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Has New York Been Promoting Unreliable DNA Evidence Leading to Wrongful Convictions?

Melissa Goldstein¹

Abstract

Deoxyribonucleic acid (DNA) is known to be the gold standard when it comes to criminal trials. However, we should be more skeptical when DNA evidence is introduced at trials. DNA analysis methods are more intricate when trying to analyze fragile or complex samples. In recent years, it has been brought to our attention that New York was using two methods to analyze DNA that were not as reliable as they appeared. One method was using software called the Forensic Statistical Tool (FST). The other technique was high sensitivity testing. Both of these techniques have flaws that should have prevented their results from being admissible at trial. It seems like New York rushed to implement these methods in court and jeopardized the lives of innocent people. Due to the unreliability of these two techniques, and the fact that they were used in thousands of cases, there is a possibility that many were wrongfully convicted.

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Introduction

Imagine being a prisoner on Riker's Island for a year and a half for a crime you did not commit. For many of us, it's unimaginable. However, this unfortunate nightmare was Terrell Gills's reality.² Almost a year has passed since his release, but his jail life is still ingrained in him.³ He has sleepless nights, will spend the day in his room with the door locked, and eats his meals at the same times he was fed while in jail.⁴ He also deals with antisocial feelings that have affected his everyday life.⁵ These are all problems that no innocent person should ever have to deal with.

In August 2015, Mr. Gills was arrested and accused of robbing a Dunkin Donuts in Jamaica, Queens.⁶ A DNA match from a sample extracted from the crime scene led to his arrest.⁷ Mr. Gills was already in the DNA database for a nonviolent conviction.⁸ He sat in jail until his trial because he couldn't pay a \$10,000 bail.⁹ He was acquitted at trial, however his attorneys still argue that charges should never have been brought to begin with.¹⁰

It turns out that this Dunkin Donuts robbery was a part of a string of Dunkin Donuts robberies.¹¹ Two other stores were robbed as well. Surveillance footage showed that the robber in all three was wearing a crimson and yellow hat, leading investigators to believe they were

² Eli Rosenberg, Can DNA Evidence Be Too Convincing? An Acquitted Man Thinks So, NEW YORK TIMES (May 16, 2017).

³ Id.

⁴ Id.

⁵ Id.

⁶ Rosenberg, *supra* note 2.

⁷ Id.

⁸ Id. ⁹ Id.

¹⁰ Id.

¹¹ Rosenberg, *supra* note 2.

looking for one man.¹² The night before Mr. Gills's trial, his attorney learned that another man had plead guilty to the first and third robberies in exchange for nine-year prison sentence.¹³

Prosecutors still would not drop the charges against Mr. Gills.¹⁴ They claimed that the evidence was too strong against him.¹⁵ They also argued that the other man implicated Mr. Gills.¹⁶ However, the other man told Mr. Gills's attorneys that he was under duress when he implicated Mr. Gills.¹⁷ On top of that, he refused to testify against Mr. Gills at the trial.¹⁸

Other inconsistencies included height discrepancies.¹⁹ The initial report said the robber was six feet tall and 200 pounds.²⁰ A forensics expert believed that the robber was about five foot ten, give or take two inches.²¹ Mr. Gills, on the other hand, was only five feet six inches.²² After a few hours the jury decided to acquit Mr. Gills.²³ One juror claimed that after she saw the surveillance video, she knew that he was not the robber.²⁴

Regardless, the jurors were initially persuaded that Mr. Gills was guilty due to the DNA match.²⁵ This DNA match also made prosecutors reluctant to drop the charges even though other evidence made it unlikely that Mr. Gills was guilty. Mr. Gills's lawyers explain that the DNA could have matched because Mr. Gills sometimes took his daughter to that Dunkin Donuts.²⁶ The sample that was tested in this case was a complex mixture.²⁷ This means it contained DNA from

¹⁴ Id.

¹⁷ Id.

²¹ Id. ²² Id.

²⁴ Id.

¹² Id.

¹³ Id.

¹⁵ Rosenberg, *supra* note 2.

¹⁶ Id.

 $^{^{18}}$ *Id*.

¹⁹ Id.

²⁰ Rosenberg, *supra* note 2.

²³ Id.

²⁵ Rosenberg, *supra* note 2.

²⁶ Id.

²⁷ Id.

three or more people. Erin E. Murphy, a New York University Law professor, who has written about DNA and forensics, claims this type of sample is more likely to contain errors.²⁸

Our broken system has broken Mr. Gills life.²⁹ He is currently living with his mother in Binghamton, New York.³⁰ He owes about \$11,000 in child support, which accrued while he was wrongfully sitting in jail.³¹ He can't pay it off, which has resulted in his driver's license being suspended.³² He's gone on three job interviews and has to explain why he has been unemployed for two years.³³ He has to answer some hard questions and explain a story to people that they are reluctant to believe.³⁴ One employer told him, "Where there's smoke, there's fire" and never called him back.³⁵ The strength of bad DNA evidence caused Mr. Gills's life to become a nightmare.

Since the 1980's DNA has become more challenging to interpret.³⁶ There are five different reasons for this.³⁷ The first is that DNA test results are more sensitive.³⁸ The second is that there are more samples coming from touch DNA that are of poor quality, are complex mixtures, or that are very small.³⁹ The third is that there are more options for statistical approaches involving probabilistic genotyping software.⁴⁰ The fourth reason is that many

³⁰ Id.

⁴⁰ Id.

²⁸ Rosenberg, *supra* note 2.

²⁹ Id.

³¹ Id.

³² Id.

³³ Rosenberg, *supra* note 2.

³⁴ Id.

³⁵ Id.

³⁶ John M. Butler, *Issues and Challenges with Forensic DNA Analysis*, NIST.COM (Feb. 14, 2017), http://strbase.nist.gov/pub_pres/Butler-DNA-SpecialSession2-AAFS2017.pdf.
³⁷ Id.

³⁸ Id.

³⁹ Id.

laboratories are not prepared to deal with complex mixtures.⁴¹ Lastly, more loci are being added because of the large number of samples contained in DNA databases.⁴²

As of February 2019, 2,372 people have been exonerated for crimes they did not commit.⁴³ That is more than 20,735 years spent in prison that should have been spent in freedom. ⁴⁴ Eyewitness misidentification testimony is known to be the most common reason for wrongful convictions. ⁴⁵ However, newer methods have been created to analyze DNA and those could also become a common reason for wrongful convictions. Some of these methods have not been deemed reliable, yet are still being used to convict criminal defendants. Scientists and attorneys have been very eager to adopt new methods before they are fully ready for the courtroom.

In New York, two methods of testing have been called into question. ⁴⁶ The first method is using a program called the Forensic Statistical Tool (FST) and the second method is known as high sensitivity testing. ⁴⁷ Cases that relied on the Forensic Statistical Tool and high sensitivity testing should be called into question. These tests have been deemed unreliable, leaving the possibility for wrongful convictions. ⁴⁸

In part one, I will explain what DNA is, how it is analyzed, and how it made its appearance into the courtroom. Then, in part two, I will discuss how FST and high sensitivity testing were created, how they work, and why these two methods were adopted in the first place.

⁴¹ Butler, *supra* note 36.

⁴² Id.

⁴³ The National Registry of Exonerations, MICHIGAN UNIV. COLL. OF LAW,

http://www.law.umich.edu/special/exoneration/Pages/about.aspx (last visited Feb. 14, 2019). 44 Id.

⁴⁵ INNOCENCE PROJECT, https://www.naacp.org/wp-

content/uploads/2016/04/IP%20Wrongful%20Convictions%20Facts%20and%20Causes.pdf (last visited Feb. 14, 2019).

⁴⁶ Lauren Kirchner, *Thousands of Criminal Cases in New York Relied on Disputed SNA Testing Techniques*, PROPUBLICA (Sept. 4, 2017), https://www.propublica.org/article/thousands-of-criminal-cases-in-new-york-reliedon-disputed-dna-testing-techniques.

⁴⁷ *Id*.

⁴⁸ Id.

In part three, I will talk about the role these two methods play in court. Part four will discuss the issues and deficiencies with these methods. In part five, I will discuss how FST and high sensitivity testing have possibly led to wrongful convictions. Finally, in part six, I will discuss what New York is doing today, as well as future steps.

Part I

In this part, I will give background information on what DNA is, how it is analyzed, and how it became such an important feature in criminal trials.

A. What is DNA?

DNA is a molecule that contains the information needed for an organism to develop, survive, and reproduce. ⁴⁹ DNA is what makes individuals unique from one another. ⁵⁰ It determines everything from a person's traits, such as eye color, to whether a person is at risk for having certain diseases. ⁵¹ The uniqueness of DNA is what makes it so compelling in the areas of forensic science and criminal law.⁵²

⁴⁹ Rachel Rettner, *DNA: Definition, Structure & Discovery*, LIVE SCIENCE (Dec. 7, 2017), https://www.livescience.com/37247-dna.html.

⁵⁰ Id.

⁵¹ *Id*.

⁵² Stuart H. James Et Al., Forensic Science: An Introduction to Scientific and Investigative Techniques 230 (4th ed. 2014).

The human genome is made up of 23 chromosome pairs and each chromosome carries many genes.⁵³ An individual's set of DNA molecules are located within the nuclei of all types of cells in the human body, except for mature red blood cells. ⁵⁴ DNA molecules themselves are made up of nucleotides. Nucleotides are a unit consisting of a base, adenine (A), thymine (T), cytosine (C), and guanine (G), which connect to a sugar molecule and phosphate group.⁵⁵ These molecules are found within cells in a twisted ladder shape, which is known as a double helix.⁵⁶ The nucleotides pair together to make up the backbone of the double helix.⁵⁷



There are two DNA types found within the cell's nuclei.⁵⁸ These are known as coding DNA and noncoding DNA, which is also misleadingly known as "junk" DNA.⁵⁹ Coding DNA codes for proteins and makes up about 3% of human genomic DNA.⁶⁰ The other 97% is made up of noncoding DNA. Noncoding DNA does not code for proteins and can be found in repetitive sequences throughout the human genome.⁶¹ This means that the same sequence is repeated over and over throughout the chromosomes.⁶² The repeating base pairs (A, C, G, or T) make up these

- ⁵⁵ *Id.* at 230.
- ⁵⁶ Id.

⁵⁹ *Id*.

⁶¹ Id.

⁵³ *Id.* at 231.

⁵⁴ Id. at 238.

⁵⁷ JAMES ET AL., *supra* note 52, at 230.

⁵⁸ *Id.* at 235.

⁶⁰ Id.

⁶² JAMES ET AL., *supra* note 52, at 235.

sequences.⁶³ An example would be the repetition of a combination of the bases "T,C,A,T" all the way through the sequence.⁶⁴

Repetitive sequences found in noncoding DNA are great tools for analyzing differences between people.⁶⁵ This is because they are highly variable and most people have different numbers of allelic repeat units.⁶⁶ It differs between people because we inherit our genetic material from our parents, half from our mother and half from our father.⁶⁷

Our genotype and phenotype, what our genes contain and how we actually look, results from repeated sequences carried by both sperm and eggs.⁶⁸ Every locus, or fixed position on the chromosome, contains an allele from our mother and another from our father.⁶⁹ As an example to demonstrate, assume the sperm carried DNA containing 5 repeats.⁷⁰ Also, assume the egg carried DNA containing 12 repeats.⁷¹ When the egg is fertilized the child's genotype/phenotype will be 5,12.⁷² This makes the individual heterozygous because the copies of the genes, or alleles, are different.⁷³ A homozygous individual would have the same number of copies at the given location, meaning the genotype/phenotype would be 12,12.⁷⁴

B. Preparing and Analyzing DNA Samples

Once a DNA sample is contained, multiple copies may need to be made in order to ensure accurate testing.⁷⁵ Understanding DNA's double helix shape has allowed forensic

⁶³ Id.
⁶⁴ Id. at 238.
⁶⁵ Id. at 235.
⁶⁶ Id.
⁶⁷ JAMES ET AL., supra note 52, at 231.
⁶⁸ Id. at 235.
⁶⁹ Id.
⁷⁰ Id.
⁷¹ Id.

 72 JAMES ET AL., *supra* note 52, at 235.

⁷⁴ Id.

⁷³ Id.

⁷⁵ *Id.* at 231.

scientists to manipulate DNA and perform tests that are an integral aspect of forensic investigations. ⁷⁶ Separating and identifying DNA in the lab depends on the double stranded DNA structure.⁷⁷

DNA collected from most crime scenes is retrieved from nucleic acid that is extracted from blood, semen, bone, hair, and dried skin.⁷⁸ When DNA is collected, there are two issues that forensic scientists deal with.⁷⁹ The first issue is that the DNA is susceptible to degradation.⁸⁰ Another issue is that only small amounts are able to be collected.⁸¹

In order to make up for degraded DNA, or only collecting a small amount, scientists make multiple copies of the sample they've received.⁸² There are three steps to copying DNA.⁸³ The first is obtaining a sequence of double stranded DNA.⁸⁴ The second is splitting it into separate strands.⁸⁵ The third is synthesizing new complements.⁸⁶ After this process, we go from having one double DNA strand to two intact DNA molecules.⁸⁷

This process is known as polymerase chain reaction (PCR).⁸⁸ Polymerase is an enzyme and is one of the many chemicals required for this process to be successful.⁸⁹ This chemical is able to withstand the 95-degree Celsius heat that is used to separate the two DNA strands.⁹⁰ It is

⁷⁶ Id.

- ⁷⁸ *Id.* at 238.
- ⁷⁹ *Id.* at 239.
- ⁸⁰ Id. ⁸¹ Id.
- ⁸² JAMES ET AL., *supra* note 52, at 231.

- ⁸⁴ Id.
- ⁸⁵ Id.
- ⁸⁶ Id.
- ⁸⁷ JAMES ET AL., *supra* note 52, at 231.

- ⁸⁹ Id.
- ⁹⁰ Id.

⁷⁷ JAMES ET AL., *supra* note 52, at 231.

⁸³ *Id.* at 241.

⁸⁸ *Id*.at 242.

important to be able to withstand 95 degrees Celsius because most proteins lose function and fall apart at that heat level.⁹¹

There are many different types of repetitive sequences.⁹² We will focus on a type called short tandem repeats (STR) because they are the current standard in forensic genetic typing.⁹³ STRs are made up of tetramers, which means they have four bases that are repeated in an array.⁹⁴ They have less than 40 repeats, making them small, but they can be readily amplified.⁹⁵

When analyzing the STRs, scientists look at different loci on the chromosomes.⁹⁶ In the mid-1990's the FBI made the standard number of loci 13.⁹⁷ However, in 2017 the standard was raised to 20 core loci.⁹⁸ This means that there are 20 core locations on the chromosome that must be analyzed when determining if a DNA sample matches a suspect.⁹⁹ DNA patterns repeat themselves at each locus and every person has their own repeats.¹⁰⁰ The number of repeats allows scientists to label each locus with a specific number, which is the allele. If a pattern repeats 11 times, the allele at the locus is an 11.

⁹¹ Id.

⁹² JAMES ET AL., *supra* note 52, at 242.

⁹³ *Id.* at 244.

⁹⁴ Id.

⁹⁵ Id.

⁹⁶ DNA profiling, SCIENCE LEARNING HUB (Dec. 1, 2005), https://www.sciencelearn.org.nz/resources/1980-dna-profiling.

⁹⁷ John M. Butler, Issues and Challenges with Forensic DNA Analysis, NIST (Feb. 14. 2017),

https://strbase.nist.gov/pub_pres/Butler-DNA-SpecialSession2-AAFS2017.pdf.

⁹⁸ Id.

⁹⁹ Id.

¹⁰⁰ People v. Collins, 15 N.Y.S.3d 564 (Sup. Ct. 2015).



the repeat region is variable between samples while the flanking regions where PCR primers bind are constant Homozygote = both alleles are the same length Heterozygote = alleles differ and can be resolved from one another Primer positions define PCR product size ©2002 Academic Press

Image 1.2: http://slideplayer.com/slide/8526371/

C. How DNA made it in the Courtroom

In November 1983, in Leicestershire, a 15-year-old schoolgirl was raped and strangled.¹⁰¹ The murder went unsolved. Three years later, another 15-year-old schoolgirl was raped and strangled nearby.¹⁰² Police collected 4,500 voluntary samples from local men and eventually received a confession from a man for the second murder.¹⁰³

As this was going on, Sir Alec Jeffreys, a geneticist at Leicester University recently developed DNA testing.¹⁰⁴ He performed DNA testing on the evidence samples found at the crime scenes of both murders and compared his results with the voluntary samples received by

¹⁰⁴ *Id*.

¹⁰¹ JAMES ET AL., *supra* note 52, at 233.

¹⁰² Id.

¹⁰³ Id.

police.¹⁰⁵ He was able to conclude that the same man raped and murdered both girls.¹⁰⁶ However, the perpetrator was not the man who confessed.¹⁰⁷

Police were tipped off to a man named Colin Pitchfork. He was a local baker who avoided voluntarily giving his DNA.¹⁰⁸ He had a coworker take the DNA test for him.¹⁰⁹ Eventually his DNA was analyzed and matched the DNA samples collected at the crime scenes.¹¹⁰ In January 1988, he was convicted and sentenced to two life sentences.¹¹¹ Colin Pitchfork became the first criminal caught with DNA evidence and the man who had previously confessed became the first suspect exonerated by DNA.¹¹²

If it weren't for DNA, Pitchfork would have gotten away with two murders.¹¹³ By the time he was being sentenced, DNA was being introduced into United States courtrooms.¹¹⁴ A few companies were able to perform DNA profiling by 1986 and by 1988 the Federal Bureau of Investigation (FBI) was able to do so as well.¹¹⁵ The earliest tests, which were similar to those used in the Leicestershire murders, required large DNA samples.¹¹⁶ The testing did not work well with small or degraded samples.¹¹⁷

Soon after, the FBI began training state crime laboratory analysts in DNA profiling.¹¹⁸ These state laboratories then began to run their own DNA tests.¹¹⁹ The FBI also developed a

- ¹⁰⁷ Id.
- ¹⁰⁸ *Id.* at 234.
- ¹⁰⁹ Id.

- 112 Id.
- 113 Id.
- 114 Id. at 235.
- ¹¹⁵ JAMES ET AL., *supra* note 52, at 235.
- ¹¹⁶ Id.
- ¹¹⁷ Id.

¹¹⁹ Id.

¹⁰⁵ Id.

¹⁰⁶ JAMES ET AL., *supra* note 52, at 233.

¹¹⁰ JAMES ET AL., *supra* note 52, at 234. ¹¹¹ Id

¹¹⁸ Id.

convicted offender database.¹²⁰ This national system is called the Combined DNA Index System (CODIS).¹²¹

Currently, there are over 15 million DNA profiles in CODIS.¹²² This system can compare DNA evidence from a crime scene and link to a profile of a convicted offender.¹²³ However, a match does not necessarily prove that a suspect is the perpetrator of the crime.¹²⁴

Since the discovery that DNA could be used in the courtroom, about 200 public laboratories have opened that conduct forensic DNA analysis.¹²⁵ There are many different protocols used, which could lead to different results coming depending on which lab conducts the analysis.¹²⁶ For a while, New York was using the Forensic Statistical Tool and high sensitivity testing to deal with the challenges faced when interpreting DNA samples.

Part II

In this part of the paper, I will be going into detail about FST and high sensitivity testing. I will talk about how they both came to be, what purposes they serve in forensic science, and how they work.

A. The Forensic Statistical Tool

FST is software that was created by Dr. Adele Mitchell and Dr. Theresa Caragine to solve the problems with analyzing complex mixtures.¹²⁷ Dr. Mitchell has a Master's degree in

¹²⁷ Richard Torres, Introduction to the Forensic Statistical Tool,

http://federaldefendersny.org/pdfs/Introduction%20to%20The%20Forensic%20Statistical%20Tool%20-%20Torres.pdf (last visited Mar. 28, 2021).

¹²⁰ JAMES ET AL., *supra* note 52, at 235.

¹²¹ Id.

¹²² Butler, *supra* note 97.

¹²³ *Id.*

¹²⁴ Id.

¹²⁵ Butler, *supra* note 97.

¹²⁶ *Id.*

Statistical Genetics and a Ph.D. in Human Genetics and Molecular Biology from Johns Hopkins School of Medicine.¹²⁸ Dr. Caragine received her doctorate in Molecular Oncology and Immunology from New York University.¹²⁹ The two worked on FST together for two years.¹³⁰ FST was then validated by a team of forensic analysts at the Office of the Chief Medical Examiner (OCME) Laboratory in New York.¹³¹ The New York State Forensic Science Commission also approved it in 2010.¹³² Dr. Mitchell and Dr. Caragine have both received awards for their work on FST.¹³³

First, it is important to understand what a complex mixture is and why it is difficult to analyze. A complex mixture is a when the sample has multiple contributors, making it difficult to figure out exactly how many contributors make up the sample.¹³⁴ When three or four alleles are found at any given loci, analysts can conclude that more than one person makes up the mixture. These profiles are even more challenging when they come from touch DNA.¹³⁵ With touch DNA, it is possible that multiple people touched a given surface prior to DNA collection.¹³⁶ It is difficult to analyze because it is subject to an increased probability for stochastic effects.¹³⁷ These are random external events that may alter the sample.¹³⁸

¹²⁸ Liz Robbins, Helping Decide Guilt or Innocence, N.Y. TIMES (Dec. 15, 2012),

¹³⁴ O' Connor, *supra* note 132.

http://www.nytimes.com/2012/12/16/nyregion/a-forensic-tool-helps-decide-guilt-or-innocence.html.

¹²⁹ Id.

¹³⁰ Id.

¹³¹ Torres, *supra* note 127.

¹³² Craig O' Connor, *Probabilistic Genotyping: The Use of the Forensic Statistical Tool (FST)*, NEW YORK OFFICE OF THE CHIEF MEDICAL EXAMINER (2014),

https://www.nist.gov/system/files/documents/forensics/CraigOConnor_DNA-2.pdf.

¹³³ Robbins, *supra* note 128.

¹³⁵ Michael D. Coble, *NIST Corner: Complex DNA Mixtures*, EVIDENCE TECH. MAG.,

http://www.evidencemagazine.com/index.php?option=com_content&task=view&id=1693 (last visited Mar. 28, 2021).

¹³⁶ Id.

¹³⁷ Id.

¹³⁸ Id.

Two examples of stochastic effects are allele drop-out and/or drop-in.¹³⁹ Allele drop-out is when a sample is examined to determine if a suspect's alleles are not apparent in the sample.¹⁴⁰ This could occur when there is missing data.¹⁴¹ On the other hand, allele drop-in is when there are alleles present in the sample that are not explained by the suspect or other possible contributors.¹⁴²

FST was designed to decipher these complex mixtures. The software calculates a likelihood ratio (LR) of the complex mixtures to try and figure out whether the DNA matches a suspect.¹⁴³ LRs are ratios used to measure the strength of the DNA evidence found at the crime scene.¹⁴⁴ They summarize the DNA evidence.¹⁴⁵ The LR is a figure calculated from a fraction, which is derived from two hypotheses.¹⁴⁶ The first hypothesis is that the source of the evidence and the suspect are the same person.¹⁴⁷ This is the numerator of the fraction and represents the prosecution's theory.¹⁴⁸ The second is that the source of the evidence is a random person who is unrelated to the suspect.¹⁴⁹ This part is the denominator of the fraction and represents the defense's theory.¹⁵⁰ When the DNA tested comes from the same person, the ratio will be greater.¹⁵¹

There are other programs out there that are similar to FST, however FST differs because OCME has designated specific probabilities for stochastic effects to factor in equations based on

¹³⁹ O' Connor, *supra* note 132.

¹⁴⁰ Id.

¹⁴¹ Id.

¹⁴² Id.

¹⁴³ Id.

¹⁴⁴ NAT'L RESEARCH COUNCIL (U.S.) COMM. ON DNA FORENSIC SCI., *The Evaluation of Forensic DNA Evidence* ch. 5 (1996), https://www.ncbi.nlm.nih.gov/books/NBK232615/.

¹⁴⁵ Id.

¹⁴⁶ Id.

¹⁴⁷ Id. ¹⁴⁸ Id.

¹⁴⁹ Nat'l Research Council (U.S.) Comm. on DNA Forensic Sci., *supra* note 144.

¹⁵⁰ Id.

¹⁵¹ O' Connor, *supra* note 132.

DNA amounts (quants).¹⁵² The software uses this predetermined figure at each locus, along with the particular quant, in determining the probability of the prosecution versus the defense hypothesis.¹⁵³

The software was created by analyzing samples of DNA mixtures by known contributors.¹⁵⁴ The OCME selected 15 loci and counted the stochastic effects at each locus.¹⁵⁵ Then they compared the results with the contributors' actual DNA profiles.¹⁵⁶ Those results were used to calculate the probabilities of additional or missing alleles at each locus, which are the drop in and drop out rates.¹⁵⁷ Finally, a mathematical analysis that factors in the probability of stochastic effects is completed.¹⁵⁸ FST uses Bayesian mathematics, which has been used in science for centuries and no one disputes its principles. In the end, the software allows analysts to deduce the LR.¹⁵⁹ Just like that, FST's creators believed they found an innovative way to analyze complex mixtures.

B. High Sensitivity Testing

High sensitivity testing is also known as low copy number (LCN) or low-level DNA.¹⁶⁰ Low copy number DNA analysis refers to enhanced methods that are used during or after PCR amplification.¹⁶¹ This technique is used to amplify extremely small DNA samples in order give

¹⁵⁶ *Id.* at 568.

¹⁵⁸ Id.

¹⁵² Id.

¹⁵³ Id.

¹⁵⁴ Id.

¹⁵⁵ Collins, 15 N.Y.S.3d at 567.

¹⁵⁷ Id.

¹⁵⁹ *Id*.

¹⁶⁰ *Collins*, 15 N.Y.S.3d at 571.

¹⁶¹ Id.

analysts more information. LCN is dependent on the amount of DNA present, not on the number of PCR cycles performed to amplify the sample.¹⁶²

The first step in this process is to determine the quantity of DNA in the sample. High sensitivity testing will be used instead of the standard methods if the quantity is low enough. When the technique was first developed, it was used on samples containing less than 100 picograms (pg) of DNA.¹⁶³ 100 pg is equivalent to 16 human cells and one cell produces about six pictograms of DNA.¹⁶⁴ Such a small sample size makes PCR amplification less reliable.¹⁶⁵ Laboratories may vary on the threshold number they use for considering a sample to be low level.¹⁶⁶ More recently, a DNA sample may be considered low level if it contains less than 200 pg of DNA.¹⁶⁷

In the standard method for DNA testing, samples undergo 28 PCR cycles.¹⁶⁸ In each cycle, the twisted DNA ladder is cut in two and each half of the ladder bonds with chemicals.¹⁶⁹ This produces a clone of the original DNA ladder.¹⁷⁰ After this process happens 28 times, the sample is about 268 million times bigger than the original that was collected.¹⁷¹ Each laboratory must have its own validated procedure for a standard method, which is used as the basis for the sensitivity comparison.¹⁷²

¹⁷² Id.

¹⁶² Id.

¹⁶³ The Conti-Vecchiotti Report, Low Copy Number (LCN) or Low Template DNA (LT-DNA), WORDPRESS, https://knoxdnareport.wordpress.com/contents/examination-of-the-technical-report-on-the-forensic-genetic-tests-bydr-patrizia-stefanoni/laboratory-analyses-reported-in-the-rtgif-regarding-item-36-knife/low-copy-number-lcn-orlow-template-dna-lt-dna/ (last visited Mar. 30, 2021).

¹⁶⁴ *Collins*, 15 N.Y.S.3d at 571.

¹⁶⁵ Id.

¹⁶⁶ Id. ¹⁶⁷ Id.

¹⁶⁸ Id.

¹⁶⁹ Collins, 15 N.Y.S.3d at 571. ¹⁷⁰ Id.

¹⁷¹ Id.

When a sample falls into the low-level range, 28 cycles does not produce enough DNA to allow an electrophoregram.¹⁷³ Electrophoregrams use a special gel to detect peaks by identifying which alleles are present at each locus.¹⁷⁴ When one or two alleles are present at all loci tested, the sample is considered to have come from one person.¹⁷⁵ High sensitivity testing solves this problem by subjecting the DNA to an additional three cycles.¹⁷⁶ Instead of 28, high sensitivity testing uses 31 cycles.¹⁷⁷

LCN analysis is not a new technique, however the OCME was the first United States laboratory to implement it.¹⁷⁸ Interestingly enough, it is the only laboratory to use it to produce evidence in criminal cases.¹⁷⁹ The OCME renamed LCN to high sensitivity testing in order to make the method sound more positive.¹⁸⁰ In a way, it hides the fact that examiners are dealing with low-level DNA and makes it sound like a more trustworthy type of testing. For the most part the methods used by the OCME are the same as they always have been, however there have been a few modifications for the increased sensitivity.¹⁸¹ In order to get the most out of the DNA collected from a substrate, the OCME uses its own specialized high sensitivity swab.¹⁸²

New York prosecutors regularly rely on this method and the medical examiner's office uses it in about ten percent of the DNA cases it analyzes.¹⁸³ Since 2005, high sensitivity DNA

¹⁷³ Id.

¹⁷⁴ *Collins*, 15 N.Y.S.3d at 571.

¹⁷⁵ Maria Alice Ciobanu, Evaluation of peak/height ratio concept towards the interpretation of complex DNA profiles, COVENTRY U (March 2014).

¹⁷⁶ Collins, 15 N.Y.S.3d 574.

¹⁷⁷ *High Sensitivity DNA Testing*, N.Y.C. OFF. OF CHIEF MED. OFFICER DEP'T OF FORENSIC BIOLOGY, http://www.nyc.gov/html/ocme/downloads/pdf/HISENS_brochure.pdf (last visited Mar. 30, 2021). ¹⁷⁸ Id.

¹⁷⁹ Collins, 15 N.Y.S.3d at 575.

¹⁸⁰ ERIN E. MURPHY, INSIDE THE CELL: THE DARK SIDE OF FORENSIC DNA 76 (2015),

https://books.google.com/books/about/Inside_the_Cell.html?id=twErCgAAQBAJ&printsec=frontcover&source=kp_read_button#v=onepage&q&f=false.

¹⁸¹ N.Y.C. Off. of Chief Med. Officer Dep't of Forensic Biology, *supra* note 177.

¹⁸² Id.

¹⁸³ Id.

testing has been used in over 7,500 cases.¹⁸⁴ Scientists have testified about it in state and federal courts for 250 cases.¹⁸⁵ New York City's OCME is now offering high sensitivity DNA testing to other jurisdictions as well.¹⁸⁶ This means that high sensitivity testing could be affecting case outcomes out of state as well.

Part III

This part of the paper will explore the role that FST and high sensitivity play in court. Courts have formed mixed opinions as to the reliability of both of these tests. It has been shown that both FST and high sensitivity testing have deficiencies that should worry both the scientific and legal fields.¹⁸⁷ Both of these methods have been used in thousands of cases, many of which have ultimately convicted criminal defendants.¹⁸⁸ On the other hand, these methods could have been used in cases that wrongfully exonerate a defendant.¹⁸⁹

A. FST in Court

Of the many cases that have used FST, there have only been Frye hearings regarding the software in two cases.¹⁹⁰ In a Frye hearing, the judge determines whether the scientific community considers methods reliable.¹⁹¹ If there is sufficient evidence that methods are generally accepted, the methods will be admissible.¹⁹² Both of these cases reached different conclusions regarding FST's admissibility.

¹⁸⁴ Id.

¹⁸⁵ Id.

¹⁸⁶ N.Y.C. Off. of Chief Med. Officer Dep't of Forensic Biology, *supra* note 177.

¹⁸⁷ See Collins, 15 N.Y.S.3d at 564.

¹⁸⁸ See id.

¹⁸⁹ See id.

¹⁹⁰ Torres, *supra* note 127.

¹⁹¹ Collins, 15 N.Y.S.3d at 570.

¹⁹² *Id.* at 586.

The first case was *People v. Rodriguez*, which took place in the Bronx, New York.¹⁹³ The second was *People v. Collins*, which occurred in Brooklyn, New York.¹⁹⁴ *Collins* is a consolidation of two cases.¹⁹⁵ The two defendants, Collins and Peaks, challenged FST and claimed it was not generally accepted in the relevant scientific community.¹⁹⁶

In *Rodriguez*, the court found that FST was an acceptable method for analyzing DNA.¹⁹⁷ However, in this case the court focused on less controversial issues surrounding FST.¹⁹⁸ These issues were the general acceptance of PCR-STR analysis, the use of likelihood ratios, and drop in and drop out rates being accounted for in the LR.¹⁹⁹ There, the court was very deferential towards New York's DNA Subcommittee and decided in favor of the People.²⁰⁰

In *Collins*, FST placed both of the defendants at the crimes in question.²⁰¹ In defendant Collin's case, the DNA was swabbed from the handlebar of a bicycle.²⁰² FST reports showed that one mixture on one handlebar was 972,000 times more likely to have come from Collins and two unknown people than coming from three unknown people.²⁰³ The other mixture was 19.4 times more likely to be a contributor than an unrelated individual.²⁰⁴ In defendant Peak's case, the defendant allegedly attacked two victims. FST was used to test a mixture found on a bra collected from the crime scene.²⁰⁵ During the initial testing, Peak's alleles were not found at two loci.²⁰⁶ However, FST concluded that the mixture was 19.6 times more likely to come from the

¹⁹⁶ Id.

¹⁹⁹ Id.

²⁰² Id.

²⁰⁶ Id.

¹⁹³ Id. at 586.

¹⁹⁴ Id.

¹⁹⁵ *Collins*, 15 N.Y.S.3d at 566.

¹⁹⁷ Torres, *supra* note 127.

¹⁹⁸ *Collins*, 15 N.Y.S.3d at 586.

²⁰⁰ Id. ²⁰¹ *Id.* at 568.

²⁰³ Collins, 15 N.Y.S.3d at 565.

²⁰⁴ Id.

²⁰⁵ Id.

Peak, the second victim, and an unknown person than the second victim and two unknown individuals.²⁰⁷

Both of the defendants in *Collins* do not object to the Bayesian mathematics used or claim that the software does calculations that are too complex for humans.²⁰⁸ Instead, they make two assertions.²⁰⁹ First, that the way drop-in and drop-out rates were assessed at each locus was not generally accepted in the scientific community.²¹⁰ Second, that FST only reflects the prosecutions hypothesis and does not allow for the defenses hypothesis to be tested.²¹¹

The *Collin's* court focused mostly on how valid the way in which the likelihood of stochastic effects at the relevant loci was computed for FST.²¹² The court also touched on FST's use of quants (DNA amounts), rather than peak heights to figure out which numbers should be used in calculating the likelihood of drop-in and drop-out.²¹³ In the end, the courts conclusion in *Collins* was not that LRs were not generally accepted, it was that FST as software was too problematic to be generally accepted.²¹⁴ As we can see, each court focused on different issues regarding FST, which is what led to the different conclusions.

B. High Sensitivity Testing in Court

In regards to high sensitivity testing, there are cases that have found it to be reliable, while others have not. *Collins* was a case that deemed it unreliable to be used in court.²¹⁵

²⁰⁷ Id.

²⁰⁸ *Collins*, 15 N.Y.S.3d at 568.

²⁰⁹ Id.

²¹⁰ Id.

²¹¹ Id.

²¹² Id.

²¹³ *Collins*, 15 N.Y.S.3d at 578.

²¹⁴ Id.

²¹⁵ See Collins, 15 N.Y.S.3d at 565.

However, in *People v. Megnath*, the court ruled that it was reliable.²¹⁶ It is concerning that some cases will allow this method to be used against criminal defendants, while other will not.

In *Collins*, the DNA swabbed from the handlebars in defendant Collin's case underwent high sensitivity testing before FST due to how small the sample was.²¹⁷ As stated above, high sensitivity testing adds three extra cycles onto the standard DNA testing protocols.²¹⁸ With this comes an increased chance for stochastic effects.²¹⁹ The OCME put new protocols into place to compensate for the stochastic effects.²²⁰ In *Collins*, the issue was whether the protocols adequately compensate.²²¹

The defense also claims that the scientific community does not agree that the high sensitivity analysis produces reliable DNA profiles.²²² Collins asserts that the analysis done in his case was not reliable because a mixture of three people's DNA was found on the bicycle handlebars.²²³ When two or more DNA profiles are retrieved, it is hard to create individual profiles for each contributor when DNA from each is sufficiently different.²²⁴ Collins claims that the DNA collected was too equal to allow for a distinct differentiation.²²⁵ The test there yielded results that Collins "could be" a contributor to DNA collected from one handlebar due to all of his alleles being present in the mixture.²²⁶ The other handlebar did not show all of his alleles, meaning that he could not be excluded.²²⁷

²¹⁶ People v. Megnath, 898 N.Y.S.2d 408 (Sup. Ct. 2010).

²¹⁷ *Collins*, 15 N.Y.S.3d at 567.

²¹⁸ Id.

²¹⁹ Id. ²²⁰ Id.

²²¹ Id.

²²² Collins, 15 N.Y.S.3d at 567.

²²³ Id.

²²⁴ Id.

²²⁵ Id.

²²⁶ Id.

²²⁷ *Collins*, 15 N.Y.S.3d at 567.

In *Megnath*, DNA evidence was recovered from the defendant's car²²⁸. This evidence was subject to high sensitivity testing and the results linked the defendant to the murder of Natasha Ramen.²²⁹ The issue in the case was whether high sensitivity testing satisfies the Frye standard.²³⁰ The court ultimately held that DNA testing has been generally accepted for many years, and high sensitivity testing did not deviate enough from the standard PCR-STR method to be called into question.²³¹ The defendant claimed that there are too many concerns with this testing method.²³² The court found that his arguments were relevant, however it is up to the trier of fact to decide whether or not the results weigh in the defendant's favor.²³³

Part IV

In this part of the paper, I will explain FST and high sensitivity testing's deficiencies. This will shed light as to why we should be bothered by the fact that these tests are being used. It is alarming that courts were allowing tests with so many issues to help determine the faith of possibly innocent people.

A. FST's Deficiencies

In *Collins*, the defense experts really honed in on FST's many deficiencies. They talk about FST's drop-out model, how FST calculates for the probability of stochastic effects, the high false positives FST produces, issues with validation studies, and FST's creators messing with data to match their assumptions.²³⁴ There was another issue that has since been resolved,

²²⁸ Megnath, 898 N.Y.S.2d 408.

²²⁹ Id.

²³⁰ Id.

²³¹ *Id.* at 412-13.

²³² *Id.* at 411-12.

²³³ *Megnath*, 898 N.Y.S.2d at 412.

²³⁴ Collins, 15 N.Y.S.3d at 579-80.

FST as a "black box."²³⁵ However, I will still talk about that issue and what was done to resolve it.

1. Drop-out Model

The first deficiency involves FST's drop-out model.²³⁶ This aspect is fundamental to the program.²³⁷ When OCME calculated the probability of stochastic effects at the loci, they modified the numbers to a certain extent to make it align with the expected results.²³⁸ The numbers were also reduced by one standard deviation in order to produce lower LRs than the actual data would have produced.²³⁹ This was done in effort to be "conservative."²⁴⁰ When Dr. Mitchell was questioned about this, she said that she did not save, or publish, the data from the "conservative" studies.²⁴¹ In this case, the probabilities of stochastic effects were calculated through computer simulations.²⁴² Defense experts believe that the effort to be "conservative" could lead to a false understanding of the drop-out rate and also miscalculate the number of contributors to the mixture.²⁴³

2. Probability of Stochastic Effects Calculations

The second deficiency also has to do with the way FST uses the numbers for the probability of stochastic effects.²⁴⁴ FST uses quants; where as other programs use peak heights.²⁴⁵ Defense experts claim that the quant calculation is not precise, so the numbers yielded

²⁴¹ Id.

²³⁵ *Id.* at 580.

²³⁶ *Id.* at 583-84.

²³⁷ *Id.* at 578.

²³⁸ Id.

²³⁹ *Collins*, 15 N.Y.S.3d at 578.

²⁴⁰ Torres, *supra* note 127.

²⁴² *Collins*, 15 N.Y.S.3d at 578.

²⁴³ *Id.* at 579. ²⁴⁴ *Id.* at 578.

 $^{^{245}}$ Id.

could be 30% greater or lower than the true quant.²⁴⁶ This does not have as much of an impact on larger DNA samples that can be analyzed using standard analysis.²⁴⁷ The effect of using quants has a far more significant impact on samples that are low level, or weigh less than 100 pg.²⁴⁸ Dr. Mitchell admits she never did a formal study on the quant value and its relation to drop out rates.²⁴⁹

3. High False Positives

A third issue is that FST produces high false positives.²⁵⁰ OCME did conduct a false positive study, however defense experts were skeptical about its reliability.²⁵¹ Most of the DNA samples tested came from touch DNA.²⁵² They used 439 different DNA mixtures and each mixture was run against a database consisting of 1,300 profiles.²⁵³ Each mixture was run against the database 480 times.²⁵⁴ In about ten percent of the runs, at least one false positive above a known contributor would result.²⁵⁵

Defense expert Dr. Rori Rohlfs, a population geneticist, recognized one issue leading to false positives.²⁵⁶ FST recognizes four races, Asian, European, African, and Latino.²⁵⁷ The software uses different numbers for allele frequency for each race.²⁵⁸ The OCME produced no data on which "false positive" test subjects identified themselves as, so Dr. Rohlfs conducted her

²⁴⁸ Id.

 252 *Id.* at 571.

²⁵⁵ Id.

²⁴⁶ Id.

²⁴⁷ *Collins*, 15 N.Y.S.3d at 578.

²⁴⁹ Torres, *supra* note 127.

²⁵⁰ Id.

²⁵¹ *Collins*, 15 N.Y.S.3d at 579-80.

²⁵³ Torres, *supra* note 127. ²⁵⁴ Id.

²⁵⁶ *Collins*, 15 N.Y.S.3d at 579.

²⁵⁷ Id. at 580.

²⁵⁸ Id.

own tests.²⁵⁹ She assigned subjects to the racial categories based on how their individual LRs matched up with the race classifications.²⁶⁰ Another doctor in the field agreed that the method she used was the best that could be done without the OCME data.²⁶¹ In the end, Dr. Rohlfs was concerned by her discoveries.²⁶²

First, she believed that her research did not allow for fair conclusion about error rates because the three Asian subjects did not represent genetic diversity for the racial category.²⁶³ Second, FST was based on too few mixtures from too few contributors.²⁶⁴ There were 480 mixtures from 61 contributors.²⁶⁵ Dr. Rohlfs believes that in order to get adequate statistics, the "false positive" tests would have needed hundreds of contributors and hundreds of thousands simulates mixtures.²⁶⁶ Most importantly, only 11 of the 480 mixtures involved contributors of all the same race."²⁶⁷ When contributors are the same race, there is allele overlap leading to more false positives. Lastly, and most importantly, mixed races are not considered.²⁶⁸ Other populations that are genetically distinct from these four races were also not accounted for.²⁶⁹ If the actual criminal and the innocent person shared an ancestor, no matter how distant, the LR could be dramatically skewed.²⁷⁰ FST does not consider interrelatedness, meanwhile other programs do, such as LikeLTD and LRmix.²⁷¹

4. Validation

²⁵⁹ Id.
²⁶⁰ Id.
²⁶¹ Collins, 15 N.Y.S.3d at 581.
²⁶² Id.
²⁶³ Id.
²⁶⁴ Id.
²⁶⁶ Collins, 15 N.Y.S.3d at 581.
²⁶⁷ Id.
²⁶⁸ Id.
²⁶⁹ Id.
²⁷⁰ Id. at 581.
²⁷¹ Torres, supra note 127, at 17.

Another issue involves FST's validation.²⁷² Within the validation studies, there are times where the same input was put into FST, however the software produced different outputs.²⁷³ OCME acknowledged this, but claimed it was an error with the calculator and not with what was being used in the casework.²⁷⁴ This means that what has been used in casework is not the same as what was validated.²⁷⁵ In addition, pristine lab samples were used during the validation testing.²⁷⁶ The various problems that can occur between the time DNA is collected and the time that it is tested were not accounted for.²⁷⁷ This includes damage from sunlight, microorganisms, cross contamination, and more.²⁷⁸

5. Skewing Data to Fit Assumptions

Additionally, FST's creators claimed that the drop-out rates would increase in a linear fashion as the quant rates decreased.²⁷⁹ However, after counting the drop-out, this does not appear to be true.²⁸⁰ The numbers OCME produced were changed from what was counted in order to reflect the linear results they wanted.²⁸¹ The defense experts believe that the OCME assumptions are not valid.²⁸²

6. FST as a "Black Box"

²⁷⁵ Id.

- ²⁷⁷ Id.
- ²⁷⁸ Id.

²⁸² Id.

²⁷² *Id.* at 16.

²⁷³ Id. ²⁷⁴ Id.

²⁷⁶ Torres, *supra* note 127, at 17.

²⁷⁹ People v. Collins, 15 N.Y.S.3d 564, 580 (Sup Ct. 2015).

²⁸⁰ Id.

²⁸¹ Id.

The last issue I will talk about is FST as a "black box".²⁸³ This has to do with the fact that FST software was not open to the public, or more importantly, to the defense counsel.²⁸⁴ Defense experts may have theories that are different from the prosecution's theories and those theories could not be tested using FST.²⁸⁵ The numbers FST produces are based on how many people contributed to a DNA mixture.²⁸⁶ It is challenging to determine exactly how many people did in fact contribute to a specific mixture in the first place.²⁸⁷ If there are four alleles found on a locus that does not necessarily mean that there are only two people in the mixture.²⁸⁸ FST is not capable of interpreting a DNA mixture that may include more than three people.²⁸⁹ The "black box" nature does not allow defense attorneys to give a LR to the jury if the prosecution wrongly estimates the number of contributors.²⁹⁰ The jury would only hear the number FST produces, which is based on the prosecution's hypothesis.²⁹¹

Since *Collins*, the Media Freedom & Information Access Clinic at Yale Law School worked with ProPublica to get OCME to release the source code for FST.²⁹² They tried to lift a protective order that was on the source code, and their efforts were successful.²⁹³ The source code can now be accessed by the public and independently reviewed for errors.²⁹⁴

B. High Sensitivity Testing's Deficiencies

- ²⁹⁰ Collins, 15 N.Y.S.3d at 580.
- ²⁹¹ Id.

 ²⁹² Aislinn Klos, A Possible Alternative to Secretive DNA Analysis, YALE L. SCH. (Nov. 27, 2017), https://law.yale.edu/mfia/case-disclosed/possible-alternative-secretive-dna-analysis.
 ²⁹³ Id.

²⁹⁴ Id.

²⁸³ *Id.* at 618.

²⁸⁴ Collins, 15 N.Y.S.3d at 580.

²⁸⁵ Id.

²⁸⁶ Id.

²⁸⁷ Id.

²⁸⁸ Id.

²⁸⁹ Robbins, *supra* note 128.

To begin with, there is no shortage of problems associated with analyzing such a small amount of DNA.²⁹⁵ The problems associated become amplified when subjecting the DNA to more copying cycles.²⁹⁶ I will be focusing on five major problems. These problems include stochastic effects such as allele drop-in and drop-out, peak height imbalance, and stutter. There are also problems with the detection threshold and profile interpretation.²⁹⁷ It is also important to keep in mind that with increased sensitivity comes an increased chance for contamination.²⁹⁸ Samples being tested with this method need to be handled with extra care.²⁹⁹ The bigger the DNA sample, the less likely the sample will be subjected to these issues.³⁰⁰

To start, remember that stochastic effects are things that happen during that process that could lead to additions or subtractions to the DNA sample being analyzed.³⁰¹ These effects can happen during the PCR process as early as in the first few cycles.³⁰² Primers may not bind in the same way for each allele at a given locus.³⁰³ This causes an imbalance between allelic products or the complete loss of alleles.³⁰⁴

1. Drop-in and Drop-out

Drop-in and drop-out rates are important stochastic effects that must be accounted for.³⁰⁵ The loss of alleles, or drop-out, occurs when the person's DNA did not register at one or more loci in the DNA sample.³⁰⁶ This would help a guilty party seem innocent because a full DNA

²⁹⁵ Id.

²⁹⁶ The Conti-Vecchiotti Report, *supra* note 163.

²⁹⁷ Id.

²⁹⁸ Id. ²⁹⁹ Id.

³⁰⁰ Id.

³⁰¹ The Conti-Vecchiotti Report, *supra* note 163.

³⁰² Id.

³⁰³ Id.

³⁰⁴ Id. ³⁰⁵ Id.

³⁰⁶ TT

³⁰⁶ The Conti-Vecchiotti Report, *supra* note 163.

profile could not be obtained.³⁰⁷ Unfortunately, a person who is actually innocent may seem guilty because he or she would not be able to be excluded as a contributor based on half of a DNA profile.³⁰⁸ On the other hand, drop-in is when the sample is contaminated with extraneous alleles.³⁰⁹ This can occur when the sample is recovered to during lab analysis.³¹⁰ This is very concerning when an innocent person's alleles get dropped into the mix because it increases the chance that the person will be perceived as the perpetrator.³¹¹

³⁰⁷ Id.

³⁰⁸ Id.

³⁰⁹ Id.

³¹⁰ Id.

³¹¹ Collins, 15 N.Y.S.3d. at 571.

Evidence: 11, 12, 14; Suspect 11, 12 Drop-out? Drop-in?			
Unknown Contributor Genotype	Drop-out Required? (Type?)	Drop-in Required? (Which allele(s)?)	
11, 11	No	Yes (14)	
11, 12	No	Yes (14)	
11, 14	No	No	
11, w*	Yes (partial heterozygous)	Yes (14)	
12, 12	No	Yes (14)	
12, 14	No	No	
12, w*	Yes (partial heterozygous)	Yes (14)	
14, 14	No	No	
14, w*	Yes (partial heterozygous)	No	
w*, w*	Yes (total homozygous)	Yes (14)	
*w is any allele other than 11, 12, 14			

Image 1.3: O'Connor, supra note 132.

2. Peak Height Imbalance

This leads to peak height imbalance for an individual who is heterozygous at a locus.³¹² Remember, if a person is heterozygous at a locus, the alleles found will be two different numbers. The example given above was 12,15. When a person is heterozygous the two alleles should have equal amounts of DNA, they should amplify equally, and have peak heights that are just about equal.³¹³ A peak height imbalance is when the difference between the heights of the two peaks is greater than 30%.³¹⁴ This means the sample could possibly be a mixture or that extraneous alleles contaminated the sample.³¹⁵

³¹⁵ Id.

³¹² Id.

³¹³ Id.

³¹⁴ Id.

3. Stutter

Another stochastic effect is stutter. Stutter is similar to drop-in, however it is not due to contamination.³¹⁶ Stutter happens when there is miscopying or slippage during the PCR process.³¹⁷ Stutter peaks are visible one repeat unit before or after a true allele of the DNA sample.³¹⁸ This is possible during PCR on any size DNA sample, but it is more difficult to deal with in low level DNA.³¹⁹ LCN DNA is magnified, which provides for more amplified stutters.³²⁰ It is possible that a stutter peak may appear twice, making it seem like a true allele to the sample.³²¹ However, there still have not been in depth studies on probability of detecting stutter twice in an analysis.³²² Analysts are also waiting on recommendations on how to analyze stutter within mixed samples.³²³ In the end, stutter peaks make it more confusing for analysts to



³¹⁶ Collins, 15 N.Y.S.3d. at 572.

- ³²² Id.
- ³²³ Id.

³¹⁷ Low template DNA problems, UNIVERSITY OF LEICESTER, https://www2.le.ac.uk/departments/emfpu/to-be-deleted/explained/low-problems.

³¹⁸ Id.

³¹⁹ Id.

³²⁰ Id.

³²¹ The Conti-Vecchiotti Report, supra note 163.

figure out what is a stutter and what is actually part of the DNA profile.³²⁴ There have not been enough studies done to ensure that the methods used now are reliable when analyzing stutter.

4. Detection Thresholds

Next, detection thresholds are thresholds used for standard STR analysis in order to reduce the stochastic effects.³²⁵ Individual laboratories have conducted their own studies to come up with a minimum peak height that serves as a stochastic control.³²⁶ Peaks that do not reach the detection threshold cannot be interpreted.³²⁷ If they are interpreted, extreme caution needs to be used and it will only be for very limited purposes.³²⁸ Due to the fact that high sensitivity testing subjects samples to more PCR cycles, the interpreted results would typically be below the threshold set for standard STR analysis.³²⁹ Currently, there is no valid method to determine what the threshold should be for high sensitivity testing.³³⁰ This is a major weak point because a minimum peak height criterion to control for stochastic effects has yet to be established.³³¹

5. Profile Interpretation

When it comes to profile interpretation, the two most influential factors are stochastic effects and the sensitivity of detection.³³² The interpretation guidelines for high sensitivity testing are based on studies done with pristine samples, not poor quality samples that would typically be collected.³³³ Also, the samples used in studies for the guidelines come from a single source.³³⁴

³²⁷ Id.

³²⁹ Id.

³³³ Id.

³²⁴ Id.

³²⁵ Id.

³²⁶ The Conti-Vecchiotti Report, supra note 163.

³²⁸ Id.

³³⁰ Id.

³³¹ The Conti-Vecchiotti Report, supra note 163.

³³² Id.

³³⁴ Id.

Once again, this does not resemble DNA that would be collected from a crime scene because often times the DNA is a mixture of multiple profiles.³³⁵ There are still no well-developed guidelines on how to interpret mixtures using high sensitivity testing.³³⁶ This is a serious problem because many samples are from touch DNA, which are mixtures, and there have been no validation studies completed or guidelines created on how to interpret the DNA.³³⁷

Part V

In this part, I will discuss how relying on deficient DNA testing methods relates to wrongful convictions. Many states, from Illinois, to Texas, to Massachusetts, have been under fire for using unreliable techniques to analyze DNA samples received from crime scenes. Many labs have not validated their methodology. In addition, there are many forensic scientists who let their zeal to help the prosecution secure a conviction get in the way of remaining ethical. Combining a lack of validation with personal biases create an equation for wrongful convictions.

A. How Do FST and High Sensitivity Testing Relate to Wrongful Convictions?

It is possible that both of these tests have led to wrongful convictions.³³⁸ Wrongful convictions are not only tragic for the person who has been wrongfully convicted, but also bad for society.³³⁹ They are a very serious problem. When this happens, nothing is accomplished because the bad guy is still roaming the streets and an innocent person is sitting in jail or prison.

³³⁵ Id.

³³⁶ The Conti-Vecchiotti Report, supra note 163.

³³⁷ See id.

³³⁸ See Collins, 15 N.Y.S.3d at 564.

³³⁹ Committee on Identifying the Needs of the Forensic Sciences Community, *National Research Council, Strengthening Forensic Science in the United States: A Path Forward*, NCJRS (Aug. 2009), https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf.
Over the years there have been many advances in forensic science.³⁴⁰ There are so many new DNA technologies that exist, and unfortunately some are based on faulty forensic science analyses.³⁴¹ In criminal cases, jurors are very deferential towards whatever DNA evidence they are presented.³⁴² This is due to the "CSI effect", which means that jurors like to see scientifically validated evidence because that is how they see it done in television shows.³⁴³ A number of studies have been done that suggest a jury is more likely to convict when presented with DNA evidence.³⁴⁴ Criminal defendants are also more likely to accept a plea deal with they learn that the prosecution has DNA evidence against them.³⁴⁵ It is important that we ensure that the jury is only hearing reliable and valid results and that criminal defendants are aware that DNA is not always dispositive.³⁴⁶ Making the public more aware of these issues should cause people to think twice before convicting a person solely because of DNA evidence.

One case that has received attention is that of Mayer Herskovic.³⁴⁷ Herskovic was sentenced to four years in prison for a gang assault where there was insufficient evidence to prove he was involved.³⁴⁸ The attack took place on a dark street and there were several assailants dressed in similar clothing.³⁴⁹ Ultimately, five men were charged.³⁵⁰ The charges were dropped against two of them, the other two took plea deals, and Herskovic was the only one to take it to trial.³⁵¹

³⁵⁰ Id.

³⁴⁰ Id.

³⁴¹ Id.

³⁴² Id.

³⁴³ Id.

 ³⁴⁴ Jessica Pishko, *The Impenetrable Program Transforming How Courts Treat DNA Evidence*, WIRED (Nov. 29, 2017), https://www.wired.com/story/trueallele-software-transforming-how-courts-treat-dna-evidence/.
³⁴⁵ Id.

³⁴⁶ Committee on Identifying the Needs of the Forensic Sciences Community, *supra* note 339.

³⁴⁷ Alan Feuer, *Lawyer for Hasidic Man Convicted in Assault Calls Him a 'Scapegoat'*, THE NEW YORK TIMES (July 17,2017), https://www.nytimes.com/2017/07/17/nyregion/mayer-herskovic-gang-assault-taj-patterson.html.

³⁴⁸ Id.

³⁴⁹ Feuer, *supra* note 347.

³⁵¹ Id.

There was one only one piece of evidence tying him to the crime scene.³⁵² This happened to be a DNA sample found on the victim's shoe.³⁵³ The victim himself testified that Herskovic was not one of the main attackers.³⁵⁴ Two witnesses even placed a different man at the scene of the crime as the fifth attacker.³⁵⁵ On appeal, Herskovic's attorney pointed out that the method used to analyze this DNA was one that a Brooklyn judge held to be inadmissible for trial.³⁵⁶ The deficiencies in either FST or high sensitivity testing could very well have led to Herskovic's conviction.

There is plenty information that suggest that FST was not properly validated, and should not have been admissible in criminal cases.³⁵⁷ FST was peer reviewed by other OCME employees when independent experts should have peer reviewed it.³⁵⁸ Also, this software is different from all others because it only gives OCME's LR.³⁵⁹ These facts reflect how the software is likely to produce very bias results. It is also concerning that the data was skewed to fit the creator's assumptions. The creators won awards for their work and the program has a significant monetary value in the private sector.³⁶⁰ This causes me to wonder if FST was created with ulterior motives.

When it comes to high sensitivity testing, OCME is the only American laboratory that produces results to be used in criminal trials.³⁶¹ It seems as if no other labs want to take the risk of wrongfully convicting a person based on a test that has so many issues that have not been

³⁵³ Id.

³⁵² Feuer, *supra* note 347.

³⁵⁴ Id.

³⁵⁵ Id. ³⁵⁶ Id.

³⁵⁷ People v. Collins, 15 N.Y.S.3d 564, 581 (Sup. Ct. 2015).

³⁵⁸ *Id.* at 576.

³⁵⁹ Id.

³⁶⁰ Klos, *supra* note 292.

³⁶¹ Collins, 15 N.Y.S.3d at 575.

resolved. Moreover, the FBI refuses to conduct high sensitivity testing.³⁶² The FBI also will not upload profiles to CODIS that are created by using high sensitivity analysis.³⁶³ Many of its critics agree that this type of testing may be helpful to find a perpetrator, however it has not been sufficiently validated.³⁶⁴ High sensitivity testing can be compared with a polygraph in the sense that it helps in furthering an investigation, but it is not reliable enough to be admitted in court.³⁶⁵

One member of New York State Commission on Forensic Science, Marina Stajic, was fired from her job because she wanted to make public a study showing high sensitivity testing failed validation tests.³⁶⁶ Her bosses were unhappy with this and told her that if she did not resign, they would dismiss her from her job.³⁶⁷ Stajic, who has a Ph.D. in forensic toxicology, worked for the OCME from 1986 to 2015.³⁶⁸ She is currently suing the City of New York and two of her superiors at the OCME.³⁶⁹

In conclusion, when taking into consideration how tragic wrongful convictions are, we should not chance letting the jury hear about DNA evidence coming from unreliable tests. The deficiencies in both FST and high sensitivity testing seem to come from carelessness on the creator's part. For example, with FST interrelatedness was not accounted for, however other tests took it into consideration. With high sensitivity testing there are no viable guidelines for analysts to follow, increasing the likelihood of yielding wrong results.

Part VI

³⁶² Id.

³⁶³ Id.

³⁶⁴ Id.

³⁶⁵ Id.

³⁶⁶ Benjamin Weiser and Joseph Goldstein, *Ex-Official Says Medical Examiner Forced Her Out Over DNA Technique*, THE NEW YORK TIMES (Feb. 18,2016), https://www.nytimes.com/2016/02/19/nyregion/ex-official-says-medical-examiner-forced-her-out-over-dna-technique.html.

³⁶⁷ Id.

³⁶⁸ Id.

³⁶⁹ Id.

New York now uses a probabilistic genotyping program called STRmix. TrueAlle is a competing probabilistic genotyping program that has posed the same questions of reliability and validity. The problems with these types of programs are that the process used to analyze sample is only something a computer could do.³⁷⁰ The complex codes and mathematical equations are not the type that a human could process.³⁷¹ This makes it hard for courts to assess the program, taking away its value to the court.³⁷² These programs are adding more pressure to already overworked attorneys because they do not understand the technology and do not have the funds to educate themselves.³⁷³

A. The Testing Methods New York Uses Today

New York no longer uses FST for complex mixtures.³⁷⁴ It now uses a program called STRmix when dealing with mixed DNA samples.³⁷⁵ STRmix is a global program and was created by New Zealand Crown research institute ESR, with Forensic Science South Australia (FSSA).³⁷⁶ This program claims to interpret DNA faster, calculate LRs, analyze a sample regardless of the number of contributors, and search the mixed DNA profiles against a database.³⁷⁷ It is important to mention that STRmix is used in thirty laboratories throughout the United States ranging from Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) and the FBI to state and local agencies.³⁷⁸

³⁷⁰ Pishko, *supra* note 344.

³⁷¹ Id.

³⁷² Id.

³⁷³ Id.

³⁷⁴ *Resolve More DNA Mixtures*, STRMIX (2019), https://www.strmix.com/assets/STRmix/STRmix-PDFs/STRmix-2-8-Brochure-September-2020.pdf.

³⁷⁵ Id.

³⁷⁶ Id.

³⁷⁷ Id.

³⁷⁸ Carrie Brunner, *STRmix Used in Brooklyn Murder Case*, NB HERARD (Dec. 15, 2017), https://nbherard.com/world/strmix-used-in-brooklyn-murder-case/38480.

Even though STRmix sounds like the perfect replacement for other methods, it still has its share of problems that should cause us to be weary. One challenge is that the person who is using STRmix has to assign the number of contributors to the DNA sample.³⁷⁹ This is very hard to do when the sample is weak or a complex mixture.³⁸⁰ If the forensic scientist gets the number wrong, the results will be significantly impacted.³⁸¹ This is especially true when it comes to analyzing the minor contributors to a DNA sample.³⁸²

Another issue with STRmix is that it is capable of producing over 1,000 pages of results.³⁸³ Some labs have hired and trained more forensic biologists to combat this. However, with such a large production of results it highly likely mistakes could be made while trying to decipher them.³⁸⁴ Regardless of the fact that experienced forensic scientists should be the only people to use STRmix, if the results fall into the hands of someone not as experienced the results may not be as reliable.³⁸⁵ Even a person with the requisite experience is capable of making mistakes when the results are produced in such a large quantity.³⁸⁶

A Judge in Potsdam, New York recently declared that STRmix was not reliable and was not admissible in 12-year-old boy's murder trial.³⁸⁷ Nick Hillary was accused of strangling Garrett Phillips in 2011.³⁸⁸ When tested using TrueAlle, Hillary was not implicated.³⁸⁹ However, when the lab used STRmix there seemed to be a match.³⁹⁰ The judge ruled that the match could

³⁸⁹ Id. ³⁹⁰ Id.

³⁷⁹ Zane Kerr, Two Years Later: A Reflection on the Implementation of STRmix in a High Throughput DNA Laboratory, PROMEGA, https://www.promega.com/-/media/files/products-and-services/genetic-identity/ishi-26-oralabstracts/6-kerr.pdf.

³⁸⁰ Id.

³⁸¹ Id.

³⁸² Id.

³⁸³ Id.

³⁸⁴ Kerr, *supra* note 379. ³⁸⁵ Id.

³⁸⁶ Id.

³⁸⁷ People v. Hillary, Ind. #: 2015-15 (St. Lawrence Cty. Ct. Aug. 26, 2016).

³⁸⁸ Id.

not be relied on in court.³⁹¹ There were no internal validation studies done that would allow for the New York State Police crime lab to use STRmix on DNA samples.³⁹² The prosecution in this case had one of the creators of STRmix calculate the probability that Hillary matched the sample.³⁹³ He ended up testifying that he had to pick and choose data to enter into the program using his own judgment.³⁹⁴ This was due to the fact that the crime lab was not authorized by the New York State Commission of Forensic Science to use STRmix.³⁹⁵

Nick Hillary's case is a prime example that not only can probabilistic genotyping programs be fully trusted, but also that people should be aware of the corruption going on in forensic science. This is just another reason why it is important to make people aware that DNA should not be viewed as the gold standard in criminal cases.

B. Moving Forward

Forensic science plays a huge role in criminal cases, so it is very important to make sure that the jury only hears the most reliable evidence. All of this information should help people realize that DNA may not really be the "gold standard" that it is made out to be. It is important to remember that real people, with real lives, are affected by the choices made by forensic scientists. In a New York Times Article about FST and DNA evidence, Dr. Caragine said:

³⁹¹ Id.

³⁹² *Hillary*, Ind. #: 2015-15.

³⁹³ Id.

³⁹⁴ Id.

³⁹⁵ Id.

"Sometimes it may free an innocent person or it may solve the crime. You don't always think about how it has a personal effect on people. It's easier not to think about it — we just have case files here and it's very clinical."³⁹⁶

I don't believe this is an outlook that people developing these programs should have. When the human component is taken out, scientists may lose focus of the main goal, which is to make sure the right person is being held responsible for the crime.

To me, it seems like New York wanted to take credit for developing new and novel DNA tests. New York used these tests to produce evidence in criminal cases at the defendant's expense. FST seems to have been a product of Dr. Mitchell and Dr. Caragine's desires to be known for creating a brilliant new method for analyzing complex mixtures. Not only does it use quants in a way not used by any other software, but also data was skewed to show information that its creators anticipated. It can also be said that New York was trying to be novel with its use of high sensitivity testing because is it the only state using it for criminal cases. It is important to note that the FBI will not even use this method. In the future, the FBI should validate and be willing to use any type of DNA test that individual states are using.

In the end, it is very important to educate people on issues surrounding DNA analysis. In criminal cases, DNA is not only important for the jury, but also for the attorneys, victims, and the defendants. The jury may rely on it to convict, attorneys rely on it to make their cases, defendants may rely on it to exonerate, and victims may rely on it to get what they believe is justice. Every person who becomes involved with the criminal justice system should have full faith that the evidence being presented is reliable.

³⁹⁶ Robbins, *supra* note 128.

Glossary

Allele: A form of a gene.³⁹⁷

Chromosome: Structures inside of a DNA molecule.³⁹⁸

Complex Mixture: A DNA sample containing the profile of more than one person.³⁹⁹

CSI Effect: The effect that crime television shows have on people, which affects the way they believe trials are supposed to go.⁴⁰⁰

Deoxyribonucleic Acid (DNA): Our body's genetic make up.⁴⁰¹

Drop-in: When the sample being tested shows extraneous alleles, which are not explained by the suspect or possible contributors.⁴⁰²

Drop-out: When a sample is missing an allele, which could be due to missing data.

Forensic Statistical Tool (FST): Software developed to analyze complex mixtures by producing likelihood ratios.⁴⁰³

Frye Hearing: A hearing to determine whether evidence should be admissible in court.⁴⁰⁴

Gene: A unit that is made of DNA that contributes to our physical appearance and the way our body's function.⁴⁰⁵

High Sensitivity Testing: Also known as low copy number. Used for testing very small sample sizes. Amplifies a sample by subjecting it to extra PCR cycles.⁴⁰⁶

Likelihood Ratio (LR): Ratios used to measure the strength of the DNA evidence found at the crime scene.⁴⁰⁷

Locus/Loci: A specific location on a chromosome.⁴⁰⁸

³⁹⁷ JAMES ET AL., *supra* note 52, at 235.

³⁹⁸ What is a Chromosome?, NIH (Jan. 9, 2018), https://ghr.nlm.nih.gov/primer/basics/chromosome.

³⁹⁹ O'Connor, *supra* note 132.

⁴⁰⁰ Committee on Identifying the Needs of the Forensic Sciences Community, *supra* note 339.

⁴⁰¹ Rettner, *supra* note 49.

⁴⁰² O' Connor, *supra* note 132.

⁴⁰³ Torres, *supra* note 127.

⁴⁰⁴ People v. Collins, 15 N.Y.S.3d 564 (N.Y. Sup. Ct., Kings County 2015).

⁴⁰⁵ What is a Gene?, NIH (Jan. 9, 2018), https://ghr.nlm.nih.gov/primer/basics/gene.

⁴⁰⁶ Collins, 15 N.Y.S.3d at 570-71.

⁴⁰⁷ The Evaluation of Forensic DNA Evidence, *supra* note 144.

⁴⁰⁸ JAMES ET AL., *supra* note 52, at 235.

Low Copy Number (LCN): A technique to analyze very small DNA samples, typically less than 100 pg.⁴⁰⁹

Peak Height: When an allele is detected on a chromosome, the chart will show a high point.⁴¹⁰

Polymerase Chain Reaction (PCR): The process used for copying DNA.⁴¹¹

Polymerase: An enzyme that furthers the process for copying DNA.⁴¹²

Probabilistic Genotyping: When complex mathematical formulas are used to determine the

likelihood that DNA comes from a particular individual.⁴¹³

Quant: Amount of DNA.414

Short Tandem Repeat (STR): They are the current standard in forensic genetic typing.⁴¹⁵

Stochastic Effects: Random effects that occur during DNA collection or analysis that impact results the test.⁴¹⁶

STRmix: The technology New York uses today to analyze complex mixtures.⁴¹⁷

Stutter: A stochastic effect that shows extraneous alleles due to miscopying during the PCR process.⁴¹⁸

Touch DNA: DNA collected from a surface touched by a person.⁴¹⁹

⁴⁰⁹ Collins, 15 N.Y.S.3d at 570-71.

⁴¹⁰ *Id.* at 572.

⁴¹¹ JAMES ET AL., *supra* note 52, at 235.

⁴¹² Id.

⁴¹³ Pishko, *supra* note 344.

⁴¹⁴ *Collins*, 15 N.Y.S.3d at 578.

⁴¹⁵ JAMES ET AL., *supra* note 52, at 242.

⁴¹⁶ Coble, *supra* note 135.

⁴¹⁷ Resolve More DNA Mixtures, supra note 374.

⁴¹⁸ Collins, 15 N.Y.S.3d at 572.

⁴¹⁹ Coble, *supra* note 135.

Babies of Technology: Assisted Reproduction and the Rights of the Child

Reviewed By: Elle Nainstein⁴²⁰

Citation: MARY ANN MASON & TOM EKMAN, BABIES OF TECHNOLOGY: ASSISTED REPRODUCTION AND THE RIGHTS OF THE CHILD (Yale University Press, 2017).

Relevant Legal and Academic Areas: Children's Rights, Assisted Reproductive Technology, Embryonic and Fetal Research Law, Family Law, Surrogacy Law, and Genetic Engineering.

Summary: In *Babies of Technology: Assisted Reproduction and the Rights of the Child*, authors Mary Ann Mason and Tom Ekman offer an in-depth look into the world assisted reproduction, including artificial insemination, cryogenics, in vitro fertilization, and surrogacy. Despite being largely unregulated and ethically controversial, the fertility market has become one of the world's most profitable industries. Thanks to cutting-edge reproductive technology, parents can now choose to examine the DNA of their embryos, eliminate any unwanted traits, and even request personalized genetic modifications. In light of these advancements, the authors believe it is time that children born by assisted reproduction are granted rights and protections of their own.

About the Authors: Dr. Mary Ann Mason, J.D., Ph.D., is a professor in the graduate school of the University of California, Berkeley, and Faculty Affiliate of the Berkeley Center for Law and Technology. Dr. Mason's published works include: *Do Babies Matter? Gender and Family in the Ivory Tower* (with Nicholas Wolfinger and Marc Goulden, 2013), *Mothers on the Fast Track* (with daughter, Eve Mason Ekman, 2007), and *Using Computers in the Law: Law Office Without Walls* (with Robert Harris, 1994). Tom Ekman, J.D., M.Ed., is a science teacher and writer, and former Director of Content Development at National Geographic Maps. Mr. Ekman's interests include social mission work and the intersection of technology and education.

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I. INTRODUCTION

Although the Constitution does not explicitly mention reproduction, the United States Supreme Court has long interpreted an individual's fundamental right to privacy to include the right to procreate⁴²¹ and raise offspring⁴²² without government interference. Times are changing, however, and the miracle of birth has become less of a miracle and more of a science. Now more than ever, an increasing number of parents are considering the benefits of assisted reproductive technology. Thanks to recent advancements in genetic engineering, today's parents will soon have the option to modify the DNA of embryos to make what some are calling "designer babies." Together, parents will be able to customize every aspect of their baby's appearance, intelligence levels, athleticism, sense of humor, and disposition. While some individuals believe that parents should have the right to alter the genes of an embryo so that their child will possess certain desired qualities, many others remain apprehensive and opposed to the idea of humans "playing God."

In *Babies of Technology: Assisted Reproduction and the Rights of the Child*, authors Mary Ann Mason and Tom Ekman discuss the most widely accepted forms of reproductive technology, including artificial insemination, cryogenics, in vitro fertilization, and surrogacy.⁴²³ Throughout the book, Mason and Ekman are quick to mention the potential risks associated with the use of such technology, as well as the lack of regulations governing assisted reproduction both domestically and abroad. The authors also emphasize the importance of granting rights to children born by assisted reproduction and propose a solution that could provide for effective long-term management of the fertility industry.

⁴²¹ Skinner v. Oklahoma, 316 U.S. 535, 541 (1942) (holding that the right to produce offspring is a fundamental right).

⁴²² See Pierce v. Society of Sisters, 268 U.S. 510, 534-35 (1925) (recognizing "the liberty of parents and guardians to direct the upbringing and education of children").

⁴²³ MARY ANN MASON & TOM EKMAN, BABIES OF TECHNOLOGY: ASSISTED REPRODUCTION AND THE RIGHTS OF THE CHILD (Yale University Press, 2017).

II. CHILDREN OF THE FUTURE

At the rate that assisted reproductive technology is advancing, it will not be long before parents are given the option to purchase and design their perfect baby. Today, an increasing number of people are starting to warm up to the idea of "liberal eugenics," an ideology that advocates for the use of genetic engineering to improve the human genepool.⁴²⁴ In contrast, others believe that allowing complete and total control over the genetics of one's offspring would pose too many ethical dilemmas. For example, it can be argued that performing genetic alterations on embryos would violate the 1964 Declaration of Helsinki, given that the very purpose of its enactment was to protect against harmful experimentation on humans.⁴²⁵ Likewise, biologists argue that human tampering could interrupt the course of evolution and result in long-term problems such as sterility, disease, and irreversible mutations.⁴²⁶ Others simply disagree with genetic engineering because they believe that it is fueled by a vain society's desire to meet and exceed its ever-increasing standards of beauty, health, and intelligence.⁴²⁷

It is important that future parents understand the dangers of designer babies. Specifically, "when parents can select desired attributes for their child, this inherently implies that a natural child is 'less than' what she could have been with genetic enhancement."⁴²⁸ Promoters of enhancement may argue, "If we already have a chance of having a tall child, what is the problem with pushing fate a bit to ensure that outcome instead of others?"⁴²⁹ The fear, however, is that genetic engineering could someday allow parents to alter their baby's height, intelligence, or

- ⁴²⁵ *Id.* at 13.
- ⁴²⁶ *Id.*
- ⁴²⁷ *Id.*

⁴²⁹ *Id.* at 53.

⁴²⁴ *Id.* at 12.

⁴²⁸ MASON & EKMAN, *supra* note 423, at 52-53.

athleticism in such a way that the end result is "beyond natural," which introduces the possibility of "super children."⁴³⁰

The United States government has made little to no effort to investigate and address the possible negative outcomes that assisted reproduction can cause for children.⁴³¹ This comes as no surprise to the authors, who believe that this pattern of indifference is rooted in America's history of dealing—or not dealing—with children's rights.⁴³² Due to the lack of regulations governing the fertility industry, the United States has become one of the world's most popular tourist destinations for assisted reproductive technology, yet the country—while gladly reaping the profits—has continuously failed to provide protection for the children who are born as a result.⁴³³ Similarly, powerful religious institutions, most notably the Catholic Church, have been extremely outspoken about their condemnation of genetic engineering.⁴³⁴ Unfortunately, those who oppose these advancements have a tendency to focus all of their energy on the banning of assisted reproductive technology, rather than advocating to protect the rights of children born of these procedures.⁴³⁵

Mason and Ekman believe that "[s]ociety is ill-prepared for this next leap and its consequences."⁴³⁶ Too many controversial questions remain unanswered, as evidenced by the following examples:

Do children have the right to be as healthy as possible? Should "unhealthy" embryos be eliminated? Do children have the right to be as genetically fit as current technology allows? Where should the line be drawn between "healthy" kids and "enhanced" kids? What is the

⁴³² *Id.*

⁴³⁴ *Id.* at 12.

⁴³⁰ *Id*.

⁴³¹ *Id.* at 21.

⁴³³ MASON & EKMAN, *supra* note 423, at 21.

⁴³⁵ *Id.*

⁴³⁶ *Id.* at 13.

role of the government? Should genetic screening for disease be mandatory? Does genetic engineering threaten a child's emotional and psychological development? Does genetic engineering change the family dynamic for the child, as well as their parents and siblings? How about the child's peer relations? Is there a basic human right to be naturally conceived? Do children have any retroactive voice in terms of challenging their parent's decisions about their genetics? Should the rich be the only ones able to use all the available genetic tools to create their version of the perfect baby?⁴³⁷

These questions encourage the reader to consider how society protects—or fails to protect—its children.⁴³⁸ At the same time, it is important to recognize that assisted reproductive technology can be a valuable source of good and a benefit to society. For example, genetic engineering has the potential to provide infertile parents with children, reduce illness, and improve the health and well-being of humankind.⁴³⁹ That being said, the authors believe that technology of this caliber should not be available unless it can be regulated and monitored in a way that prioritizes the interests of the children.⁴⁴⁰

III. SPERM

Artificial insemination, or the process of injecting sperm into a female's vagina or uterus, is the oldest and most recognized form of assisted reproduction.⁴⁴¹ Today, artificial insemination is frequently used to increase the production of livestock.⁴⁴² This means that the majority of our pork and dairy products are the result of artificial insemination.⁴⁴³ "The acceptance of [artificial

⁴³⁷ *Id.* at 25-26.

⁴³⁸ MASON & EKMAN, *supra* note 423, at 26.

⁴³⁹ *Id.* at 55.

⁴⁴⁰ Id.

⁴⁴¹ Id. at 59.

⁴⁴² Id.

⁴⁴³ MASON & EKMAN, *supra* note 423, at 59.

insemination] technology worldwide provided the impetus for developing other technologies, such as cryopreservation and sexing of sperm, estrous cycle regulation, and embryo harvesting, freezing, culture and transfer, and cloning."⁴⁴⁴ In other words, artificial insemination was the catalyst that started the entire assisted reproductive technology revolution.⁴⁴⁵

In 1866, John Hunter became the first doctor to attempt artificial insemination in the United States, ultimately carrying out a total of fifty-five inseminations with varied success.⁴⁴⁶ However, it was not until the 1970s, when sperm banks first opened their doors to the public, that artificial insemination started to grow in popularity.⁴⁴⁷ Though unconfirmed, the total number of babies in the world born via artificial insemination is thought to be in the millions.⁴⁴⁸ However, because the majority of these procedures are performed privately, without the aid of a clinic, and are rarely recorded, it is practically impossible to accurately determine the total number of children of artificial insemination in existence.⁴⁴⁹

Recently, a number of foreign nations have chosen to ban anonymous sperm donation and grant all donor-conceived children the right to obtain the identity of their donor.⁴⁵⁰ Some of these nations include Germany, The Netherlands, New Zealand, Norway, Sweden, Switzerland, the United Kingdom.⁴⁵¹ The original argument for providing anonymity was that without it, there would be fewer sperm donors.⁴⁵² Surprisingly, the exact opposite has been true. In the United

⁴⁴⁴ Id.

⁴⁴⁵ *Id*.

⁴⁴⁶ Id.

⁴⁴⁷ *Id*.

⁴⁴⁸ MASON & EKMAN, *supra* note 423, at 59-60.

⁴⁴⁹ *Id.* at 60.

⁴⁵⁰ *Id.* at 64.

⁴⁵¹ *Id.*

⁴⁵² *Id.* at 64-65.

Kingdom, for example, the number of sperm donors has steadily increased since the banning of anonymity in 2005.⁴⁵³

A major legal issue in the world of sperm donation is the potential for paternity lawsuits that would require the genetic father to provide financial support.⁴⁵⁴ Risks such as these are what cause some donors to seek anonymity in the first place.⁴⁵⁵ The majority of anonymous donors at larger sperm banks are male students who are looking to earn some extra money on the side⁴⁵⁶ Ironically, these same young men would end up facing lawsuits targeting their assets eighteen years later.⁴⁵⁷ Luckily, most of today's sperm banks provide a contract that protects the donor from any future paternity lawsuits.⁴⁵⁸

IV. EGGS

Men have been freezing their sperm for decades, but it wasn't until 1999, when flashfreezing procedures were created, that women could choose to store their eggs in cryobanks.⁴⁵⁹ In 2012, the American Society for Reproductive Medicine announced that the freezing of a woman's eggs for possible use later in life, otherwise known as "social freezing," was no longer considered experimental.⁴⁶⁰ Though this announcement was not meant to be an endorsement for social freezing, an increasing number of career women have begun freezing their eggs with the intention of getting pregnant later in life.⁴⁶¹

⁴⁵³ MASON & EKMAN, *supra* note 423, at 65.

⁴⁵⁴ *Id.* at 82.

⁴⁵⁵ Id.

⁴⁵⁶ Id.

⁴⁵⁷ *Id*.

⁴⁵⁸ MASON & EKMAN, *supra* note 423, at 82.

⁴⁵⁹ *Id.* at 88.

⁴⁶⁰ *Id*.

⁴⁶¹ *Id.* at 90.

It should be noted, however, that children born via frozen eggs face more possible complications than children born via frozen sperm donors.⁴⁶² This is because the eggs are extracted through a medical procedure and frozen in a commercial egg bank for an indefinite period of time.⁴⁶³ Each of these steps increase the risk of possible health consequences.⁴⁶⁴ The combination of the fertility drugs used to boost egg production and the insertion of multiple embryos in the womb increases the chances for a double, triple, or even quadruple birth.⁴⁶⁵ This can be extremely problematic, as children of multiple births are especially vulnerable to cerebral palsy, learning disabilities, blindness, developmental delays, and infant death; this is often attributed to that fact that most are born prematurely with very low birth weights.⁴⁶⁶

In an essentially unregulated fertility industry, egg banking and in vitro fertilization can present their own set of problems.⁴⁶⁷ While a child's right to know the identity of his or her donor or birth parents is the same regardless of whether a child is conceived by donor egg, donor sperm, or both, there are a number of reasons why a couple may opt for sperm donation over egg banking.⁴⁶⁸ Specifically, "[e]xtracting eggs is expensive, time-consuming, and all too often leads to failure."⁴⁶⁹

V. Embryos

Historically, embryos have always been the most controversial form of assisted reproductive technology.⁴⁷⁰ Those who consider procreation to be the beginning of life generally

⁴⁶⁶ *Id*.

⁴⁶² *Id.* at 94.

⁴⁶³ MASON & EKMAN, *supra* note 423, at 94.

⁴⁶⁴ Id.

⁴⁶⁵ Id.

 $^{^{467}}$ *Id.* at 112.

⁴⁶⁸ MASON & EKMAN, *supra* note 423, at 112.

⁴⁶⁹ Id.

⁴⁷⁰ *Id.* at 114.

view embryos generated in vitro to be children from the very moment of conception.⁴⁷¹ "This position has been embraced by the Catholic Church and the Right-to-Life movement, spawning battles in the courts and major political opposition over the last decade."⁴⁷² At the heart of the dispute is scientific testing on human embryos, otherwise known as stem cell research, the act of which is still prohibited in most of the United States to this day.⁴⁷³

Those who think of human embryos as children have also expressed concern for the hundreds of thousands of frozen, surplus embryos that have been accumulating in tanks of liquid nitrogen over the years.⁴⁷⁴ Though the United States has no policy addressing the fate of frozen embryos, England has imposed a five-year rule which provides that if the donor cannot be found, or is not willing to pay for continued storage, the embryos are destroyed.⁴⁷⁵ Frozen embryos can present an emotional struggle for those who created them.⁴⁷⁶ Fertility clinics typically create surplus embryos to increase the chances of achieving a successful pregnancy during the first or second cycle of in vitro fertilization, yet many parents consider their excess frozen embryos to be potential children and refuse to donate them for research or adoption.⁴⁷⁷ In other countries, such as Italy, the practice of freezing embryos has been banned altogether.⁴⁷⁸

So, what is the connection between children's rights and the storage of unused embryos? At a minimum, the author believes that children of assisted reproduction should always have the right to know the identity and medical history of their biological parents.⁴⁷⁹ The exception,

- ⁴⁷⁴ *Id.* at 116.
- ⁴⁷⁵ *Id.* at 117.
- ⁴⁷⁶ *Id.* at 118.
- ⁴⁷⁷ Id.

⁴⁷¹ *Id*.

⁴⁷² Id.

⁴⁷³ MASON & EKMAN, *supra* note 423, at 114.

⁴⁷⁸ MASON & EKMAN, *supra* note 423, at 118.

⁴⁷⁹ *Id.* at 121.

however, is that embryos that are sold or donated may not carry a record of this information.⁴⁸⁰ As with sperm and egg donors, anonymity is never in the child's best interest.⁴⁸¹

VI. WOMBS

Traditional surrogacy, in which the surrogate mother is also the biological mother, is thought to be the oldest form of assisted reproduction.⁴⁸² Gestational surrogacy, on the other hand, is when the surrogate is implanted with an embryo and carries the child to term.⁴⁸³ More often than not, the embryo is provided by the couple who retained the surrogate, and in less common cases, the egg is a provided by a donor.⁴⁸⁴ In either situation, the child will not be genetically related to the surrogate.485

The use of a surrogate mother, sometimes distastefully referred to as "rent-a-womb" by those who are opposed to the idea of surrogacy, has the potential to cause far more legal difficulties and provoke even greater emotional concern than sperm or egg donation.⁴⁸⁶ Not all U.S. states permit surrogacy, but those that do have created a profitable industry that serves both domestic and international clients.⁴⁸⁷ Using a surrogate from the U.S. can offer two major advantages: any baby born in the U.S. is automatically a citizen, and the states that support surrogacy also accept gay couples.⁴⁸⁸ Internationally, surrogacy is often banned, or limited to heterosexual couples who are infertile.489

- ⁴⁸⁰ Id.
- ⁴⁸¹ Id.

- ⁴⁸⁴ Id. ⁴⁸⁵ Id.
- ⁴⁸⁶ *Id.* at 132.
- ⁴⁸⁷ Id.

⁴⁸² *Id.* at 133.

⁴⁸³ MASON & EKMAN, *supra* note 423, at 133.

⁴⁸⁸ MASON & EKMAN, *supra* note 423, at 132-33.

⁴⁸⁹ *Id.* at 133.

The authors believe that the rights of children born by surrogates should include the right to know the identity of one's biological parents and surrogate, the right to have a healthy surrogate who is medically evaluated on a regular basis before and during the pregnancy, the right to citizenship in the county where one is born or where one legal parent is a citizen, the right to universal standards to ensure that surrogates are treated equally in all countries, and the right to have one's biological parents, legal parents, and surrogate listed on their birth certificate.⁴⁹⁰

VII. CONCLUSION

In the final chapter, Mason and Ekman propose the creation of a new regulatory agency that would be responsible for certifying and monitoring all fertility clinics, supervising all forms assisted reproduction, and regulating the use and storage of all eggs, sperm, and embryos.⁴⁹¹ In this regard, I agree wholeheartedly. Currently, hundreds of U.S. federal agencies and commissions exist for the sole purpose of overseeing various aspects of the country's needs, including a space program, wildlife and national park conversation and preservation, consumer product safety, and public education. If created, a federally funded fertility agency would provide the perfect balance between scientific advancement and human rights. Furthermore, while it is impressive that assisted reproductive technology has managed to come a long way in such a short period of time, society needs to reevaluate its priorities and start putting the same amount of effort into implementing rights and protections for babies that are born as a result of this technology.

⁴⁹⁰ *Id.* ⁴⁹¹ *Id.* at 197.

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<u>The Rights of Nature:</u> <u>A Legal Revolution That Could Save the World</u>

Reviewed By: Elle Nainstein⁴⁹²

Citation: DAVID R. BOYD, THE RIGHTS OF NATURE: A LEGAL REVOLUTION THAT COULD SAVE THE WORLD (ECW Press, 2017).

Relevant Legal and Academic Areas: Environmental and Natural Resources Law, Animal Welfare, Property, Land Use Law, Pollution Control, Climate Change Legislation, and the Endangered Species Act.

Summary: In *The Rights of Nature: A Legal Revolution That Could Save the World*, author David R. Boyd addresses the past, present, and future state of the legal rights of nature. The book offers an in-depth description of the ways in which cultures and laws are transforming to protect the planet and the species with whom we share it. With climate change on the horizon, Boyd notes that a movement has been building in courtrooms and communities around the world, where lawyers and citizens are working together to advocate for the legal rights of animals. In recent years, more judges and legislatures are recognizing that endangered species have the legal right to exist, and that ecosystems—rivers, forests, and mountains—have their own enforceable privileges.

About the Author: David R. Boyd is an environmental lawyer and an associate professor at the Institute for Resources, Environment, and Sustainability at the University of British Columbia. Boyd is the award-winning author of over 100 articles and eight books, including *The Optimistic Environmentalist: Progress Towards a Greener Future* and *Cleaner, Greener, Healthier: A Prescription for Stronger Canadian Environmental Laws and Policies*.

⁴⁹² Syracuse University College of Law, Juris Doctor expected 2019.

I. PREFACE

In his book *The Rights of Nature: A Legal Revolution That Could Save the World*, author David R. Boyd sets out to address past and present issues associated with the rights of nature, as inspired by his love for the natural world.⁴⁹³ From the very first page, Boyd sets the tone by offering personal stories that detail the wonder and excitement that he has felt while observing orcas in their wild habitat.⁴⁹⁴ As a species, orcas live in matrilineal societies, meaning that adult females and their offspring join together to form cohesive units of close-knit families, known as pods.⁴⁹⁵ Like humans, differing populations of orcas have unique dialects, mating patterns, and food preferences.⁴⁹⁶ Moreover, orcas can communicate by using echolocation, allowing their voices to travel over kilometers of ocean.⁴⁹⁷ Even though existing technology gives humans the power to eavesdrop on these conversations, scientists can only speculate about what is being said.⁴⁹⁸

Regardless of their advanced capabilities, orcas, otherwise known as killer whales, are listed as an endangered species in both the United States and Canada.⁴⁹⁹ This classification can be attributed to a period between the 1960s and 1970s when a large number of orcas were captured and subsequently placed into aquariums for display.⁵⁰⁰ At the time, adult orcas made desperate attempts to protect their young calves from abduction, often getting themselves killed in the process, but nothing they did could ultimately prevent humans from tearing their communities apart.⁵⁰¹ Today, wild orcas are still struggling to recover because their population faces a variety

⁴⁹³ David R. Boyd, The Rights of Nature: A Legal Revolution That Could Save the World, at xiii (ECW Press,

^{2017).}

⁴⁹⁴ *Id.* at xiii-xiv.

⁴⁹⁵ *Id*. at xv.

⁴⁹⁶ Id.

⁴⁹⁷ Id.

⁴⁹⁸ BOYD, *supra* note 493, at xv.

⁴⁹⁹ Id.

⁵⁰⁰ Id. ⁵⁰¹ Id.

of threatening conditions, including food shortages, an accumulation of toxic industrial chemicals in the water, and noises from boat traffic which interfere with the orcas' ability to hunt.⁵⁰² Unfortunately, orcas in captivity have an even shorter life expectancy than those who are free.⁵⁰³ While wild orcas have an anticipated life expectancy of fifty years, with some having been known to survive for as long as 100 years, the average lifespan for orcas in captivity is significantly reduced to a range of merely twenty-five to forty years.⁵⁰⁴ Moreover, even though orcas in captivity have developed a reputation for injuring and sometimes killing people, including their trainers, wild orcas have never been known to harm human beings.⁵⁰⁵ This goes to show that orcas, like many other intelligent species, are not meant for captivity; rather, they are meant to be free and even more so—it is their right to be free.

To remedy this harm, governments in both the United States and Canada are desperately working to develop new strategies for restoring the wild orca population.⁵⁰⁶ Despite the protection of the U.S. Endangered Species Act, the U.S. Marine Mammal Protection Act, and Canada's Species at Risk Act, the number of killer whales has continued to decline. Here, Boyd wonders, "[w]ould their future be brighter if they had legal rights?"⁵⁰⁷ The author goes on to propose that a lack of environmental protection laws, paired with a rise in urban and suburban development, has resulted in the destruction of our lands and ecosystems.⁵⁰⁸ Nevertheless, Boyd points out that "[c]hange is in the air."⁵⁰⁹ Years ago, nobody thought twice when SeaWorld pulled killer whales from the ocean and dropped them into tiny pools for human entertainment. Nowadays, in most

⁵⁰⁴ Id.

 $^{^{502}}$ Id. at xv-xvi.

⁵⁰³ BOYD, *supra* note 493, at xvii.

⁵⁰⁵ Id.

⁵⁰⁶ Id. ⁵⁰⁷ Id.

⁵⁰⁸ BOYD, *supra* note 493 at, xviii-xix.

⁵⁰⁹ Id.

countries, such an act would be condemned.⁵¹⁰ In this book, Boyd considers the extent to which existing laws recognize the rights of animals and nature, and seeks to point out the potential benefits that can be gained from society's acknowledgement of the need for such rights.⁵¹¹

II. INTRODUCTION: THREE DAMAGING IDEAS AND A POTENTIAL SOLUTION

Over the past two centuries, the human population has increased from one billion in the year 1800 to 7.5 billion today.⁵¹² Due to increased longevity and improved health, humans are expected to reach a population of ten billion by the year 2050.⁵¹³ In order to meet a substantial rise in economic demands, we have taken to the appropriation of land, forests, water, wildlife, and other natural resources.⁵¹⁴ As a result, humans are depleting natural resources at a rate that is approximately 1.6 times faster than they are being replenished.⁵¹⁵

Boyd suggests that our ongoing use and misuse of other animals, species, and nature is rooted in three related ideas.⁵¹⁶ The first, anthropocentricism, is the widespread human belief that we are separate from, and superior to, the rest of the natural world.⁵¹⁷ The second is that everything in nature is our property, to be used as we see fit.⁵¹⁸ Third, humans believe that the primary objective of modern society is limitless economic growth.⁵¹⁹ Humans are the only species with rights to all land, water, wildlife, and ecosystems on the planet.⁵²⁰ By allowing humans to be the only species with such rights, we are saying that we are the only species that matters.⁵²¹

- ⁵¹⁵ Id.
- ⁵¹⁶ Id.

⁵¹⁰ Id.

⁵¹¹ *Id.* at xix-xx.

⁵¹² *Id.* at xxii.

⁵¹³ BOYD, *supra* note 493, at xxii.

⁵¹⁴ Id.

⁵¹⁷ *Id.* at xxii-xxiii.

⁵¹⁸ BOYD, *supra* note 493, at xxiii.

⁵¹⁹ Id.

⁵²⁰ *Id.* at xxvii-xxix.

⁵²¹ *Id.* at xxix.

Fortunately, a legal revolution has been building in courtrooms, legislatures, and communities around the world, as more and more people are fighting for the rights of animals, rivers, forests, and ecosystems.⁵²² In light of these changes, society has the potential to mitigate the harm suffered by sentient animals, stop human-driven species extinction, and protect the planet's life support systems.⁵²³

III. THE RIGHTS OF ANIMALS

A. Breakthroughs in Understanding Animal Minds

Humans tend to either forget, or simply choose to ignore, the fact that we are animals.⁵²⁴ It used to be thought that non-human animals were "automatons that merely reacted instinctively to external stimuli."⁵²⁵ That was until Dr. Donald Griffin, an American zoology professor, suggested that animals are conscious beings, even if they might think about different things or in different ways than humans.⁵²⁶ This field of science, called cognitive ethology, focuses on the study of the minds, awareness, and consciousness of non-human animals.⁵²⁷ Humans have been said to possess certain unique traits, dubbed the "hallmarks of humanity," which we use to distinguish ourselves from other species.⁵²⁸ These traits include: intelligence, emotions, language, tool use, memory, culture, foresight, cooperation, altruism, and self-awareness.⁵²⁹ Yet, scientists have concluded that other species have been shown to possess these traits too.⁵³⁰

- ⁵²⁴ *Id.* at 7.
- ⁵²⁵ Id.
- ⁵²⁶ Id.

⁵²⁹ Id. ⁵³⁰ Id.

⁵²² *Id.* at xxxv-xxxvii.

⁵²³ BOYD, *supra* note 493, at xxxv.

⁵²⁷ *Id.* at 7-8.

⁵²⁸ BOYD, *supra* note 493, at 8.

B. The Evolution of Animal Welfare

In 1641, the Puritans of the Massachusetts Bay Colony passed the first American law prohibiting cruelty of animals.⁵³¹ The law read that "[n]o man shall exercise any tirranny or crueltie towards any bruite creatures which are usuallie kept for man's use."⁵³² Animal welfare organizations were later created in the eighteenth and nineteenth centuries, and since then, the pace of progress has accelerated.⁵³³ Only thirty years ago, the majority of states had classified serious animal cruelty offenses as nothing more than minor infractions with minimal penalties.⁵³⁴ By 2014, animal cruelty had been classified as a felony offense in all fifty states.⁵³⁵ Moreover, the Animal Legal Defense Fund has reported recent improvements in laws protecting animals, including mandatory reporting by veterinarians of animal cruelty, harsher penalties for offenders, mental health evaluations and counseling for offenders, and banning convicted offenders from owning animals in the future.⁵³⁶

Recently, World Animal Protection performed an international assessment which evaluated the extent to which laws and policies protect animals and improve their welfare.⁵³⁷ Out of more than fifty countries, those who received the highest ranking, an A grade, were Switzerland, Australia, the UK, and New Zealand.⁵³⁸ Despite their recent progress, the United States and Canada both received D grades.⁵³⁹ What those high-ranking countries have recognized is that animals are not merely things, but are sentient beings with more than just the ability to respond to

⁵³¹ *Id.* at 26.

⁵³² Id.

⁵³³ BOYD, *supra* note 493, at 26.

⁵³⁴ Id

⁵³⁵ Id.

⁵³⁶ *Id.* at 27. ⁵³⁷ *Id.* at 28.

⁵³⁸ BOYD, *supra* note 493, at 28.

⁵³⁹ Id.

stimuli.⁵⁴⁰ Sentience, by definition, means that animals have emotions and can experience both physical and psychological pain and pleasure.⁵⁴¹

Although human interest in animal welfare has grown stronger with time, animal cruelty laws still exclude common but violent practices in agriculture, fishing, hunting, trapping, and medical and scientific research, where much of the harm inflicted on animals is deemed to be "necessary" or standard industry practice.⁵⁴² For some people, if a human activity is enjoyable, convenient, or profitable, then subjecting animals to violence, cruelty, and neglect is justifiable.⁵⁴³ People are either ignorant of the degree to which animals are harmed, or turn a blind eye to such suffering in order to avoid changing their own behavior.⁵⁴⁴ Humans kill over 100 billion animals per year, which equates to about fifteen animals per person annually, and that number is rising.⁵⁴⁵

C. Can a Chimpanzee Be a Legal Person?

In 1996, lawyer Steven Wise founded the Nonhuman Rights Project, an organization dedicated to securing legal rights for certain animals that he views as having "advanced intelligence."⁵⁴⁶ After extensive scientific research, Wise concluded that great apes, elephants, African grey parrots, and cetaceans "are not just conscious, they are self-conscious (they are conscious that they are conscious), they demonstrate complex abilities to communicate, and possess some or all of the elements of a 'theory of mind."⁵⁴⁷ Wise has made historical legal breakthroughs through lawsuits brought on behalf of individual members of these species being

⁵⁴⁰ Id.

⁵⁴¹ Id.

⁵⁴² *Id.* at 34.

⁵⁴³ BOYD, *supra* note 493, at 34.

⁵⁴⁴ Id.

⁵⁴⁵ Id.

⁵⁴⁶ *Id.* at 38.

⁵⁴⁷ Id.

held in captivity.⁵⁴⁸ He has vowed to never stop fighting for the rights of animals who he believes should be recognized as "non-human persons."549

D. The Expansion of Animal Rights

All over the globe, there is a growing movement to recognize non-human animals as legal persons.⁵⁵⁰ A legal person is not necessarily defined as a human being, but rather as an entity to which the law recognizes and grants specific rights.⁵⁵¹ Right now, corporations, ships, churches, and municipalities are all considered to be legal persons with varying rights and responsibilities.⁵⁵² While the notion that animals should be granted rights is controversial, society's evolving views of morality and advancements in scientific understanding are ultimately compelling movement in this direction.⁵⁵³ Boyd admits that factory farming is an "outlier," as only minimal strides have been made in reducing the suffering of animals in such an industry.⁵⁵⁴ Nevertheless, the author emphasizes that the world is on the verge of acknowledging that animal rights, while different from human rights, must be protected, respected, and fulfilled.⁵⁵⁵

IV. THE RIGHTS OF SPECIES

A. Saving Endangered Species: "Whatever the Cost"

In the late nineteenth and early twentieth centuries, the populations of polar bears, migratory birds, whales, and various other species were in rapid decline due to human activities.⁵⁵⁶ As a result, national parks and wildlife refuges were created, and a number of international treaties

⁵⁵² Id.

⁵⁴⁸ BOYD, *supra* note 493, at 38.

⁵⁴⁹ *Id.* at 43.

⁵⁵⁰ *Id.* at 48. ⁵⁵¹ Id.

⁵⁵³ BOYD, *supra* note 493, at 57. ⁵⁵⁴ Id.

⁵⁵⁵ *Id.* at 58. ⁵⁵⁶ *Id.* at 69.

were signed and national laws enacted to protect endangered species from extinction.⁵⁵⁷ Then, in 1973, two landmark legal developments marked a revolutionary change for the rights of species.⁵⁵⁸ The first was the Endangered Species Act (ESA), which is still perceived to be one of the world's most influential environmental laws.⁵⁵⁹ The ESA states that any proposed human activity which would jeopardize the existence of a listed endangered species cannot proceed, and prohibits any species threatened by global extinction from being imported into the U.S.⁵⁶⁰ Additionally, the enactment of the ESA required the U.S. government to host a multi-country meeting to develop an international treaty that works to protect endangered species.⁵⁶¹ That meeting produced the second landmark legal development, a treaty entitled the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), often described as "the Magna Carta for animals."⁵⁶²

The ESA has made a significant improvement in the recovery of many once-endangered species.⁵⁶³ For example, in the 1960s, the populations of California condors, whooping cranes, and black-footed ferrets had decreased to less than twenty-five.⁵⁶⁴ Today, there are over 400 condors, more than 600 whooping cranes, and an excess of 1,000 black-footed ferrets.⁵⁶⁵ In total, more than thirty different species have recovered enough to be removed from the endangered species list.⁵⁶⁶ According to the Center for Biological Diversity, the populations of more than twenty endangered American wildlife species have increased by 1,000 percent in recent decades and "90 percent of species . . . are on track to meet their recovery targets."⁵⁶⁷ Additionally, since its enactment, more

⁵⁵⁹ Id.

⁵⁶² Id.

⁵⁶⁴ Id.

⁵⁶⁶ Id.

⁵⁵⁷ Id.

⁵⁵⁸ BOYD, *supra* note 493, at 70.

⁵⁶⁰ *Id.* at 72-74. ⁵⁶¹ *Id.* at 72.

⁵⁶³ BOYD, *supra* note 493, at 77.

⁵⁶⁵ Id.

⁵⁶⁷ *Id.* at 78.

than 100 other countries have used the ESA as a basis for the development of their own laws and regulations for protecting endangered species.⁵⁶⁸

B. Endangered Species Laws Go Global

Many people are shocked to learn that illicit trading of plants and animals is the third largest international crime, after drugs and weapons.⁵⁶⁹ Illegal smugglers profit by selling items that are sourced from endangered species, including "everything from teak, rosewood, and ivory to aquarium fish, reptiles, and traditional medicine products, such as bear gall-bladders, rhino horns, and tiger penises."⁵⁷⁰ While CITIES helped to ensure the preservation of species, the agreement was made purely for the benefit of current and future generations of humans, rather than for the protection of species for their own sakes.⁵⁷¹ Thus, in 1982, the United Nations agreed upon the World Charter for Nature (WCN), which calls for humans to follow a moral code of action, and states that every life form is unique and deserving of respect, regardless of its worth to humans.⁵⁷² Now, most people would agree that it is immoral for humans to knowingly or negligently cause other species to become endangered or extinct.⁵⁷³ In 2015, Pope Francis echoed this belief when he suggested that "[i]t is not enough . . . to think of different species merely as potential 'resources' to be exploited, while overlooking the fact that they have value in themselves We have no such right."⁵⁷⁴

In 1778, Mongolia set aside land to create Bogd Khan Uul, the first national park in the world.⁵⁷⁵ Since then, nations all over the globe have designated over twenty-five million square

⁵⁶⁸ BOYD, *supra* note 493, at 78.

⁵⁶⁹ *Id.* at 85.

⁵⁷⁰ Id.

⁵⁷¹ *Id.* at 86. ⁵⁷² Id.

⁵⁷³ BOYD, *supra* note 493, at 97.

⁵⁷⁴ Id.

⁵⁷⁵ *Id.* at 98.

kilometers of land as parks and wildlife sanctuaries.⁵⁷⁶ Humans are often prohibited from engaging in harmful activities, such as hunting, fishing, mining, logging, and oil and gas extraction, upon these protected lands.⁵⁷⁷ Boyd notes that while this represents significant progress, these protections are not always enforced, and that the amount land that we have put aside encompasses only about fifteen percent of land on Earth.⁵⁷⁸ Many ecologists have come to the conclusion that "nature needs half," meaning that in order to avoid massive biodiversity loss, humans would be forced to relinquish possession over fifty percent of the world's ecosystems.⁵⁷⁹ While this may be difficult to envision in the short term, some countries have already chosen to set aside twenty-five percent of their ecosystems.⁵⁸⁰ Furthermore, the U.S. and Canada, who currently reserve between ten and fifteen percent of their land for protected areas, have both made international commitments to boost their percentage of land protected to seventeen percent by the year 2020.⁵⁸¹

V. THE RIGHTS OF NATURE: FROM TREES TO RIVERS AND ECOSYSTEMS

In the late 1960s, Walt Disney proposed building a ski resort in the Sierra Nevada Mountains in California, to be located in the Mineral King Valley, an area which was cherished and frequently visited by hikers and backpackers.⁵⁸² Disney's plans included a new highway, power lines, hotels, restaurants, swimming pools, parking lots, and eighty acres of downhill skiing infrastructure.⁵⁸³ The resort was expected to attract over five million visitors annually, which would ultimately transform the valley from remote wilderness into a heavily populated area. Regardless of the needs of wild animals and ecosystems present in the area, the U.S. Forest Service

- ⁵⁷⁹ *Id.* at 99.
- ⁵⁸⁰ Id.

⁵⁸² *Id.* at 102.

⁵⁷⁶ Id.

⁵⁷⁷ Id.

⁵⁷⁸ BOYD, *supra* note 493, at 98.

⁵⁸¹ Id.

⁵⁸³ BOYD, *supra* note 493, at 102.

gave the project the green light in 1969.⁵⁸⁴ The Sierra Club responded by filing a lawsuit, arguing that the project should be halted and the permits cancelled.⁵⁸⁵

Ultimately, the issue of whether or not the Sierra Club had proper standing to bring the lawsuit led the parties to appeal to the U.S. Supreme Court.⁵⁸⁶ Justice William O. Douglas, one of the nine judges on the Supreme Court at the time, had been a passionate outdoorsman ever since he overcame a rare form of paralysis after rehabilitating his legs by hiking in the Cascade Mountains.⁵⁸⁷ In his judgement, Justice Douglas proposed that there should be a rule allowing "environmental issues to be litigated before federal agencies or federal courts in the name of the inanimate object about to be despoiled, defaced, or invaded by roads and bulldozers and where injury is the subject of public outrage."⁵⁸⁸ Douglas argued that since inanimate parties such as ships and corporations are considered capable of launching litigation, such a right should extend to valleys, meadows, rivers, beaches, swamps, or even air.⁵⁸⁹ While Douglas was unable to persuade the majority of his colleges to join him in this proposition, Justice Blackmun concurred with Douglas that it made sense to grant standing to organizations that were qualified to speak on behalf of the environment.⁵⁹⁰

Despite losing their case for lack of standing, the Sierra Club eventually prevailed in the court of public opinion and, thankfully, Disney's ski resort was never built.⁵⁹¹ In 1978, Congress made the Mineral King Valley a part of Sequoia National Park, which, as Boyd states, protects it

⁵⁸⁴ Id.

⁵⁸⁵ Id.

⁵⁸⁶ *Id.* at 103.

 $[\]frac{587}{10}$ Id. at 104.

⁵⁸⁸ BOYD, *supra* note 493, at 104.

⁵⁸⁹ *Id.* at 105.

⁵⁹⁰ Id.

⁵⁹¹ *Id.* at 108.

from "ill-conceived development forever."⁵⁹² To this day, the Mineral King Valley remains in its original form: green with lakes, waterfalls, various wildlife habitats, and no cell phone service.⁵⁹³

A. Watershed Moments: Asserting the Rights of American Ecosystems

In recent years, the rights of nature have gained traction in communities across the country.⁵⁹⁴ That is why Thomas Linzey, a successful environmental lawyer, founded the Community Environmental Legal Defense Fund (CELDF), an organization created to assist communities in legal battles against industrial pollution and the exploitation of environmental resources.⁵⁹⁵ Attorneys at CELDF work with communities "to pass local ordinances that prohibit unwanted industrial practices, including factory farms, fracking for oil and gas, large-scale water withdrawals, hazardous waste dumping, and open pit mining."⁵⁹⁶ Thanks to a rise in public opposition to environmental destruction, more and more legal battles are being fought to secure a healthier future for people, animals, and ecosystems.⁵⁹⁷

VII. CONCLUSION

Boyd asserts that "[h]uman actions have unleashed a tsunami of death and destruction upon the planet, killing tens of billions of animals annually, causing the worst mass extinction in sixtyfive million years, and eroding the integrity of ecosystems and natural cycles that support all life on Earth."⁵⁹⁸ Luckily, a global movement has emerged, calling for people to acknowledge that animals, wild species, and nature have rights that demand our protection and respect.⁵⁹⁹ However, to move from the exploitation of nature to respecting nature, there must exist "a massive

⁵⁹⁴ *Id.* at 110.

⁵⁹² Id.

⁵⁹³ BOYD, *supra* note 493, at 108.

⁵⁹⁵ Id.

⁵⁹⁶ *Id.* at 112.

 $^{^{597}}$ *Id.* at 130.

⁵⁹⁸ BOYD, *supra* note 493, at 219.

⁵⁹⁹ Id.

transformation of law, education, economics, philosophy, religion, and culture."⁶⁰⁰ The author notes that this shift could take decades to be implemented.⁶⁰¹

Moving forward, humans cannot continue to prioritize property rights over animal rights, burn through fossil fuels faster than they are being replenished, and treat nature as a mere commodity for economic growth.⁶⁰² Instead, we must modify our behavior in ways that will establish a mutually beneficial relationship with nature, such as considering the needs of non-human species, shifting to 100 percent renewable energy, encouraging local production and consumption, and, eventually, adopting a circular economy in which all inputs, outputs, and byproducts are non-toxic, reusable, recyclable, or compostable.⁶⁰³ Finally, the public, in addition to being thoroughly and consistently informed, must demonstrate a commitment to making these changes, e.g., by speaking out about the rights of nature and electing politicians who are willing to do the same.⁶⁰⁴

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⁶⁰⁰ *Id.* at 230.

⁶⁰¹ Id.

⁶⁰² Id.

⁶⁰³ See BOYD, supra note 493, at 230-31.

⁶⁰⁴ Id.

<u>"With Cars Like These, Who Needs Policies?" – The Inevitable</u> <u>Battle Between Autonomous Vehicles, The Insurance Industry,</u> <u>Manufacturers and Consumers</u>

Rachel Theodorou⁶⁰⁵

Abstract

This note serves to explore the many reactions of the insurance industry, manufacturers and consumers to autonomous vehicles (AVs) and the possibilities of liability regulation. The tort system may be capable of handling automotive accidents now, but it will become less and less proficient at adapting as the levels of autonomy increase. A likely shift away from tort and strict liability theories toward product liability will be best suited to provide both consumers and manufacturers with defenses, but is currently outdated and must be adjusted to fit the new standards of the autonomous automotive industry.

How the shifted liability should be regulated, by whom and when are additional questions that will be answered in this note. If consumers no longer have the need to purchase and maintain car insurance, who should be held liable in the event of a crash – the car manufacturer, software company, human occupant(s), third party, or a combination? Furthermore, what will happen to the insurance companies? The answer to these questions are vital to the adoption of autonomous vehicles and must be decided before they become widely available. The debate on whether regulation should be performed at the federal or state level is already underway, but no authentic progress has yet been made.

⁶⁰⁵ Syracuse University College of Law, Juris Doctor expected 2019. The author would like to extend a special "thank you" to Professor Keli Perrin for her guidance and encouragement throughout the development of this note.
Introduction and background

The year is 2050. It is a dreary, rainy October day, and you do not feel like walking to school. You enter the garage and ease yourself into the self-driving Tesla your parents bought you as a high school graduation present three years ago. The car senses your presence and asks where you would like to go. You order the car to take you to school. As the car pulls out of the driveway, you open Netflix on your phone, eager to re-watch your favorite episode of The Office. You are not worried about keeping an eye on the road; you grew up with autonomous vehicles and trust them far more than you trust human drivers.⁶⁰⁶ After all, since the first fully-autonomous vehicle was introduced in 2038, car accidents have become a subject of fiction – only occurring a few times per year.⁶⁰⁷

Every now and then, your eyes wander, briefly scanning the horizon before returning to your phone. You notice that the visibility is extremely limited due to the intensity of the rain, and you wonder how AVs do what they do. Suddenly, the car stops and your eyes dart up. There is a truck stopped in the middle of the road, you assume it is not autonomous because of its design. Before you can form another thought, you hear the squeal of tires and the crunch of metal before you feel the impact of the car behind you crash into you. Your car lurches forward, anticipating the crash, but its anomalous lapse in judgment causes it to slam into the truck in front of you.

What happens next? Who is to blame? America's current regulatory framework is not adequately prepared to answer these questions. The National Highway Traffic Safety Administration (NHTSA) has stated that these questions are obstacles that will prevent

 ⁶⁰⁶ Critical reasons for crashes investigated in the National Motor Vehicle Crash Causation Survey, NHTSA.gov (Feb. 2015), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115.
⁶⁰⁷ Id.

innovation and delay the adoption of autonomous technology, and must be answered.⁶⁰⁸ While the federal government acting through the NHTSA has not made any substantial steps toward developing actual regulations, a large number of states have already developed and implemented their own regulatory systems.⁶⁰⁹

Autonomous technology is not new; in fact, it has been around for over 100 years. By definition, autonomous technology is a "class of technology that can respond to real world conditions without help."⁶¹⁰ While the mind may imagine something out of a Terminator movie, autonomous technology can be incredibly simple. For example, Roomba vacuum cleaners, which were first introduced in 2002, are able to navigate different surfaces and avoid collision with humans, pets, furniture and anything else in their way.⁶¹¹ Automated conveyer belts are able to sort between recyclable and non-recyclable materials.⁶¹² There are even windows that "adapt to light levels to achieve goals such as heating, cooling, growing plants or achieving indoor light parameters set by users."⁶¹³ Autonomous technology is all around us, and we must not be afraid to use it in its full capacity.

The journey toward fully autonomous vehicles goes back to the 1940s when cruise control was invented. Popular Science published an article in April 1958 in response to the increasing popularity of cruise control, warning that "robots are slowly taking over a driver's chores," calling the concept "faintly ominous," but ultimately concluding that it is a "genuine

⁶⁰⁸ Cristina K. Lunders, et. al., *Autonomous vehicles: the legal landscape in the US*, NORTON ROSE FULBRIGHT, 5 (Aug. 11, 2016), http://www.nortonrosefulbright.com/knowledge/publications/141954/autonomous-vehicles-the-legal-landscape-in-the-us.

⁶⁰⁹ State laws on autonomous vehicles, COUNCIL OF STATE GOV'TS (Sept. 2016), http://knowledgecenter.csg.org/kc/system/files/CR automomous.pdf.

⁶¹⁰ John Spacey, 7 *examples of autonomous technology*, SIMPLICABLE (May 31, 2017), https://simplicable.com/new/autonomous-technology.

⁶¹¹ Id.

⁶¹² Id.

⁶¹³ Id.

help that promotes safety" by reducing driver fatigue.⁶¹⁴ Anti-lock brakes became commercially available in the 1970s and have greatly reduced stopping distances on slick pavements.⁶¹⁵ In the mid-1990s, electronic stability control (ESC) was introduced. ESC allows the car to selectively apply the brakes to certain wheels when the driver presses the brake pedal in order to increase control on turns and slippery surfaces, and saved over 2,000 lives between 2008 and 2010.⁶¹⁶

Many modern vehicles have features such as steering and parking assistance, blind spot warnings, lane drift warnings, forward collision warnings and countless others. Tesla is paving the way towards the first fully automated vehicle, but the necessary technology, regulations and consumer confidence required are currently nonexistent.

I. Understanding autonomous vehicles

To better understand my reasoning for suggesting certain methods of regulation in later sections of this note, it is best to first understand the levels of autonomy that currently exist. In September 2016, the NHTSA adopted a standard of six levels of autonomy established by the international Society of Automotive Engineers (SAE) several years prior.⁶¹⁷ The range of levels begins at Level 0, where there is absolutely no automation, and ends at Level 5, where a driver "figure" is optional.⁶¹⁸ The SAE divides the levels into two categories, split based on who monitors the environment, the human driver (Levels 0 through 2) or the automated driving system (Levels 3 through 5). ⁶¹⁹

⁶¹⁴ John Villasenor, *Products liability and driverless cars: issues and guiding principles for legislation*, BROOKINGS, 4 (Apr. 24, 2014), https://www.brookings.edu/research/products-liability-and-driverless-cars-issues-and-guiding-principles-for-legislation/.

⁶¹⁵ Id.

⁶¹⁶ Id.

⁶¹⁷ Loz Blain, *Self-driving vehicles: what are the six levels of autonomy?*, NEW ATLAS (June 8, 2017), https://newatlas.com/sae-autonomous-levels-definition-self-driving/49947/.

⁶¹⁸ Id.

⁶¹⁹ Automated driving, SAE INTERNATIONAL (2014), http://www.sae.org/misc/pdfs/automated_driving.pdf.

Level 0 requires the human driver at the wheel to be in complete control of the primary functions of the vehicle at all times (steering, accelerating, braking, shifting lanes, etc), as well as to monitor the conditions of the roadway.⁶²⁰ Many vehicles on the road today are considered to be at Level 0 — even those currently being manufactured. A common misconception is that cruise control is autonomous technology when it actually is not. Level 0 vehicles can have cruise control, as well as warning features, but as long as the human driver maintains full situational awareness and control of the speed and steering functions, the vehicle remains at Level 0.⁶²¹

Examples of vehicles at Level 1 ("driver assistance") are those that are able to control either the speed or steering on its own, but not both simultaneously; the driver still maintains responsibility for monitoring the road, and must be able to take over at any given time.⁶²² Adaptive cruise control is a perfect example of Level 1 automation. When enabled, your car will maintain a speed that will keep a safe distance from the vehicle in front of you, speeding up or slowing down where appropriate.⁶²³ Another example is parking assistance, which greatly benefits those of us not gifted with the ability to parallel park.

Level 2 automation, known as "partial automation" or "combined function automation," is where things take a more futuristic turn.⁶²⁴ Level 2 involves the concurrent automation of at least two primary control functions, such as steering and driving.⁶²⁵ This "hands off the wheel, eyes on the road" approach only applies at certain times and under certain limited driving situations, requiring the driver to be available to take control of the vehicle when necessary.⁶²⁶

⁶²⁰ Path to autonomy: self driving car levels 0 to 5 explained, CAR AND DRIVER (Oct. 3, 2017),

https://www.caranddriver.com/features/path-to-autonomy-self-driving-car-levels-0-to-5-explained-feature. ⁶²¹ Villasenor, *supra* note 614, at 19.

⁶²² Id.

⁶²³ Blain, supra note 617.

⁶²⁴ CAR AND DRIVER, supra note 620.

⁶²⁵ Id.

⁶²⁶ Blain, supra note 617.

The driver is also still responsible for monitoring the conditions of the roadway. Tesla's Autopilot, Volvo's Pilot Assist and Audi's Traffic Jam Assist are examples of Level 2 technology.⁶²⁷ These features combine adaptive cruise control with another feature such as lane centering, while the driver controls functions such as lane changing.⁶²⁸

Tesla was the first company to make the jump from Level 1 to Level 2 automation in 2014; other companies have followed suit, but none have yet been able to make the leap to Level 3, conditional automation.⁶²⁹ Allowing the driver to cede full control of "all safety-critical functions...and to rely heavily on the vehicle to monitor for changes" in the conditions of the roadway is asking too much of manufacturers and engineers at this point, but not for much longer.⁶³⁰ In September 2017, Audi announced that it will release the first Level 3 vehicle, an A8, in 2019.⁶³¹ The car, rather than the driver, will have the task of actively monitoring the environment when the automated system is engaged, though the human driver must still be prepared to respond to a request by the vehicle to intervene.⁶³² Audi's Traffic Jam Assist feature can only be used when the vehicle is moving under 37 miles per hour, which means that once the conditions of Level 3 autonomous driving are no longer present, the driver has to take the wheel.⁶³³

While Level 3 has been dubbed the "stickiest" level of autonomy due to its requirement that the driver be able to take over when they have not necessarily been paying attention,

http://www.thedrive.com/sheetmetal/15724/what-are-these-levels-of-autonomy-anyway. 633 Id.

⁶²⁷ CAR AND DRIVER, supra note 620.

⁶²⁸ Villasenor, *supra* note 614, at 20.

⁶²⁹ Blain, supra note 617.

⁶³⁰ Villasenor, *supra* note 614.

⁶³¹ *The Audi vision of autonomous driving*, AUDI NEWSROOM (Sept. 11, 2017), https://media.audiusa.com/en-us/releases/184#gallery.

⁶³² Justin Hughes, Car autonomy levels explained, THE DRIVE (Nov. 3, 2017),

transitioning from Level 3 to Level 4 will be the most difficult for manufacturers to achieve.⁶³⁴ Level 4 is known as "high automation," and allows the driver to not only keep their hands and eyes off the road, but their mind as well – sometimes.⁶³⁵ Ford's autonomous vehicles expert, Jim McBride, believes it is unfair to ask drivers to "instantaneously intervene" like they would in a Level 3 vehicle, which is why Ford is focusing on going straight to Level 4, bypassing Level 3 completely.⁶³⁶ At this level, the vehicle is designed to perform all safety-critical functions while also monitoring roadway conditions throughout the entire trip, meaning the driver will simply provide a destination but will not be expected to take control at any point, under the right circumstances.⁶³⁷

Level 4 vehicles are anticipated to be able to operate without any human input, but only under certain environments "defined by factors such as road type or geographic area."⁶³⁸ Google's prototype autonomous vehicle, the Firefly, was a true self-driving car, although it has been retired as of June 2017.⁶³⁹ Maxing out at a whopping 25 miles per hour, the Firefly lacked pedals and a steering wheel, giving is experimental passengers a peak into the future.⁶⁴⁰ While the Firefly was only a prototype, it is implausible to expect Level 4 vehicles to do away with steering wheels and pedals because the driver may, on occasion and with sufficient notice, have to take over, during poor weather conditions, for example.⁶⁴¹ Level 4 is a tangible goal, but it is unlikely to be reached until at least 2025.⁶⁴²

⁶³⁴ Id.

⁶³⁵ Blain, supra note 617.

 ⁶³⁶ Hope Reese, Updated: autonomous driving levels 0 to 5: understanding the differences, TECHREPUBLIC (Jan. 20, 2016), https://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/.
⁶³⁷ Villasenor, supra note 614.

vinasenoi, supra note 014.

⁶³⁸ CAR AND DRIVER, *supra* note 620.

⁶³⁹ Mike Murphy, *The cutest thing Google has ever made is dead*, QUARTZ (June 13, 2017),

 $https://qz.com/1005083/the-cutest-thing-google-has-ever-made-is-dead-waymos-firefly-self-driving-cars-goog/. \\ ^{640}$ Id.

⁶⁴¹ Hughes, *supra* note 632.

⁶⁴² Definition: levels of AD, 2025 AD (Dec. 18, 2015), https://www.2025ad.com/latest/the-levels-of-automation/.

One of the biggest demarcations between Levels 4 and 5 is the requirement that the driver be present in the vehicle while it is moving. At Level 4, we will be able to spin our seats around, a lá Captain Kirk, and chat with our fellow passengers, but we will not necessarily be able to summon our cars to come pick us up – that's where Level 5 comes in. Level 5 is the highest level of automation there is. Here, humans "are nothing but cargo that tell the car where to take them," with the car neither wanting nor needing the help of humans.⁶⁴³ Going back to the hypothetical scenario described in the introduction of this note, a Level 5 vehicle will be able to perform all driving tasks, in any and all conditions, with absolutely no interference by the human driver.⁶⁴⁴ Google's Firefly may no longer be with us, but Waymo, Google's autonomous vehicle project, is now using a test fleet of Chrysler Pacifica hybrids to develop its Level 5 technology for production.⁶⁴⁵ Level 5 brings us into the more distant future than Level 4; experts believe introduction of Level 5 vehicles licensed for use on all public roads will not occur until at least the late 2030s.⁶⁴⁶

II. How accidents are currently handled

In 2016, there were over 40,000 deaths related to motor vehicle accidents, resulting in 4.6 million reported injuries, and costing over \$400 billion in "wage and productivity losses, medical expenses, administrative expenses, employer costs and property damage."⁶⁴⁷ To say the accident business is lucrative would be a massive understatement. Attorneys, auto repair shops, health care providers, and of course, insurance companies all benefit from the "crash economy."⁶⁴⁸

⁶⁴³ Hughes, *supra* note 632.

⁶⁴⁴ Federal Automated Vehicles Policy, U.S. DEP'T. OF TRANS. (Sept. 2016),

https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016.

⁶⁴⁵ CAR AND DRIVER, supra note 620.

⁶⁴⁶ 2025 AD, *supra* note 642.

⁶⁴⁷ NSC Motor Vehicle Fatality Estimates, NSC.ORG (2017), http://www.nsc.org/NewsDocuments/2017/12-month-estimates.pdf.

⁶⁴⁸ David B. Sudzus, *Autonomous Vehicles – Liability and Policy Issues*, 4 DRAKE MGMT. REV. 13 (2015), http://faculty.cbpa.drake.edu/dmr/0412/DMR041204S.pdf.

A mixture of tort, contract and state regulatory laws requires drivers to obtain and maintain insurance.⁶⁴⁹ The result is a "mandatory-insurance regime" that has a significant impact on the litigation that occurs after crashes.⁶⁵⁰ The tort system also determines which party is to blame for the accident, who must pay damages and how those damages are to be allocated. While this system works now, it will quickly become outdated as the human driver component is gradually and completely removed.

A. Tort theories

There are three common tort theories that are used to establish and apportion liability when it comes to automotive accidents: traditional negligence, no-fault liability and strict products liability.⁶⁵¹ Each theory apportions blame differently, but they all ultimately strive to achieve the same goal – justice and compensation for the victim.

i. Traditional negligence

The most common tort liability theory of traditional negligence holds that drivers have a duty to exercise reasonable care while operating a vehicle.⁶⁵² If that duty of care is violated in the event of an accident, the drivers are liable for any injuries caused by their breach of duty; "the central idea of liability for negligence is that a party should be held liable for harms caused by unreasonably failing to prevent the risk."⁶⁵³ Manufacturers must also exercise a reasonable degree of care when it comes to designing their products, as long as the consumer is using the

⁶⁴⁹ *Id.* at 16.

⁶⁵⁰ Id.

⁶⁵¹ James M. Anderson, *Autonomous Vehicle Technology: A Guide for Policymakers*, RAND CORP., 112 (2016), https://www.rand.org/pubs/research_reports/RR443-2.html.

⁶⁵² Sudzus, *supra* note 648, at 16.

⁶⁵³ Anderson, *supra* note 651.

product in a reasonably foreseeable way.⁶⁵⁴ If a consumer is injured while using the product in a way the manufacturer intended, then the manufacturer is liable for the harm caused.

There are several types of negligence that are applied when courts assign liability and apportion damages: comparative negligence, contributory negligence, a combination of the two, and in rare cases, gross negligence.⁶⁵⁵ Comparative negligence comes into play when the plaintiff is partially responsible for their injuries.⁶⁵⁶ For example, you are crossing an intersection when you are struck by another driver who ran a red light. You are seriously injured because you were texting while driving. Due to your carelessness, the court requires you to pay 30% of the total damages, with the defendant paying the remaining 70%.⁶⁵⁷

If the theory of recovery under contributory negligence was applied to the situation described above, you, the plaintiff, would be prohibited from collecting any damages at all because you caused your own injury.⁶⁵⁸ While many states are doing away with contributory negligence claims, in the few jurisdictions where it is still applied, victims cannot recover any amount, no matter how miniscule their percentage of fault was.⁶⁵⁹ Some states use a combination of contributory and comparative negligence, allowing an accident victim to recover damages if their own negligence contributed to the accident by less than 50%.⁶⁶⁰

Lastly, there is gross negligence, which is rarely claimed. The majority of car accidents are caused by mere carelessness (changing radio stations, eating, etc). However, gross negligence

⁶⁵⁴ Villasenor, *supra* note 614, at 7.

⁶⁵⁵ *Types of negligence*, THE GALLAGHER LAW FIRM, LLC (last visited Nov. 12, 2017), http://gallagher-law-firm.com/types-of-negligence/.

⁶⁵⁶ Id.

 ⁶⁵⁷ Contributory and comparative negligence: defenses in car accident cases, FINDLAW (last visited Nov. 12, 2017), http://injury.findlaw.com/car-accidents/defenses-contributory-and-comparative-negligence-in-car-accident.html.
⁶⁵⁸ Id.

⁶⁵⁹ Id.

⁶⁶⁰ Id.

is applied when it can be demonstrated that the defendant acted with reckless disregard toward the safety and care of others (i.e., drunk driving).⁶⁶¹

The negligence liability theory has been heavily influenced by the mandatory-insurance regime.⁶⁶² Insurance companies have adopted a set of rules that aid in allocating fault.⁶⁶³ For example, a driver who rear-ends another vehicle is usually presumed to be at fault. The reasonableness standard that accompanies negligence can sometimes prove problematic or uncooperative with the given circumstances, and these unofficial rules allow for more "general analyses of reasonableness and causation" to be made in most car crash cases, which avoids the formal litigation process. Insurance adjusters tend to refer to these simple rules instead of performing a complex and general analysis of whether or not a driver was negligent.⁶⁶⁴

ii. No-fault liability

No-fault liability comes into play when the severity of a crash victim's injuries has not reached a certain threshold. This threshold varies between jurisdictions, but is usually a set dollar amount or level of severity (e.g., if you are involved in a crash and your hospital bills do not meet or exceed \$5,000, litigation is not permitted).⁶⁶⁵ In states that apply this theory, victims are prohibited from suing other drivers but are instead compensated for their injuries through their own personal insurance, regardless of which party was at fault.⁶⁶⁶ This approach was designed to reduce costs and make it easier for victims to recover, but has proved disappointing because costs are still higher than desired.⁶⁶⁷

⁶⁶¹ The Gallagher Law Firm, LLC, *supra* note 655.

⁶⁶² Anderson, *supra* note 651.

⁶⁶³ Id.

⁶⁶⁴ *Id.* at 113.

⁶⁶⁵ Id.

⁶⁶⁶ Id.

⁶⁶⁷ Anderson, *supra* note 651, at 143.

Advocates for this theory argue that it eliminates the process of determining who the blameworthy party is, and ensures that compensation is available to crash victims irrespective of whether anyone was legally at fault, which in turn reduces lawsuits and litigation, saving society money.⁶⁶⁸ Though only currently used in a handful of states, this theory's popularity is growing as the level of vehicular autonomy increases because it reduces the responsibility of the individual driver.

iii. Strict products liability

A rarer, but still utilized, theory of liability is strict products liability. This theory only applies to abnormally dangerous or "ultrahazardous" activities, slightly differing when pertaining to either the driver or manufacturers, and is usually not used in an accident setting but rather a malfunction or defect case.⁶⁶⁹ It presents a lose-lose situation when applied to the manufacturer because even if the manufacturer exercises all possible care when designing or building their products, if one is shipped with an unintended flaw, and that defect causes injury, the manufacturer will be held strictly liable for damages.⁶⁷⁰

B. Why the current system is incompatible with fully autonomous vehicles

The theories of liability described above are not sufficiently equipped to handle accidents involving fully, let alone partially, autonomous vehicles. If lawmakers and policymakers allow the recovery system to continue without adjusting it to the new and changing technology, a floodgate of litigation will open up, harming manufacturers, consumers and all other actors that had a role in the creation of the vehicle and the accident.⁶⁷¹

⁶⁶⁸ Id. at 113.

⁶⁶⁹ Steven Wittenberg, Automated Vehicles: Strict Products Liability, Negligence Liability and Proliferation, ILL. BUS. LAW J. (2016).

⁶⁷⁰ Id.

⁶⁷¹ Id.

i. Why negligence theories will not work

Proponents of negligence liability believe applying that set of theories to accidents involving autonomous vehicles will create a "more refined system of comparative fault and will present a cheaper price per unit for consumers."⁶⁷² Recovery under the negligence theories allow for the "apportionment of fault between parties, including those who could have avoided the accident in a cost-efficient manner."⁶⁷³ For example, manufacturers or software companies could install warning systems in their vehicles that would alert the driver if and when the automated technology goes offline, becomes defective or is hacked. A simple tweak in the programming could save hundreds, if not thousands, of lives annually.

While that sounds like a feasible objective, it can't be regarded as such. Negligence is synonymous with falling below an established reasonable standard of care, which cars – regardless of their level of autonomy – cannot be held to.⁶⁷⁴ Expecting autonomous vehicles to act reasonably, and holding them responsible for accidents raises ethical questions that go beyond the subject matter of this note. Additionally, allowing accident victims to recover under a negligence claim may ultimately excessively deter prospective buyers from purchasing and exploring the emerging technology, which could indefinitely delay or prohibit the benefits of said technology from coming to fruition. ⁶⁷⁵

The no-fault theory is the only subsection of negligence that would be a practical solution to the question of who is to be held liable. However, it is not quite ready to handle autonomous technology at this point in time because it has not been adjusted to accommodate the technology.

⁶⁷² Id.

⁶⁷³ Id.

⁶⁷⁴ Gary E. Merchant & Rachel A. Lindor, *The Coming Collision Between Autonomous Vehicles and the Liability System*, 42 SANTA CLARA L. REV. 1321, 1323 (2012).

⁶⁷⁵ Anderson, *supra* note 651, at 134.

It might be a viable option in the future, however, as long as it retains the "model of having individual car owners be fiscally responsible for crashes."⁶⁷⁶ It will also preserve the already extensive "crash economy," of insurers and other parties, without having to make difficult determinations about responsibility between drivers, automobile makers, software companies, etc.⁶⁷⁷ This will benefit insurance companies, who may become obsolete once fully autonomous vehicles become widely available. Manufacturers will benefit as well because the likelihood of them facing increased liability costs that may slow the introduction of the technology will potentially be reduced.⁶⁷⁸

ii. Why strict products liability is not ready yet

Strict products liability, when applied to accidents involving autonomous vehicles, is arguably the best way to separate and impose liability. If tweaked to better accommodate the foreseeable issues concerning autonomous vehicles, consumers and manufacturers alike will benefit substantially. Consumers would be better protected because manufacturers would be pressured to sell fewer defective cars by taking greater care in creating the product.⁶⁷⁹ Manufacturers would benefit because, while being the party most likely to be blamed in the event of an accident, will theoretically be subject to less lawsuits because of an improved product.

This theory will also enable courts to resolve conflicts with relatively little administrative cost because there will not need to be any evidence of misconduct, which will be explained in greater detail in the following section. Both the burden of proof and cost for plaintiffs in such proceedings will also be lower and more relaxed for that same reason. However, strict products

⁶⁷⁶ Anderson, *supra* note 651, at 144.

⁶⁷⁷ Id.

⁶⁷⁸ Id.

⁶⁷⁹ Villasenor, *supra* note 614, at 8.

liability will prove to be less flexible in cases of comparative fault (for plaintiffs) because manufacturers will have several defenses available: product misuse, assumption of risk, state of the art and comparative and contributory negligence. Despite placing fault solely on the manufacturer and the resulting increased consumer costs, strict products liability will produce higher demand, ultimately benefitting manufacturers.⁶⁸⁰

III. How accidents involving autonomous vehicles should be handled

So, what makes levels so important? They serve as guidelines for how technologically advanced a vehicle is, aiding policymakers, manufacturers and insurance companies in determining how autonomous vehicles should be regulated.⁶⁸¹ Experts believe there are three stages that will be relevant in the regulation process: automated, autonomous, and driverless.⁶⁸² It is imperative to distinguish between the autonomous and driverless stages because driverless is a more advanced stage of autonomous.⁶⁸³ While drivers may not be concerned with such distinctions, the differences could bear great significance when it comes to car insurance, as they will change the "risk profile" of the vehicle.⁶⁸⁴ Insurance companies must learn how the changing capabilities of autonomous vehicles impact driving risk if they are to survive the massive shift that will come with Level 4 and 5 technology.

A. How should liability be regulated and why?

Regulating autonomous vehicles is not a task that can be performed overnight, and therefore, we should take great care in deciding how to do so. Consumer adoption will be one of the biggest hurdles manufacturers and insurance companies will need to overcome, and with a

⁶⁸⁰ Wittenberg, *supra* note 669.

⁶⁸¹ Reese, *supra* note 636.

⁶⁸² Id.

⁶⁸³ Id.

⁶⁸⁴ Id.

few adjustments, strict products liability will be the perfect cure for this dilemma. By assuaging consumers' fear of liability regarding such foreign technology, strict products liability easily outweighs the "modest benefit of a reduced cost per unit" associated with negligence theories.⁶⁸⁵ When accidents are caused by defective technology, consumers will not be held liable but manufacturers will, therefore increasing road safety.⁶⁸⁶ Strict products liability law "offers a time-tested framework that has proven to be adaptive to technology-driven issues in many other contexts. There is good reason to be optimistic that it will be equally capable of doing so when applied to autonomous vehicles."⁶⁸⁷

The doctrine of "caveat emptor" will become obsolete as the number and complexity of autonomous vehicles on the roads increase. Strict products liability will force manufacturers to absorb costs because they are in the "best position to avoid defective products," though this increased cost is unlikely to hinder the development of autonomous vehicles due to substantial investment in the product.⁶⁸⁸ A number of manufacturers are already offering to compensate for damages caused by defective technology in their autonomous vehicles. In a press release, Volvo took this one step further by declaring "Volvo will accept full liability whenever one of its cars is in autonomous mode, making it one of the first car makers in the world to make such a promise."⁶⁸⁹

i. Claims under strict products liability

⁶⁸⁵ Wittenberg, *supra* note 669.

⁶⁸⁶ Id.

⁶⁸⁷ Villasenor, *supra* note 614, at 4.

⁶⁸⁸ Id.

⁶⁸⁹ US urged to establish nationwide federal guidelines for autonomous driving, VOLVO.COM (Oct. 2015), https://www.media.volvocars.com/global/en-gb/media/pressreleases/167975/us-urged-to-establish-nationwide-federal-guidelines-for-autonomous-driving.

Under strict products liability, victims have three types of defects to claim:

manufacturing, design, and failure to warn.⁶⁹⁰ A manufacturing defect is present when the product fails to meet the manufacturer's specifications and standards.⁶⁹¹ Manufacturer can be found strictly liable for such defects even if it exercised all possible care in preparing the product.⁶⁹² The 2014 Brookings article on autonomous vehicles describes a perfect example of a manufacturing defect:

Consider a manufacturer of fully autonomous vehicles that usually ships its cars with well-tested, market-ready automatic braking software. However, suppose that in one instance, it accidentally ships one vehicle with a prototype version of the software containing a flaw not present in the market-ready version. If the vehicle becomes involved in an accident attributable to the flaw, a person injured in the accident could file a claim for damages arising from this manufacturing defect.⁶⁹³

The existence of this claim will provide the necessary incentive for manufacturers to produce the safest products possible, which will not only protect them against lawsuits, but will increase consumer trust in the new technology.

Another kind of defect claim is the design defect, alleged when foreseeable risks of harm could have been reduced or avoided completely if the manufacturer had used a reasonable alternative design.⁶⁹⁴ On occasion, a product's design contains a defect that causes harm. When it comes to autonomous vehicles, these claims are likely to arise in connection with the shared

⁶⁹⁰ Anderson, *supra* note 651, at 123.

⁶⁹¹ Id.

⁶⁹² Reese, *supra* note 636.

⁶⁹³ *Id.* at 9.

⁶⁹⁴ Sudzus, *supra* note 648, at 18.

responsibilities between the human driver and the vehicle.⁶⁹⁵ If an accident occurs due to the driver of a Level 3 vehicle not being able to take control in the allotted time, the injured party could argue that the vehicle had a design defect because it should have alerted the driver earlier.

There are two tests used to determine if a design defect existed: the consumer expectations test and the risk-utility test. The consumer expectations test will most likely fade into oblivion as the levels of autonomy increase because it is suspected that consumers will have false expectations about the technology.⁶⁹⁶ When applying the risk-utility test, courts "weigh the benefits, or utility, provided by the particular design against the costs, or risks, associated with it."⁶⁹⁷ The factors used by courts in conducting these analyses vary from jurisdiction to jurisdiction, though the tests generally examine whether use of an alternative solution could have avoided or reduced the design defect without increasing the cost of the product or impairing its utility. ⁶⁹⁸

Victims may also claim a product was defective if it lacked the appropriate warnings. Whether the danger be hidden or obvious, manufacturers have an obligation to warn of those possible hazards; if they do not, the product may be found defective, and they can be held liable for any injuries attributable to this lack of information.⁶⁹⁹ Because manufacturers cannot anticipate every kind of danger that could arise during the use of an autonomous vehicle, they tend to issue such warnings conservatively.⁷⁰⁰ For example, Mercedes-Benz includes a very broad warning to consumers whose vehicles are equipped with the Distronic Plus feature, an automatic braking system. The warning says, "always pay attention to traffic conditions even

⁶⁹⁵ Reese, *supra* note 636.

⁶⁹⁶ Anderson, *supra* note 651, at 125.

⁶⁹⁷ Id.

⁶⁹⁸ Reese, *supra* note 636.

⁶⁹⁹ Anderson, *supra* note 651, at 127.

⁷⁰⁰ Villasenor, *supra* note 614, at 10.

when DISTRONIC PLUS is activated. Otherwise, you may fail to recognize dangers in time, cause an accident and injure yourself and others."⁷⁰¹ By keeping the warning general, the manufacturer can protect itself against extensive lawsuits.

ii. Manufacturer defenses

Contributory or comparative negligence, assumption of risk, state of the art and product misuse are defenses available to manufacturers under strict products liability claims. An example of the negligence defenses, as defined in Section II(a)(i), would be if the driver of an autonomous vehicle failed to carefully monitor the conditions of the roadway or failed to take control of the steering or brakes.⁷⁰² In those cases, the plaintiff's damages would be reduced or eliminated (depending on the jurisdiction) because they acted negligently.

When consumers choose to operate autonomous vehicles in autonomous mode, they assume the risks associated with their actions.⁷⁰³ Under this theory, by performing the activity of driving, the driver "manifests willingness to accept the risk," and cannot recover damages.⁷⁰⁴ Additionally, if the manufacturer warns consumers about a known defect, and an accident occurs because the consumer failed to heed that warning, the manufacturer can claim it took all precautionary measures in warning the consumer, who threw caution to the wind. However, if the defect is unknown or the accident occurs because of unforeseeable circumstances surrounding the defect, the assumption of risk defense may be void.⁷⁰⁵

A defense against design defect claims is the state of the art defense. Manufacturers can assert that there was no safer alternative design that could've been used without unnecessarily

⁷⁰¹ Id.

⁷⁰² Wittenberg, *supra* note 669.

⁷⁰³ Id.

⁷⁰⁴ Id.

⁷⁰⁵ Id.

increasing the price of the product, or because such safer designs were not technologically feasible at the time of production.⁷⁰⁶ The last manufacturer defense is product misuse. This can be claimed when the consumer has altered the software or mechanical equipment of the vehicle, and an accident occurs because of the alteration.⁷⁰⁷

B. Who gets regulated and why or why not?

When it comes to deciding who should be regulated, no precedence nor guidance exists to help answer this question. While the industry is struggling to come to a conclusion, there are four options to choose from: manufacturers, consumers, insurance companies and any other third parties that are involved with the car-making process (i.e., software companies). In my eyes, the answer is clear; if manufacturers are going to be held liable when one of their autonomous vehicles crash, they should be regulated. As discussed above, strict products liability will serve as a means of regulation because of the incentive it will create for manufacturers to produce and sell the safest products possible.⁷⁰⁸ Third parties such as software companies, programmers and technology developers, should also be regulated, but perhaps to a lesser degree because the manufacturer will have the ultimate responsibility of ensuring that the equipment and software that put into their vehicles is satisfactory.

It would not make sense to regulate the consumers who purchase autonomous vehicles because consumer trust and adoption is one of the key ingredients to the success of AVs.⁷⁰⁹ Consumers will initially have to pay higher insurance premiums (which should be reduced over

⁷⁰⁶ Stephen S. Wu, *Product liability issues in the U.S. and associated risk management*, AMERICAN BAR, 587 (2015), https://www.americanbar.org/content/dam/aba/administrative/science_technology/2016/autonomousdriving_product liabilitychapter.authcheckdam.pdf.

⁷⁰⁷ Sudzus, *supra* note 648.

⁷⁰⁸ Wittenberg, *supra* note 669.

⁷⁰⁹ Jerry Albright, *Marketplace of change: automobile insurance in the era of autonomous vehicles*, KPMG, ii (Oct. 2015), https://assets.kpmg.com/content/dam/kpmg/pdf/2016/06/id-market-place-of-change-automobile-insurance-in-the-era-of-autonomous-vehicles.pdf.

time), and convincing them to invest in unfamiliar technology at a higher price will not be easily done if they have face regulations.⁷¹⁰ An example of a consumer regulation would include requiring consumers to obtain or purchase a special type of license to operate autonomous vehicles, or take a special driver's test.

Regulating insurance companies will not be necessary as they will face radical changes, and quite possibly, extinction. Autonomous vehicles will undoubtedly lower accident rates, resulting in industry loss costs.⁷¹¹ Experts at global consulting firm KPMG believe that the personal insurance sector could shrink to 40% of its current size; the "elimination of excess capacity could bring severe market issues, with changing business models and new competitors only adding to the turbulence and speed of change."⁷¹² The relationships between insurance providers, plaintiffs, drivers (defendants) and manufacturers are already complicated, and adding autonomous vehicles into the mix will only add to the complication.⁷¹³

To ensure their survival, insurance providers could incentivize consumers to use certain autonomous technologies by offering policy discounts or by requiring greater access to data that could be used to reconstruct the actions that a driver of an autonomous vehicle took in the moments before an accident.⁷¹⁴ Manufacturers may be encouraged or required to obtain insurance coverage as a way of managing product liability risk.⁷¹⁵ A "robust" insurance program will allow manufacturers to shift the risk of products liability to the insurance companies who will be able to "defend and indemnify" manufacturers against claims.⁷¹⁶

⁷¹⁰ Anderson, *supra* note 651, at 18.

⁷¹¹ Albright, supra note 709.

⁷¹² Id.

⁷¹³ Villasenor, *supra* note 614, at 13.

⁷¹⁴ Id.

⁷¹⁵ Wu, *supra* note 706, at 589.

⁷¹⁶ Id.

While some experts see the era of autonomous vehicles as the inevitable doom of the insurance industry, it has the potential to be just the opposite.⁷¹⁷ Autonomous vehicles will contain and transmit an enormous amount of data, which could hypothetically be hacked; by creating and extending privacy and information security policies to manufacturers, insurance companies will be able to revive themselves.⁷¹⁸

In Hong Kong and Australia, Tesla is experimentally selling car insurance with its vehicles as part of their overall vision to one day include insurance in the final price of all its cars.⁷¹⁹ Like Tesla, other AV manufacturers will find companies willing to create customized policies, and eventually premium costs to manufacturers will be reduced.⁷²⁰ "Insurance companies will have a unique opportunity to develop policies to provide protection to both individuals and corporations – manufacturers of the vehicles and tech – in this new environment."⁷²¹

C. At what level should regulation occur and why or not?

Deciding the level at which regulation should occur is a topic of much debate. Since consumer adoption is going to play such a large role in the success of autonomous vehicles, policymakers must make the laws surrounding them straight-forward and uniform. Regulation can either occur at the state or federal levels, or policymakers can take a different approach and leave it up to the courts to establish precedent. Each option comes with its own set of positive and negative aspects, but the choice is clear – regulation should occur at the federal level.

⁷¹⁷ Kyle Campbell, *How will self-driving cars impact your car insurance?*, NY DAILY NEWS (June 2017),

http://www.nydailynews.com/autos/street-smarts/what-will-self-driving-cars-do-to-car-insurance-article-1.3280495⁷¹⁸ Wu, *supra* note 706.

⁷¹⁹ Danielle Muoio, *Tesla is pushing the insurance industry to prepare for massive disruption*, BUSINESS INSIDER (May 2017), http://www.businessinsider.com/how-tesla-self-driving-cars-are-changing-insurance-industry-2017-5. ⁷²⁰ Id.

⁷²¹ Anderson, *supra* note 651, at 4.

The current precedential framework is not adequately equipped to handle lawsuits involving autonomous vehicles, so courts should not be permitted to establish precedents over time. This will take too long, increasing administrative costs and burdening the court system with complex issues that it is unprepared to solve.⁷²² Once a uniform system of regulations is established by the federal government, courts will have the necessary guidance to accurately assign and apportion liability in cases involving accidents related to autonomous vehicles.

Allowing each individual state to create their own set of regulations will impose unnecessary hardship on consumers, manufacturers and insurance companies, as they will have to abide by 50 separate sets of guidelines. However, 33 states (as of January 2, 2018) have already introduced legislation related to the operation of self-driving vehicles, with 21 of those states and the District of Columbia actually passing laws.⁷²³ These laws include permitting higher level autonomous vehicles to "take to public roads as test vehicles" as well as extending limited protection from liability to manufacturers.⁷²⁴ While it is great that states are being proactive in preparing for the arrival of autonomous vehicles, the federal government needs to step in and establish a uniform standard by which they should be regulated.⁷²⁵

The NHTSA released a "Policy Statement Concerning Automated Vehicles" in September 2017, announcing a \$4 billion plan to accelerate the development and adoption of safe vehicle automation through real-world pilot projects."⁷²⁶ Unfortunately, no further action has been taken by the federal government since that statement was made, nor have any long-term plans been revealed. Volvo's CEO, Håkan Samuelsson warned that a lack of federal guidelines

⁷²² Wittenberg, *supra* note 669..

⁷²³ Autonomous vehicles – self-driving vehicles enacted legislation, NCSL.ORG (Sept. 2017),

http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.a ⁷²⁴ K.C. Webb, Products Liability and Autonomous Vehicles: Who's Driving Whom?, 23 RICH. J.L. & TECH. 1, 14 (2016).

⁷²⁵ Id.

⁷²⁶ Webb, *supra* note 724 at 16.

may "cost the U.S. its leading position in the field."⁷²⁷ He explained that Europe suffered by having a "patchwork" of rules and regulations, and that the lack of federal involvement will impede the growth, development and adoption of autonomous technologies because manufacturers will not be able to conduct credible tests to develop vehicles that meet the various guidelines of all 50 states.⁷²⁸

D. When should regulation occur and why or why not?

There are several options in regard to the timing of regulating autonomous vehicles. It can begin now, before Level 3 autonomous vehicles are on the road, it can be a continuous process with regulations changing as the levels of autonomy increase, or regulation can occur when fully autonomous vehicles are here and ready to use. While we cannot predict with certainty how consumers will react to this technology, the answer is clear – we need to start preparing now for the sake of consumers, manufacturers and the insurance industry.⁷²⁹ Insurance companies must consider the potentially devastating impact autonomous vehicles will have on the industry and should take precautionary action now to prevent becoming obsolete.⁷³⁰ More thorough changes can be made later based on "movement in lead indicators." ⁷³¹

Experts in this field have a hard time agreeing on when insurance industries should start preparing for higher level autonomous vehicles. James Lynch, the chief actuary at the Insurance Information Institute, explained that this revolution is going to take a long time, and that the insurance industry will "change as the technology emerges."⁷³² That kind of thinking could cause the very demise of the industry according to the founders of RethinkX, an independent think tank

⁷²⁷ Webb, *supra* note 724, at 46-47.

⁷²⁸ Id.

⁷²⁹ Albright, supra note 709.

⁷³⁰ Id.

⁷³¹ Id.

⁷³² Campbell, *supra* note 717.

focused on monitoring technological disruption.⁷³³ They believe the insurance sector of the economy will face almost certain annihilation because of the predicted 90% reduction in accident rates.⁷³⁴ While this decline will pose certain challenges to insurance companies, they will find other ways to stay afloat (i.e., cybersecurity insurance).

A proactive approach to regulation will also benefit manufacturers because they will be prepared for the inevitable flood of litigation that will occur when highly automated vehicles first hit the road.⁷³⁵ When it comes to autonomous vehicles, meeting minimum standards is insufficient in establishing consumer trust and ensuring consumer adoption. Studies have shown that once consumers understood the potential benefits of autonomous technology (safer travel, the ability to multitask, faster commutes and more independence), they were more likely to use it.⁷³⁶ "Consumer education and awareness will be important – and a key area of manufacturer focus – to promote adoption."⁷³⁷ Therefore, manufacturers need to make a commitment to safety established by a comprehensive risk management program.⁷³⁸

Conclusion

There is no doubt that autonomous vehicles are going to revolutionize every aspect of the automotive industry. Not only will they save countless lives, they will also save society hundreds of billions of dollars.⁷³⁹ Those who were previously unable to drive (i.e., the elderly, disabled, minors, etc) will enjoy a newfound sense of freedom and independence that will come with Level 4 autonomy, while current drivers can cease worrying about drunk drivers, people who

⁷³³ Id.

⁷³⁴ Id.

⁷³⁵ Wu, *supra* note 706, at 588.

⁷³⁶ Wittenberg, *supra* note 669.

⁷³⁷ Id.

⁷³⁸ Wu, *supra* note 706, at 588.

⁷³⁹ Adam Thierer, When the trial lawyers come for the robot cars, SLATE (Jun. 2016),

 $http://www.slate.com/articles/technology/future_tense/2016/06/if_a_driverless_car_crashes_who_is_liable.html.$

text while driving, and anyone else who drives while distracted.⁷⁴⁰ Autonomous vehicles should not be feared, but rather welcomed with hesitantly open arms – because accidents will not become obsolete overnight. Accidents will still occur with automated vehicles but strict products liability will incentive manufacturers to create the safest products possible.

Additionally, regulation should occur on a federal level, as to prevent varying state laws from conflicting with one another. While this has the potential to prevent or delay the creation and adoption of autonomous vehicles, it will not, as long as the proper measures are taken. Manufacturers can proactively prepare for the regulations by creating the safest products possible, and insurance companies can start figuring out how to accommodate automated vehicles, so when they finally arrive, every player in the system is ready.

⁷⁴⁰ Anderson, *supra* note 651, at 37.

MODERN DAY TECHNOLOGY: NOT ACCESSIBLE TO ALL, BUT NECESSARY TO NAVIGATE THIS SOCIETY

Kristian Walker⁷⁴¹

ABSTRACT

In this day and age, technology is at the heart of almost every aspect of daily life. We use it to research, pay bills, conduct business and communicate. Everyday this technology becomes more advanced as developers come up with new applications to provide convenience to its users. However, is it still convenient when you cannot talk to Siri, or hear Alexa? These new developments may provide convenience to some but they fail to accommodate a large portion of the population that rely on them just as heavily. Where disability regulations were written in far less advanced times, there are no explicit guidelines governing the development of modern technology leaving people with disabilities to fight for access to the same technology much of society uses every day.

⁷⁴¹ Syracuse University College of Law, Juris Doctor expected 2019. I would like to thank Professor Schwartz for his encouragement and help throughout the development of this note.

I. INTRODUCTION

Technology makes new and exciting advances every day. To many, this progression offers new ways to communicate, gather information and socialize with our peers. Unfortunately, often times, this technology does not accommodate persons with disabilities. The Americans with Disabilities Act (ADA) defines disability as "a person who has a physical or mental impairment that substantially limits one or more major life activity".⁷⁴² Nearly 56.7 million people in the United States have some sort of disability and 38.3 million of those people have a severe disability.⁷⁴³ That is a large portion of the population that is confronted with difficulty and inequality when using the internet, electronic entertainment such as television and movies, cell phones and new devices such as Siri and Alexa.

Internet Accessibility and the Disabled

The barriers to internet access have been steadily increasing for people with disabilities. Text-recognition software had been sufficient by allowing access to blind users and enabling the deaf to navigate the internet without running into sound barriers.⁷⁴⁴ Unfortunately, over time as technology advances, websites use more and more graphics and different forms of media that do not accommodate the assistive devices many people with disabilities use.⁷⁴⁵ These people include those who are blind or visually impaired, deaf, the learning disabled and the elderly.⁷⁴⁶

⁷⁴² What is the definition of disability under the ADA?, ADA NATIONAL NETWORK: INFORMATION, GUIDANCE, AND TRAINING ON THE AMERICANS WITH DISABILITIES ACT, *available at* https://adata.org/faq/what-definition-disability-under-ada.

⁷⁴³ Disability Awareness Day, VISUALLY, available at https://visual.ly/tag/disability-statistics.

 ⁷⁴⁴ See Patrick Maroney, Note, The Wrong Tool for the Right Job: Are Commercial Websites Places of Public Accommodation Under the Americans with Disabilities Act of 1990?, 2 VAND. J. ENT. L. & PRAC. 191, 192 (2000).
⁷⁴⁵ Id.

⁷⁴⁶ Id.

Because the ADA does not specifically have regulations in place for websites, the guidelines websites follow are governed by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C).⁷⁴⁷ The primary goal of the W3C is universal access: "[t]o make the Web accessible to all by promoting technologies that take into account the vast differences in culture, languages, education, ability, material resources, access devices and physical limitations of users on all continents."⁷⁴⁸ This means that the WAI has made a commitment to the removal of barriers that prohibit or limit use by people with disabilities.⁷⁴⁹ The guidelines set forth by the WAI aim to teach website publishers how to create websites in a way that will accommodate all people without limiting their ability to use graphics, or other forms of media.⁷⁵⁰ Their standards ensure access to disabled people who rely on screen readers and other means of assistance.⁷⁵¹

II. TITLE III OF THE AMERICANS WITH DISABILITIES ACT AND THE INTERNET

A. Places of Public Accommodation under the ADA

The ADA was designed "to provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities."⁷⁵² Title III of the ADA specifically prohibits discrimination by public accommodations including a "place of exhibition or entertainment," a "service establishment," and a "place of education."⁷⁵³

⁷⁴⁷ Web Content Accessibility Guidelines 1.0, W3C, available at http://www.w3.org/TR/WAI-WEBCONTENT/ (last visited Jan. 12, 2018).

⁷⁴⁸ W3C's Goals, *available at* http://www.w3.org/Consortium/.

⁷⁴⁹ See Cynthia D. Waddell, *The Growing Digital Divide in Access for People with Disabilities: Overcoming Barriers to Participation*, UNDERSTANDING THE DIGITAL ECONOMY (May 1999), *available at* http:// www.aasa.dshs.wa.gov/access/waddell.htm.

⁷⁵⁰ Web Content Accessibility Guidelines 1.0, W3C, at http://www.w3.org/TR/WAI-WEBCONTENT/(last visited Jan. 12, 2018).

⁷⁵¹ Id.

⁷⁵² 42 U.S.C. § 12101(b)(1) (2000).

⁷⁵³ 42 U.S.C. § 12181(7) (1990).

Title III explicitly lists twelve categories that take into account almost every type of entity.⁷⁵⁴ These places of public accommodation must, under the ADA, make reasonable modifications to accommodate people with disabilities or be seen as discriminating against them.⁷⁵⁵

B. The Internet as a Place of Public Accommodation

Title III was enacted during a time when the internet was not as commonplace in society as they are today. As a result, the legislation does not directly address whether, or to what extent, its provisions regulate this medium of communication.⁷⁵⁶

Circuits are split over whether a place of public accommodation is limited to actual physical structures or just simply needs a close nexus to a physical structure.⁷⁵⁷ Jurisdictions that interpret "public accommodation" as requiring a physical structure have ruled that Title III does not apply to the internet.

C. Relevant Case Law

I. Gil v. Winn Dixie

One case, Gil v Winn Dixie, ruled that websites are public accommodations under the ADA and therefore, must follow the ADA regulations.⁷⁵⁸ In this case, Gil sued Winn Dixie Stores seeking injunctive relief under Title III of the Americans with Disabilities Act (ADA).⁷⁵⁹ Gil is legally blind and suffers from a learning disability. In order to access the internet, Gil uses a screen reader software.⁷⁶⁰ Gil attempted to use this software to access Winn Dixies website that

⁷⁵⁴ Id.

⁷⁵⁵ Ruth Colker & Bonnie Poitras Tucker, The Law of Disability Discrimination. 371-73 (3d ed. 2000).

⁷⁵⁶ Kelly E. Konkright, An Analysis of the Applicability of Title III of the Americans with Disabilities Act to Private Internet Access Providers, 37 Idaho L. Rev. 713, 714-15 (2001).

⁷⁵⁷ *Id.* at 715.

⁷⁵⁸ Gil v. Winn-Dixie Stores, Inc. 257 F. Supp. 3d 1340, 1348-49 (S.D. Fla. 2017).

⁷⁵⁹ *Id.* at 1342.

⁷⁶⁰ *Id.* at 1343.

contains information regarding store locations, how to fill and refill prescriptions, Winn Dixie store brands and other store information.⁷⁶¹ Gil alleged that, upon access, Winn Dixies website did not integrate with the screen reader software and did not have any other accommodation for the visually impaired to view its contents.⁷⁶² This lack of accommodation did not allow Gil to have "full and equal enjoyment of the services, facilities, privileges, advantages and accommodations provided by and through its website."⁷⁶³ In response to Gil's suit, Winn Dixie filed a motion for judgment on the pleadings, stating that websites are not "places of public accommodation" under the ADA and therefore could not violate the ADA.⁷⁶⁴ The United States filed a statement of interest under 28 U.S.C §517 and Winn Dixie moved to strike the statement.765

The Court denied the motion to strike the statement of interest because Winn Dixie's claim that it was filed untimely and without leave of the court, had no legal basis.⁷⁶⁶

Title III of the ADA "prohibits the owner of a place of public accommodation from discriminating on the basis of disability in the full and equal enjoyment of the goods, services... of any place of public accommodation".⁷⁶⁷ Public accommodation is defined as "a private entity, or facility operated by a private entity, whose operations affect commerce, and which falls within one of the following twelve categories", where those categories include "office of a lawyer, pharmacy, insurance office, professional office of a health care provider, hospital...".⁷⁶⁸ Winn Dixie disputed that its website qualifies as a public accommodation but

- ⁷⁶⁴ *Id.* at 1349.
- ⁷⁶⁵ Id. ⁷⁶⁶ Id.

⁷⁶¹ *Id.* at 1344.

⁷⁶² Id.

⁷⁶³ *Gil*, 257 F. Supp. 3d at 1348.

⁷⁶⁷ 42 U.S.C. §12182(a). ⁷⁶⁸ 42 U.S.C. §12181(7).

Gil claimed it was a public accommodation because (1) it allows customers to fill or re-fill prescriptions for in store pick up or delivery and (2) the website is directly connected to the physical stores and has a true nexus to Winn Dixies pharmacy and grocery stores.⁷⁶⁹

Courts are divided on whether the ADA limits public accommodations to physical places.⁷⁷⁰ Courts in the First, Second and Seventh Circuits have found that the ADA can apply to websites independent of their connection to a physical place.⁷⁷¹ While courts in the Third, Sixth and Ninth Circuits have concluded that accommodations must be physical places.⁷⁷² Courts in the Eleventh Circuit have held that the ADA does not apply to websites that are not connected to a physical location.⁷⁷³ However, if a plaintiff can establish a nexus between the website and a physical location, it is subject to the ADA.⁷⁷⁴

The Florida Court falls under the Eleventh Circuit and based its decision on whether Gil was able to establish a true nexus between Winn Dixie's website and its physical location.⁷⁷⁵ The Court found that Gil was able to establish a nexus because Winn Dixie's website serves as a gateway to Winn Dixie's physical store locations.⁷⁷⁶ Therefore, the websites inaccessibility denied Gil's rights under the ADA causing the Court to deny Winn Dixie's motion for judgment on the pleadings.⁷⁷⁷

The Court concluded that Winn Dixie would not be unduly burdened by making

⁷⁷² Id. ⁷⁷³ Id.

⁷⁶⁹ *Gil*, 257 F. Supp. 3d at 1349.

⁷⁷⁰ *Id.* at 1348.

⁷⁷¹ Id.

⁷⁷⁴ *Gil*, 257 F. Supp. 3d at 1348.

⁷⁷⁵ *Id*.

⁷⁷⁶ *Id.* at 1349.

⁷⁷⁷ Id.

their website accessible to the visually impaired.⁷⁷⁸ Additionally, Winn Dixie must conform their website to follow the Web Content Accessibility Guidelines 2.0 (WCAG) to allow visually impaired individuals to access their website and permit full and equal enjoyment under the ADA.⁷⁷⁹ Further terms of the injunction stated that any third party vendors who participate on the website must also be fully accessible to the disabled by conforming to WCAG 2.0 criteria.⁷⁸⁰

II. Robles v. Dominos Pizza

The second case, Robles v Dominos Pizza resulted in a much different outcome. In this case, Robles brought suit against Dominos seeking injunctive relief, claiming that Dominos' website was not accessible to the visually impaired.⁷⁸¹ Specifically, Dominos website did not allow a user to complete purchases with a particular screen reading software used by the visually impaired.⁷⁸² Additionally, the Dominos mobile app did not allow Robles to access the menu using his iPhone's "VoiceOver" software.⁷⁸³ Because of this, Robles claimed that Dominos' website and mobile app were not compliant with the Web Content Accessibility Guidelines 2.0 (WCAG) and conformity to those guidelines would allow disabled users to have equal access to the Dominos portals.⁷⁸⁴ Dominos motioned for summary judgment on numerous grounds; (1) Neither Dominos' website or mobile app are places of public accommodation under the Americans with Disabilities Act (ADA), (2) This lawsuit violates due process because the ADA and Department of Justice (DOJ) regulations are silent on standards that apply to private and public websites and fail to mention whether compliance with WCAG standards are necessary to

- ⁷⁸³ Id.
- ⁷⁸⁴ Id.

⁷⁷⁸ *Id.* at 1350.

⁷⁷⁹ *Gil*, 257 F. Supp. 3d at 1351.

⁷⁸⁰ Id.

⁷⁸¹ Robles v. Dominos Pizza LLC, No. CV1606599SJOSPX, 2017 WL 1330216, at *1 (C.D. Cal. Mar. 20,

^{2017).}

⁷⁸² Id.

comply with the statute, and (3) There are no violations of any applicable standards. Additionally, Dominos argued that Robles' claims should be stayed because the DOJ had not promulgated any accessibility regulations for websites or mobile apps of private businesses.⁷⁸⁵ Since the initial filing of this suit, Dominos has included accessibility banners on both its website and mobile app that direct users who access using a screen reader to call a specific number for assistance.⁷⁸⁶

The Court granted Dominos' motion and dismissed Robles' complaints.⁷⁸⁷ Congress tasked the Attorney General with promulgating regulations clarifying how places of public accommodation must meet the statutory obligations under the ADA.⁷⁸⁸ Additionally, Congress provided that the DOJ must issue regulations with respect to Title III of the ADA.⁷⁸⁹ Without these regulations, the court cannot determine what is necessary for a website to be in compliance with the ADA regulations.⁷⁹⁰ The Court concluded that calling on Congress, the ADA and the DOJ would allow these obligations to be uniformly regulated and allow due process for private and public businesses.⁷⁹¹ Until then, Dominos' motion to dismiss, had to be granted.⁷⁹²

III. National Association of the Deaf v. Netflix Inc.

One of the more recent cases focused on the lack of accommodation by one of the most popular video streaming sources, Netflix. In National Association of the Deaf v. Netflix, Inc. the National Association of the Deaf (NAD) brought suit against Netflix for its failure to provide closed captioning on all of its movies and shows.⁷⁹³ Additionally, Netflix failed to adequately

⁷⁸⁵ *Id.* at *2.

⁷⁸⁶ *Robles*, 2017 WL 1330216 at *7.

⁷⁸⁷ *Id.* at *8.

⁷⁸⁸ Id.

⁷⁸⁹ Id.

⁷⁹⁰ Id.

⁷⁹¹ *Robles*, 2017 WL 1330216 at *8.

⁷⁹² *Robles*, 2017 WL 1330216 at *9.

⁷⁹³ Nat'l Ass'n of the Deaf v. Netflix, Inc., 869 F. Supp. 2d 196, 200 (D. Mass. 2012).

categorize the few movies that did have captioning, making it difficult for deaf users to find titles accommodating to them.⁷⁹⁴

Netflix made four arguments that were all denied by the court: 1) There is no "public accommodation" as required for a claim under the ADA; 2) NAD failed to prove that Netflix controls the captioning as required under the ADA; 3) the Communications and Video Accessibility Act precludes NAD's interpretation of the ADA; and 4) NAD's claim is moot.⁷⁹⁵ The court held the ADA did not intend to be limited to the parameters set by the twelve categories of entities they listed as public accommodations and ultimately ruled in favor of the NAD.⁷⁹⁶

These cases are just a few examples of the struggle that people with disabilities face daily because they have to fight for the same rights that others get handed to them regularly.

D. The Right to Internet Access

In the 1960s and 1970s the disability rights movement gained momentum by passing laws such as the Rehabilitation Act of 1973, the Education for All Handicapped Children Act of 1975, and the Americans with Disabilities Act of 1990.⁷⁹⁷ In alignment with the civil rights movement, the goal of the disability rights movement was to show that access to information and communication is a civil right for Americans.⁷⁹⁸ It is unfortunate that with the rapid advancement of technology and the everyday use of the internet, there are still conversations to be had about accessibility to the disabled. It should be a guaranteed right to have access and based on the outcomes of

⁷⁹⁴ Id

⁷⁹⁵ *Id.* at 199.

⁷⁹⁶ Id.

⁷⁹⁷ Jonathan Bick, *Americans with Disabilities Act and the Internet*, 10 ALB. L.J. SCI. & TECH. 205, 211 (2000). ⁷⁹⁸ *Id*.

some court cases, states may be beginning to agree with that idea.

As the Internet and other electronic information technologies become part of our everyday life, it is imperative that we interpret the ADA broadly enough to meet these technological and social changes to include people with disabilities in all facets of these advancements.⁷⁹⁹

C. Other Acts that Provide Access to Information Technology for the Disabled

Persons with disabilities use technology for many of the same reasons as everyone else; to socialize, conduct business and gather information. However, they also use it to enhance their abilities and potential to live independently. As a result, Congress has enacted several overlooked, but important, pieces of legislation to increase access to technological information and other devices. These Acts include The Rehabilitation Act, the Television Decoder Circuitry Act and the Hearing Aid Compatibility Act.

The Rehabilitation Act of 1973 was momentous in the history of the United States of America and the world at large. It stipulated the grounds upon which an action would be considered a discriminatory.⁸⁰⁰ More so, it documented the instances that would amount to discrimination based on disability.⁸⁰¹ Notably, the inventions that aimed at uniting people were to be designed to accommodate the needs of the disabled.⁸⁰² Therefore, the technological advancements in use today were subject to

⁷⁹⁹ Id. at 207.

 ⁸⁰⁰ Cassidy Kemp et al., "Do the Americans With Disabilities Act Grab Bar Recommendations Best Meet the Needs of Older Adults? A Pilot Study." *American Journal of Occupational Therapy* 71, no. 4_Supplement_1 (2017): 7111520277p1-7111520277p1.
⁸⁰¹ Id.

⁸⁰² 1*a*.

⁸⁰² Id.

scrutiny to evaluate their degree violation.⁸⁰³ However, the Rehabilitation Act was ambiguous in its statement as it did not stipulate the categories of the firms that would be subject to scrutiny and possible prosecution.⁸⁰⁴

Nevertheless, the ambiguity was solved in 1990 with the drafting of the American Disabilities Act. It stipulated that both government and private sectors of the economy were subject to evaluation of their adherence to the laws prohibiting discrimination based on disability.⁸⁰⁵ Therefore, the discrimination that is evident in the production of technology-oriented merchandise and programs is not due to the lack of laws but the blatant disregard of their essence.

Section 508 of the Rehabilitation Act only applies to federal agencies.⁸⁰⁶ It requires federal agencies to make information technology accessible to federal employees with disabilities.⁸⁰⁷ The law mandates accessibility unless there would be an undue burden placed on the federal agency in order to provide accessibility.⁸⁰⁸ Undue burden, as seen in the ADA, means that providing accessibility must not cause excessive difficulty or expense.⁸⁰⁹ Where an undue burden presents itself, the federal agency must still make sure the information is accessible by some other means.⁸¹⁰

The Television Decoder Circuitry Act of 1990 required that televisions have the necessary circuitry for closed captioning.⁸¹¹ This ensures that those who may be deaf, or heard of hearing can read the conversation or other audible sounds on the screen that

⁸⁰⁷ *Id*.

⁸⁰³ Id.

⁸⁰⁴ Id.

⁸⁰⁵ Kemp et al., *supra* note 800.

⁸⁰⁶ 29 U.S.C. § 794d (2000).

⁸⁰⁸ Id.

^{809 36} C.F.R. § 1194.4 (2004).

⁸¹⁰ *Id*.

⁸¹¹ 47 U.S.C. §§ 303(u), 330(b).
occur in television and movies.⁸¹² There are two types of captioning, closed captioning and open captioning.⁸¹³ Open captioning is affixed to the television screen at all times.⁸¹⁴ Meaning users with hearing disabilities and those without will see the captions always. Closed captioning provides the viewer with the option to display captions or not.⁸¹⁵ The issue of captioning has reappeared in modern day technology when it comes to movie theatres and television commercials.

The Hearing Aid Compatibility Act of 1988 mandated that persons with disabilities have equal access to telephone services by requiring all telephones to be hearing aid compatible.⁸¹⁶ This did not include cellular phones.⁸¹⁷

IV. FAILURE TO ACCOMMODATE THE DISABLED IN MODERN TECHNOLOGY

A significant population of the world in the twenty-first century is disabled. According to the report released by the disabilities' associations all over the globe, 19% of the population for the United States of America, 18% of the people of the United Kingdom, 17% of Australia and more than 12% of Canadians are disabled.⁸¹⁸ The data above is just a low estimate because the approximation was released in 2016. On the other hand, only 13% of the world's technological advancements can be used by people with disabilities.⁸¹⁹ In this case, it is essential to recognize that disability manifests in various ways, including blindness, aphasia, deafness or physical incapacitation. Therefore, it is an injustice of notable magnitude that as the rest of the world

⁸¹² *Id*.

⁸¹³ What is the difference between open and closed captioning?, DO-IT, *available at* https://www.washington.edu/accessit/print.html?ID=1050.

⁸¹⁴*Id.*

⁸¹⁵ Id.

⁸¹⁶ 47 U.S.C. § 610(b)(1)(B).

⁸¹⁷ Id.

 ⁸¹⁸ Emily Hardesty, Accessibility and Special Collections Libraries: Using Technology to Close the Digital Divide,
PUBLIC SERVICES QUARTERLY 12, no. 4 (2016): 329-333.
⁸¹⁹ Id.

enjoys the benefits of modern technology, only 9% of the disabled people all over the globe can access and use them satisfactorily.⁸²⁰

A. Failure to Accommodate the Blind

Communication is vital in driving the economy of the world. Similarly, it is important in the management of personal affairs. Since the turn of the twenty-first century, the world has enjoyed the possibility of long-distance communication with their families, relatives and business associates without the need to travel for physical contact. In fact, since the invention of mobile money transfer mechanisms, most businesses are conducted over the phone.⁸²¹ However, it is disappointing to note that of all the firms dealing in the manufacture of mobile phones, none have considered including the special needs of the disabled.

Apple, Sony, Nokia, Huawei, LG among other mobile phone manufacturers have neglected the needs of the disabled to the extent that no product is specifically meant for use by persons who cannot use the typical mobile phones due to incapacitation. For instance, the blind cannot see the phones that have been made for other people. This means they have to modify their use of phones or only access their phones with the help of their loved ones or any other person who cares to help.⁸²² Consequently, they cannot send messages, calls or access other applications installed on the phone without the help of others.

Factoring in the invention of speech-instigated access to the phones, only 3% of the disabled persons all over the world can afford them.⁸²³ The phones that utilize the voice of the person to initiate access to mobile phone applications were invented in 2009 by Apple, followed by

 $^{^{820}}$ Id

⁸²¹ Id.

⁸²² Id.

⁸²³ Thany Thao & Sasid Tsanthaiwo, *Apple Inc. In the Years to Come* (June 20, 2017) https://dx.doi.org/10.2139/ssrn.2993019.

Samsung.⁸²⁴ Since then, no other firm has developed the program. Therefore, the prices of the phones have been commanded by the existing oligopoly between Samsung and Apple.⁸²⁵ A typical mobile phone with active voice-operated program costs 3000 United States dollars.⁸²⁶ It means that only a few people can afford it. Consequently, the rest end up purchasing the typical phones, and using them with the help of the persons who care to assist.⁸²⁷ Therefore, despite the innovation of the voice-operated program to help the blind to use the mobile phones independently, other obstacles such as pricing has ensured that the status quo is retained.⁸²⁸ As such, the firms that can invent, produce and subsidize the gadgets that allow access by disabled persons are unwilling to accomplish the humane act.⁸²⁹ Hence, the modern technology has not benefitted the disabled.

B. Failure to Accommodate Deaf People

Approximately one million people in the United States population are functionally deaf.⁸³⁰ Out of that one million, about 1 in every 1,000 people became deaf prior to reaching the age of 18.⁸³¹ These millennials commonly use technology on a regular basis.

Many individuals that were born deaf or became deaf early in life, use what is commonly referred to as "deaf speech" or "deaf accent".⁸³² The voices of deaf individuals are diverse in terms of pace, volume, clarity and projection, however, there is an overall tonality that provides

⁸²⁴ Id.

⁸²⁵ See id.

⁸²⁶ Id.

⁸²⁷ See id.

⁸²⁸ See Thao & Tsanthaiwo, supra note 823.

⁸²⁹ Id.

⁸³⁰ Research Support & International Affairs, GALLAUDET UNIVERSITY, available at

https://research.gallaudet.edu/Demographics/deaf-US.php.

⁸³¹ Id.

⁸³² Deaf Accent, TURNING, http://connor.typed.com/blog/deaf-accent.

a unique marker of the deaf accent.⁸³³ Depending on how thick the accent is, it can be hard for the naked ear to understand. That is part of the reason American Sign Language (ASL) is the most commonly used means of communication in the deaf community.⁸³⁴

Like any other language, there are regional differences in ASL.⁸³⁵ Individual countries may even have varying dialects in diverse areas.⁸³⁶ ASL is not a subset of the English language but rather an independent language of its own.⁸³⁷ It is formally recognized by government agencies and educational institutions.838

How is it that the deaf community is respected universally and has its own language, yet still is not adequately accommodated in modern day technology?

Imagine how difficult it must be to be a member of the deaf community and wanting to use technology such as Siri, or other voice interfaces such as Amazon Echo which are not sign language friendly. It is nearly impossible. These voice recognition technologies struggle to recognize atypical voices or speech patterns.⁸³⁹ That means that many individuals with speech disabilities are not able to enjoy the luxuries of sending a text message, making a hands-free phone call or search something on the internet all through voice commands.⁸⁴⁰

According to a report released by the Consumer Technology Association of the United States of America, 98% of the gadgets produced by various firms only use voice perpetuated

⁸³³ Id.

⁸³⁴ Understanding Deaf Culture, MASS.GOV (2019), https://www.mass.gov/service-details/understanding-deafculture.

⁸³⁵ Id.

⁸³⁶ Id. ⁸³⁷ Id

⁸³⁸ Id.

⁸³⁹ Emily Mullin, Why Siri Won't Listen to Millions of People with Disabilities, SCI. AM. (May 27, 2016), https://www.scientificamerican.com/article/why-siri-won-t-listen-to-millions-of-people-with-disabilities/. ⁸⁴⁰ Id.

communication.⁸⁴¹ It means that for a phone call to be completed the persons using the phones must speak, hence facilitating communication.⁸⁴² Since the invention of the mobile phones, only one firm has attempted to develop programs and equipment to facilitate communication between the deaf through a call.⁸⁴³ It was a Nokia, back in 2005.⁸⁴⁴ The plan required the physical attachment of a phone to the deaf user.⁸⁴⁵

The attachment entailed the connection of the person's nervous system aligned with the recognition of sound and the deciphering of the meaning of the relevant voices.⁸⁴⁶ When one called, the user would press the 'receive' button to imitate the communication and once the person on the other side of the line started talking, the deaf user would feel the vibrations of the sounds to extract meaning, hence enabling a voice call with the deaf.⁸⁴⁷ Since 2005, none of the highly innovative firms such as Apple or Samsung has attempted to enhance the invention.⁸⁴⁸ The invention of FaceTime by Apple has been a considerable step in deaf communication as it allows users to see each other and therefore sign language can be used. However, it still has drawbacks of requiring users to prop up their phone so their hands are free, and it is only available between iPhone users.⁸⁴⁹

It is common knowledge that phone calls bear privacy of the matters being talked about by the callers. Therefore, the persons with a hearing disability are disadvantaged because they have to employ another person or seek assistance to communicate with other people over a phone

⁸⁴¹ HERBERT CROLY, The Promise of American Life (Princeton Univ. Press, 2014).

⁸⁴² Id.

⁸⁴³ Id.

⁸⁴⁴ Id. ⁸⁴⁵ Id.

⁸⁴⁶ See CROLY, supra note 841.

⁸⁴⁷ Id.

⁸⁴⁸ Id.

⁸⁴⁹ Sam Costello, Everything You Need to Know About FaceTime for the iPhone or

iPad, LIFEWIRE (Jan 25, 2019), available at https://www.lifewire.com/what-is-facetime-2000237.

call therefore infringing on their privacy.⁸⁵⁰ As many others enjoy the convenience brought about by the advancements in mobile phones such as the iPhone 8 by Apple, the deaf are unable to easily make a simple mobile phone call.⁸⁵¹ Therefore, the modern technology is not inclusive of the needs of the disabled.

C. Failure to Accommodate the Physically Impaired

Persons with physical impairments are usually the most affected by the incapability to use the modern technologies. Regarding a relatable example, before the wheelchairs were invented, the physically challenged persons faced a daunting task when it came to the movement.⁸⁵² After the wheelchairs were developed, the disabled persons had to face the obstacle of the staircases in buildings at their workplaces and homes.⁸⁵³ As things progressed, the elevator was invented. All along, the structural, technological advancements were spearheaded by the adherence to the Transport Rights of the People with Disability in the American National Accord.⁸⁵⁴

On the contrary, the rights of the persons with disabilities to convenient technological exposure, have been limited to the adjustment to the conventional means. Despite the acclaim of the privileges accrued to such status, the stakeholders in the Information Technology industry seem to ignore that fact.⁸⁵⁵ In fact, they act ignorant to the pleas of the people who are physically challenged.⁸⁵⁶ Not that the concerned firms are unable to produce phones that increase contact with the disabled persons, it just seems uneconomical to them.⁸⁵⁷

⁸⁵⁰ See CROLY, supra note 841.

⁸⁵¹ *Id.*

⁸⁵² Id. ⁸⁵³ Id.

 $^{^{854}}$ *Id.*

⁸⁵⁵ Giulia Gualco-Nelson, *Reversing Course in California: Moving CEQA Forward*, 44 ECOLOGY L. Q. 155, (2017). ⁸⁵⁶ *Id.*

⁸⁵⁷ Id.

Some developments in the technology sector have not benefited the disabled due to their predicaments. For instance, the mobile phone applications such as Instagram and Facebook can only be used by initiating contact with the phone screens to access and use the application.⁸⁵⁸ On iPhones, Siri can open the application but she cannot scroll through your feed or post specific pictures or like someone's post.⁸⁵⁹ In the case of a person with limited or no hand mobility, they cannot use these applications in confidence. Therefore, however private the information was, they will require the help of other persons to use it. As the disabled persons struggle to use the applications and programs availed by the mobile phones, it is evident that the stakeholders in the industry have not done enough to alleviate the situation.⁸⁶⁰ However mild the case appears, the innovations of the telecommunications industry have been specifically designed to cater to the needs of ordinary people, completely neglecting the rights and freedoms of the persons with disability.⁸⁶¹

The California Code of Regulations stipulates that any gadget that is intended for sale and use in the state of California ought to have the duplicate copies of the products intended for use by the blind, deaf, aphasic and the physically impaired.⁸⁶²

In this case, the impairment need not include the body parts that interact with the technological gadget.⁸⁶³ Therefore, if for example, a mobile phone is to be sold in California, it ought to have duplicate configurational copies of the same device to be used by persons whose hands depict impairment.⁸⁶⁴ If it does not have copies that match all the four categories, the

⁸⁵⁸ John Pateman & Ken Williment, Developing community-led public libraries: Evidence from the UK and Canada. Routledge (2016).

⁸⁵⁹ Id.

⁸⁶⁰ Id. ⁸⁶¹ Id.

 $^{^{862}}$ Id.

⁸⁶³ See PATEMAN & WILLIMENT, supra note 858.

⁸⁶⁴ Id.

manufacture of devices and the distributor ought to provide a comprehensive and sensible reason in writing to the State Government of California for consideration.⁸⁶⁵ Therefore, to avoid the hassle of the bureaucracy involving the state governments, the firms may supply the said copies to curb the evident discrimination.⁸⁶⁶

D. Failure to Accommodate the Aphasic

Persons with speech impairment have been victimized explicitly by technological advancements. Typically, many mobile phone applications can be used without the need for speech. However, as the technological advancements have become rife, the speech operated applications are a common occurrence. For instance, mobile phone applications such as Siri are operated by the use of conversational speech between the user and the program to satisfy the needs of the person.⁸⁶⁷ As such, the users' requests are conveyed through speech. However, since the mute cannot speak, the application is of no use to them. In this case, Siri's design only provides for speech-initiated conversations with the program.⁸⁶⁸ That may be great for some users, but for the aphasic, artificial intelligence such as Siri provide them no relief in assisting them with daily tasks.⁸⁶⁹

There have been calls by the American Association of People with Disabilities to convince the producer to modify the configuration.⁸⁷⁰ However, all the pleas have gone unheard.⁸⁷¹ Despite the availability of laws such as the ADA, that intend to prioritize the consideration of the persons with disabilities, the will by the firm's is fundamental in the

⁸⁶⁵ Id.

⁸⁶⁶ Id.

 ⁸⁶⁷ Robin Christopherson, *Siri update makes AI work harder for disabled users*, ABILITYNET (Sept. 6, 2016), available at https://www.abilitynet.org.uk/news-blogs/siri-update-makes-ai-work-harder- disabled-users.
⁸⁶⁸ *Id*.

⁸⁶⁹ Id.

⁸⁷⁰ Hannah Rudstam et al., *Leveraging new rules to advance new opportunities: Implications of the Rehabilitation Act Section 503 new rules for employment service providers*, JOURNAL OF VOCATIONAL REHABILITATION 41, 193 (2014). ⁸⁷¹ Id.

¹¹⁶

realization of that course. So far, firms have proven that the need for convenient marketing outweighs the supposed economic constraint of considering the disabled in their design of products and services.⁸⁷² Similar to the deaf, the mute cannot make ordinary mobile phone calls because of the disability and FaceTime only serves iPhone users.⁸⁷³ Therefore, the technological advancement regarding mobile phones does not benefit them.

A manifestation of the ineffectiveness of technological advancements for the disabled is the Alexa program. Despite its ability to provide information regarding various subjects around the user, persons with hearing and speech impairment are victims of the program.⁸⁷⁴ The deaf are unable to hear the utterances of the program while the mute cannot command it for use.⁸⁷⁵ Therefore, the program is ineffective when used by the impaired because they cannot utilize its potential to achieve the desired convenience.⁸⁷⁶ It is clear that Amazon did not consider the large portion of the population that live with varying disabilities when they developed the program. However, such has been the trend by many firms who are in the Information Technology industry. Technological development conducted by the stakeholders in the industry has neglected the needs of the disabled to the extent that it seems that it does not matter anymore.⁸⁷⁷ It would be prudent for the firms to reconsider their approach because they are violating moral obligations towards the disabled, breaking legal bindings and losing a viable market for their innovations.

In 2014, Amazon produced a program that interacted with the users depending on their nature. For instance, when the user signed in with the program, it quizzed if the user was

⁸⁷² Id.

⁸⁷³ Id.

⁸⁷⁴ Jeffrey Bigham et al., *On How Deaf People Might Use Speech to Control Devices*, available at http://www.cs.cmu.edu/~jbigham/pubs/pdfs/2017/deafiot-poster.pdf.

⁸⁷⁵ *Id.* ⁸⁷⁶ *Id.*

⁸⁷⁰ Id.

⁸⁷⁷ See Rudstam et al., supra note 870.

disabled in any way.⁸⁷⁸ Therefore, people with disabilities would choose their respective disability orientations.⁸⁷⁹ The Amazon Echo, as it was called, had different configurations in its operating system that enabled it to restructure the interactive approach to suit the user.⁸⁸⁰ However, the physically challenged were left out of the configuration because of technical aspects.⁸⁸¹ Although minimal, at least some effort had been made to curb the seclusion of the disabled in line with legal and moral obligations of the firm.

Nevertheless, the program was discontinued by the developer because it was uneconomical.⁸⁸² The program cost \$17,000 to develop, with Amazon's market price placed at \$26,000 allowing very few people to afford it.⁸⁸³ From this instance, it is safe to note that the manufacturers' prioritization of financial interests has hindered the relation of convenience by the disabled persons.

According to the ADA, the essence of development and enhancement technology is to increase harmony.⁸⁸⁴ On the contrary, the current trend regarding the Information and Technology systems is increasing the divide between the disabled persons and the others because of the evident seclusion.

E. CONCLUSION

To sum up, the discrimination of the persons with disability in the design, configuration, and manufacture of technological devices is evident. The blind, deaf, mute and the physically challenged persons struggle to use the modern technological devices such as mobile phones

⁸⁷⁸ Philip Zazove et al., US medical schools' compliance with the Americans with Disabilities Act: findings from a national study, ACADEMIC MEDICINE 91, no. 7 (2016): 979-986.

⁸⁷⁹ Id.

⁸⁸⁰ Id.

⁸⁸¹ Id. ⁸⁸² Id.

⁸⁸³ See Zazoye et al., supra note 878.

⁸⁸⁴ What is the Americans with Disabilities Act (ADA)?, supra note 742.

because of their unsuitable designs. Also, the applications and programs intended for use on the mobile phones are often inconveniencing for the persons with disability. For instance, the programs such as Siri that require voice-text combinations would be a hurdle for the blind, deaf and the mute. Also, the physically impaired persons may find it difficult to use mobile phones entirely and, therefore, need help from a third person.

Being in a position where third party assistance is necessary for the use of technology can sometimes infringe on the right to privacy and deprive users of their freedoms. In an effort to combat this, the federal governments and the state administrations of the United States of America and the United Kingdom have passed regulations to curb the discrimination in technology manufacturing based on disability. The vision to curb disability-based discrimination is the basis for the establishment of the Rehabilitation Act and the ADA. Modern technology has intensified, and advancements being made by companies such as Samsung and Apple are widening the divide between the ordinary persons and the disabled. People with disabilities are being left behind in the technological development process as they struggle to learn and adapt to the operation of the already existing devices. As technology continues to advance, the varying guidelines and regulations need to update to encompass the modern-day technology ensuring equality among all users.