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ABSTRACT

In the criminal justice system, not all offenders are brought to justice; unfortunately, cold cases exist and provide long-term challenges to investigators. From historic breakthroughs in forensic DNA analysis to today's new trends, advancements in technology continue to give investigators hope of resolving unsolved mysteries with no clear-cut suspect. This article examines the progression of DNA analysis over the past three decades and explores the recent trends in the use of genealogy websites to solve cold cases. DNA technology's innovative uses, from its early years to modern, are explored herein. By exploring traditional DNA analysis to advances that explore the potential for family-relationship connections in genealogy databases, one can observe the path that has led to the use of familial DNA analysis from these ever-popular ancestry databases used by civilians for lineage research. In examining the recent exploratory use of ancestry DNA databases for criminal-investigation purposes, the clear promise and pitfalls of such new technology are outlined for consideration.

KEY WORDS DNA Analysis; Familial DNA; Ancestry; Genealogy

A HISTORY OF MAJOR ADVANCES IN DNA ANALYSIS

Between the late 1970s and the mid-1980s, the Golden State Killer taunted the state of California by terrorizing his victims. While the people of California lived in fear, the Golden State Killer continued his spree of crimes. The belief is that the killer committed

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at least 12 murders, raping at least 50 victims, and committed more than one hundred break-ins. All the police knew was that he was a young white male. For more than 40 years, the sadistic serial killer lived as a free man. In April of 2018, the police used GEDmatch, a genealogy website that primarily assists users in discovering distant family members through DNA analysis. Law enforcement began innovatively using the database to assist in unraveling the mystery behind the identity of the Golden State Killer. After learning that a distant relative of the alleged killer was a consumer of GEDmatch, the police had a break with their first promising lead after more than 40 years of silence. The Golden State Killer made headlines again, but this time, he was no longer an unknown quantity; through investigators' use of the genealogical database, the long-sought criminal of legend had a name: Joseph DeAngelo. DeAngelo's arrest led to preliminary charges of multiple counts of first-degree murder after the police recovered DNA from GEDmatch that matched the uploaded crime-scene DNA. To understand how we arrived at ancestry database usage in criminal matters, we need to observe the beginnings of advance DNA use in forensics.

FROM FINGERPRINTS TO DNA—THE EVOLUTION OF IDENTIFYING FORENSIC ELEMENTS

Fingerprints are the ridge patterns on a person's skin are unique from person to person. Around the mid-1880s, Sir Francis Galton became interested in fingerprints, which led to him collecting thumb impressions (Lee 2001:32). By 1892, Galton's collection of fingerprints had created such a stir in the law-enforcement community that they were utilized in criminal cases as a form of evidence to be used for unique personal identification that could tie a suspect to a crime scene (Lee 2001:32). During the 1980s, DNA testing was available forensically for the first time. Like fingerprints, DNA is a unique genetic fingerprint of every cell in our body. The complex nucleotide code of each person is thousands of times more unique than a fingerprint, making the DNA much-sought-after gold standard of modern forensic evidence. The first DNA technique was restriction fragment length polymorphism, which exploits variations in DNA sequences (Geberth 2018). Geberth explains that "the RFLP technique involved the process of identifying polymorphic regions that are unique to each individual." Eventually, larger RFLP targets were replaced by much shorter pieces of DNA with unique repetitive sequences, allowing forensic scientists to examine more unique targets per sample and to develop a much more distinguishing DNA profile for drawing comparisons between profiles obtained from evidence and from suspect DNA standards. These new DNA targets were called short tandem repeats, or STRs.

If forensic scientists received a positive match indicating that the suspect was at the scene of the time during the committed offense, that result brought a strong case against the suspect. This concept introduced a driving force in the criminal justice system that is a major source of evidence in successful convictions today. Despite the rise in convictions, police labs still did not have a database to store convicted felons' DNA. By the 1990s, police finally expanded DNA use into databasing, whereby DNA profiles from cold cases or from felony-convicted offenders were cataloged for rapid cross-referencing

across new investigations and reopened cases with new leads. The ultimate goal of this database was to store the aforementioned profiles such that new cases could be connected to old, unsolved incidents and to help identify recidivists with felony convictions when individuals made another criminal mistake; by making these connections, investigators could ideally improve case resolution and deter former offenders from recidivating. This advancement in technology was formally called the Combined DNA Index System, or CODIS. According to Glen C. Forrest, "CODIS was developed by the US Department of Justice and the FBI and combines computer technology with forensics" (Forrest 2017:60). Because DNA profiles are electronically catalogued in an online-accessible database, "CODIS enable[s] investigators to compare DNA samples and is used worldwide for sharing and comparing DNA data" (Forrest 2017:60). Forrest also characterizes CODIS's availability as free to all police forensic laboratories, further alluding to the broad, expansive manner by which DNA profiles could now be shared and compared across geographic borders.

At first, CODIS helped provide a larger list of potential suspects via cold-case connections and felony-offender identifications; however, further developments would create a third means by which CODIS could be utilized. In the 2000s, technology expanded to allow police to look for suspects based on family relatedness through CODIS, so long as a family member was actually present in the system. Stefan Kiesbye states that "familial searching scours existing DNA databases for partial matches that suggest an unidentified suspect may be a close relative of someone in the database" (Kiesbye 2012:70–74). Kiesbye illustrates that the process of familial search "involves computerized comparison of DNA samples, then a ranking in another of the likelihood that the known offender profile generally related is to the unknown profile generated from crime scene evidence" (Kiesbye 2012:70–74). To summarize, familial DNA analysis utilizes the knowledge of parentage and family inheritance of DNA to establish partial matches to the evidence profiles of open cases. The new addition to CODIS introduced familial searches as a further enhancement to modern crime investigation by expanding the examination of potential suspects through comparison of profiles in CODIS with nonregistered family members as a means to net potential suspects previously not considered through traditional investigative leads. This new technology helped catch the notorious serial killer known as the Grim Sleeper and truly helped solidify the use of familial DNA searches through CODIS. The Grim Sleeper was an infamous serial killer who preyed on prostitutes and drug addicts during the mid-1980s in California. With the new technology of familial DNA, investigators discovered the Grim Sleeper's son was in CODIS and made a partial match to the known offender and an unknown relative, who was identified as the killer in the case. Determining that the son had been too young during the slayings, investigators tested his father's DNA after recovering it from a discarded slice of pizza; furthermore, a partial match secured the closure of the infamous case.

When police receive a partial match from the CODIS familial search, they may follow up by surveillance of the new suspect. Typically, to get a standard DNA profile to match against the evidence in their case, the police will follow the potential suspect until the suspect throws away something in the trash or on the ground, which is considered

public domain. The police then use the discarded waste to create a standard DNA profile from the suspect to compare with case evidence profiles and, in doing so, determine if probable cause sufficient for an arrest is present. The Grim Sleeper case, with its use of publicly discarded waste, highlights the importance of collection of DNA from discarded objects. Because cast-off items are often merely touched or make contact with a suspect in limited fashion, and because they frequently do not contain cell-rich sources of bodily fluids for high-quantity DNA harvesting, forensic scientists needed to establish more sensitive methods for DNA collection and profile development. Enter the concept of touch DNA analysis.

TOUCH DNA

At the start of DNA analysis, forensic scientists had to have a large amount of DNA to obtain a successful profile; typically, a body fluid stain the size of quarter was needed (*Scientific American* 2008). Today, the advent of touch DNA analysis requires only a few cells of skin shed onto an evidence item to successfully develop a full DNA profile. According to author Chris Anderson (2018), a person sheds about 400,000 skin cells per day. Skin cells shed onto surfaces that people come in contact with, and they remain deposited upon said items with a simple touch. Sample sizes of skin cells are very tiny; however, advances in DNA chemistry allow these cells to be tested forensically. According to author Joe Minor (2013), "touch DNA is evidence with no visible staining that would likely contain DNA from the transfer of epithelial cells from the skin to an object." The author of the article "What Is Touch DNA?" characterizes touch DNA as not requiring that someone be able to see the evidence; furthermore, investigators only need seven skin cells from the outermost skin cells to build a DNA profile (*Scientific American* 2008). Anderson (2018) illustrates the process of collecting skin cells for evidence as starting with swabbing a surface where an item was likely to be touched or handled. From just a few cells with limited quantities of DNA therein, the process known as polymerase chain reaction (PCR) is used to create multiple copies of the DNA retrieved from a piece of evidence (*Scientific American* 2008).

Today's PCR kits for forensic analysis have highly specialized primers to target specific spots (called loci) of human DNA, as well as a polymerase enzyme that can use only a few strands of DNA to make sufficient copies of DNA to develop a unique profile for comparative purposes. The DNA made via PCR is tagged with specific fluorescent markers, and through the use of capillary electrophoresis, a unique DNA profile is generated based on the size and charge of each molecular STR fragment present in the sample. This DNA profile is electronically generated in what is known as an electropherogram. An electropherogram displays the unique STRs present for each target from a forensic PCR kit. The electropherogram is a "specific genetic portrait of the person" (*Scientific American* 2008), so evidentiary electropherograms and electropherograms from suspect standards (e.g., buccal swabs or blood standards) are compared and the rarity of the evidence matching any other random unrelated person on the planet can be statistically calculated to establish the likelihood that the suspect was indeed the culprit responsible for a given misdeed. The loci from forensic kits today do

not reveal any specific information such as gender and race, as they are located in non-gene sequences in one's DNA (*Scientific American* 2008). Touch DNA evidence and familial CODIS searches were the most recent trend until 2018, when a novel expansion on the familial-search concept using genealogy websites created even newer possibilities for leads in cold cases.

GENEALOGY DATABASES: FROM PERSONAL INSIGHT TO FORENSIC INQUIRY

The growth of personalized "at home" DNA kits has increased extraordinarily over the past few years by a number of companies. All it takes is a swab of DNA from a person to unlock the past. These companies offer services such as locating family origins and identifying branches on family trees, and as such, they shed new light on stories that have gone untold in one's family history. A typical success story for a genealogy website might involve a reunion of birth parents with their son or daughter, for example. Genealogy websites such as Ancestry and 23andme bring people closer to learning about their ancestors and, with permission, connecting with distant family members. In addition, these at-home DNA kits can predict, using a person's genes, illnesses and potential health problems. In recent trends, these genealogy websites have become a tool for users of law enforcement in attempts to crack cold cases. Specifically, ancestry-based databases have become a recent part of the novel expansion into forensic DNA analysis.

Genealogy websites have thousands of users, with a sample of their DNA stored as a result of these at-home kits becoming common in many retail consumer outlets. Based on the widespread use and multitude of DNA profiles in these ancestry databases, investigators have a new database type under which they can expand their familial searches, which were once restricted to CODIS alone. The police create an account with a genealogy website, and the DNA they send to the company is from a cold case. For instance, GEDmatch offers a comparison of the submitting user's profile and the genetic code given to their site to more than one million other profiles, giving investigators who submit DNA to the database site a rather large filter through which to snag a potential suspect based on ancestry, thereby expanding on the relationship-based matches traditionally completed via CODIS search.

Indiana has a success story of its own relating to cold-case resolution using ancestry-based DNA databases. In July of 2018, a nightmare finally ended in Fort Wayne after recent developments in the April Tinsley case. In July of 2018, a case unsolved since 1988 was finally closed after Tinsley's killer confessed to the abduction, sexual assault, and murder of the eight-year-old girl. Investigators used a genealogy website that narrowed their search of suspects to two brothers. After used condoms were recovered from the trash can of one suspect so as to gain a suspect standard for comparison against the Tinsley case evidence, DNA tests confirmed a match to John D. Miller, one of the brothers identified as a possible suspect through familial DNA analysis on an ancestry site. After being brought into custody, Miller confessed to the murder.

Between the Tinsley case in Indiana and the use of ancestry profiling to identify the Golden State Killer, the breakthrough potential of genealogy databases for familial

DNA suspect development certainly appears to have merit. In fact, the site GEDmatch has been linked to five additional U.S. cold cases in Washington and Pennsylvania (Maron 2018), where investigators are using its potential to provide new insights into suspect development. Although these stories certainly bring promise to resolution of once unresolved cases, it is important to look at both the benefits and the limitations of this incredibly new resource for investigation.

PROS OF GENEALOGY DATABASES

Cold cases always seem precarious to law-enforcement agencies and the public in general because no criminal is brought to justice and families never receive closure from the justice system. Any advancement in technology that increases the chances of a cold case being solved are welcome additions to the proverbial toolkit of the modern criminal justice system. Currently, GEDmatch's database appears to be the biggest source upon which investigators may draw leads because it allows people to upload their DNA information from any genetic kit or consumer company for comparison, which makes the samples openly accessible to search, unlike the Ancestry and 23andme websites, which make users send in a swab of DNA so the company can process the swab, make its own profile, and then make comparisons across uniform DNA profiles developed by the company's consistent in-house methods (Shapiro 2018).

Receiving a match from GEDmatch and other ancestry websites can generate a list of genetic relatives who share a significant portion of DNA with a potential suspect (Legacy Tree, N.d.). Thus, the list of genetic relatives helps investigators identify a distant relative who can be surveilled to garner a standard to compare to cold case evidence. In terms of genealogical distance, ancestry databases are capable of tracking as far back as distant cousins to be matched; in some cases, partial matches can be traced as far back as a second, third, or fourth set of great-grandparents (Legacy Tree, N.d.). According to author Justin Jouvenal (2018), newspaper articles, census records, and obituaries are used to build a family tree. The author of "The Secrets in Your Spit" states that "in case of criminal investigations, once these individuals are identified, contemporary DNA samples obtained are from discarded materials" (Legacy Tree, N.d.). The author also states that "these new sample standards are used to compare against the crime scene evidence" (Legacy Tree, N.d.).

In summary, ancestry databases have given the police a new tool in the search for potential suspects not found in criminal databases. With early successes in cases such as the Golden State Killer and April Tinsley cases, there has been an expansion of investigators using genealogy in hopes of solving their cold cases. Despite the recent success of familial-based ancestry DNA searches, forensic scientists and criminal-justice scholars fear there could be too much rapid reliance on this new trend and that the potential of an innocent suspect being tracked down by genealogical means could overshadow the successes of the budding method.

POTENTIAL CONCERNS WITH GENEALOGY DATABASES

Wrongful convictions wrought from ill-utilized or poorly researched forensic methods have cost states millions of dollars in wrongful-conviction lawsuits (Augenstein 2016, 2018a,b). The precedence of misused or abused forensic tools leading to wrongful convictions could find further credence if investigators maintain to use these promising genealogy websites without having stringent guidelines to use such resources, or a better understanding of the pitfalls of ancestry DNA testing. As more headlines sweep across the country, the impression appears that the police heavily use this tool as the main contributor.

Currently, no investigative agency or forensic laboratory has concrete guidelines for the police to follow when deciding whether to use genealogy sites, or how to appropriately make use of their services, for that matter. Furthermore, if the police find a potential suspect, they surveil the suspect in a public place until the suspect throws away trash that can be used to generate a touch DNA sample for comparison against crime evidence. The discarded trash obtained by the police is legally collected, as the waste is viewed as abandoned source of evidence in a public place without the need for privacy concerns or warrant use.

To date, the Golden State Killer and April Tinsley's killer await trial, presently acting as the sole examples of alleged success of genealogy to solve criminal matters. Tinsley's alleged killer confessed to the chilling crime, giving some support in favor of ancestry database usage, but this still is an individual case and by no means a source of statistical significance in favor of this method.

Although this trend glimpses a bright future, there has not been a case involving genealogy as the main source of forensic evidence. In fact, forensic science laboratories currently do not support the use of genealogy profiling as a source of evidence for courtroom use. Paul Misner, Biology Section Supervisor for the Indiana State Police Crime Laboratory, has publicly stated that DNA targets used in forensic DNA kits today are quite different from the DNA targets analyzed using ancestry DNA kits from genealogy agencies, going so far as to state that comparing forensic DNA targets to genealogy DNA targets is akin to "comparing apples to oranges" (Houser 2018). Given that the DNA tested from consumer DNA kits looks at all the DNA (genomic sequencing), protein coding parts (exome sequencing), or very small targets called single nucleotide polymorphisms that are smaller even than the STRs used in forensic kits, it does appear that genealogy comparisons using a mix-and-match approach tocompare profiles between methods is ill-advised, as incorrect profile inclusions or exclusions could result when attempting to make a match (Saey 2018a,b).

A clear issue with genealogy comparisons using profiles from forensic-evidence profiles thus arises, where incorrect comparisons, if enacted without proper research and groundwork to validate ancestry-based searches, could lead to wrongful convictions. Such a potential outcome is in fact a pressing concern, given that the website GEDmatch allows literally *any* DNA profile developed from any number of variable genetic-testing kits to be uploaded into its online database (Curtis 2018). Given that Indiana State Police Biology Supervisor Paul Misner stated that comparing different DNA targets across different genetic kits is like comparing two fruits of vastly different origins and looking for

similarities, the concern becomes apparent: so-called inclusive suspect leads and assumptions of relation are being made in cold cases without any strongly established precedent or proven validity clearly demonstrating that DNA profiles from crime-based and non-crime-based genetic testing kit results should be liberally compared and contrasted.

As Mr. Misner alluded, in using this form of search for cold-case suspects, America is currently, in fact, comparing apples to oranges and accepting the results as legally and scientifically permissible, which could prove disastrous for the long-term potential of familial genealogy-based forensic searches. To make matters worse, genealogy-based searches are internationally rejected because of the lack of scientific rigor behind such new methods. In New Zealand, police and forensic-science laboratories are rejecting consumer-focused genealogy-based searches currently and are reviewing their current, highly restrictive familial-search DNA laws to determine if the more generalized search methods using consumer DNA profiles employed by sites such as GEDmatch are legitimate and legally permissible (Coster 2018).

To boil down the ramifications of these claims: Countries outside the United States fear that playing mix-and-match with widely varying DNA profiles using completely different genetic testing kits and chemistries could lead to false convictions and call into question forensic DNA methods of this sort. These countries instead opt for level-headed analysis of the full merits and flaws of consumer ancestry lead developments before actually presenting such findings in court without proper proof that these methods are accurate and reliable. With modern forensic DNA kits analyzing a handful (24 to 27) of loci (targets) from crime evidence for suspect profile development, and genealogy kits having upwards of 35,000 more targets (Coster 2018) under analysis in their profiles, using chemistry and components that vastly differ between products to garner distinctly different DNA profiles, logic would dictate that formative scientific research looking at profile accuracy between kits should occur before genealogy profile uploads are trusted for convictions. For the time being, America appears to be putting the proverbial cart before the horse in this particular matter as it applies to creating new leads in old cases using DNA analysis.

Accuracy of genealogy kits and databases provides yet another source concern to address. Fox59, a news station in Indianapolis, Indiana, did a study comparing results from two genealogy websites. According to author Aishah Hasnie (2018), “Fox 59 asked four employees who previously took a DNA test on their own, to do it again; furthermore, they wanted to see how their new results matched up with their original results.” In this study, Anchor Jim O’Brien became the first team member to compare results; the newest test came back close to the original test. Anchor Neal Moore’s tests were the most accurate, confirming the same ethnicity. The last two tests, for anchors Brandi Ostojic and Jordan Morton, were troubling; the tests provided different results.

In another case of inaccurate at-home DNA results, pharmacist Julie Kennerly-Shah received a false-positive result for two serious medical syndromes from a third-party DNA testing agency, indicating that private DNA testing kits are still lacking in terms of scientific accuracy and research rigor (Coast Live 2018). Coinciding with this study, Tina Saey of Science News analyzed her DNA across multiple ancestry-testing agencies. Saey found that each consumer testing agency used netted mixed results, from

well-explained and detailed DNA data to generalized and vague results that contrasted what she knew about her lineage (2018a,b). Shana Dennis found that reports of her Chinese ancestry varied between 29 percent and 58 percent , depending on which consumer DNA testing service she used, leading her to question how accurate geanlogy-based DNA testing services are, and to challenge the public's tendency to fully invest in "scientific results" without actually understanding the methods behind them or the accuracy thereof (Lawton and Ifama 2018). In summary, varied results from multiple websites opens up a theoretical concern about genealogy database usage, in the form of what the authors of this document would like to coin "genetic phishing," whereby investigators could shop their evidentiary DNA samples around until finding a company that would produce a hit suiting their subjective (and unethical) pursuit for a suspect.

In addition to comparison concerns and accuracy issues, legal consequences of genealogy testing provides yet another venue to critique this new forensic trend. After the announcement of the arrest of Joseph DeAngelo as the primary suspect in the Golden State Killer case came from a distant relative who was a member on GEDmatch, it created a burning question: Is this genetic dragnet method legal? GEDmatch considers itself a public website, and anyone has access to view its content. The DNA uploaded to ancestry sites such as GEDmatch from evidentiary samples is inherently acceptable because it is collected via legally accepted means. The DNA that becomes concerning for legal scholars is so-called waste DNA, which is the DNA taken from items discarded in public-access trash receptacles or discarded without the source's knowledge of its potential for use in criminal cases. The use of non-warrant-retrieved evidence currently is seen as constitutionally valid per a landmark ruling by the U.S. Supreme Court in 2013, whereby collection of DNA from public sources (e.g., sidewalks, public trash cans) and collection upon arrest do not violate Fourth Amendment considerations to privacy because DNA is seen as being no more invasively used for biometric identification than its counterpart, the fingerprint (Ford 2018).

Even though a person whose DNA is collected from discarded items in connection with a crime is not legally aware of the suspicion surrounding him or her, no legal intervention of collection from such sources has brought significant merit in the American legal system. Speculation as to the legality of such sources for DNA arises again when the police obtain a suspect lead from a genealogy website whose use is for relatives to learn about their heritage. In fact, in the wake of ancestry dragnets for criminal investigations, many genealogy websites have shuttered their database access until more rigorous privacy policies can be enacted, citing investigative use as being an unexpected and unwarranted intrusion upon the original intent of their databases and the DNA profiles submitted to their organizations via consumer access (Augenstein 2018b; Balsamo and Cooper 2018; Hemphill 2018).

Unlike Ancestry and 23andme, which have specific privacy policies that protect users, some sites such as GEDmatch do not protect their users from law enforcement, however, leaving consumers to be unwitting genetic informants on their loved ones. Without the protection from law enforcement that allows for warrant-less DNA collection, and now through the use of public-access genealogy sites lacking proper legal protection of DNA profiles uploaded to their databases, the police currently have free rein

to pursue suspect leads that, while legally permissible in the United States, lack the expected ethical rigor in developing logical suspect leads from typical detective work. According to author Seth Augenstein, "in Europe, recently the General Data Protection Regulation [GDPR] basically [gave] members of the public more rights over the use of personal information" (Augenstein 2018b). As such, international protections regarding access of consumer DNA profiles appear to be much stronger than that provided to American genealogy enthusiasts here in the United States. Without privacy laws that logically protect people and their DNA from unwilling or unknowing use in criminal matters, civilians are afraid that law enforcement agencies will continue to abuse their authority because of legal loopholes that do not consider ancestry-profile databases as private sources of DNA evidence for comparative purposes.

One must also consider future ramifications pertaining to DNA being collected and stored on ancestry databases as it pertains to upcoming forensic applications. Currently, much research has been invested into phenotypical, or physical-feature, DNA analysis for forensic purposes. Recently, forensic scientists were able to create a composite sketch of a suspect's face and provide a physical-feature report for a suspect in a case more than 40 years old using new DNA targets (Levenson 2018).

Given how creative investigators are in their pursuit for suspect leads, one can conjure ideas for the next use, and therefore area of possible misuse, regarding ancestry databases. For instance, consider the genealogy databases that upload a consumer's whole genome, which is the entirety of one's DNA makeup. Instead of merely comparing forensic DNA loci or genealogy loci for suspect-lead development, one must ponder the potential for investigators to take phenotypic forensics and extrapolate its benefits to whole genomes currently being untapped across untold genealogy databases. Imagine a future, then, in which consumers are unwitting investigators, unknowingly proffering up their DNA sequences for phenotypic DNA analysis leading to race, gender, and physical feature characteristics (e.g., eye color, hair color) being conjured against themselves or close relatives, with the result that they become suspects in cold cases. If ancestry databases can be used without knowledge or consent from investigators in the Golden State Killer case, one must ponder what the next unforeseen use of consumer DNA databases and ancestry databases will be in the never-ending quest for justice.

CONCLUSION

Closure is the missing piece in every cold case, and the recurring challenge for investigators. Advancements in recent trends of genealogy have provided a new way with which to resolve cold cases. By using the DNA of family members who are consumers of genealogy company products, investigators today have a new resource from which to establish new leads for suspects. Once investigators find a potential suspect, the police surveil the suspect until they can obtain public-access items for suspect DNA profile standard development. These discarded items and the profiles of persons therein are then used on genealogy sites to establish familial leads akin to those of the successful familial searches once restricted to CODIS database profiles. The public is now concerned that this process is illegal because of their giving investigators unwitting access to their DNA

and the familial relationship stories it can tell, yet the methods currently being used by modern investigators are so new that such legal ramifications have yet to be tested in a court of law. Furthermore, accuracy concerns and comparisons between vastly different forms of DNA targets and genetic chemistries draw increased scrutiny down upon this novel method for suspect-lead generation. Although actual suspects having been identified in decades-old cases gives cause for further research into the utility and validity of searching genealogical database for forensic and investigative purposes, one must also ponder the perils of adopting methods lacking sufficient scientific discourse that could easily be batted away pending one ill-fated Daubert hearing.

REFERENCES

Anderson, Chris. 2018. "Tyson Case: Attorneys Say Use of Touch DNA to Show Guilt is Rare." *Herald Tribune*. Retrieved July 21, 2018 (http://www.heraldtribune.com/article/LK/20120322/News/605198559/SH/).

Augenstein, Seth. 2016. "Flawed FBI Hair Analysis Leads to $13.2M Wrongful Conviction Lawsuit." *Forensic Science Magazine*. Retrieved August 9, 2018 (https://www.forensicmag.com/article/2016/03/flawed-fbi-hair-analysis-leads-132m-wrongful-conviction-lawsuit).

Augenstein, Seth. 2018a. "DNA Mixture Analysis Thrown Out of Texas Murder Trial—But Software Debate Remains." *Forensic Science Magazine*. Retrieved August 9, 2018 (https://www.forensicmag.com/news/2018/06/dna-mixture-analysis-thrown-out-texas-murder-trial-software-debate-remains).

Augenstein, Seth. 2018b. "Golden State Killer Backlash? Public Databases Shutting Down in Wake of Arrest." *Forensic Magazine*. Retrieved August 9, 2018 https://www.forensicmag.com/news/2018/05/golden-state-killer-backlash-public-databases-shutting-down-wake-arrest).

Balsamo, Michael, and Jonathan J. Cooper. 2018. "Genealogy Website Didn't Know It Was Used to Seek California Serial Killer." *Pioneer Press*. Retrieved August 9, 2018 (https://www.twincities.com/2018/04/27/golden-state-killer-genealogy-website-used-dna/).

Coast Live. 2018. "How At-Home DNA Testing Can Go Wrong on Coast Live." WTKR 3. Retrieved August 9, 2018 (https://wtkr.com/2018/06/13/how-at-home-dna-testing-can-go-wrong-on-coast-live/).

Coster, Deena. 2018. "Law Commission Review of DNA Law Will Look at Use of Genealogical Websites." Retrieved August 13, 2018 (https://www.stuff.co.nz/national/106202343/law-commission-review-of-dna-law-will-look-at-use-of-genealogical-websites).

Curtis, Caitlin. 2018. "Online Genealogy Has Created an Unregulated Forensic Database for Police." ABC News. Retrieved August 13, 2018 (http://www.abc.net.au/news/science/2018-08-13/online-genealogy-police-dna-databases-golden-state-killer/10094220).

Ford, Matt. 2018. "How the Supreme Court Could Rewrite the Rules for DNA Searches." *New Republic*. Retrieved August 9 2018 (https://newrepublic.com/article/148170/supreme-court-rewrite-rules-dna-searches).

Forrest, Glen C., ed. 2017. *Police Technology: 21st Century Crime-fighting Tools.* New York: Britannica Educational Publishing.

Geberth, Vernon J. 2018. "30 Years of DNA Technology.'' *Forensic Magazine*. Retrieved June 17, 2018 (https://www.forensicmag.com/article/2017/03/30-years-dna-technology).

Hasnie, Aishah. 2018. "Fox59 Finds Out: How Accurate Are DNA Ancestry Kits?" Retrieved June 21, 2018 (https://fox59.com/2018/05/23/fox59-finds-out-how-accurate-are-dna-ancestry-kits/).

Hemphill, Anjali. 2018. "Golden State Killer Case Raises Privacy Concerns about DNA Submitted to Genealogy Websites." Fox 5. Retrieved August 9, 2018 (http://www.fox5dc.com/news/local-news/golden-state-killer-case-raises-privacy-concerns-about-dna-submitted-to-genealogy-websites).

Houser, Shannon. 2018. "New DNA Tools and Technology Help Investigators Solve Decades-Old Crimes." Fox 59 News. Retrieved August 9, 2018 (https://fox59.com/2018/07/17/new-dna-tools-and-technology-help-investigators-solve-decades-old-crimes/.)

Jouvenal, Justin. 2018. "To Find Alleged Golden State Killer, Investigators First Found His Great-Great-Great Grandparents." *Washington Post*. Retrieved June 20, 2018 (https://www.washingtonpost.com/local/public-safety/to-find-alleged-golden-state-killer-investigators-first-found-his-great-great-great-grandparents/2018/04/30/3c865fe7-dfcc-4a0e-b6b2-0bec548d501f_story.html?noredirect=on&utm_term=.f5a9ebd0be2a).

Kiesbye, Stephan, ed. 2012. *DNA Databases.* Farmington Hills, MI: Greenhaven Press.

Lawton, Georgina, and Daisy Ifama. 2018. "'It Made Me Question My Ancestry': Does DNA Home Testing Really Understand Race?" *Guardian*. Retrieved August 13, 2018 (https://www.theguardian.com/lifeandstyle/2018/aug/11/question-ancestry-does-dna-testing-really-understand-race).

Lee, Henry C. 2001. *Advances in Fingerprint Technology.* Boca Raton, FL: CRC Press.

Legacy Tree. N.d. "Using Your Spit: Genetic Genealogy to Solve Cold Cases." Retrieved July 13, 2018 (https://www.legacytree.com/blog/the-secrets-in-your-spit-using-genetic-genelogy-to-solve-cold-cases).

Levenson, Eric. 2018. "Scientists Sketched Out a Suspect's Face Using DNA from a 42-Year Old Cold Case." CNN News. Retrieved August 9, 2018 (https://www.cnn.com/2018/07/24/us/cold-case-marinette-camping-trnd/index.html).

Maron, Dina Fine. 2018. "Cold Cases Heat Up as Law Enforcement Uses Genetics to Solve Past Crimes." *Scientific American*. Retrieved August 10, 2018 (https://www.scientificamerican.com/article/cold-cases-heat-up-as-law-enforcement-uses-genetics-to-solve-past-crimes/).

Minor, Joe. 2013. "Touch DNA: From the Crime Scene to the Crime Lab." *Forensic Science Magazine*. Retrieved August 9, 2018 (https://www.forensicmag.com/article/2013/04/touch-dna-crime-scene-crime-laboratory).

Saey, Tina Hesman. 2018a. "Consumer DNA Testing Promises More Than It Delivers." Science News. Retrieved August 9, 2018 (https://www.sciencenews.org/article/consumer-genetic-testing-dna-genome).

Saey, Tina Hesman. 2018b. "What I Actually Learned about My Family after Trying 5 DNA Ancestry Tests." Science News. Retrieved August 9, 2018. (https://www.sciencenews.org/article/family-dna-ancestry-tests-review-comparison).

Scientific American. 2008. "What Is Touch DNA?" Retrieved July 21, 2018 (https://www.scientificameric.com/article/experts-touch-dna-jonbenet-ramsey/).

Shapiro, Emily. 2018. "How DNA and Genetic Genealogy Are Becoming Major Game-Changers in Decades-Old Cold Cases." ABC News. Retrieved August 10, 2018 (https://abcnews.go.com/US/dna-genetic-genealogy-major-game-changer-heat-decades/story?id=56172244).