more after the crimes were committed with the help of genetic genealogy. The oldest case on the list was a homicide from Santa Clara, CA that was committed in 1973 and 45 years later the perpetrator was convicted.

Figure 5 here details the year the crime was committed for each case that was solved with the use of genetic genealogy from April 2018 to January 2019:

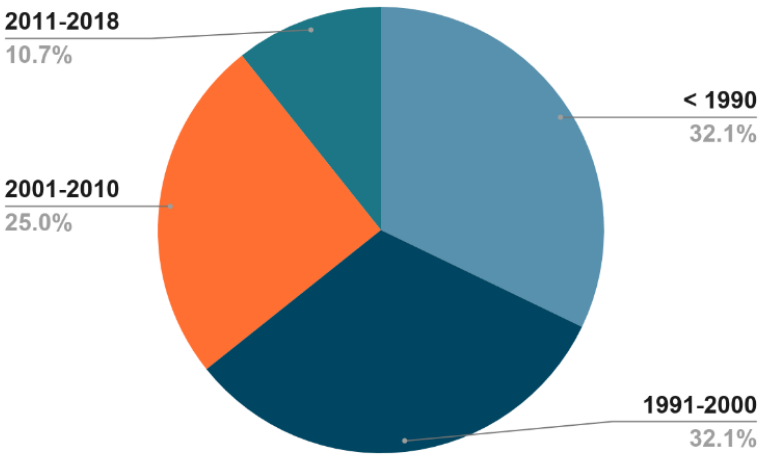

Figure 5: Year of crime committed for cases solved by Parabon from April 2018 to January 2019.

Source: "Genetic genealogy for cold case and active investigations," Greytak, Ellen M., Cece Moore, Steven L. Armentrout. *Forensic Science International*. 2019.

Identifying Remains

In addition to aiding criminal investigations, genetic genealogy can also be used to help identify human remains. The DNA testing, matching, and tree-building process remains the same, only it is the identity of a body being sought rather than a suspect of a crime. Again, in this circumstance, genetic genealogy acts as a useful tool in identifying individuals in investigations that have gone cold or in cases in which all other methods of identification have been exhausted with no success.

DNA Doe Project. The DNA Doe Project (DDP) is a non-profit organization established in 2017 that uses genetic genealogy to aid law enforcement in identifying John and Jane Does. This organization consists of dozens of professional genetic genealogists who volunteer their time and expertise to the cause. The DNA samples they receive from law enforcement are analyzed for atDNA SNPs and then uploaded to the GEDmatch database just as Parabon does.

As of 2021 the DDP has helped identify 39 John and Jane does and at present the organization has 70 ongoing investigations, detailed in Table 1:

Table 1. DNA Doe Project Cases

John and Jane Does Identified by DDP		Ongoing Investigations		
Independently	**Assisting Law Enforcement**	**DNA Testing Phase**	**Genealogical Research Phase**	**In need of More Funding**
20	19	16	48	6

Source: DNA Doe Project. 2021. https://www.dnadoeproject.org/

Additionally, the DNA Doe Project has a DDP Fund program that aims to assist smaller and less funded agencies to be able to utilize their services. This monetary aid helps to cover lab costs and other expenses and enables genetic genealogy to be used in situations where it might not have been a viable option otherwise.

IV. RISKS OF GENETIC GENEALOGY

Although genetic genealogy has proven to be an extremely beneficial tool, there are concerns that need to be taken into consideration before it is employed. Due to the high-profile nature of the Golden State Killer case in 2018, a great amount of attention was brought upon law enforcement's use of genetic genealogy and several ethical concerns became a part of the public conversation.

Privacy Concerns

The primary concern regarding police use of genetic information was privacy. Although detectives accessed a public database in which users voluntarily uploaded their information, many debated the ethicality of utilizing such a database without users' knowledge that their information could be used in a police investigation or to possibly implicate a family member in a crime. Genetic genealogy professionals and law enforcement argued that there was no open access to genetic information, rather they were only informed when a familial match to their sample was found, and that the benefits of the tool vastly outweigh any potential risk. However, the GEDmatch site, the DTC sites, and the Department of Justice (DOJ) all created or amended their privacy regulations in response to the increased popularity and scrutiny of genetic genealogy.

GEDmatch. Since GEDmatch was originally created as a genealogy tool for the general public, there were no terms of service regarding use of the database by law enforcement at the time of the Golden State Killer investigation. The company received significant backlash for unknowingly allowing police access to their users' information.

In response to these concerns, GEDmatch created an "opt in" procedure in May 2019 that forced all users to decide whether they would like their data to be made available for the purposes of police investigations [3]. However, in making this change GEDmatch defaulted all accounts in their system to "opt out" unless users specifically chose to change it. This act ultimately shrunk the search pool available to law enforcement from a million users to zero overnight. By October 2019 only 181,000 of the 1.3 million GEDmatch users had opted in [4] and by May 2020 that number had slowly risen to 260,000 [5]. Genetic genealogist Cece Moore compared the massive loss of data to burning libraries [4].

Currently, a forensic science company called Verogen, Inc. that acquired GEDmatch in 2019, is in the process of establishing a separate database called GEDmatch Pro which will be specifically for use by law enforcement and genetic professionals assisting with

investigations. This system will essentially copy over all genetic information from users who have "opted in" and will separate the police search pool from the main site which is geared more toward genealogy hobbyists. The creation of such a database will streamline the genetic genealogy research process described in this report and could become an unparalleled investigative tool.

DTC Testing Companies. Direct-to-consumer genetic testing companies such as Ancestry and 23andMe have notoriously strict regulations regarding their response to law enforcement requests and their users' privacy. Ancestry has the largest database and thus has received the most requests for information. According to the Ancestry Guide to Law Enforcement, "Ancestry does not voluntarily cooperate with law enforcement . . . and does not allow law enforcement to use Ancestry's services to investigate crimes or to identify human remains" [6]. The majority of requests that Ancestry receives from law enforcement are related to nonviolent criminal investigations such as fraud or identity theft, but even in those cases the company "will try to minimize the scope or even invalidate the warrant before complying" [7]. According to their yearly transparency reports, Ancestry has received only five requests from law enforcement in regard to accessing their DNA database or users' genetic information since 2015. Ancestry has challenged all five requests, four of which were withdrawn and one of which is unresolved.

All requests are detailed in Table 2, below:

Table 2. Law Enforcement Requests For Information From Ancestry from 2015 to 2020

Year	Related to credit card misuse, fraud, or identity theft		Related to DNA database access or genetic information	
	Number of Requests	Cases in which information was provided	Number of Requests	Cases in which information was provided
2015	14	13	0	N/A
2016	9	8	0	N/A
2017	34	31	0	N/A
2018	10	7	0	N/A
2019	8	6	1	0
2020	7	1	4	0

Source: "Ancestry Transparency Report," Ancestry. 2021. https://www.ancestry.com/cs/transparency/

Since these policies make it nearly impossible for Ancestry to aid in criminal investigations, Parabon, the DNA Doe Project, and law enforcement agencies who have successfully solved cases through genetic genealogy are encouraging the public to submit their DNA results to sites like GEDmatch. The hope is that one day the GEDmatch Pro database can grow to include more users who have been tested by the

DTC companies and choose to have their information available for law enforcement use.

DOJ guidelines. Due to the rise in interest in genetic genealogy practices, the increase in privacy concerns, and the lack of existing federal regulations, the United States Department of Justice produced an Interim Policy in September 2019 to provide guidance to law enforcement until more permanent legislation could be created [8]. This policy detailed the situations in which using genetic genealogy is appropriate and permitted, the internal steps required to initiate the process, and the limitations regarding data control and privacy.

According to the policy, the DOJ requires that law enforcement must identify themselves as such to any third-party forensic or genealogical company involved and only enter or search forensic profiles in databases in which the users have been provided explicit notice that their information might be made available to law enforcement. Additionally, any investigative agencies using these services are only permitted to use biological samples for identification purposes and not to determine genetic predispositions for diseases, medical conditions, or psychological traits. Finally, if a suspect is arrested and charged with a criminal offense, their forensic profile and any other data must be immediately removed from any database and record of the removal be made.

Legal precedent. In late 2019 Detective Michael Fields of the Orlando Police Department announced that he was granted a search warrant by Judge Patricia Strowobridge of the Ninth Judicial Circuit Court of Florida which allowed him access to the full GEDmatch database, regardless of whether the members had “opted in” or not [9]. Industry experts believe that a court’s ability to override the terms of service put in place by the company could set a dangerous precedent for future cases and have a devastating effect on genetic privacy. The primary concern is that this decision could potentially lead to warrants for DTC genealogy companies such as Ancestry, which has approximately 15 million users, resulting in essentially no restrictions to law enforcement at all.

Public Response. According to a 2018 survey published in the scientific journal *PLOS Biology*, the majority of people surveyed supported law enforcement’s use of genetic information in criminal investigations [10]. Between 89 and 91% of respondents approved of law enforcement’s use of genealogical websites for investigations regarding violent crime, children, or missing persons, and 46% supported the use in instances of nonviolent crime. Approximately 75% of respondents even supported law enforcement creating fake profiles on genealogical websites in order to investigate crimes, though this is prohibited by most DTC sites and the DOJ guidelines.

The staggering level of support from the general public is detailed here in Figure 6:

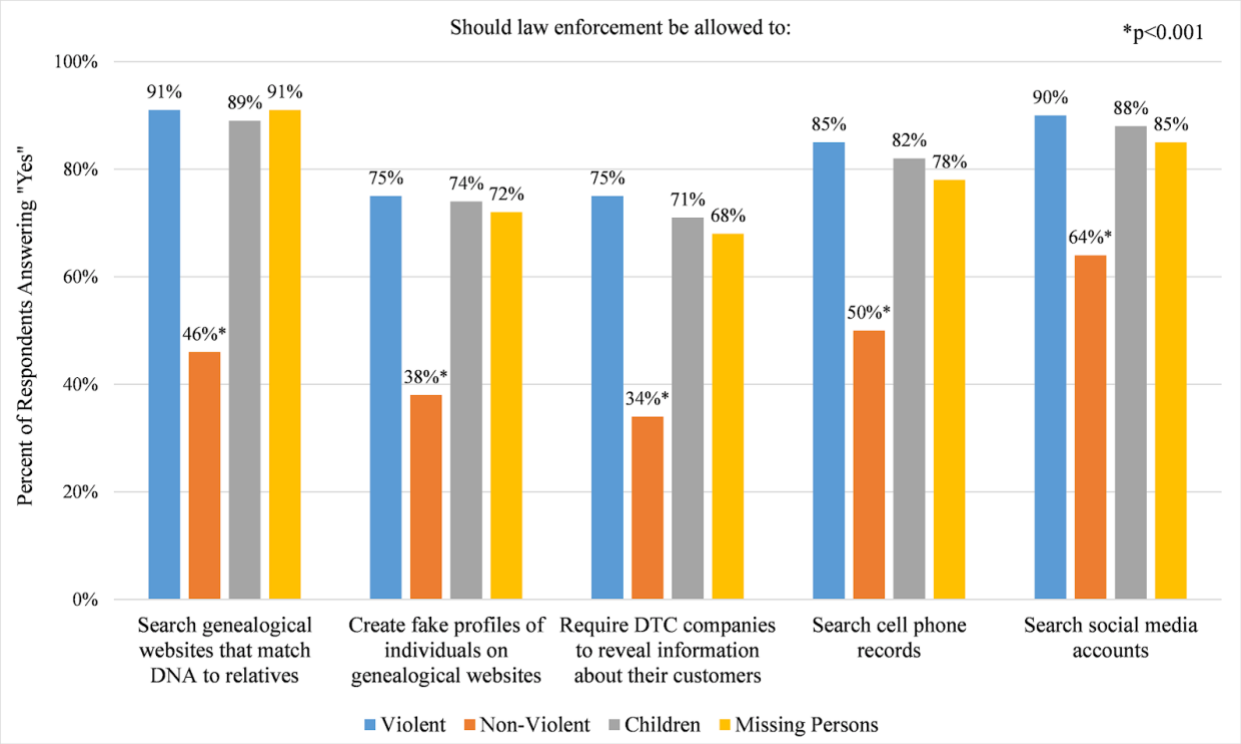

Figure 6: Public approval rates regarding law enforcement use of genealogical investigative techniques.

Source: "Should police have access to genetic genealogy databases? Capturing the Golden State Killer and other criminals using a controversial new forensic technique," Guerrini, Christi J., Jill O. Robinson, Devan Petersen, Amy L. McGuire. *PLOS Biology*. 2018.

After the *PLOS Biology* article was published, an independent genealogist in Ireland, Maurice Gleason, decided to complete a similar survey whose data pool consisted of other genealogists around the world [11]. When asked specifically if they would be comfortable with law enforcement agencies using DNA data on GEDmatch to help identify serial rapists and serial killers, 85% of respondents said yes. When asked if they would be comfortable if their DNA was used to help identify bodies or remains, 92% of respondents said yes.

In regard to whether law enforcement agencies need additional regulations put in place regarding the use of genetic genealogy, there was a mixed response, shown here in Figure 7:

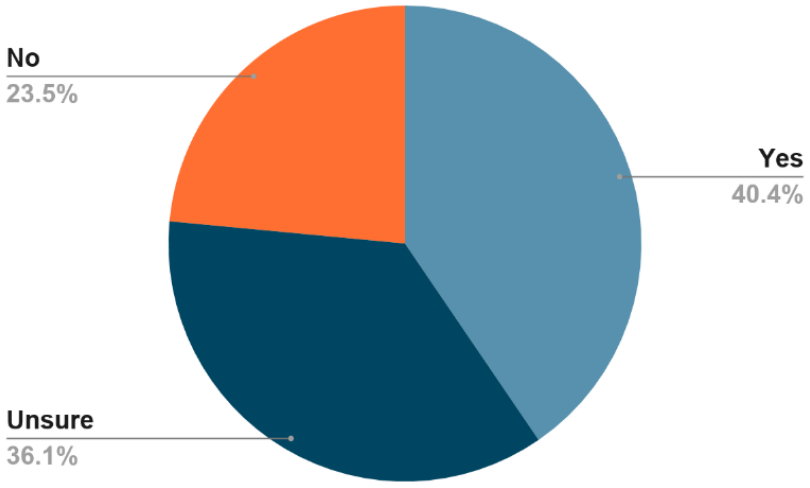

Figure 7: Percent of survey responses regarding the need of additional regulations for law enforcement's use of genetic genealogy.

Source: "How do you feel about your DNA being used by the police?," Gleason, Maurice. *Genetic Genealogy Ireland.* 2018.

When prompted for comment regarding their answer to this question many respondents were unsure of the current regulations in place and their effectiveness. The greatest concerns they had were related to the need for search warrants to access information, the possibility of targeting the wrong suspects, and possible abuses of the information by law enforcement.

Potential Misuse

In addition to the privacy concerns that were raised regarding genetic genealogy after the capture of the Golden State Killer, many also worried about the ways in which this technology could be misused, intentionally or otherwise. The process of genetic genealogy relies on the accuracy of the DNA technology, the matching software used, and the research skills of the genealogist involved, none of which are infallible. It is overwhelmingly agreed upon by all parties involved that genetic genealogy is *only* an investigative tool and should be used solely for the purposes of generating leads. It is up to law enforcement agencies to make sure the information gathered is thoroughly investigated and corroborated by other evidence, and that no suspect is prosecuted solely based on genetic genealogy findings.

CONCLUSION

It is clear there are advantages to using genetic genealogy that exceed its original intended use. Genetic Genealogy is not an investigative tool that was originally created for or presented to law enforcement, but rather it was an existing technique that officers utilized in a specific case and in doing so opened the door to a completely new application: crime-solving.

The data provided in this report proves that genetic genealogy has the potential to reduce the amount of unsolved cold cases and violent crimes, provide answers for the families of the victims, and get potentially dangerous perpetrators off the streets.

The benefits of genetic genealogy for human identification are too considerable to ignore, despite the concerns raised and limitations placed on its use. As these techniques continue to be used further regulations will undoubtedly be put in place by state or federal legislature. This will hopefully help to streamline the process and allow law enforcement and researchers to get the most use out of genetic genealogy with the least amount of interference. Additionally, It is important to keep the public informed of these new technologies and their ability aid investigations. Encouraging the public to volunteer their DNA results to police through the GEDmatch site is a necessary part of the process and will only grow the search pool and increase the probability of success.

Law enforcement agencies must be diligent about following the rules put in place by the DOJ and research databases, take great care to investigate all leads and corroborate evidence without prejudice or bias, and gather genetic genealogy information in *addition* to building a traditional case. If all of those practices are followed, genetic genealogy has the potential to help law enforcement solve the “unsolvable” for decades to come—with the public’s support behind them.

APPENDIX A: GLOSSARY

Autosomal DNA (atDNA): DNA located in non-sex chromosomes; contains genetic material inherited from all ancestors

Autosome: All non-sex chromosomes

Centimorgan (cM): a measure of genetic distance; the total number of cMs shared across all chromosomes can be used to determine how closely related two people are

DNA Chip: a collection of microscopic DNA spots attached to a silicon glass surface; used to detect Single Nucleotide Polymorphisms (SNPs)

DNA Profile: a small set of DNA variations that is unique to every individual

Locus/loci: specific physical location/s of a gene on a chromosome

Mitochondrial DNA (mtDNA): DNA located in mitochondria in each cell of the body; contains genetic material inherited through the maternal line

Nucleotide: organic molecules that form the basic structural unit of DNA; represented by the letters A (adenine), C (cytosine), G (guanine), and T (thymine)

Point Mutation: a single change, addition, or deletion to a sequence of DNA at a specific point

Short Tandem Repeat (STR): a tract of repetitive DNA that occurs at thousands of specific locations within an organism's genome

Single Nucleotide Polymorphism (SNP): a single point mutation at a specific locus, found in more than 1% of the population

Y-Chromosome DNA (Y-DNA): DNA located in the Y-Chromosome of male individuals; contains genetic material inherited through the paternal line

APPENDIX B: REFERENCES

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