CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE
FACULTY OF ECONOMICS

BACHELOR THESIS

DNA Analysis

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Declaration

I declare that the bachelor thesis on topic: "DNA Analysis – Comparison of DNA Databases in Czech Republic and United Kingdom" was written individually by me, by the help of specific literature and other sources which are included in the review of used material, and by the help of consultations with supervisor JUDr. Ing. Bohumír Štědroň LL.M. Ph.D

In Prague 26th April 2011

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Signature

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DNA Analysis

Analýza DNA

Summary

This bachelor thesis focuses on the actual use of DNA analysis. The emphasis will be placed mainly on DNA databases of Czech Republic and United Kingdom. Both systems have their own specific characteristics that significantly differ one from the other. Some of those characteristics could be considered to be advantages while other rather as disadvantages mainly with regard to the right for privacy. Therefore, will be introduction of the topic (as well as its historical development) followed by comparative analysis of Czech and British national DNA databases. Another objective of this thesis is to find out whether it's appropriate, possible and beneficial to implement certain characteristics of one system to the other.

Key words: DNA, database, legal, sample, profile, UK, Czech Republic

Souhrn

Tato bakalářská práce se zaměřuje na využití analýzy DNA. Jak název napovídá, důraz bude kladen především na DNA databáze České republiky a Spojeného království. Oba systémy mají své specifické charakteristiky, které je od sebe výrazně odlišují. Některé z těchto charakteristik můžou být považovány za výhody, zatímco jiné spíše za nevýhody, především vzhledem k právu na soukromí. Proto bude seznámení s tématem následováno komparativní analýzou České a Britské národní databáze DNA. Dalším z cílů této práce je zjistit, zda by bylo vhodné, možné a výhodné implementovat určité vlastnosti jednoho systému na systém druhý.

Klíčová slova: DNA, databáze, právní, vzorek, profil, UK, Česká republika

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1. Introduction

DNA, or deoxyribonucleic acid, is the cornerstone of this bachelor thesis. DNA is the carrier of genetic information in all organisms and determines the development and characteristics of the whole organism. With the help of DNA sample, we're able to safely identify each individual and we can obtain the genetic profile that gives a lot of information about physical properties of the individual. I should emphasize that we're only able to identify a person if there is some comparative material. With enough material is reliability of DNA analysis over 99,999% [1]

DNA typing as it is now known was first described in 1985 by an English geneticist Alec Jeffreys. Dr. Jeffreys found that certain regions of DNA contained DNA sequences that were repeated over and over again next to each other. He also discovered that the number of repeated sections present in a sample could differ from individual to individual. By developing a technique to examine the length variation of these DNA repeat sequences, Dr. Jeffreys created the ability to perform human identity tests. [2]

DNA testing has totally changed the way the criminal justice system investigates crime. No other forensic tool works with such the level of confidence that DNA. When a suspect's DNA matches samples from a crime scene - or a DNA databank - it guarantees a conviction. DNA testing also has proven innocence. The history of DNA in criminal investigations reveals a profile unmatched by any other forensic technology.

This bachelor thesis is focused on the actual advantages and disadvantages of DNA databases. I'll also provide a comparison of Czech Republic and United

Kingdom in terms of DNA databases. I have picked United Kingdom because it‘s the true founder of forensic science but also because United Kingdom has the oldest and currently second biggest DNA database in the world. There are some often discussed questions about DNA databases – wouldn’t it be better if everyone’s DNA profile would be stored in National DNA database (in Czech Republic)? Although, the acquisition cost of a database like this would be quiet high, it could (in my opinion) save a lot of money in a long run. That is, of course, just a very theoretical solution.

On the other hand, for example Portugal had plans to introduce DNA database of its entire population. However after informed debate including opinion from the Portuguese Ethics Council the database introduced was of just the criminal population. Denmark has Danish Newborn Screening Biobank at Statens Serum Institut which keeps a blood sample from people born after 1981. The purpose is to test for Phenylketonuria and other diseases. [3]

2. Thesis Objectives and Methodology

A comparison between Czech Republic and United Kingdom with respect to DNA databases will be one of my main objectives. I'll focus on the actual advantages and disadvantages of both, Czech and United Kingdom National DNA databases due to their size, procedure of sampling, etc. I’d also like to point out some PROS and CONS of extending DNA databases. Another of my goals is to point out some of the main differences regarding legal issues of DNA databases. Mainly in UK rises the DNA database a lot of public concern which is closely linked to the fact, that UK’s police have the right to store DNA sample of acquitted people. This thesis should also provide an answer to the hypothesis, that UK uses current legislative as an excuse for unethical extension of DNA database by unnecessary storage of highly personal data of innocent people. The

size of this database, and its rate of growth, is giving concern to civil liberties and political groups in the UK.

3.1. History of DNA Analysis

3.1.1. Brief history

According to Nature Education, Friedrich Miescher identified in 1869 what scientists later called DNA - "inside the nuclei of human white blood cells “. Than, later on, news broke that scientists Jim Watson and Francis Crick had figured out where to look to get a complete picture of an individual's hereditary information, only the scientific community and astute, forward-thinking people fully understood the implications of this break-through in 1953. The DNA helix, with confusing explanations of how it worked, was added to high school science books and slowly, DNA became a recognizable term used in everyday conversation. Watson and Crick's revelation of the "secret of life" languished nearly 30 years in laboratories and institutions of higher learning before law enforcement officials began to use it. A third researcher, based in the United Kingdom, proved the final link to the marriage between DNA and the International law enforcement community. The key discovery for criminal investigations did not come until 1984, however, when Sir Alex Jeffreys identified what he named "genetic fingerprints," according to the University of Leicester. It marked the first time scientists could differentiate individual DNA. [5]

3.1.2. Function of DNA Analysis

DNA testing uses only a small fraction of a person's genetic code. Genetic fingerprints rely on "minisatellites," described by the University of Leicester as "short sequences of chemical building blocks" with variations "unique to each person". Narrowing the focus even further, genetic profiling - the kind of testing appropriate for criminal investigations---examines only one minisatellite at a time, says the University of Leicester. Although different methods have become standard practice, tests must meet admissibility standards for evidence. [5]

3.1.3. Early applications

The first criminal justice application proved a confessed murderer innocent. In 1986, the Enderby murder case, a case local to Leicester, saw the first use of DNA profiling in criminology. Two young girls had been raped and murdered, one in 1983 and one in 1986. After the second murder, a young man was arrested and gave a full confession. The police thought he must have committed the first murder as well, so they asked Professor Jeffreys to analyse forensic samples – semen from the first and second victims, samples from the victims, and blood from the prime suspect. "The police were right – both girls had been raped by the same man," says Professor Jeffreys. "But it wasn't the man who had confessed. At first I thought there was something wrong with the technology, but we and the Home Office's Forensic Science Service did additional testing and it was clear that it was not his semen. He had given a false confession and was released – so the first time DNA profiling was used in criminology, it was to prove innocence." [5]

With the DNA profile of the criminal, the police launched the world's first DNA-based manhunt. Blood samples from more than 5000 men in the local community were collected. The murderer nearly got away with it – sending a proxy in to give a blood sample – but eventually he was apprehended and got two

life sentences. "This man would have killed again, no doubt about it," says Professor Jeffreys." DNA testing helped to save lives." Within a year, DNA profiling was being used around the world. But the development of the technique was not finished. The arrival of the polymerase chain reaction enabled another huge leap in forensics: the development of national DNA databases. [5]

3.2. How is DNA typing done?

Only one-tenth of a single percent of DNA differs from one person to the next. Scientists can use these variable regions to generate a DNA profile of an individual, using samples from blood, bone, hair, and other body tissues and products. [13]

In criminal cases, this generally involves obtaining samples from crime-scene evidence and a suspect, extracting the DNA, and analyzing it for the presence of a set of specific DNA regions (markers). [6]

[6]Scientists find the markers in a DNA sample by designing small pieces of DNA (probes) that will each seek out and bind to a complementary DNA sequence in the sample. A series of probes bound to a DNA sample creates a distinctive pattern for an individual. Forensic scientists compare these DNA profiles to determine whether the suspect's sample matches the evidence sample. A marker by itself usually is not unique to an individual; if, however, two DNA samples are alike at four or five regions, odds are great that the samples are from the same person. If the sample profiles don't match, the person did not contribute the DNA at the crime scene. [6]

If the patterns match, the suspect may have contributed the evidence sample. While there is a chance that someone else has the same DNA profile for a particular probe set, the odds are exceedingly slim. The question is how small do the odds have to be when conviction of the guilty or acquittal of the innocent lies in the balance? Many judges consider this a matter for a jury to take into consideration along with other evidence in the case. Experts point out that using DNA forensic technology is far superior to eyewitness accounts, where the odds for correct identification are about 50:50. The more probes used in DNA analysis, the greater the odds for a unique pattern and against a coincidental match, but each additional probe adds greatly to the time and expense of testing. Four to six probes are recommended. Testing with several more probes will become routine, observed John Hicks (Alabama State Department of Forensic Services). He predicted that DNA chip technology (in which thousands of short DNA sequences are embedded in a tiny chip) will enable much more rapid, inexpensive analyses using many more probes and raising the odds against coincidental matches. [6]

3.1. Interesting Uses of DNA Forensic Identification

Identifying September 11th Victims

[6]Identifying the victims of the September 11, 2001, World Trade Center attack presented a unique forensic challenge because the number and identity of the victims were unknown and many victims were represented only by bone and tissue fragments. At the time of the attack, no systems were in place for rapidly identifying victims in disasters with more than 500 fatalities. The National Institutes of Justice assembled a panel of experts from the National Institutes of Health and other institutions to develop processes to identify victims using DNA collected at the site. Panel members produced forms and kits needed to enable the

medical examiner’s office to collect reference DNA from victims’ previously stored medical specimens. These specimens were collected and entered into a database. The medical examiner's office also received about 20,000 pieces of human remains from the World Trade Center site, and a database of the victims’ DNA profiles was created. New information technology infrastructure was developed for data transfer between the state police and medical examiner’s office and to interconnect the databases and analytical tools used by panel members. In 2005 the search was declared at an end because many of the unidentified remains were too small or too damaged to be identified by the DNA extraction methods available at that time. Remains of only 1585, of the 2792 people known to have died had been identified. In 2007, the medical examiner's office reopened the search after the Bode Technology Group developed a new methodology of DNA extraction that required much less sample material than previously necessary. The victim DNA database and the new methods have allowed more victims to be identified, and further identifications will be possible as forensic DNA technology improves. [6]

The DNA Shoah Project

The DNA Shoah Project is a genetic database of people who lost family during the Holocaust. The database will serve to reunite families separated during wartime and aid in identifying victims who remain buried anonymously throughout Europe. [6]

Disappeared Children in Argentina

Numerous people (known as "the Disappeared") were kidnapped and murdered in Argentina in the 1970s. Many were pregnant. Their children were taken at birth and, along with other kidnapped children, were raised by their kidnappers.

The grandparents of these children have been looking for them for many years. Read an article about a DNA researcher who has been helping them. [6]

Tomb of the Unknowns

Scientists cracked one of the great mysteries of European history by using DNA tests to prove that the son of executed French King Louis XVI and Marie-Antoinette died in prison as a child. Royalists have argued for 205 years over whether Louis-Charles de France perished in 1795 in a grim Paris prison or managed to escape the clutches of the French Revolution. In December 1999, the presumed heart of the child king was removed from its resting place to enable scientists to compare its DNA makeup with samples from living and dead members of the royal family -- including a lock of his mother Marie-Antoinette's hair. [6]

Peruvian Ice Maiden

[6]The Ice Maiden was a 12-to-14-year old girl sacrificed by Inca priests 500 years ago to satisfy the mountain gods of the Inca people. She was discovered in 1995 by climbers on Mt. Ampato in the Peruvian Andes. She is perhaps the best preserved mummy found in the Andes because she was in a frozen state. Analysis of the Ice Maiden's DNA offers a wonderful opportunity for understanding her genetic origin. If we could extract mitochondrial DNA from the Ice Maiden's tissue and successfully amplify and sequence it, then we could begin to trace her maternal line of descent and possibly locate past and current relatives. [6]

Super Bowl XXXIV Footballs and 2000 Summer Olympic Souvenirs

The NFL used DNA technology to tag all the Super Bowl XXXIV balls, ensuring their authenticity for years to come and helping to combat the growing epidemic of sports memorabilia fraud. The footballs were marked with an invisible, yet permanent, strand of synthetic DNA. The DNA strand is unique and is verifiable any time in the future using a specially calibrated laser. [6]

3.4. DNA Databases in United Kingdom and Czech Republic

3.4.1. DNA Databases - introduction

[3]Already a couple years after DNA fingerprinting was invented, was this method often used in police investigations. Suddenly there was a need for a comprehensive, comparative database. That would greatly increase the likelihood of successful application of new methods. As the world's first was in 1995, established national DNA database in the UK. The second one was set up in New Zealand. France set up the FNAEG in 1998. In the USA, the FBI has organized the CODIS (Combined DNA Index System) database, which is nowadays the biggest DNA database in the world. CODIS was originally intended for monitoring sex offenders, afterwards it has been extended to include almost any criminal offender. At the international level, it was decided on the establishment of national databases of DNA in 1997, and this political decision was grounded by Resolution No. 193/1997 of the Council of Europe. For practical reasons it is necessary that the emerging DNA databases are mutually compatible and could experience sharing of genetic profiles. [3]

3.4.2. CODIS (Combined DNA Index System)

Shortly after discovering the possibility of using DNA for forensic needs became even FBI interested in the method. In 1990, was run a pilot project of CODIS database system in local laboratories in 14 US states.

Nowadays, it is the core of the (US) national DNA database, developed specifically to enable public forensic DNA laboratories to create searchable DNA databases of authorized DNA profiles. The CODIS software permits laboratories throughout the country to share and compare DNA data. In addition, it provides a central database of the DNA profiles from all user laboratories. A weekly search is conducted of the DNA profiles in this national database, known as the National DNA Index System (NDIS), and resulting matches are automatically returned by the software to the laboratory that originally submitted the DNA profile. [7]

The index system has three levels of operation. The term "DNA database" is sometimes used without specific reference to the level, which may lead to misunderstandings. For example, some categories of profiles are allowed in a State's database but not in the National database. The term "CODIS lab" is also misused in reference to a state laboratory that does the analysis of convicted offender samples. That is a misnomer since CODIS also contain other profiles such as forensic profiles. [7]

CODIS uses two indexes to generate investigative leads in crimes for which biological evidence is recovered from a crime scene. The convicted offender index contains DNA profiles of individuals convicted of certain crimes ranging from certain misdemeanors to sexual assault and murder. Each State has different "qualifying offenses" for which persons convicted of them must submit

a biological sample for inclusion in the DNA database. The forensic index contains DNA profiles obtained from crime scene evidence, such as semen, saliva, or blood. CODIS uses computer software to automatically search across these indexes for a potential match. [7]

A match made between profiles in the forensic index can link crime scenes to each other, possibly identifying serial offenders. Based on these "forensic hits," police in multiple jurisdictions or States can coordinate their respective investigations and share leads they have developed independent of each other. Matches made between the forensic and convicted offender indexes can provide investigators with the identity of a suspect(s). It is important to note that if an "offender hit" is obtained, that information typically is used as probable cause to obtain a new DNA sample from that suspect so the match can be confirmed by the crime laboratory before an arrest is made. [7]

3.4.3. United Kingdom National Criminal Intelligence DNA Database

Legal use of DNA analysis in police practice was in Great Britain encouraged by so-called Police and Criminal Evidence Act 1984 (PACE). Under this Act Police obtained the right to collect DNA samples and individual profiles compared to those that were found at a crime still unsolved. The creation of the first DNA database was implemented in 1995, when DNA Database in England and Wales was set up, in which DNA of already convicted or accused persons was inserted. [1]

Already in 1996, were approved two major changes in the functioning of the database, and that in turn enabled the creation of a single National UK DNA

Database. That allowed to make speculative comparisons of DNA profiles in order to find a match in the existing police records, and not only in England and Wales, but across the UK, and was allowed to cross-search all local DNA databases. In Scotland and Northern Ireland there were separated DNA databases established in 1996. Those weren't at the beginning linked with the national DNA database (because of technical and legislative obstacles). Scottish database was connected with the National Database at the end of 1997. Northern Ireland database wasn't linked to the National database until 2005. [1]

All data held on the National DNA Database are governed by a tri-partite board consisting of the Home Office, the Association of Chief Police Officers and the Association of Police Authorities (APA); there are also independent representatives present from the Human Genetics Commission. The data held on the NDNAD is owned by the police authority which submitted the sample for analysis. The samples are stored permanently by the companies that analyzed them, for an annual fee. [10]

All records in the UK National DNA database are identified by bar code and also include information on holders of the DNA (name, date of birth, ethnicity and gender), a police component, a laboratory which took the sample, and information about the nature of the sample and a method that was used to obtain DNA profiles. According to police statistics, has the creation of this database significantly improved the success of the British police in detecting crime from 24% to 43%. And therefore the whole project gains rather extensive support among politicians and the public. [1]

That's, of course, the main reason, why is the number of DNA samples in the database growing so rapidly (grows by ca 30 000 samples per month). At the end of 2005 the database contained about 3.5 million genetic profiles of convicted persons and 264,000 samples collected at crime scenes. The database

also includes the genetic profiles of children, because age of criminal responsibility in the UK is set at age 10 years. The proportion of children (or persons under 15 years) in the total number of genetic profiles within the database was at the end of 2005 approximately 7%. [1]

In percentage terms includes the database in December 2005 around 5.2% of the population of Great Britain. That is the highest proportion of the population of the country in the world. The national DNA database in USA included at the end of 2005 only 0.5% of the population. But as the number and complexity of the entire database increases, the question of security becomes more acute. Even the discoverer of the identification methods using DNA Alec Jeffreys suggested that the database should be supervised by independent supervisory authority. The obtained DNA samples should be after comparative tests destroyed, so the contained genetic information wouldn't get to unauthorized hands. Also, that the police themselves had to learn the identity of a convicted offender in court. In the end, the proposed arrangements haven't been implemented. [1]

England and Wales

[8]There was a major change in the functioning of the National DNA database in 2001 as well, when in England and Wales came into force a law on basis of which National database of DNA started to store DNA profiles and samples of people accused of committing a crime, regardless of whether these persons were subsequently exempt. In April 2004 was the rule further expanded - collection of DNA and its deposit into the National DNA database now in England and Wales occurs in the context of any arrest (excluding only the smallest of infractions), even without person's permission. In many cases, no one is even being accused of anything, but the DNA of the person still remains in the National database. You don't even have to be convicted or even charged of anything. Just the fact that you were moving at a crime scene is a good enough

reason to take and store your DNA sample. In 2005-06 45,000 crimes were matched against records on the DNA Database; including 422 homicides (murders and manslaughters) and 645 rapes. [11]

However, not all these matches have led to criminal convictions and some were matched with innocent people who were at the crime scene. Critics argue that the decision to keep large numbers of innocent people on the database does not appear to have increased the likelihood of solving a crime using DNA. [8]

Scotland

. The situation is a bit different in Scotland where the law allows to transfer person's DNA sample to the national database DNA only if that person was accused or already convicted. Even here, however, is preparing a legislative change that will allow the national DNA database to enter information on persons who have been accused of serious sexual or violent crimes. Also it allows keeping the sample within the database for up to five years after acquittal. [9]

Isle of Man

Samples are collected by the Isle of Man Constabulary's Scientific Support Department from crime scenes. Afterwards, they are sent to the UK for testing against the database. Samples from suspects are also added to the database, but are removed if the suspect is not convicted of the crime. [9]

3.4.4. Main Forensic Service Providers in UK

3.4.4.1. Laboratory of the Government Chemist

To make the situation even more controversial, British police often uses private company Laboratory of the Government Chemist (LGC) to analyze DNA samples of arrestees. LGC, after the tests, passes the information to the National Register, but they keep a copy of obtained DNA samples together with highly personal information about their owners, including name, age, skin color or home address. [1]

At one time the police would automatically have gone to the publicly-owned Forensic Science Service (FSS) for all their forensic work, but since 1999 the forensic service industry has been privatized, with different companies competing for police business. In 1996, once the state-owned Laboratory of the Government Chemist, LGC Ltd was sold off by the Major government for £5 million. In February 2010 LGC was valued at £257million. It's grown in other ways, too, since privatization: staff numbers have increased from 270 to more than 1,500, and several other firms have been bought up, including, in 2005, Forensic Alliance, then the UK's largest private provider of forensic science services to the criminal justice system. [11]

3.4.4.2. Forensic Science Service

Little bit different story has another company, that provides forensic services for criminal investigations – Forensic Science Service (FSS). This company was the original founder of UK's National DNA Database in 1995 and was, as well as LGC fully publicly-owned company. Actually, because the industry wasn't yet privatized, FSS had in this field (Criminal investigation forensic service) kind of a monopoly. Than, in 1999 (after the privatization), FSS gained Trading Fund Status. In 2005, FSS status changes from a Trading Fund to a GovCo – a 100-per cent owned Government Company. Therefore, FSS is still publicly-owned, but after privatization of the industry lost the mayor market share. Although, Forensic Science Service is still the market leader in the supply of forensic services to police forces in England and Wales and has a global reputation for the development and deployment of new and advanced techniques. [10], [14]

3.4.5. Czech National DNA database

In the Czech Republic was the method of personal identification by DNA first used in 1992. With the gradual spread of this method, the Czech police began to enforce the possibility of creating a central DNA database. The legal basis for the project was provided by Police Act and Criminal Procedure in 2002 on which basis came binding instructions of the Police President No 88/2002 on the implementation, operation and use of national DNA database. [1]

This database contains DNA profiles obtained at locations yet unexplained crimes and people who have been convicted for committing particularly serious crimes or were for those crimes prosecuted. Genetic profile of persons accused of committing a crime, found people, after which the searches were announced and people without full legal capacity. In this case, however, have the police certain

limitations: the police are allowed to determine their genetic profile only when there is no other way, how to obtain their personal data, enabling future identification. The national DNA database contains genetic profiles of corpses and skeletal remains of finding corpses of unknown identity as well. It should be stressed that the compulsory instruction of the President of the police or other law does not allow the Police collect biological material and to determine the genetic profile of all defendants and suspects. [1]

The collection of biological material can be done at every police station. Kriminalistický ústav (Institute of criminology) in Prague and its regional branches is in charge of the genetic profile reading or providing an analysis. Sampling is usually performed by oral saliva swab. 25th May 2006, Parliament adopted Act No. 321/2006 Coll. amending the Police Act. This law added to § 42 paragraph 3 E, which says that "If you can not act under paragraph 1 because of person's resistance unless it's blood taking or some other similar act associated with the intervention of the bodily integrity, is police officer after a futile challenge entitled to overcome this resistance. The way to overcome the resistance must be proportionate to the intensity of resistance. This basically gives police the right (when warranted) to withdraw biological material even by force. Convicted person's profiles are kept for eight years after they are entered and crime scene stains are kept until they are identified. [1]

4. Privacy and ethical issues of DNA databases

4.1. United Kingdom

The UK National database certainly helps in solving crimes and is able convict a criminal years after the crime has been committed, although many innocent people, including children from the age of ten are arrested but never

charged. Further concern has been raised over the 24,000 samples held of children and young people aged from 10 to 18 who have never been convicted, cautioned or charged with any offence. [15]

Some people have argued that there should be time limits on how long DNA profiles can be retained on the database, except for people convicted of serious violent or sexual offences. For example GeneWatch UK has launched a campaign calling on people to reclaim their DNA if they have not been charged or convicted of a serious offence, and has called for more safeguards to prevent misuse of the database. The Human Genetics Commission has argued that individuals' DNA samples should be destroyed after the DNA profiles used for identification purposes have been obtained. [16]

Case of S. and Marper v. the United Kingdom - example

The case involved two claimants from Sheffield, England: Mr. S. and Michael Marper. Mr S. was arrested on 19 January 2001 at the age of eleven and charged with attempted robbery. His fingerprints and DNA samples were taken. He was acquitted on 14 June 2001. Michael Marper was arrested on 13 March 2001 and charged with harassment of his partner. His fingerprints and DNA samples were taken. The charge was not pressed because Marper and his partner became reconciled before a pretrial review had taken place. The men's information was held by South Yorkshire Police, although neither was convicted of any offence. The judgment could have major implications on how DNA records are stored in the UK's national database. The judges said keeping the information "could not be regarded as necessary in a democratic society". Home Secretary Jacqui Smith said she was "disappointed" by the European Court of Human Rights' decision. The database may now have to be scaled back following the unanimous judgment by 17 senior judges from across Europe. [4]

On the other hand, even the inventor of DNA fingerprinting, Professor Sir Alec Jeffreys said the practice was highly discriminatory and measures should be taken to safeguard against particular individuals or groups being targeted. And he called for the creation of a national database, storing the profiles of the entire UK population, which would be managed by an independent body. “If we’re all on the database, we’re all in exactly the same boat – the issue of discrimination disappears,” he said. His radical solution is a national DNA database from the entire population held by a specially created body. [17]

Jeffreys also suggests recording only those parts of a DNA profile that identify an individual, not the parts providing information about someone’s appearance, or their susceptibility to disease. [17]

Similar position has Lord Justice Sedley, one of England’s most experienced appeal court judges, who said: “We have a situation where if you happen to have been in the hands of the police then your DNA is on permanent record. If you haven’t, it isn’t. He said the only option was to expand the database to cover the whole population and all those who visited the UK, even for a weekend. [18]

Figures compiled from Home Office statistics and census data show almost 40% of black men have their DNA profile on the database. That compares with 13% of Asian men and 9% of white men. [25] The most common explanation for the racial disparities has been accusations of police racism and racial bias, as evidenced by the reaction of the then chair of the home affairs select committee, Keith Vaz MP, in August 2009 who said that “Such disparity in the treatment of different ethnic groups is bound to lead to a disintegration of community relations and a lack of trust in the police force.” [18]

These allegations have been denied by the National Policing Improvement Agency (NPIA), which runs the National DNA database. According to the NPIA, the database is a successful tool in fighting crime and points out that "between April 09 and 28th January 2010 the National DNA Database produced 174 matches to murder, 468 to rapes and 27,168 to other crime scenes." [19]

(The National DNA Database, (online), URL: http://www.npia.police.uk/en/8934.htm)%0D In addition, the NPIA says that the "National DNA Database continues to provide police with the most effective tool for the prevention and detection of crime since the development of fingerprint analysis over 100 years ago. Since 1998, more than 300,000 crimes have been detected with the aid of the Database, reassuring the public that offenders are more likely to be brought to justice." [19]

The NPIA points out that of all of the subject profiles retained on the DNA Database by ethnic appearance as at 16 October 2009, 77.57% were "White North European", 2.06% were "White South European," 7.83% were black, 5.67% were Asian, 0.82% were Middle Eastern, 0.69% were Chinese, Japanese or South East Asian, and 5.365 were unknown. [20] [25]

(NDNAD by Ethnic Appearance, URL: http://www.npia.police.uk/en/13852.htm)%0D%5D These figures would indicate that whites still form a majority of the DNA database records, but that individual groups within ethnic communities have a disproportionate presence on the database relative to their numbers.

4.2. Czech Republic

Whereas the Czech Republic has a much smaller database and conditions under which it is possible to place a DNA profile into the database are also much

stricter than in United Kingdom, there is not as harsh public concern about the privacy issues.

Although, even in Czech Republic, we do have sort of a breakthrough case which is closely linked with wide DNA sampling in prisons all over the Czech Republic during 2007. According to the decision of the District Court for Prague 7 was withdrawing of DNA sample from prisoner Albert Žirovnický illegal. Until then, police and Interior Ministry took the view that the Police Act allowed them to take DNA of 16 000 prisoners that were incarcerated for intentional crime act. However, that probably wasn't the case of the former head of Prague Discoland Žirovnický, (who is currently being sentenced for sixteen years in Mírov prison for murdering a friend in 2000). Although, judge rejected Žirovnický's claim for 300 000Czech crowns (for nonmaterial damage) at the same time she clearly pointed out the police mistake. "It has been proven that there was an illegal official procedure, however, swabbing the oral cavity didn't cause to the claimant no damage." said the judge while handing down the verdict. She also reminded that Žirovnický already gave his DNA sample voluntarily back in 2001, when police investigated him for the murder and that also didn't cause him any harm. Though, even the judge did not understand why police during the nationwide sampling in prisons re-took Žirovnický's DNA sample when the sample was already in the national database. According to Žirovnický, (but also the court's witnessing expert on DNA Daniel Vanek) the police did not justify the extraction of DNA in prisons in 2007, as well as the placement of the samples into the database. Žirovnický also complained that he was forced to hand in his sample under the threat of violence. Addressed representatives of civic associations think that the current verdict may bring another wave of Czech prisoners' claims, but also unpleasant consequences for the police, which may lead to a possible disposal of the samples from 2007. According to the Human Rights League leader David Zahumenský in 2007 was applied a different police law which was

very general and vague in regard to the issue of collection of genetic samples. According to Záhumenský is now the legislation now more precise. [21]

5. Comparison of Czech Republic and United Kingdom

5.1. Comparative analysis of UK and Czech Republic DNA databases

Clearly, they are some differences between Czech and UK's DNA data banking. As I mentioned earlier, the UK's National DNA database is the oldest and largest forensic DNA database of its kind in the world, containing 5.2% of the population. Handling own sample to the database is in Great Britain widely used. It could certainly prove to be quiet handy in some particular cases, (such as identifying September 11th Victims) where person's human remains can be identified based on DNA analysis.

In contrast, Czech National DNA database currently contains around 77 000 profiles witch is approximately 0, 077% of Czech population. It's also right of Czech citizens to handle DNA sample by themselves but it's definitely not as popular like in UK. [22]

UK's idea of privatizing an industry that has something to do with law enforcement in terms of investigation seems extreme. We can also consider it as a significant difference. Kriminalistický ústav is Czech Republic's only provider of criminal investigation forensic service and is directly administered by the police (therefore state-owned).

Another difference is that in Czech Republic is stored only, what we call DNA profile. DNA profile is a barcode from which we can only find out person's gender. UK's database contains person's DNA profile as well as the actual sample.

Different is also the length of data storage. Length of storage in United Kingdom is based only on guidelines developed by the police after the agreement with the Supervisory Authority. Data of trivial perpetrators of crimes are kept 5 years, more serious for 10 years. If someone commits two offenses or is sentenced to more than 6 months imprisonment, person's data will be kept for 20 years. If someone commits a serious crime such as murder, data will be in the database until person's death.

In Czech Republic are DNA profiles of convicted persons kept in the DNA database until those persons turn 80 years of age. If they die before that, their profile is stored for another 20 years after their death with respect to any undetected crime, without the need for regular screening of 3-year data as required by the provisions of § 42i of the Police Act. [23]

Also, as I mentioned earlier, in Czech Republic has police the right to withdraw DNA sample from an individual only if there's no other way how to get individual's personal information and the individual must be accused of heavy crime. [1]

On the other hand, police in United Kingdom has the right to withdraw DNA sample from anyone, who's accused of a recordable crime of any sort. Oral swab is not an issue of consent (only for collection of blood is always necessary consent of the person). Police catch the perpetrator and by force wipe his mouth and cut off the hair. The same procedure is applied according to my findings in Sweden as well Of course, it's highly controversial but it definitely has its advantages. Let me provide you with a real life example.

[12]A few months after the DNA profile of the 19-year-old careless driver was uploaded to the database, it was flagged as a close but not perfect match to the profile of the probable killer of Colette Aram. Aram, a 16-year-old trainee hairdresser from Keyworth in Nottinghamshire, was abducted, raped and

strangled on 30 October 1983 – five years before the careless driver was born. The police had a few circumstantial leads to go on: a stolen red Ford Fiesta; a handwritten message from the killer saying they'd never catch him; a paper towel recovered from the toilet of a pub, the Generous Briton, where shortly after the murder a man with blood under his fingernails had eaten a ham sandwich, drunk a pint of orange juice and lemonade, and told the landlady an unlikely story about having driven up the M1 to see some friends who weren't in. Twenty thousand people were interviewed in the course of the investigation, but the killer wasn't found.

In October 2008, on the 25th anniversary of the murder, Nottinghamshire police announced they had new evidence, derived using the latest forensic DNA analysis techniques. (DNA profiling didn't exist when Aram was murdered, and the national DNA database wouldn't come into existence for another 12 years.) They could now "say with certainty" that Aram had been in the red Fiesta, and that her killer had gone to the Generous Briton. They also had his DNA profile. But it didn't match any of the four million profiles on the database. A new tactic was called for.

The database was searched again, this time for "near misses": profiles similar enough to the killer's that they could belong to a member of his family. The DNA of the 300 closest (male) hits was then re-examined, this time looking at markers on the Y-chromosome: as all the DNA on this is passed from father to son, it's a very good indicator of familial relationships between men (allowing for mutations, my father, uncle, cousin and his son all have the same Y-chromosome as me, inherited from my grandfather). But all 300 near misses came back negative. As more profiles were added to the database, the same checks were carried out.

Eventually, after 600 near misses had been re-tested, the markers on the 19-year-old careless driver's Y-chromosome came up as a match for the killer's. His father and two uncles were arrested in April 2009. Their swabs were flown to the forensics lab by helicopter (the custody clock was ticking) and a positive match to the killer's profile confirmed within nine hours. The careless driver's father, Paul Hutchinson, a 51-year-old newspaper delivery agent, was charged with Colette Aram's murder. He pleaded guilty on 21 December, and on 25 January was sentenced to life imprisonment [12]

Table 1, own illustration

	UK National Criminal Intelligence DNA Database		**Czech National DNA database**	
in view of	**Strengths**	**Weaknesses**	**Strengths**	**Weaknesses**
size	Very comprehensive, **5.2%** of UK population, growing rapidly	Every fifth person does not have a current criminal record	contains only profiles of convicted people	contains only ca **0.09%** of Czech population, growing slowly
What is being stored?	**DNA profile and the actual sample** – crime can be proved later more easily	Privacy issues	Cheaper, less privacy issues	**DNA profile** (shows only gender) gives space for later legal defense
How long is it stored?	**Basically forever**	Includes innocent people	**Until the convict turns** 80 years of age	Perhaps too long
sampling	From **anyone accused of a recordable offence**	Recordable offence might be for example being drunk	From people **convicted or accused of heavy crime**	Main reason why does the database grow slowly
Providers	**State-owned**	Controversial,	**State-owned**,	No

	and private, competition (lower cost)	private sector in law enforcement	no controversy	competition, possibly higher cost

6. Conclusion

Primary objective of this thesis was to compare two quite different institutions due to their attributes. Comparative analysis of both DNA databases pointed out the most obvious differences, which were in this case size and sampling procedure. They also differed in the fact for how long do they store saved data and in terms of what kind of data do they store.

Both databases have their strengths and weaknesses. Among strengths of Czech National DNA database is the fact, that it only contains DNA profile of convicted people and the DNA profiles aren't stored indefinitely. Price for that is lower accuracy and slower growth of Czech National DNA database compared with UK.

Due to the UK legislative might even a banal arrest lead to the detection of serious crime. I would consider it a major advantage of the existing UK system. Even though the UK system is more repressive for example in terms of sampling procedure and police powers, it's in my opinion more useful due to the amount of samples stored in the United Kingdom's DNA database. It is true that the database grows, often at the expense of innocent people. This raises legitimate concerns about privacy. On the other hand, extending the number of profiles on the National DNA Database could prove to be beneficial as it could lead to an increased number of convictions. Also, using DNA samples in criminal prosecutions could provide more conclusive evidence in court than the use of fingerprints alone.

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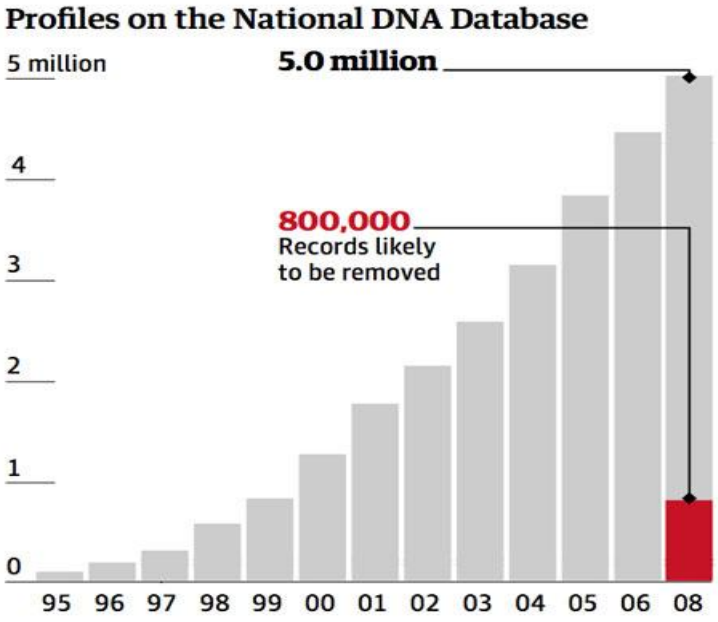
8. Appendix

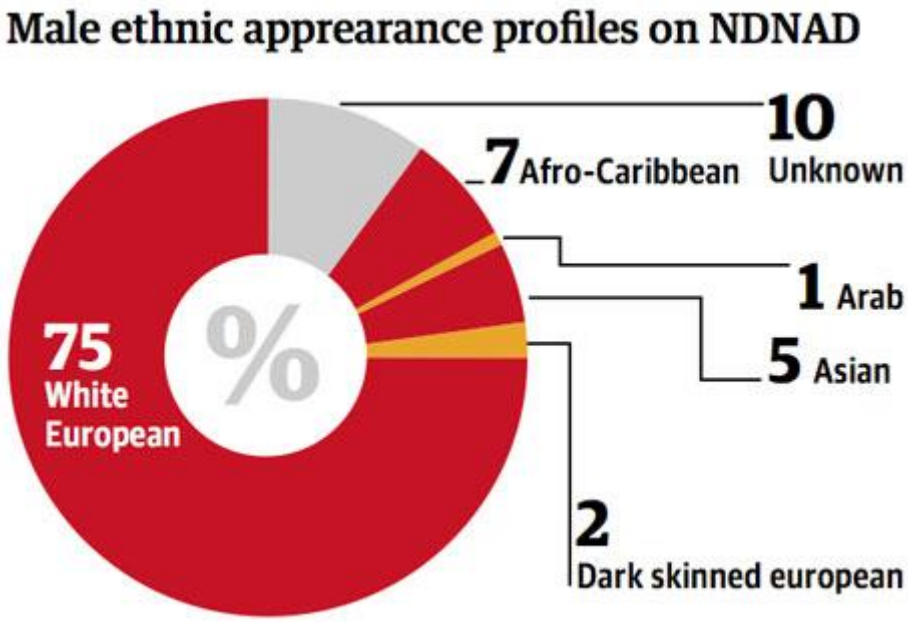
Table 2 [24]

Country (Year established)	Reference profile size	Crime-scene sample size	Suspect to scene hits	Scene to scene hits	Entry criteria for suspects	Entry criteria for convicted offenders	Removal criteria
UK (1995)	2.5 million	200,000	550,000	30,000	Any recordable offence*	Entered as suspect	Never removed, including suspects
USA (1994)	1.52 million	67,000	Figure unavailable	Figure unavailable	No suspects entered, but under revision	Depends on state law	Depends on state law
Germany (1998)	286,840	54,570	13,700	5,500	Offence leading to >1 yr in prison	After court decision	After acquittal or 5–10 years after conviction, if prognosis is good
Austria (1997)	64,740	11,460	3,200	1,350	Any recordable offence*	Entered as suspect	Only after acquittal
New Zealand (1996)	44,000	8,000	4,000	2,500	No suspects entered	A relevant offence (including ≥7 yr in prison)	Never removed, unless conviction quashed
Switzerland (2000)	42,530	7,240	4,840	5,540	Any recordable offence*	Entered as suspect	After acquittal or 5–30 years after conviction
France (2001)	14,490	1,080	50	70	No suspects entered	Sexual assault and serious crime	40 years after conviction
Finland (1999)	8,170	5,450	2,080	780	Offence leading to >1 yr in prison	Entered as suspect	Only after acquittal
Slovenia (1998)	4,820	2,360	370	80	Any recordable offence*	Entered as suspect	Depends on severity of crime
Netherlands (1997)	4,260	13,700	2,520	4,260	No suspects entered‡	Offence leading to >4 yr in prison	20–30 years after conviction
Sweden (2000)	3,980	9,860	2,500	4,750	No suspects entered	Offence leading to >2 yr in prison	10 years after release from prison



Graph 1 [25]

Graph 2 [25]



Graph 3 [25]