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Dna Testing Is the Most Effective Procedure to Solve Crimes

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DNA TESTING IS THE MOST EFFECTIVE

PROCEDURE TO SOLVE CRIMES

by

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of the Requirements for the Degree

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Abstract

There are several different techniques to solve crimes. Fingerprinting has been used as an investigative tool to help law enforcement find suspects. By using the fingerprints obtained at a crime scene, investigators can try to find a match within the fingerprint database. Since fingerprints are truly unique, there are better technological advances that will aid law enforcements and forensic scientists confirm a suspect was at the crime scene. By using DNA, deoxyribonucleic acid, technology, established in 1985 but was first used in 1987 in law enforcement, as the main investigative tool, several different crimes can be solve by analyzing the evidence gathered at a crime scene. Since DNA is as highly variable as a fingerprint, it can help forensic scientists and law enforcement have a clear and effective way to identify any persons involved at a crime scene. Since law enforcement agencies are establishing DNA profile databases, it will help law enforcement agencies around the nation identify a suspect if the suspect commits a crime in another state and see if they have any outstanding warrants against them. DNA technology, which is also being called the chemical fingerprint, is still currently evolving and is becoming more efficient for both law enforcement agencies and forensic scientists.

CHAPTER 1

Introduction

In the United States, deoxyribonucleic acid or DNA analysis is almost exclusively used to investigate violent crimes. The use of deoxyribonucleic acid to identify, confirm, or exonerate suspects has become a staple for many law enforcement agencies. It has become one of the most effective processes to investigate violent crimes. It has also become an effective way to improve clearance rates for violent crimes, particularly in rape cases. The effectiveness of DNA in violent crimes have led to efforts to expand DNA evidence collection and processing to other types of crimes, for instance, property crimes.

In recent years, many have argued against using genetic material, DNA, to develop measures to genetically profile criminals and suspects. These profiles can be used as unique identifiers because this type of profiling is closely linked to racial profiling. Since the inception of forensic DNA profiles, these profiles have been used to free more than 140 wrongfully convicted prisoners. Some of these convicted prisoners were on death row and some have served decades for rape they did not commit. Law enforcement can occasionally solve cold cases and catch a rapist or other perpetrators that have left their genetic material behind. This, essentially, can be matched with the DNA profile that exists in the database (Ossorio & Duster 2005).

Statement of the Problem

While there are many concerns about forensic DNA databases, many have argued these databases go against biomedical ethics. Since these databases are used in a complete different matter, forensic scientists have counter-argued that the DNA databases are constructed from other biomedical tools. These databases are used in the struggle against crime. The decision to create or store a genetic profile is made solely by law enforcement and government officials (Patyn & Dierickx 2010).

Most of the European Union Member States have established a national forensic DNA database since the mid-1990s. These mass DNA profile databases have enabled law enforcement agencies to identify DNA stains found at crime scenes. Many government officials have argued that the person's privacy is not violated. By emphasizing that the stored DNA profiles do not contain sensitive genetic information, these profiles are under the highly regulated statutory privacy protection regulations. It has been generally overlooked that the law enforcement officials store the DNA samples. Even though these DNA samples are actually a potential source of genetic information, these samples have not been the subject of discussion. Both European and United States regulations offer inadequate protection to completely prevent the use of these forensic DNA samples for purposes beyond the time of collection (N. Van & Dierickx 2008).

Overview of the Problem

Deoxyribonucleic acid, or DNA, is the single most important building block in life. In the world of criminology, DNA can be used to help guide law enforcement in the right direction in several different cases. In recent events, forensic scientists in Israel have demonstrated that there are possibilities of DNA evidence being tampered with. This undermines the credentials that DNA testing and analyzing is the gold standard in evidence processing. These scientists have fabricated blood and saliva samples, which contain DNA, from a person other than the original person. The scientists demonstrated that if they access the DNA profile in the database, they could create a new sequence to match the sequence in the profile. This can be easily done without getting access to the original tissue sample. The scientists can fabricate DNA samples by amplifying the tiny sample into a large quantity of DNA by the genome amplification process (Pollack 2009).

Fabricated DNA evidence could be planted in a crime scene can create more problems than creating solutions for law enforcement agencies. By using the same techniques to extract the DNA sequence for genetic testing, scientists can extract DNA from a discarded cup, cigarette butt, a used tissue, a hair follicle, or anything a person has used to create a DNA sequence and plant that DNA at a crime scene. A science advisor for the American Civil Liberties Union, Tania Simoncelli, stated these new findings are something to worry about in the criminology field. Since the criminal justice system relies on DNA analysis technology to solve crimes, the fabricated DNA sequence can be more easily planted at a crime scene than a fingerprint (Pollack 2009).

Purpose of the Project

There are many different perceptions about deoxyribonucleic acid, or DNA, testing in the world of criminology. The potential of modern forensic science techniques in the investigation of sexual violent cases has a significant role as a scientific method to process the evidence in criminal justice. While using DNA testing as a forensics protocol, sexual assault cases can demonstrate the importance of physical and forensic evidence that will resolve many cases. Since the first use of DNA technology in law enforcement has helped solve crimes, it can be used throughout the crime spectrum. It is highly important that this technology is utilized to investigate any evidence obtained from crime scenes because there is a possibility of a suspect leaving any physical and forensic evidence. With the success of DNA technology and testing protocols, it is important to have all DNA evidence processed through the various DNA technologies available to forensic and law enforcement agencies.

Definitions

Case verification

The labor and non-labor process resources used by the state crime lab to determine if the offender's DNA matches a sample in the State DNA Index System, SDIS, in the state of offence. This process will include the cost of reanalyzing the sample and reporting the match to the local crime lab. Usually this process will occur if the Combined DNA Index System Entry, CODIS, has a match to an offender in the SDIS and does not have a forensic match (Roman, Reid, Reid, Chalfin, Adams, and Knight 2008).

Combined DNA Index System or CODIS Entry

The labor and non-labor process resources used after obtaining the genetic profile. This process occurs prior to uploading the profile into the Combined DNA Index System, CODIS. The process includes recording the DNA profile, determining if the profile meets the proper criteria for CODIS uploads, uploading the DNA profile into the CODIS, and the reviews that are appropriate for the process (Roman, Reid, Reid, Chalfin, Adams, and Knight 2008).

Deoxyribonucleic Acid or DNA

Deoxyribonucleic acid, or DNA, is the genetic material found in every living cell. The DNA structure is a long, filamentous molecule that is two strands twisted into a double helix.

DNA is a polymer of four nucleotides: Adenine (A), Guanine (G), Cytosine (C), and Thymine (T). DNA is a genetic molecule where the information is encoded by the specific sequence of nucleotides (Friedman 1999).

DNA Testing

DNA testing is a 3-step process that involves, first, generating a DNA profile. Second, in the case of a crime, the crime scene DNA profile is compared to a suspect. If the DNA profiles differ at any given point, the suspect is excluded from the crime scene evidence. Finally, if a match does occur, the random match probability, which is the statistical value that estimates the likelihood of an individual is picked from a population by chance, is calculated. If enough genetic identifiers are examined and are determined to be rare, the random chance of selecting an individual with the same DNA type could be as low as 1 in several trillion. Considering how populated the earth is, it is evident why DNA testing highly valued (Friedman 1999).

Forensic DNA Profiling

Forensic DNA profiling, first used in 1986 in England, is used to help identify a suspect. The sample collected from a crime scene is analyzed and matched to an established DNA profile in the database. Restriction Fragment Length Polymorphism (RFLP) remains a widely used method of DNA identity testing (Friedman 1999).

National DNA Index System (NDIS)

In 1994, a national data bank of DNA profiles was established after the DNA Identification Act passed. This database contains DNA profiles that can be searched by crimes laboratories throughout the country to solidify their efforts to identify a suspect of a crime and link the DNA sample from one crime to another (Roman, Reid, Reid, Chalfin, Adams, and Knight 2008).

Profile generation

The labor and non-labor process resources that expends once the sample has been identified as human DNA and prior to creating a profile in the database. The process includes DNA extraction, quantification, dilution, concentration, sample cleanup, amplification, gene mapping identification, and proper review procedures (Roman, Reid, Reid, Chalfin, Adams, and Knight 2008).

Summary

The *American Heritage Dictionary* defines science as the observation, identification, description, experimental investigation, and theoretical explanation of a phenomenon (American Heritage Dictionary, 1992). When science is applied to the field of criminology, it can be deduced that forensic science is the observation, identification, description, experimental investigation, and the theoretical explanation of a crime. Forensic science is among the most ancient of human endeavors. Long before recorded history, crime scene investigators wanted to apply physical evidence to support or contest eyewitness testimony, which was the foundation to the development of crime theories.

CHAPTER 2

Review of the Literature

This literature review was accomplished by accessing Regis University online library resources and various electronic academic databases to locate scholarly articles. Databases accessed included: Academic Search Premier and EBSCOhost. Additionally, Regis interlibrary loan services provided scholarly articles not available online. To search for pertinent literature, databases mentioned above were queried by entering subject terms and keywords, such as "criminology", "DNA profiling", "genetics", "DNA testing", "tampering", "forensic science", "forensics" and "evidence". As a result, a thorough review was conducted including examination of seminal literature on the development and content of forensic science and criminology.

This literature review revealed a number of researchers analyzing the use of genetic material in the field of criminology. In the existing literature, there are noticeable differences of creating and using DNA profiles to positively identify suspects. It has also been shown that while DNA can be found at any crime scene, it is possible for DNA to be fabricated and planted in any crime scene. Since there are new obstacles, many researchers argue strongly that DNA testing and profiling is still an essential part in criminology.

Theoretical Framework

DNA evidence has led to a considerable amount of suspect identifications and arrests than any other evidence processing protocols. With the aid of the Combined DNA Index System (CODIS) database, identifying a suspect was twice the rate than the other testing procedures. With the help of the CODIS database, suspects were three times more likely to be arrested if there was a match. Since DNA has been applied to the most serious crimes, suspects identified using DNA evidence has a substantially more serious criminal history than those identified through the traditional investigative approach.

Every human cell, with the exception of sperm and eggs that only contain half the DNA, contains more than 7 billion pairs of nucleotides. DNA sequences are highly different between two individuals, with the exception of identical twins. Nonetheless, not all regions are equally variable. Some, such as the hemoglobin gene, are highly conserved. These tend to be identical between individuals. Variations in the hemoglobin gene can result in genetic disease, for instance, sickle cell anemia. Other loci are highly variable, which prevents two people from having the same DNA sequence (Friedman 1999).

Forensic science is a historical discipline in its very nature. Physical and biological traces left by the human body can determine whether a person has been in a particular place or in contact with another person or object, which may include DNA and fingerprints, iris scanning, photographs, or images on CCTV (close-circuit television) cameras. Among these biometric identifiers, DNA profiling has become the most frequently used to help identify individuals. This type of profiling has become an essential tool in crime prevention, detection, and deterrence. Since there are an increasing number of countries investing in computerized forensic databases, it enables law enforcement agencies and forensic experts to compare DNA profiles and fingerprints from the crime scenes to the automated basis (Machado & Silva 2012).

Forensic scientists are using genetic techniques and knowledge generated through biomedical research, have forged on to develop methods for genetic profiling of suspects. These profiles may uniquely identify individuals. Genetic technologies and discoveries can be useful to law enforcement. By testing 13 highly variable regions of the human genome, scientists can create a genetic profile that uniquely identifies an individual. Forensic DNA profiling has been used to free more than 140 wrongfully accused prisoners, some of whom were on death row, and others served for rapes they did not commit. Law enforcement occasionally can score a cold hit and catch a rapist or other perpetrator who leaves biological material at the scene of the crime. This technique can be used to help officials match the DNA from the crime scene to a DNA profile that already exists in the database (Ossorio & Duster 2005).

There are three different ways for law enforcement to use genetics to solve crimes. First, the practice is to use DNA in post-conviction situations to determine whether there was a wrongful conviction, a practice that can help free the innocent. This does not require the DNA profiles to be saved in any database, nor does it require the DNA be stored in a tissue bank. As long as the evidence from the crime scene is properly preserved, the DNA can be accessed at a later date to be analyzed and compared to the person who had committed the crime (Ossorio & Duster 2005).

Second, the collection of DNA to form a DNA profile database that can be used for identification purposes. Currently, states collect DNA from people convicted of a variety of crimes. Some even collect DNA from suspects or arrestees in pretrial circumstances. Forensic DNA databases create a net to catch the guilty. This also helps identify a suspect when law enforcement personnel search for a match between the DNA left at the scene of an unresolved crime and the profile of any person in the database. These databases can be used to match any persons who were already convicted of one crime with the material left at another unresolved crime scene. Law enforcement personnel can also use forensic DNA databases to determine whether a person who is stopped and arrested has DNA that matches material left at a crime scene unrelated to the present detainment (Ossorio & Duster 2005).

The third and final way for law enforcement to use genetics involves testing crime scene material for information that could be used to create a physical or behavioral profile of a suspect. A person's DNA contains information about many other aspects of his or her life and health. Although the traditional DNA identification profile tests non-coding regions of DNA, coding regions can be also tested. DNA left at a crime scene could be tested for ancestry informative markers and for genetic markers of observable physical traits, i.e. hair and/or eye color. It could be tested for the possibility that the source of the DNA has an inherited disease. Genes that correlate with behaviors or psychological traits could be tested. Such tests could produce a physical and psychological profile of a suspect and some estimates of other relevant characteristics, such as where the person can be found. Furthermore, by using the traditional individual-identification genetic markers, police may be able to identify siblings or parents of any person who leave material at the crime scenes by asking the computer for a partial match rather than a perfect match to a profile in the database (Ossorio & Duster 2005).

Biosocial criminology has emerged as a powerful way to organizing scientific findings into a broader, biologically informed criminology. The paradigm appears to be gaining momentum. More biologically informed studies of rime have been published in traditional criminology journals; more books on the topic have been published in the past few years than ever before; more students have been trained in the area; and more conference panels have been produced at major academic conferences. For biosocial criminology to expand, criminology will have to change. First, most PhD granting programs in criminology places a heavy emphasis on criminology theories, which forces students to understand the minutia of theories in favor of understanding empirical findings from a diverse range of fields. Although traditional criminology is a multidisciplinary field and has much to offer, biosocial criminologists require more than an understanding of four social bonds (Wright & Cullen 2012).

Second, the subjugation of science to disciplinary sacred values should be abandoned. Criminology touches on politically difficult subjects, such as race, behavior, and justice. If criminology is to advance as a science, it must abandon its political sensitivities in favor of an emphasis on the sometimes politically inconvenient findings that emerges from science. Biosocial criminology obviously threatens the sacred values of the discipline, but it can replace those values with others, such as scientific honesty, objectivity, and discourse unencumbered by political considerations (Ossorio & Duster 2005).

Summary

Since its first inception in 1984, DNA technology has undergone a remarkable rapid evolution from an exotic, slow, and expensive process to a routine practice. When this new technology was introduced to the field of criminology, it was first used in 1986 and has become an important investigative tools used by law enforcement and forensic science agencies throughout the world. DNA profiling has been used in thousands of criminal cases to place suspects at the crime scene. It has also excluded innocent individuals that have been wrongfully accused of a crime. In recent years, DNA evidence has been the center of several high-profile court cases throughout the world. Given the remarkable process of DNA profiling technologies, several new technologies are on the horizon. These new methods will increase the speed and genetic differentiation while dramatically lower the cost of DNA profiling. Speed and lower cost will facilitate the compilation of DNA profile databases throughout the world. As DNA evidence continues to grow, society must balance the needs for law enforcement with privacy concerns.

Fingerprints are probably one of the earliest methods of human identification and have been used as an early marker for criminal forensic human identification. Although fingerprint identification has been used in countless criminal investigations during the past centuries, useful fingerprints are not always recovered. However, the transfer of biological evidence between the perpetrator and the victim characterizes many major felonies, such as homicides and sexual assaults.

Since every individual on this earth is uniquely different, with the exception of identical twins, biological evidence can be used to differentiate human and non-human evidence. This method of testing DNA can individuate biological evidence to exclude the innocent suspect and incriminate the true offender. Given that DNA is present in every cell in our bodies, DNA is not only present in blood and semen, but it is also present in hair follicles, saliva, urine, fecal matter, phlegm, teeth, bone, and pieces of loose skin.

Contribution this Study Will Make to the Literature

Although identifying methods have been used by forensic scientists for many years, the power of discrimination and sensitivity of these methods have not been great. With the advent of newer and effect methods in DNA testing technology, it is possible to recover enough DNA from the back of a licked postage stamp to discriminate between the person who licked the stamp and every person that is living.

With the extraordinary degree of sensitivity and discrimination already established and perceived, it seems clear that the convergence of molecular biology and semiconductors is on the rise. New technologies promise to reduce the cost and increase the speed of DNA testing. As a result of the technological advances, DNA testing and profiling will still be the main stable of evidence processing.

CHAPTER 3

Methodology

This study proposal was reviewed and approved by the Regis University Institutional Review Board (IRB). This author received IRB approval as an exempt study on July 10, 2013. The IRB number for this project is 13-216.

Content Analysis

Content analysis is a method for summarizing any form of content by counting various aspects of the content. It is also a social science methodology that is based on the understanding of human communication, which includes writing, painting, and context. In turn, this method is the understanding of the text, the phrases used, key terms, the authenticity and authorship. It is a quantitative, scientific method that can look at the objectivity, inter-subjectivity, the validity, and the ability to replicate specific documents (audiencedialogue.net 2013).

Quantitative Research Method

Quantitative is the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect (Babbie 2011).

Research Questions

Research findings have indicated DNA testing and profiling are highly controversial. In recent years, many have argued against using DNA to forge the development of DNA profiles of criminals and suspects. Although these perceptions do not deter law enforcement agencies and forensic scientists to go forward and creating these profiles, these profiles have uniquely identify individuals and have freed many innocent suspects of their convicted crimes. Therefore, this research proposal desires to answer these exploratory questions through a systematic process. These questions guide this qualitative study:

Research Question 1: *Since there are many different challenges DNA testing and profiling has endured, how effective is this procedure?*

Research Question 2: *With the possibility of DNA fabrication, how can forensic scientists argue whether the means of DNA testing will still be the gold standard in criminology?*

The first research question explores the prevalence of using DNA testing technologies for evidence processing. With many cases being resolved in this fashion, there are still some people who believe this type of evidence processing is not effective and will continually be an expensive way to facilitate prosecutions.

The second research question explores the prevalence of the possibility of analyzing a fabricated DNA sequence from any crime scene. Since there are means of people making DNA sequences from anything another person touches, the sequence produced can be mixed within other evidence collected.

Research Methodology

A qualitative research study was carried out using an interpretative approach. This content analysis allows the topic to be researched and analyzed by seeing how effective DNA testing has been in the field of criminology. Also, provide the pivotal information about the different crimes that use DNA testing procedures on the evidence collected. The crimes include sexual assaults, property crimes, automotive theft, and other crimes.

Procedure

The idea of creating DNA databases emerged quickly after the technology was introduced into courtrooms and police laboratories in both the United States and England. By passing these laws, states were required to gather genetic samples of convicted offenders as early as 1988. Congress gave its support to the idea in 1994 by authorizing grants to the states and establishing guidelines for a national database. Defense lawyers and civil liberties advocates criticized many of the moves along the way and argued that it is against the most expansive database proposal, but federal and state legislations have upheld DNA sampling from convicted offenders (Jost 1999).

The Federal Bureau of Investigations, or FBI, officials were predicting as early as 1988 that DNA typing would become as routine as fingerprinting and were talking about the possibility of linking state databases to a national system that is comparable to the bureau's national fingerprint files. Colorado passed a law in 1998 requiring genetic sampling of convicted sex offenders before they could be paroled. In 1999, California began considering the creation of a statewide database. Virginia became the first state to require DNA samples from all convicted felons in 1990, which was one of 12 states to pass some form of DNA sampling legislation during this time period. In 1994, 29 states had passed such laws and in 1998, every state passed these types of laws.

Table 3.1. The Complete Breakdown of DNA Databases Based on the Types of Offense

All the states have passed laws to establish databases containing DNA profiles of convicted offenders. All the laws at least cover sexual offenders. In addition, a majority of the states maintain DNA profiles for offenses against children or murder. Four stats – Alabama, New Mexico, Virginia, and Wyoming – require DNA profiles for all convicted felonies. One state, Louisiana, has a law requiring DNA profiling of arrestees as well as convicted offenders, but the law has not been put into effect.

	Date	**Sex Offenses**	**Murder**	**Assault**	**Offenses Against Children**	**Robbery**	**Burglary**	**Kidnapping**	**Juveniles**	**Felonies Only**	**Stalking**
Alabama	1994	X	X	X	X	X	X	X		X	X
Alaska	1996	X	X	X	X	X		X	X	X	
Arizona	1989	X			X						
Arkansas	1995	X			X						
California	1989	X	X	X	X				X	X	
Colorado	1988	X			X						
Connecticut	1994	X									
Delaware	1994	X			X						
Florida	1990	X	X								
Georgia	1992	X			X						
Hawaii	1992	X	X		X						
Idaho	1997	X	X		X						
Illinois	1990	X			X						
Indiana	1996	X	X	X	X	X	X	X		X	
Iowa	1989	X	X	X			X	X			
Kansas	1991	X	X		X				X		
Kentucky	1992	X								X	
Louisiana	1997	X	X	X	X	X		X		X	
Maine	1995	X	X	X	X	X	X	X	X	X	
Maryland	1994	X			X						
Massachusetts	1997	X	X	X	X	X	X	X			
Michigan	1990	X		X							
Minnesota	1989	X							X		
Mississippi	1995	X									
Missouri	1991	X								X	
Montana	1995	X	X	X	X	X		X	X		
Nebraska	1997	X	X		X			X		X	X
Nevada	1989	X			X						
N. Hampshire	1996	X							X	X	
New Jersey	1994	X									
New Mexico	1997	X	X	X	X	X	X	X	X	X	

	Date	Sex Offenses	Murder	Assault	Offenses Against Children	Robbery	Burglary	Kidnapping	Juveniles	Felonies Only	Stalking
New York	1994	X	X	X						X	
No. Carolina	1993	X	X	X	X	X		X			X
North Dakota	1995	X			X						
Ohio	1995	X	X		X		X	X	X		
Oklahoma	1991	X	X	X	X			X			
Oregon	1991	X	X		X		X		X		
Pennsylvania	1995	X	X		X				X		X
Rhode Island	1998	X	X							X	
So. Carolina	1995	X		X					X		
South Dakota	1990	X			X						
Tennessee	1991	X							X		
Texas	1995	X			X		X	X			
Utah	1994	X	X		X		X				
Vermont	1998	X	X	X	X	X	X	X			
Virginia	1990	X	X	X	X	X	X	X		X	X
Washington	1990	X	X	X	X	X		X	X		
West Virginia	1995	X	X	X	X	X		X			X
Wisconsin	1993	X	X	X	X		X	X			
Wyoming	1997	X	X	X	X	X	X	X		X	
TOTALS		50	29	22	36	15	13	20	16	14	6

Note: Congress has not passed a law requiring DNA profiling for federal offenders, including those in the District of Columbia.

Source: FBI Laboratory Division, June 1998.

Table 3.1: This table provides the complete national breakdown of committed crimes that requires a DNA profile to be created and the established year states made DNA profiling databases. This table was provided by the Federal Bureau of Investigation Laboratory Division.

When the DNA Identification Act, which is a part of the Violent Crime Control and Law Enforcement Act, was created in 1994, congress fully supported the creation of a national DNA database. This act specifically authorized the FBI to establish a national index of DNA identification records of any person who has committed a crime and analyzes the DNA samples recovered from crime scenes and samples recovered from unidentified human remains (Jost 1999).

By looking at the legislation in place for the types of committed crimes and the creation of the DNA database in each state, as demonstrated in Table 1, it can be helpful to see if DNA testing is a recommended and needed service to find the perpetrator. Since every state has their own legislation and regulations about DNA testing, it is important to see why creating a state and/or a national DNA database will allow law enforcement agencies become more efficient and have a more effective way to capture offenders. This will demonstrate why it is important to take this type of testing to help release the wrongfully accused, persecute the perpetrator, and give DNA testing a chance to improve and succeed in the field of criminology. Furthermore, it will allow biosocial and forensic scientists to find more efficient and effective ways to justify DNA testing for evidence processing.

The national database of DNA profiles was established in 1994 when the DNA Identification Act passed. This database contains DNA profiles that can be used to search crime laboratories throughout the country to find any suspect's DNA to see if they have a criminal history or have any sort of link between crime scenes. These databases provide a forensic index containing profiles from crime scenes, an offender index containing profiles taken from personal items from unidentified victims, any unidentified victim's remains index containing profiles taken from personal items from the victim, a missing person's index containing profiles of any missing person, and the relatives of missing person's index containing generated profiles from the missing person's close relatives.

In order for any laboratory throughout the country to compare test results, the FBI has specified core genetic areas, known as loci, are used in the CODIS. These strategic requirements for a profile upload to the various indexes in the NDIS. There are thirteen core loci the FBI has established. If a profile is to be uploaded into the NDIS forensic index, the FBI requires ten to thirteen core loci to be present. There are additional regulations that do exist for the upload of forensic profiles to the NDIS. Uploading these profiles consists of electronically submitting the DNA sequence, or DNA base-pairs, onto the NDIS. When the profile has been successfully uploaded onto the NDIS, it will become a profile in the national database and will continually search through the many profiles until a match occurs (Roman, Reid, Reid, Chalfin, Adams, and Knight 2008).

At a state level, the Colorado SDIS is operated by the Colorado Bureau of Investigation. The database is made up of two main indexes. The first is a forensic index and the second is the offenders convicted of felonies. The submission standards of Colorado's SDIS emulate the NDIS when DNA profiles are uploaded. The DNA profile must have a minimum of thirteen loci to be uploaded into the offender index and a minimum of ten loci to be uploaded into the forensic index (Colorado Bureau of Investigation 2013).

The state of Colorado requires a confirmation process for offenders and forensic matches. If there is an offender match, an additional process is taken. Every local crime laboratory is notified of the SDIS match. The state laboratory does not provide identifying information until there is a confirmed match. To confirm a positive match, the state laboratory reanalyzes the original sample, which had a match, to verify it had produced the same DNA profile as the submitted crime scene profile. If this produces a match between the original and reprocessed sample, the state crime laboratory will provide the local crime laboratories with the offender's identity (Colorado Bureau of Investigation 2013).

If there is a SDIS forensic match, the local crime laboratory will verify a match has occurred. If the match is confirmed, the local crime laboratories will exchange detailed paperwork about the cases and the assigned investigators' contact information.

Chapter Summary

DNA identification has moved from an experimental technique to an established crime-solving tool for police and prosecutors in the United States, as well as worldwide law enforcement. Since law enforcement agencies have created DNA databases, this database has been a useful tool for law enforcement and the justice system to link criminals and/or suspects to unsolved crimes. Since the creation of the DNA Identification Act in 1994, it has helped establish a national DNA database to help convict and capture offenders if they cross state lines. Many have considered this database as un-ruling and could possibly cause more damage than good. Congress has fully supported this decision from the start of DNA collection and database of convicted criminals. By the middle of the 1990s, DNA evidence was no longer a scientific curiosity, but as an established forensic technique. Police and prosecutors used it in investigations and criminal trials, while defense lawyers discovered the technology could be used to exonerate a defendant years after their conviction.

The idea of creating DNA databases emerged quickly after the technology was introduced into courtrooms and police laboratories. States passed laws requiring genetic samples from some convicted offenders as early as 1988. Congress gave their support by authorizing grants to every state and established guidelines for the national database. Even though every state differs in which crimes committed should have DNA collected for their database, all of states have agreed sexual offenses is the most important crime for creating a DNA database.

CHAPTER 4

Data and Methods

By looking at the national average of profiles generated, it is viable to see whether or not it is appropriate to create a forensic profile for a perpetrator. This analysis identifies the best practices in DNA collection and examines the importance of predictions of whether the DNA samples result in forensic profiles. In this aspect, it will allow the profiles to be deemed suitable for CODIS uploading and get results if the profile has a match in the CODIS and offender databases.

Results

Table 4.1. CODIS Statistics Through 2007

Category	Total Number
Investigations Aided	62,059
Forensic Index Hits	11,750
Offender Index Hits	49,813

Source: FBI Laboratory Division 2007. *Note:* of the 49,813, 43,305 had hits on the SDIS (State DNA Index System) and 6,508 hits on the NDIS (National DNA Index System)

In Table 4.1, the national statistics of criminals that were uploaded onto the national CODIS database that correlates to the amounts of hits in the offender and forensic databases.

Table 4.2. NDIS Statistics Through 2007

Category	Total Samples
Offender Index	5,372,773
Forensic Index	203,401

Source: FBI Laboratory Division 2007.

Table 4.2 provides a descriptive statistics for national uploads based on the amount of uploads into the national DNA index system database of the 178 NDIS-participating sites that consist of

126 local laboratories and 52 state laboratories, including all the FBI Laboratory and the United States Army Criminal Investigation Laboratory.

Table 4.3. Uploads onto the National DNA Index System

	2001	2002	2003	2004	2005	2006	2007
Offender Profiles	750,929	1,247,163	1,493,536	2,038,514	2,826,505	3,977,433	5,372,773
Forensic Profiles	27,897	46,177	70,9031	93,956	126,315	160,582	203,401
Investigations Aided	3,635	6,670	11,220	20,792	30,455	43,156	62,059
Forensic Hits	1,031	1,832	3,004	5,147	7,071	9,529	11,750
Offender Hits	2,371	5,032	8,269	13,855	21,519	32,439	49,813
National	167	638	1,151	1,864	2,855	4,276	43,305
State	2,204	4,394	7,118	11,991	18,664	28,163	6,508

Source: FBI Laboratory 2009.

Table 4.3. With the rise in criminal activity throughout the nation, the amount of criminal and forensic profiles has also risen. Since many states require suspects to submit a DNA sample for their database, the sample is analyzed and submitted onto the NDIS.

Table 4.4. Types of Sample Collected

	Means	Standard Deviation
Blood	0.21	0.41
Cells – Touched/Handled Items	0.59	0.49
Cells – Worn Items	0.04	0.18
Cells – Oral	0.14	0.34
Other	0.05	0.21

Source: Urban Institute.

Table 4.4. This table demonstrates how the DNA was collected at crime scenes. With the majority of the evidence items being touched or handled, at 59 percent, by the suspect, the analyzed cells were skin or epithelial cells that were left behind. The second most common form was blood evidence, at 21 percent respectfully.

Table 4.5. Case Characteristics – National

		Means	Standard Deviation
Types of Offenses	Residential	0.57	0.49
	Commercial	0.29	0.44
	Auto-Related	0.13	0.36
	Other	0.01	0.08
Points of Entry	Door	0.36	0.48
	Car	0.12	0.33
	Window	0.33	0.47
	Other	0.17	0.37
Crime Scene Unlocked		0.17	0.38
Items Stolen	Automobile/Parts	0.04	0.20
	Monetary Items	0.11	0.32
	Drugs, Alcohol	0.01	0.11
	Electronics	0.38	0.48
	Jewelry	0.13	0.32
	Tools	0.06	0.24
	Nothing	0.09	0.29
	Other	0.18	0.38

Source: Urban Institute

Table 4.5. This table gives a descriptive, detailed analysis of the national percentage of crime characteristics. Since the majority of the crimes were committed at a residence (57 percent), the crimes that are included in this offense include burglaries, sexual assaults, murders, and other crimes.

Table 4.6 Investigative Practices – National

		Mean	Standard Deviation
Collection Type	Swab	0.58	0.49
	Entire Item	0.35	0.48
	Both	0.07	0.35
Evidence Collector	Forensic Specialist	0.58	0.50
	Police Officer	0.40	0.50
	Detective	0.02	0.15
	Other	0.00	0.06
Fingerprints Collected		0.35	0.49

Source: Urban Institute

Table 4.6. The descriptive statistics for investigative practices of the samples collected. The majority of the evidence was swabbed at the crime scene. Evidence collection was handled by

both forensic specialists and front-line officers evenly. Detectives and other collectors, for instance victims, only represented a fraction of the evidence collected from a crime scene. Although DNA was collected at the crime scenes, 38% of the evidence collected at the crime scene was fingerprints.

Table 4.7. Descriptive Statistics for Crime Scene Attributes of Cases in Denver, Colorado

	Attribute	Treatment Group	Control Group	Full Sample
Crime Type	Residential	50%	58%	54%
	Commercial	23%	20%	21%
	Auto-Related	26%	20%	21%
	Other	1%	2%	2%
Point of Entry	Door	27%	38%	33%
	Window	39%	30%	35%
	Car	25%	20%	22%
	Other	9%	12%	10%
Property Unlocked		13%	17%	15%
Evidence Collector	Patrol Officer	29%	43%	36%
	Detective	4%	5%	5%
	Forensic Specialist	67%	52%	60%
Fingerprints collected		24%	22%	23%
Items Stolen	Electronics	42%	28%	35%
	Other	58%	72%	65%
	Nothing	1%	0%	1%

Source: The Denver Crime Laboratory Bureau, the Denver Bureau of Investigation, and the Denver Police Department. *Note*: Treatment cases or groups were treated by undergoing DNA processing to identify a viable profile and was compared to a known offender or forensic profile. Control cases or groups did not have the DNA undergo any type of testing for a minimum of 60 days. This was to ensure the case processing similarities and ensured the outcome for both groups were measured 60 days after being assigned.

Table 4.7. This table demonstrates how evidence was collected through various crimes in Denver. The majority of the evidence collected was performed by forensic specialists. Also, the average number of samples collected in Denver did have a significant outcome for SDIS hits.

Table 4.8. Descriptive Statistics for Attributes of Samples Processed in Denver, Colorado

	Attribute	Treatment Group	Control Group	Full Sample
Sample Type	Blood	35%	56%	45%
	Cells – Touched or Handled	7%	11%	9%
	Cells -Oral	41%	40%	40%
	Cells – Worn	9%	21%	15%
	Other	4%	3%	3%
Collection Type	Swab	43%	24%	34%
	Whole Items	57%	75%	66%
	Both	0%	0%	0%

Source: The Denver Crime Laboratory Bureau, the Denver Bureau of Investigation, and the Denver Police Department

Table 4.8. This table demonstrates how each group was treated. In the control groups, blood was collected significantly higher than the treatment group, 56 percent and 35 percent respectfully. Treatment case evidence was more likely collected by swabs and did not collect as many whole items as in the control group. By looking at the percentage of collection types, it is more likely to collect whole items than swabbed evidence from crime scenes.

Table 4.9. Suspects Identified, Attested, and Prosecuted in Denver

	Treatment Group	Control Group
Suspect Identified	56%	18%
Suspect Arrested	39%	14%
Cases Accepted for Prosecution	46%	17%

Source: The Denver Crime Laboratory Bureau, the Denver Bureau of Investigation, and the Denver Police Department

Table 4.9. This table shows the case outcomes for Denver. There is a significant difference in the case outcome between the treatment and control groups. The treatment group helped law enforcement agents positively identify suspects. These cases were more likely to lead to an arrest and prosecution.

Table 4.10. Methods Used to Identify Suspects in Denver, Colorado

	Treatment Group	Control Group
Suspect Identified	56%	18%
Traditional Investigation	19%	18%
CODIS Hits	29%	---
Forensic Hit/Investigative Lead	7%	---

Source: The Denver Crime Laboratory Bureau, the Denver Bureau of Investigation, and the Denver Police Department

Table 4.10. This table demonstrates how suspects were identified throughout the city and county of Denver. For most of the DNA tested cases, 29 percent had an offender hit and 7 percent had a suspect identified by a forensic hit. Respectfully, 56 percent of the suspects were identified for committing the crime.

CHAPTER 5

Discussion

Comparing the statistics for the crimes committed in Denver to the national statistics, the law enforcement and forensic science agencies are performing close to or above the national average. Since most of the crimes committed are residential, for both the national crime statistics and Denver's statistics, it can be said that the majority of the committed crimes, such as sexual assaults, murders, burglaries, and many other crimes, would more likely yield a suspect who will have a SDIS or a NDIS profile. This can lead to a CODIS profile that will help law enforcement and forensic science agencies process the evidence collected from crime scenes place a suspect at any given timeframe.

While looking at the national statistics, evidence collected from a crime scene that will most likely score a hit on the CODIS would be any cellular material left behind on touched or handled, 59 percent, items by a suspect. Blood evidence was a secondary analysis tool, at 21 percent. Throughout the nation, swabbed evidence, at 58 percent, was the prime protocol to collect any type of cellular material left in a crime scene. This way ensures the cellular material can be broken down, analyzed, and matched up to a profile in the SDIS, NDIS, or CODIS database.

Although the data collected and analyzed for the state of Colorado had two different groups, the treatment group provided the state and local crime laboratories more of a positive outcome for matches in the CODIS than control cases or groups. Treatment cases or groups were treated by undergoing DNA processing to identify a viable profile and was compared to a known offender or forensic profile. Control cases or groups did not have the DNA undergo any type of testing for a minimum of 60 days. This was to ensure the case processing similarities and ensured the outcome for both groups were measured 60 days after being assigned.

The suspect was identified 56 percent of the samples analyzed in the treatment group yielded a match to the SDIS, while 18 percent of the samples in the control group yielded a positive match in the SDIS. When looking at the successful rates of analyzing the DNA sample that will lead to an arrest, treatment groups, 39 percent of the samples, yielded better results than control groups, only 14 percent of the samples led to an arrest. The amount of prosecutions also was much higher in the treatment groups, 46 percent, than the control groups, 17 percent respectfully. This data demonstrates that any suspect who has had a prior DNA profile created and uploaded onto the SDIS, LDIS, or CODIS helped law enforcement and forensic science agencies positively identify the offender, lead to their arrest, and prosecuted for their actions.

It is evident that in Colorado, law enforcement and forensic science agencies are more willing to collect pure cellular material for testing and analysis than any item(s) touched or handled by the suspect. In Colorado, blood evidence, at 45 percent, and orally collected cells, 40 percent, were most likely collected to be analyzed compared to the other collection types; compared to the national average, blood evidence is only collected for 21 percent of the cases and orally collected cells at 14 percent. These types of collection procedure will allow law enforcement and forensic science agencies to analyze and see if there is a match in the LDIS, SDIS, NDIS, and/or CODIS.

Furthermore, when law enforcement agents collect entire item evidence, which includes clothing items or items the suspect has touched or handled, these items were used to have DNA testing and analysis performed to identify any potential suspects or positively identify a suspect at the crime scene. The national average for touched and/or handled items, 59 percent, was much higher than in Denver, 9 percent. This data demonstrates that other departments are willing to collect every item they feel is essential to the investigation. This type of evidence collection can ensure there could be a match a profile in the LDIS, SDIS, NDIS, and/or CODIS.

It can be concluded that any personnel trained in gathering evidence will yield better results to finding a match in the LDIS, SDIS, NDIS, or CODIS. This allows the evidence collected to be thoroughly analyzed and correlate with any DNA profile in the database. When looking at the statistics both nationally and locally, in Denver, forensic specialists are more than likely to gather DNA evidence and have a more successful outcome when the sample is matched to a DNA profile, 58 percent nationally and 60 percent in Denver. Patrol officers will also yield better results when evidence is collected, 50 percent nationally and 36 percent in Denver. This could be a result of the type of evidence the officers will collect, since some patrol officers will collect every item in the crime scene to be analyzed for DNA.

Conclusion

Deoxyribonucleic acid, or DNA, is an organic polymer that is found in every cell of every organism. Since DNA is composed of a sting of nucleotides, every person has a different variation of sequences and is a way to differentiate every person. This observation led to the first forensic DNA testing in 1984. As techniques for manipulating and analyzing DNA become more efficient and more long-lasting, forensic DNA testing will continually improve. Depending on the amount of sample and level of degradation, several techniques can be applied to narrow the likelihood of a perpetrator was at a crime scene. Additionally, an advantage to DNA testing is the ability to review previous cases that were decided primarily on older technology. In this instance, DNA techniques can be used to reanalyze material that may acquit previously convicted individuals.

The importance of various crime scenes and evidence collector contribute to the collection of DNA samples open up to forensic analysis. This ultimately will help identify a suspect. The analysis is highly important for law enforcement agencies that are willing to expand the role of officers and detectives at crime scenes and forensic laboratories, who help identify, collect and analyze the DNA evidence.

The analysis produces four main findings. First, there is no evidence that DNA is collected by crime scene technicians that are more likely to match a DNA profile or subsequent CODIS hit than DNA evidence that is collected by police officers or detectives. Since DNA evidence is becoming a more important platform for investigation and clearing high volume crimes, it is highly cost efficient if law enforcement agents receive the proper training to collect DNA evidence. Essentially, it would help allocate some of the costs associated with DNA testing protocols to the training programs in police academies.

Second, blood and saliva samples are significantly more likely to have a match to DNA profiles when the samples consist of cells from touched and/or handled items. Since blood samples are three to five times more likely to have a match in the CODIS, finding and analyzing blood samples is significantly more cost-effective than the other alternatives.

Third, whole collected items will serve as a better platform for evidence processing than swabs when processing for DNA. This practice will maximize the probability of matching a DNA profile. Evidence, such as a bottle, can be used in multiple types of DNA evidence. This type of evidence provides a touched and/or handled sample, cells left on the mouthpiece, and fingerprints. Swabbed evidence had 30 percent lower odds of matching up with a DNA profile and are 50 percent less likely to be uploaded into the CODIS and having a match.

Lastly, it is important to consider the specific scenario of the crime scene. Crime scenes that resulted in stolen property, where the property was unlocked, had lower odds of matching a DNA sample or profile. Since there are various factors that will contribute to inefficient evidence collecting, there is a possibility of a sample not finding a DNA profile match. Since it takes a longer response time to collect effective DNA evidence, it may allow victims to clean up the crime scene, especially if the victims do not think the DNA will be collected.

It is clear that DNA technology will advance as well as database technology for analyzing forensics data. The power of DNA technology should be incredibly useful for the field criminology. The limitations of these technologies should always be kept in mind. DNA can never be used to prove that a person committed the crime, but used to prove the person was present at the scene.

It is important to keep in mind that every law enforcement agency throughout the country, but also worldwide, uses different types of DNA analysis tools. Since there are different technologies out there to aid law enforcement and forensic science agencies analyzing the DNA evidence, each agency will argue their DNA testing and analysis is the best in the business. Since these technologies do not perform the same, newer technology is being developed to emulate and perform the same type of DNA analysis. Since the technology is still evolving to become more efficient, both time and cost wise, it is important to test how effective the newer technologies will perform.

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