

Technologies in the twilight zone

Early lie detectors, machine learning and reformist legal realism

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Abstract

Contemporary discussions and disagreements about the deployment of machine learning, especially in criminal justice contexts, have no foreseeable end. Developers, practitioners and regulators could however usefully look back one hundred years to the similar arguments made when polygraph machines were first introduced in the United States. While polygraph devices and machine learning operate in distinctly different ways, at their heart, they both attempt to predict something about a person based on how others have behaved. This paper, through an historical perspective, examines the development of the polygraph within the justice system – both in courts and during criminal investigations - and draws parallels to today's discussion. It can be argued that the promotion of lie detectors supported a reforming legal realist approach, something that continues today in the debates over the deployment of machine learning where 'public good' aims are in play, and raises questions around how key principles of the rule of law can best be upheld. Finally, this paper will propose a number of regulatory solutions informed by the early lie detector experience.

Introduction

If machine learning and artificial intelligence were people, they would be teenagers, and young teenagers at that. Systems powered by AI rely on several methods and techniques,¹ many of which are in a state of flux.² The science behind the technology is not yet mature, established or universally accepted,³ with Google's Ali Rahimi recently describing machine learning as 'alchemy'.⁴ Machine learning is already embedded into products and applications - Internet search, behavioural advertising and online shopping recommendations - where performance can be just good enough without (most of the time) serious consequence. Despite its immaturity however, machine learning is increasingly promoted and used in high-stakes decision-making environments, such as criminal justice, health, immigration, staff performance monitoring and fraud detection. In addition, 'tech-

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¹ The European Commission's High Level Expert Group on Artificial Intelligence, 'A Definition of AI: Main Capabilities and Scientific Disciplines' Brussels, 18 December 2018.

² Karen Hao, 'We analyzed 16,625 papers to figure out where AI is headed next' Jan 25, 2019 *MIT Technology Review* <https://www.technologyreview.com/s/612768/we-analyzed-16625-papers-to-figure-out-where-ai-is-headed-next/>

³ For instance: Angèle Christin 'The Mistrials of Algorithmic Sentencing' *Logic* <https://logicmag.io/03-the-mistrials-of-algorithmic-sentencing/>; Lars Syll, 'Machine learning — getting results that are completely wrong' Feb 20, 2019 *Real-World Economics Review Blog* <https://rwer.wordpress.com/2019/02/20/machine-learning-getting-results-that-are-completely-wrong/>; Richardson, Rashida and Schultz, Jason and Crawford, Kate, 'Dirty Data, Bad Predictions: How Civil Rights Violations Impact Police Data, Predictive Policing Systems, and Justice' (February 13, 2019). New York University Law Review Online, Forthcoming. Available at SSRN: <https://ssrn.com/abstract=3333423>; Kalev Leetaru, 'How Data Scientists Turned Against Statistics' Mar 7, 2019 *Forbes* <https://www.forbes.com/sites/kalevleetaru/2019/03/07/how-data-scientists-turned-against-statistics/#5aa244c257c8>; McStay highlights speculative and uncertain aspects of Beyond Verbal's voice analytics patent in Andrew McStay, *Emotional AI: The Rise of Empathic Media* (Sage, 2018).

⁴ Matthew Hutson, 'AI researchers allege that machine learning is alchemy' May 3, 2018 *Science*.

fantasy' has become embedded in media culture,⁵ leading to distorted dreams of what the technology can actually do.⁶ As McQuillan comments, 'machine learning is nothing like the emergent general intelligence that characterizes cultural representations of AI and is instead a set of mathematical methods that can perform amazing yet utterly thoughtless feats of classification.'⁷

This is not the first time that a technology with an element of the fantastical about it has become part of popular cultural life and, in parallel, promoted as a solution to serious societal issues. The first part of the twentieth century witnessed considerable enthusiasm in the United States for the potential utility of the polygraph device, or 'lie detector'.⁸ Its use in criminal cases marked a rejection of 'born criminal' theories,⁹ and was supposed to herald 'a new era, free from the crude third degree methods.'¹⁰ It was said to be more scientific than potentially unreliable eye witness testimony.¹¹ Claims were made for high degrees of certainty, even that polygraph methods were 100% efficient and accurate.¹² Bunn argues that the 'legend' of the lie detector was to a considerable extent an invention of the detective pulp fiction of the time, 'a byproduct of the whodunit.'¹³ Yet the device's image of magic infallibility was contested from the start. The science was disputed, transparency demanded, legal and ethical issues raised. Even one of the inventors of the modern polygraph, Leonarde Keeler, argued that there was, in fact, no such thing as a 'lie detector'.¹⁴

The historical approach taken in this paper follows that advocated by Pound: the use of history can be used to 'illustrate...how legal precepts – rules, principles, conceptions and standards – have met concrete situations of fact in organising human society in the past and enabling or helping us to judge how we may deal with such situations with some assurance in the present.'¹⁵ This paper also uses elements of *legal archaeology* by considering case facts in their historical context, other evidence and wider historical and social settings 'outside the law library',¹⁶ in order to explore the 'micro-history' of key cases and legislation. This approach can help to understand underlying social, policy or political goals,¹⁷ particularly relevant to the landmark case of *Frye* discussed below. The author is aware of the need to avoid the dangers of using history simply to explain the present or viewing history as linear progress.¹⁸ A degree of caution is required regarding generalisations based

⁵ John Naughton, 'Don't believe the hype: the media are unwittingly selling us an AI fantasy' 13 Jan 2019 *The Guardian* https://www.theguardian.com/commentisfree/2019/jan/13/dont-believe-the-hype-media-are-selling-us-an-ai-fantasy?CMP=fb_a-technology_b-gdntech;

⁶ Ben Shneiderman, 'What alchemy and astrology can teach artificial intelligence researchers' Feb 21, 2019 *The Conversation*.

⁷ Dan McQuillan 'People's Councils for Ethical Machine Learning' (2018) *Social Media & Society* 4(2).

⁸ The Oxford dictionary definition of a polygraph is "a machine designed to detect and record changes in physiological characteristics, such as a person's pulse and breathing rates, used especially as a lie detector." <https://en.oxforddictionaries.com/definition/polygraph> Last Accessed 25/02/2019. 'Polygraph' means 'many writings' based upon the different recordings of blood pressure, pulse and respiration that are generated by the device.

⁹ Geoffrey C. Bunn, *The Truth Machine: A Social History of the Lie Detector* (John Hopkins University Press, 2012).

¹⁰ Maurice Fioch, 'Limitations of the Lie Detector' 40 *J. Crim. L. & Criminology* 651 (1949-50).

¹¹ *People v. Kenny* 167 Misc. 51, 52 (N.Y. Misc. 1938).

¹² n11.

¹³ n9.

¹⁴ Leonarde Keeler, 'Debunking the Lie Detector' 25 *Am. Inst. Crim. L. & Criminology* 153 (1934).

¹⁵ R. Pound, 'Introduction' in F. Pollock and F.W. Maitland, *The History of English Law before the time of Edward I* (2nd ed. Washington 1959).

¹⁶ A W Brian Simpson, *Leading Cases in the Common Law* (Clarendon Press 1995) 12.

¹⁷ Julie Novkov, 'Legal archaeology' (2011) 64(2) *Political Research Quarterly* 348, 348, 350.

¹⁸ Laura Cahillane, 'The Use of History in Law: Avoiding the Pitfalls' in *Legal Research Methods: Principles and Practicalities*, ed. Laura Cahillane and Jennifer Schweppe (Clarus Press, 2016).

upon past legal treatment in one jurisdiction of one particular technology deployed within a social context very different from today's. This paper argues however that sufficient parallels can be drawn between the two technologies (and the aims of those who would promote their use) to justify learning from the early polygraph experience. The link to the polygraph 'hangs over' modern machine learning-based emotion detection technology,¹⁹ and the polygraph itself has gained recent acceptance in the US and UK for post-offence monitoring of sex and other violent offenders.²⁰ Bunn describes the polygraph as a 'disciplinary technique in the arsenal of "technologies of the self" held by those authorities whose responsibilities include classification, regulation and normalization.'²¹ This description could apply equally to the use of reactive machine learning systems (such as fraud detection), pre-emptive predictive tools (such as those designed to predict the risk of an individual committing a serious criminal offence),²² and systems that administer a sanction or decision based on analysis of an individual's profile or predicted future behaviour.²³

Furthermore, the early arguments played out in US courts over the use of the polygraph suggest a wider struggle between proponents of a 'reformist' version of legal realism, and those who favoured traditional rules and concepts. This arguably continues today in the debates over the deployment of machine learning where 'public good/benefit' aims are in play, and raises questions around how key principles of the rule of law²⁴ are to be upheld. The resolution (or lack of it) of such struggles as it relates to the polygraph reveal issues of law and policy, justice and legitimacy that must be tackled as a matter of urgency if we are not to find machine learning tools filling gaps that should not be filled, and therefore all AI and machine learning tools becoming tarred with the same brush. This paper contributes to this important debate by concluding with regulatory proposals for machine learning informed by the early lie detector experience.

Taking an evaluative approach of the way competing values have played out in practice, this paper will look back to early-mid twentieth century case-law and journal commentary, focused upon the US, that considered whether polygraphs had a place in the criminal law investigative and trial process.²⁵ It will highlight a number of rules and proposed principles and standards that emerged, and propose how these could help guide the integration of machine learning into present and future decision-making. It focuses upon the US and UK legal frameworks and in particular upon machine learning that relates to decisions affecting individuals within their policing and criminal justice systems. It is beyond the scope of this article to consider the reasons why polygraph investigative programmes took off in the US, Russia, Japan and many Eastern European states, but less so in the

¹⁹ Andrew McStay, *Emotional AI: The Rise of Empathic Media* (Sage, 2018).

²⁰ See for instance UK's Offender Management Act 2007, the first introduction of the polygraph test into the criminal justice system in the UK, as a means by which to monitor specific sex offenders on licence.

²¹ n9.

²² Marion Oswald, Jamie Grace, Sheena Urwin & Geoffrey C. Barnes (2018) 'Algorithmic risk assessment policing models: lessons from the Durham HART model and 'Experimental' proportionality' *Information & Communications Technology Law*.

²³ Karen Yeung, 'Algorithmic regulation: A critical interrogation' *Regulation & Governance* (2018) 12, 505-523.

²⁴ Tom Bingham, *The Rule of Law* (London, Penguin Press 2010): 1. The law must be accessible, clear & predictable. 2. Questions of legal rights should be resolved by the law and not the exercise of discretion. 3. The law should apply equally to all, except where objective differences justify differentiation. 4. Ministers must act within their powers and not exceed their limits. 5. The law must afford adequate protection of fundamental human rights. 6. The law should provide access to justice, especially where people cannot resolve inter-personal disputes themselves. 7. Courts and tribunal processes should be fair. 8. The state should comply with international law.

²⁵ For an excellent review of more recent case-law and legislation, see Jacqueline Elton, 'The Polygraph in the English Courts: A Creeping Inevitability or a Step too Far?' (2017) *JCL* 81 (66).

UK. Rules of evidence focused on reliability and relevance,²⁶ and a strong data protection and human rights framework will have been influential but cannot present the full picture, as an initial (non-comprehensive) survey of European Court of Human Rights case law does not suggest any red-lines regarding the use of polygraph tests per se.²⁷

This paper is structured thus. A concise history of the use of the early polygraph in the United States follows this introduction. The paper then assesses the reasoning behind key decisions that influenced the admissibility (or otherwise) of lie detector testimony in early criminal cases, and considers the use of lie detectors in other justice contexts. A discussion of analogies between lie detectors and machine learning identifies parallels between legal issues that emerge. The influence of reformist legal realism in respect of both technologies is then discussed. Finally, it is proposed that the operation of law with respect to polygraphs, and the systematic flaws and gaps in regulation that have been exposed as the technology has developed, suggests areas of focus for those engaged in policy considerations around present day use of machine learning.

A concise history of the early polygraph

The invention of the polygraph had no eureka moment. Machines for measuring emotions (and later, lies) via bodily changes, together with their associated tests and procedures, began in the 1880s in Italy with the aim of rendering ‘visible the criminal’s dangerousness’.²⁸ Increasing interest in criminology spawned a wide variety of measurement devices with disquieting names – for instance, the goniometer for measuring the angle of the face and the tachyanthropometer, a chair fitted with callipers designed to extract eleven measurements from the body. Measurement and systematic data collection were crucial to building criminology’s scientific authority.²⁹ By the early 1900s, accounts of the ‘electric psychometer’ were featuring in the American press and in magazine stories.³⁰ In a 1914 short story, novelist GK Chesterton had his fictional detective Father Brown and his friend Flambeau discuss the ‘new psychometric method’, Brown commenting that he found the method as valueless as the medieval idea that blood would flow from a body if its murderer touched it. Rather presciently, Father Brown added that ‘no machine can lie...nor can it tell the truth.’³¹

Hugo Munsterberg, a psychologist based at Harvard University, has been described as the American pioneer of modern lie detection.³² His ‘truth-compelling machines’ included the ‘pneumograph’ which recorded variations in breathing and the ‘sphygmograph’ which recorded the heart.³³ Highlighting problems with eye witness testimony, Munsterberg hoped to see his psychological tests

²⁶ R. v. Bonython (1984) 38 SASR 451; Criminal Procedure Rules 2015 (as amended), 19.4(h) – expert’s report must ‘include such information as the court may need to decide whether the expert’s opinion is sufficiently reliable to be admissible as evidence’ <http://www.justice.gov.uk/courts/procedure-rules/criminal/docs/2015/crim-proc-rules-2015-part-19.pdf>.

²⁷ *FAZLIYSKI v. BULGARIA* (Application no. 40908/05), 16 April 2013: breach of article 6(1). Nothing wrong with a polygraph test being carried out by an expert but decision-making panel considered themselves bound by it and refused to scrutinise it in any way; *TYAGUNOVA v. RUSSIA* (Application no. 19433/07) 31 July 2012. Breach of Articles 3 and 8 included failure to follow up suspect’s polygraph test results, which showed that the latter had “guilty knowledge” in connection with the applicant’s rape; *BRAGADIREANU v. ROMANIA* (Application no. 22088/04) 6 December 2007: applicant took polygraph test without a lawyer present. His conviction was not based solely on this evidence. Therefore, although regrettable, such a circumstance was not in itself sufficient for the finding of a violation of Article 6.

²⁸ n9.

²⁹ n9.

³⁰ n9.

³¹ G.K. Chesterton, *The Mistake of the Machine* (1914).

³² Don Grubin and Lars Madsen, ‘Lie detection and the polygraph: A historical review’ *The Journal of Forensic Psychiatry & Psychology*, June 2005; 16(2) 357-369, 359.

³³ n9.

used to understand the veracity of witnesses, bringing him into open conflict with John Henry Wigmore, a leading expert on evidence.³⁴ William Marston, Harvard psychologist, lawyer and former student of Munsterberg, believed that the changes in systolic blood pressure (blood pressure when the heart beats) reflected whether or not people were answering questions deceptively. To carry out his deception test, he used a blood pressure cuff and measured the heart rate using a stethoscope after each question, stating each reading as it occurred, a time-consuming process.³⁵ A charismatic proponent of the use of lie detector testimony in court, Marston's evidence based on his test was put forward in the landmark case of *Frye*.³⁶ Lepore notes that the lawyers for the accused were former Legal Psychology students of Marston's, and argues that 'The point wasn't really to defend Frye; the point was to bring into a court of law a new science of evidence.'³⁷ Although Marston failed in his objective in the *Frye* case, his legacy was twofold: first, 'transmuting early applied psychology into a criminological meme,'³⁸ and secondly, as his alter-ego Charles Moulton, creator of the character 'Wonder Woman', whose lasso of truth shares the lie detector's characteristic of benign coercion.

PhD physiology student and part time Berkeley police employee, John Augustus Larson built on the work of Marston. He studied interrogations taking place in the police department and came up with a model for a device that took note of the reactions of the interviewee indicated by changes in blood pressure, pulse rates and respiration. In 1921, he created a method for chronicling this information on a rolling drum of paper so that a permanent record could be made, the first modern polygraph instrument.³⁹ Leonarde Keeler, a protégé of Larson's, developed the first portable polygraph instrument.⁴⁰ Keeler also made changes to Larson's invention by way of recording galvanic skin response due to sweat, based on the work of Fordham University psychologist Reverend Walter G. Summers. Supported by progressive police chief August Vollmer, Keeler's work within various police departments established the polygraph as an interrogative device in criminal investigations.⁴¹

In 1952, the operation of Keeler's portable detector was described as follows:

'Four methods of detection are used...A blood pressure cuff attached to the subject's upper right arm controls a pen which records changes in pulse and blood pressure. A harness is paced around the upper part of the subject's chest; this is connected with a pen which records changes in the rate of breathing. Two metal plates adjusted to the left wrist pick up electrical changes in the skin which are recorded by a third pen. The three pens make their records simultaneously on a moving roll of paper about eight inches wide. The most important recent development...came as a result of research conducted in 1945 by John E. Reid. Reid found that a subject's blood pressure could be changed by various forms of unobserved muscular activity...The instrument devised to record this muscular activity not only minimizes possible error in the other methods but also acts as a detector itself.'⁴²

There was no one inventor of the lie detector, despite the use of this construct in contemporary reporting. While Larson and Keeler certainly built upon the work of Marston, they disagreed on

³⁴ Kenneth J. Weiss, Clarence Watson, Yan Xuan, 'Frye's Backstory: A Tale of Murder, a Retracted Confession, and Scientific Hubris' *J Am Acad Psychiatry Law* 42: 226-33, 2014.

³⁵ Jill Lepore, 'On Evidence: Proving Frye as a Matter of Law, Science, and History' *The Yale Law Journal*, 2014-15; 124(4), 882-1345.

³⁶ *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

³⁷ n35.

³⁸ n34.

³⁹ n32.

⁴⁰ n32.

⁴¹ n32.

⁴² 'The Lie Detector' 1 Drake L. Rev. 50 (1952).

many aspects, including whether a continuous or discontinuous blood pressure technique should be favoured, whether lowering of blood pressure could indicate deception and the relative importance of respiration and word association time in indicating deception.⁴³ (The questioning process can often be overlooked but could be said to be as important as the selection of input data is to a machine learning model.)⁴⁴ Bunn argues it was exactly because the lie detector was 'old technologies applied to a new end', that its depiction as an invention was necessary to give it scientific credibility. Furthermore, the term 'lie detector' was 'a form of linguistic "black boxing": the simplification of scientific complexity and human agency.'⁴⁵ Fundamentally though, all recognised polygraph methodologies share the same premise: that 'certain psychological processes result in physiological cues that can be measured and interpreted with the polygraph for the purpose of aiding in the detection of deception' with such measurements remaining largely unchanged from Keeler's original models.⁴⁶

The early lie detector in, and out, of court

The *Frye*⁴⁷ decision is often cited as the case that made polygraph evidence inadmissible in court in the US. As mentioned above, the indictment of James Alphonso Frye for the murder of one Doctor Brown in Washington D.C. offered William Marston with an opportunity to present his lie detector evidence in court and so publicise his research. The extended argument between defence counsel and Justice McCoy over the submission of Marston's evidence makes entertaining reading.⁴⁸ The trial judge expressed the following main reasons for his decision to exclude Marston's evidence: a) the test had been performed on Frye over a month previously and was therefore irrelevant to the truth or falsity of his statements during the hearing; b) it was the jury's task to decide upon the question of whether anyone was telling the truth, making 'use of that thing which God Almighty has implanted in us, the power of observation'; c) it was too late to carry out the test at the hearing itself; d) due to the many variables, Marston's research was based on probabilities; e) the machine itself was not 'infallible'.

Although it is of course impossible to be certain, a sense of impatience, and even some defensiveness, might be detected in the comments of the self-confessed 'old' judge 'inured to certain general principles'. He was openly dismissive of Marston's research, stating that it had taken all of five minutes to take in. The appeal by Frye's lawyers to the D.C. Circuit Court of Appeals was based solely upon the exclusion of Marston's testimony. They were again given short shrift.⁴⁹ Associate Justice Van Orsdel highlighted in his short judgment the difficulty of defining when a scientific principle or discovery crosses the line between 'experimental and demonstrable' (in the sense of being logically proved); it was this line which determined whether evidence should be admissible. Van Orsdel concluded that '*somewhere in this twilight zone*', the evidential force of the principle must be recognised.⁵⁰ However, '*the thing from which the deduction is made must be*

⁴³ n9.

⁴⁴ For an account of two main procedures, Comparative Question Test and Concealed Information Test, see John Synnott, David Dietzel & Maria Ioannou (2015) 'A review of the polygraph: history, methodology and current status' *Crime Psychology Review*, 1:1, 59-83.

⁴⁵ n9.

⁴⁶ John Synnott, David Dietzel & Maria Ioannou (2015) 'A review of the polygraph: history, methodology and current status' *Crime Psychology Review*, 1:1, 59-83.

⁴⁷ n36.

⁴⁸ Reproduced in Jill Lepore, 'On Evidence: Proving Frye as a Matter of Law, Science, and History' *The Yale Law Journal*, 2014-15; 124(4), 882-1345.

⁴⁹ Lepore notes that Marston was arrested for fraud just after the appeal was lodged, and the charges not dropped until after the appeal hearing, a situation that cannot have helped their cause: Jill Lepore, 'On Evidence: Proving Frye as a Matter of Law, Science, and History' *The Yale Law Journal*, 2014-15; 124(4), 882-1345.

⁵⁰ n36.

sufficiently established to have gained general acceptance in the particular field in which it belongs.⁵¹ This reasoning established the Frye test as the baseline for admitting new scientific evidence in the majority of US courts for the next 70 years.⁵²

On the face of it, *Frye* seemed determinative as regards admission of lie detector testimony in criminal cases. Study of early case-law and journal commentary reveals a situation that was not so clear-cut. US appellate courts in the 1930s and 1940s appear to have been fairly consistent in their rejection of lie detector evidence based on the *Frye* standard (even if such evidence was put forward by the defendant to demonstrate innocence). Appellate courts recognised the potential ‘utility’ of the polygraph⁵³ in particular for the investigation of crime,⁵⁴ but rejected its place in the courtroom. For instance, the majority of the Nebraska Supreme Court considered that, if such evidence were admitted, the function of cross-examination would be impaired, and while the examiner could be cross-examined as to his qualifications and procedures used, ‘the machine itself...escapes all cross-examination.’⁵⁵ Goldblatt comments that, despite apparent ‘scientific advancements and improvements’ in the twenty years since the *Frye* case, the ‘overwhelming majority of courts have closed their eyes and ears to the admissibility of lie detector evidence.’⁵⁷

The same consistency of approach cannot be seen in early trial court decisions however. John E. Reid, polygraph developer and co-author of a book on lie detection and criminal investigation, points to ‘a great number of unappealed trial court cases...in which lie-detector test results have been admitted as evidence over the objection of the opposing counsel.’⁵⁸ These include the New York case of *People v Kenny* in 1938. Raymond Kenny was charged with the hold-up of a delicatessen store and as a second offender, was facing a sentence of between thirty to sixty years if convicted.⁵⁹ The trial revolved around conflicting eye witness testimony, and the results of a lie detector test were offered to demonstrate Kenny’s innocence.

The scientific expert that was put forward to testify as to the results was Father Walter Summers, a Jesuit and Head of the Department of Psychology of the Graduate School of Fordham University. During initial examination, he outlined his confidence that the device was ‘100 per cent efficient and accurate in the detection of deception’.⁶⁰ As Goldblatt notes, ‘a better qualified expert could not have been found.’⁶¹ Not only was he the inventor of a new form of lie detector, the

⁵¹ *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

⁵² Until the ‘general acceptance’ test was challenged in *Daubert v Merrell Dow Pharmaceuticals* 509 U.S. 579, 113 S.Ct. 2786 (1992) and substituted by a test of reliability and relevance. English cases demonstrate a tacit acceptance of the principle in *Daubert*, according to Goymer J, 2014:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293507/His_Honor_Judge_Andrew_Goymer_oral_transcript.pdf

⁵³ *State v. Bohner* 210 Wis. 651, 246 N.W. 314 (1933).

⁵⁴ *State v. Lowry* 163 Kan. 622, 185 P. 2d 147 (1947).

⁵⁵ *State v. Cole* 354 Mo. 181, 188 S.W. 2d 43 (1945).

⁵⁶ *Boeche v. State* 151 Neb. 368, 37 N.W. 2d 593 (1949). Justice Chappell disagreed with the opinion that, as a matter of law, the lie detector had not gained sufficient recognition to justify admission of expert testimony and expressed the view that ‘modern court procedure must embrace recognized modern conditions of mechanics, psychology, sociology, medicine...failure to do so will only serve to question the ability of courts to efficiently administer justice.’

⁵⁷ Samuel A. Goldblatt, ‘Evidence – Admissibility of Results of Lie Detector Tests’ 1950 WASH U.L.Q. 255 (1950).

⁵⁸ John E. Reid, ‘The Lie Detector in Court’ 4 *DePaul L. Rev.* 31 (1954).

⁵⁹ Legalizing the Lie Detector, 1 *Legal Chatter* 41 (1938).

⁶⁰ n11.

⁶¹ n57.

psychogalvanometer which measured electrical currents rather than heartbeat, he had two doctorates and an impressive history of study in 'Europe.'⁶²

The judge was convinced, remarking, 'The lie detector is a decided step forward in legal procedure, which is merely an ascertainment of truth...It seems to me that this pathometer and the technique by which it is used indicate a new and more scientific approach to the ascertainment of truth in legal investigations.'⁶³ It was reported that one of the jurors claimed that 'the machine was the deciding factor...a wonderful thing.'⁶⁴ The juror went onto predict that in time, the lie detector would simplify the work of a jury; in this case however, 'it lengthened the work because we wasted so much time talking about the machine.'⁶⁵

The *Kenny* case was the exception rather than the rule, although it was not the only exception. It was claimed by journalist Alva Johnston in 1944 that the lie detector had been used in 60,000 cases, establishing 'its uncanny power of penetrating guilty secrets.'⁶⁶ The 1930s and 1940s reportedly saw an approach in the Chicago courts whereby lie detector evidence was used in probation hearings,⁶⁷ in the solution of 'bastardy cases,' and admitted where agreed to by both parties (an approach strongly advocated for by Reid, a lie detector expert).⁶⁸ Such agreement and stipulation involved waiver of rights to object to the admissibility of the evidence, and in one trial included the requirement that the court 'be required to further instruct the jury that they should not accept the test results or the examiner's opinion as conclusive on the issue before them.'⁶⁹

A 1952 law review reports upon a Michigan case in which both the defendant and plaintiff agreed to take a lie detector test. The trial judge found for the defendant, commenting that the test was 'a definite aid...in supporting what appeared to be the preponderance of evidence.' The appellate court concluded that there was no prejudicial error as the evidence favoured the defendant in any event.⁷⁰

During this period, accounts can be found of use of lie detector testimony both in the criminal investigatory stage, and also in semi-judicial determinations outside of court. Kiraeofe reports in 1948 that use of lie detector testimony had largely been confined to pre-trial investigations as means of obtaining confessions and suggesting clues, and expresses the fear that, if admitted as evidence, 'complete credence would be placed in them.'⁷¹ In 1949, Fioch, a clinical psychologist working with offenders noted the potentially 'dubious' findings of the lie detector in relation to particular individuals, commenting that it was therefore 'surprising' to find 'at least one state parole board...making use of it as an aid in the determination of innocence or guilt for commutation recommendations.'⁷²

⁶² n57.

⁶³ *People v. Kenny* 167 Misc. 51, 52 (N.Y. Misc. 1938), Colden J.

⁶⁴ Legalizing the Lie Detector, 1 *Legal Chatter* 41 (1938).

⁶⁵ Legalizing the Lie Detector, 1 *Legal Chatter* 41 (1938).

⁶⁶ Alva Johnston, 'The Magic Lie Detector: The Saga of Leonarde Keeler' V.A., Editor and Compiler Leonard. Academy Lectures on Lie Detection (1957) Original article dated 1944.

⁶⁷ Alva Johnston, 'The Magic Lie Detector: The Saga of Leonarde Keeler' V.A., Editor and Compiler Leonard. Academy Lectures on Lie Detection (1957) Original article dated 1944.

⁶⁸ n58.

⁶⁹ n58.

⁷⁰ 50 N.W. 2d 172 (Mich.1951) reported in 'The Lie Detector' 1 *Drake L. Rev.* 50 (1952).

⁷¹ W.C. Kiraeofe, 'Lie Detector Tests as Evidence' *JAG J.* 5 (1948).

⁷² n10.

Goldblatt recounts that, where lie detectors were used to obtain admissions and confessions, the courts have rejected any objection to the use of the device as a means of inducing such admissions and confessions.⁷³ Inbau highlights common mistakes made in lie detector test procedures during such investigatory stages: a person might be unfit for the test due to extensive interrogation, or even physical abuse, beforehand; the examiner might be unqualified or unfit and in particular may be one who 'will feel impelled to make a definite diagnosis in practically every case.'⁷⁴ Inbau reports on the risk that examiner reports are in many instances accepted at face value and upon the assumption that the technique 'produced results approximately perfection.'⁷⁵ Although there may have been some self-interest in Professor Inbau's concerns regarding unqualified and unsuitable examiners,⁷⁶ his concern that students should be made to realise that lie detector technique was subject to limitations and should not be represented as infallible has much resonance today.⁷⁷

Selected analogies between the early lie detector and machine learning

Prediction and categorisation of human behaviour

Early lie detectors and modern machine learning tools are of course different things. They operate in different ways, analyse data differently and interact with human operators and subjects in different ways. When considering the criminal justice context however, fundamentally both technologies attempt to predict or categorise human behaviour based on assumptions about, and comparison with, the behaviour of others. Machine learning systems do this by predicting 'future action or behavior based on algorithmic identification of unexpected correlations within massive data sets that would not be detectable by human cognition.'⁷⁸ Supplied with input data and a target function, machine learning generates a mathematical function, a pattern, that maps inputs to that target, with the aim that this function will also predict the target for new data. Yet when applied to human behaviour, the overarching concern remains that 'the adaptive nature of complex social phenomena remains elusive even when a system is trained on unprecedented volumes of data. This means that the fundamental assumption that underlies any ML system i.e. that reality is governed by mathematical functions, does not necessarily hold for human society.'⁷⁹

The polygraph is based upon the theory that psychological states associated with deception generally affect physiological responses in a consistent way which can then be measured, but there remains little basis for claims of extremely high accuracy: 'Although psychological states often associated with deception...do tend to affect the physiological responses that the polygraph measures, these same states can arise in the absence of deception.'⁸⁰ Even in the over-optimistic early years, this was appreciated. Fioch highlights 'significant deviations in reactions to the test' which would make results somewhat dubious: from individuals who had no appreciation of the significance of falsification, 'antisocial types', 'pathological liars', those with 'circumscribed amnesia' who would deny the crime without demonstrating physiological change.⁸¹ Further concerns are

⁷³ n57.

⁷⁴ Fred E. Inbau, 'Some Avoidable Lie Detector Mistakes' 40 *J. Crim. L. & Criminology* 791 (1949-1950).

⁷⁵ n74.

⁷⁶ Fred Inbau was a former director of Chicago Police Scientific Crime Laboratory, expert in interrogation techniques, advocate of the use of lies and deceit in police interrogation, and author of a book about lie detection and criminal investigation <https://www.nytimes.com/1998/05/28/us/fred-inbau-89-criminologist-who-perfected-interrogation.html>

⁷⁷ n74.

⁷⁸ n23.

⁷⁹ Mireille Hildebrandt, 'Preregistration of machine learning research design' in *Being Profiled: Cogitas Ergo Sum* (Amsterdam University Press, 2018).

⁸⁰ National Research Council. 2003. *The Polygraph and Lie Detection*. Washington, DC: The National Academies Press.

⁸¹ n10.

raised by use of polygraph testing for preemployment screening as 'it involves inferences about further behavior on the basis of information about past behaviors that may be quite different'.⁸²

Societal aims

Overcoming perceived human inadequacies and fixing societal issues are motivations that can be detected in the development of both technologies within the criminal justice system. Machine learning tools are advocated and deployed as prioritisation tools and as forms of risk-based regulation and actuarial justice.⁸³ Risk based approaches to the prioritisation of resources around the management and triaging of offenders and those at risk of offending have grown in importance in recent decades,⁸⁴ with the impact of austerity and resulting reduction in police officer numbers playing a significant role in the perceived need to work differently and prioritise effectively.⁸⁵

This crime prevention policing role is linked to crime risk factors (such as hot spot policing)⁸⁶ and actuarial methods to assess the 'future dangerousness'⁸⁷ of an individual. Yeung describes the process as follows:

'Individual and social phenomena are reconstructed as risk objects so that the focus of analysis is no longer the biographical individual but their risk profile, created by reconstructing fragments of individual identity by combining variables associated with different categories and levels of risk.'⁸⁸

Despite their objective portrayal, machine learning tools are consistently *subjective*. They can process only the data provided to them, historical data which will contain elements of subjectivity. In the criminal justice context, tools making predictions based on historical offender data will be affected by past arrest history, force targeting decisions, social trends and prioritisation of certain offences.⁸⁹

Polygraphs, too, reconstruct individuals based on fragments of data - physiological responses - and place them along a line between truthful and deceptive. Early machines were said to be more reliable than human witnesses, a more scientific way of ascertaining the 'truth' and even as a 'cure for crime'.⁹⁰ The development of the lie detector was closely associated, as machine learning in policing is today, with a 'social work' and crime prevention role for the police, and a scientific approach applied towards 'the investigation and removal of social, economic, physical, mental and moral factors underlying crime'.⁹¹ In recent years, the lie detector has been resurrected as a

⁸² n80.

⁸³ n23.

⁸⁴ n23.

⁸⁵ Rowland Manthorpe, 'Predictive algorithms: Hidden revolution taking place in UK's councils and police forces' 1 March 2019 *Sky News* <https://news.sky.com/story/predictive-algorithms-hidden-revolution-taking-place-in-uks-councils-and-police-forces-11650160>.

⁸⁶ David P. Farrington, Doris Layton MacKenzie, Lawrence W. Sherman, Brandon C. Welsh, *Evidence-Based Crime Prevention* (Routledge, 2003).

⁸⁷ Jordan Hyatt & Richard Berk 'Machine Learning Forecasts of Risk to Inform Sentencing Decisions' (2015) *Federal Sentencing Reporter* 27, 222-228.

⁸⁸ n23.

⁸⁹ n22.

⁹⁰ William Marston, quoted in Geoffrey C. Bunn, *The Truth Machine: A Social History of the Lie Detector* (John Hopkins University Press, 2012).

⁹¹ August Vollmer quoted in Geoffrey C. Bunn, *The Truth Machine: A Social History of the Lie Detector* (John Hopkins University Press, 2012).

‘therapeutic polygraphy’⁹² based on studies that concluded that the threat of the test is more likely to induce increased disclosures from monitored sex offenders because of fear of the result.⁹³

Bunn argues that no lie detector examination takes place under ‘objective’ scientific conditions; the person is also subject to more covert scrutiny of their gestures, expressions, talkativeness and enthusiasm.⁹⁴ Although a suspect could not be compelled to face the lie detector, ‘it doesn’t look good, however, for one who proclaims his innocence to refuse.’⁹⁵ This supported, Bunn argues, the concept of the lie detector as an ‘alternative legal system’ – if you volunteered, you were innocent; if you didn’t, you were guilty.⁹⁶ By analogy, machine learning is now so embedded in many commercial processes that it is virtually impossible for a consumer to refuse to use it. Within policing and criminal justice, machine learning tools have been deployed throughout the system, from investigatory and intelligence-generation, to sentencing and post-sentence monitoring. Due to the nature of policing and criminal justice, this is not generally regarded as an ‘opt-in/out’ process for individuals.⁹⁷

Accuracy and the human in the loop

A tendency can be detected in the operation of both technologies to down-play the role of the human, as operator and interpreter of the output, and as subject of the analysis. Hildebrandt points out, in relation to machine learning, that:

‘Machines do not experience light, temperature, sound or touch, nor do they have any understanding of natural language; they merely process data. Whereas such data may be a trace of, or a representation of light, temperature, sound, touch or text, it should not be confused with what it traces or represents.’⁹⁸

Despite this, outputs can be represented as the truth or the whole picture, and the need for human interpretation, discretion and judgement reduced. Bunn reminds us that the lie detector is not only a machine – it is a complex array of techniques, concepts, procedures and symbols,⁹⁹ many of which are still subject to dispute and criticism today.¹⁰⁰ Although diagnosis of deception was a subjective, interpretative human act, the use of graph paper with its peaks and troughs led people to believe that the machine ‘could almost speak for itself, so obvious was the appearance of the lie.’¹⁰¹ At best, however ‘the device can claim only to detect symptoms of emotions consistent with the examinee’s belief in the truth of his or her answers’¹⁰² and then only within a continuum of expected responses.¹⁰³ Hyperbolic assertions of accuracy rates of over 90% were common in early reporting

⁹² n32.

⁹³ Theresa A Gannon, Jane Wood, Afroditi Pina, Eduardo Vasquez and Iain Fraser, ‘The evaluation of the mandatory polygraph pilot’ *Ministry of Justice Research Series 14/12*, July 2012.

⁹⁴ n9.

⁹⁵ Alva Johnston, ‘The Magic Lie Detector: The Saga of Leonarde Keeler’ V.A., Editor and Compiler Leonard. *Academy Lectures on Lie Detection (1957)* Original article dated 1944.

⁹⁶ n9.

⁹⁷ It is beyond the scope of this paper to discuss individual rights with regard to automated decision-making within the General Data Protection Regulation.

⁹⁸ n79.

⁹⁹ n9.

¹⁰⁰ American Civil Liberties Union, ‘How Lie Detectors Enable Racial Bias’ October 2, 2018 <https://www.aclu.org/blog/privacy-technology/how-lie-detectors-enable-racial-bias>.

¹⁰¹ n9.

¹⁰² Richard H. Underwood, ‘Truth Verifiers: From the Hot Iron to the Lie Detector’ 84 *Ky. L.J.* 597 (1995).

¹⁰³ Jacqueline Elton, ‘The Polygraph in the English Courts: A Creeping Inevitability or a Step too Far?’ (2017) *JCL* 81 (66).

and in scientific literature,¹⁰⁴ despite the difficulty of ascertaining the occasions on which deception was practised undetected or an innocent person was misreported guilty! Reid claims that ‘the few mistakes that do occasionally occur are those in which a guilty person’s lying is undetected, rather than those of an innocent person being reported guilty’ but provides no evidence to back up this claim.¹⁰⁵

In a comment that could have been written in respect of modern machine learning, Forkosch says:

‘Preconceived theories are relegated to the dung heap and the mathematical probability curve is invoked as a check. General laws, or probability curves, are plotted against the background of unending tests, to the end that the truth may become more and more certain.’¹⁰⁶

With respect to Summers’ tests with his ‘psychogalvanometer’, where his conclusions had resulted in the prosecution of two cases and non-prosecution and release of two others, Forkosch further comments that:

‘These experiments upon actual cases have been predicated upon the infallibility of Father Summers’ conclusions for, if fallible in the slightest degree, it would be shocking to permit a life to be gambled upon the wheel of chance. Probability has given place to certainty, as indeed it must, if a *mechanical jury* is to be substituted for our unpredictable jury of twelve human and emotional people.’¹⁰⁷

Forkosch concluded that the machine was neither infallible nor undebatable, but an instrument to ‘diagnose hypothetical subjective occurrences’.¹⁰⁸ It should be noted that Forkosch was a member of the New York bar, and the opening provocation of his article – ‘Shall there be a re-evaluation of our historic legal traditions culminating in an impersonal and mechanical court and jury?’ – suggests a kindred spirit to Justice McCoy in the *Frye* case, as does his conclusion that ‘our legal ship best lie in its harbor of accepted rules of evidence.’

Percentage accuracy rates are common also in literature relating to machine learning models, statistical risk assessment and machine based emotion detection. McStay warns against displacing the contextual nature of emotional life by a ‘veneer of metric-based certainty about what emotions are’, especially where used in automated systems to flag deception.¹⁰⁹ The AUC (area under the curve)¹¹⁰ statistic favoured to demonstrate a model’s predictive validity has been argued to be misleading and uninformative in the context of offender risk management due to the high margins of error often involved.¹¹¹ Where interventions are put in place to prevent the event or action being predicted, percentage accuracy rates are blind to such interventions. Furthermore, such tools are designed to score or categorise an individual - low risk, high risk and so on – which can be as equally unnuanced and open to misinterpretation as the early lie detector graph. Other relevant uncodified factors are not taken into account. When dealing with humans, risk prediction accuracy is likely to be subject to some fundamental limit due to the importance of extrinsic external factors relevant to

¹⁰⁴ n9.

¹⁰⁵ n58.

¹⁰⁶ Morris D. Forkosch, ‘The Lie Detector and the Courts’ *New York University School of Law Contemporary Law Pamphlets* 1(13) (1939).

¹⁰⁷ n106.

¹⁰⁸ n106.

¹⁰⁹ n19.

¹¹⁰ The total area within the curve formed by plotting the true positive rate against the false positive rate. AUC = 1 is perfect prediction.

¹¹¹ Cooke D.J. and Michie C. (2014) ‘The generalizability of the Risk Matrix 2000: On model shrinkage and the misinterpretation of the area under the curve’ *Journal of Threat Assessment and Management* 1(1) 43.

the specific individual.¹¹² Hildebrandt sets out that ‘in real life situations...future data can always disrupt the predictive accuracy of the hypothesis target function.’¹¹³ Forecasts, classifications or predictions produced by many existing algorithmic tools are probabilities (that the person or situation in question has a similarity to people or situations in the past). ‘But they appear at times to be presented as something more: a prediction of reoffending becomes a ‘risk’ of reoffending and thus the risk if, say, a person is given parole.’¹¹⁴

The polygraph was also presented as something more. Polygraph inventor Keeler emphasises that there are no instruments recording bodily changes that deserve the name ‘lie-detector’ – a diagnosis of deception is made from tangible symptoms by an examiner ‘using whatever mechanical aids he has at his disposal.’¹¹⁵ The fact that there was a ‘human in the loop’, the operator, was used to support the case for admission of lie detector testimony in court proceedings. Goldberg argues that the risk that an innocent person might be convicted is minimised because of the burden of ‘showing the lie’ is placed upon the operator, who is subject to cross-examination. Furthermore, the lie detector results will not displace the jury who, it is argued, will weigh the test results and opinion of the operator like any other evidence.¹¹⁶

This assertion was countered somewhat by a piece of contemporary research. After the Kenny case, Forkosch was able to poll the entire jury. Although none admitted to basing their decision solely on the lie detector testimony, six jurors thought that the testimony was ‘*conclusive proof*’ of the defendant’s guilt or innocence, and five agreed that they had accepted it ‘*without question*’ (an early example of automation bias perhaps). As Forkosch remarks, ‘what has become of Judge Colden’s closing words, “The testimony will be received and the jury permitted to evaluate it” when five categorically accept it without hesitation and do not “evaluate” it in the light of the entire testimony?’¹¹⁷

Opacity

The early lie detector was the original black box. Its ‘magic’ - its theatricality, opacity and intimidating character - benefited those who would promote its use.¹¹⁸ Bunn explains that:

‘Expository articles often included a photograph of the enigmatic instrument, a depiction that explained yet mystified at the same time. Here was a gadget fabricated from reassuringly complex components, all of which were encased within a scientific-looking “black box.” By describing the instrument thus, however, the question what exactly it was fabricated from remained unanswered.’¹¹⁹

Much has been written about the opacity of machine learning tools,¹²⁰ and the need for ‘transparency’ and ‘explanations’ in order for the individual to judge for herself the fairness of the

¹¹² Hofman JM, Sharma A, Watts DJ. (2017) ‘Prediction and explanation in social systems’ *Science* 355, 486–488.

¹¹³ Mireille Hildebrandt, ‘Privacy as Protection of the Incomputable Self’: From Agnostic to Agonistic Machine Learning’ (2019) *Theoretical Inquiries of Law* 19(1).

¹¹⁴ Marion Oswald (2018) ‘Algorithmic-assisted decision-making in the public sector: framing the issues using administrative law rules governing discretionary power’ in ‘The growing ubiquity of algorithms in society: implications, impacts and innovations’ issue of *Philosophical Transactions of the Royal Society A*.

¹¹⁵ n14.

¹¹⁶ Benjamin Goldberg, ‘In Re Lie Detector’ 2 S. C. L. Q. 266 (1949).

¹¹⁷ n106.

¹¹⁸ AA Lewis, ‘Looking for an Honest Man’ *Scientific Monthly* 49 (1939).

¹¹⁹ n9.

¹²⁰ For instance, Burrell J. ‘How the machine ‘thinks’: understanding opacity in machine learning algorithms’ (2016) *Big Data Soc.* 3.; Wachter S, Mittelstadt B, Russell C. ‘Counterfactual explanations without opening the black box: automated decisions and the GDPR’ (2017) (<https://arxiv.org/abs/1711.00399>)

system (although this approach has been strongly criticised).¹²¹ This contrasts with the approach taken with early lie detectors where the ‘critical link’ was the operator.¹²² This man (because inevitably it was a man, dressed in a white lab coat or dark suit) was the keeper of the machine, the priest who could interpret the oracle’s musings. But there was no official regulation of lie detector practitioners or their methods. Johnston states that ‘any man, woman or child can set up as a lie-detector expert, and a crooked official would have no difficulty in finding just exactly the kind of expert that he needed.’¹²³ As a result, Keeler argued for the licensing of ‘medico-legal’ technicians.¹²⁴

Reformist legal realism, the lie detector growing up and regulatory lessons for machine learning

Reformist legal realism

It can be speculated that Justice Colden, who presided over the *Kenny* case, was a reforming legal realist. He favoured a forward-thinking version of jurisprudence in which ‘new concepts must beat down the crystalized resistance of the legally trained mind that always seeks precedent before the new is accepted into the law.’¹²⁵ To Colden, the ‘truth’ equated with the facts, and the lie detector, with its underlying behaviourist approach, was a better way of ascertaining that truth, especially as he had been convinced that the lie detector represented ‘a science from which varying inferences may not be drawn.’¹²⁶ Rules of evidence and cross-examination had been used for hundreds of years but only ‘for lack of any better approach.’ Perhaps he would have supported Cohen’s view that ‘it is through the union of objective legal science and a critical theory of social values that our understanding of the human significance of law will be enriched,’¹²⁷ and Llewellyn’s view of law as a means to social end, not an end in itself.¹²⁸ This is not to say however that legal rules and principles of justice were discounted. As we have seen above, ‘celebrity’ inventors of the lie detector were themselves involved in campaigns to change those rules of evidence to admit polygraph testimony on the basis of arguments around fairness, human unreliability and scientific progress, for instance Reid’s support of the admission of lie detector evidence upon agreement and stipulation, and Marston’s evidence in the *Frye* case itself. They published articles in legal and criminology academic journals, with press reports of the machine as ‘witness’, or returning verdicts of innocence or guilt, contributing to their cause.¹²⁹

Today’s machine learning could also be said to support ‘*reformist legal realism*’, an approach that aims to advance productivity, efficiency and the human condition (although often narrowly defined) by an emphasis on empirical evidence and scientific methods. The creators of a machine learning classification tool that analysed textual content from existing ECHR case law, and was said to predict the court’s decisions with 79% accuracy, argue that predictive accuracy depended on non-legal facts of the case rather than on legal arguments, thus giving some support to the theory of legal realism.

¹²¹ Edwards, Lilian and Veale, Michael, *Slave to the Algorithm? Why a 'Right to an Explanation' Is Probably Not the Remedy You Are Looking For* (May 23, 2017). 16 *Duke Law & Technology Review* 18 (2017).

¹²² n102.

¹²³ n95.

¹²⁴ n14.

¹²⁵ Colden J quoting Steinbrink J in *Beuschal v. Manowitz* 151 Misc. 899 (N.Y. Misc. 1934).

¹²⁶ n11.

¹²⁷ Felix Cohen, ‘Transcendental Nonsense and the Functional Approach’ (1935) 35 *Columbia Law Review* 809-849.

¹²⁸ Karl N. Llewellyn, ‘Some Realism about Realism’ (1931) 44 *Harvard Law Review* 1222.

¹²⁹ See examples on page 147 of Geoffrey C. Bunn, *The Truth Machine: A Social History of the Lie Detector* (John Hopkins University Press, 2012).

¹³⁰ ¹³¹ So if a legal realist approach is the one that actually exists, why not adapt the legal process to incorporate such AI judges?¹³²

Machine learning tools as means of prioritisation, risk-based regulation and detecting rule violations have been discussed above. To take another of many possible examples, it has been argued that an algorithm could provide a more specific and transparent way of detecting *and evidencing* unlawful discrimination, compared with attempting to analyse ambiguous human decision-making.¹³³ The authors' proposals, followed through to their logical conclusion, would appear to have an outcome that early lie detector proponents would likely have supported, and which would transform the relevant decision-making environment itself¹³⁴: i.e. *it may be possible to detect discrimination statistically via an algorithm; therefore, the algorithm must therefore make the decision - and only the algorithm - resulting in significant alteration of decision-making processes and the requirement for a new legal framework to support the prevention of discrimination through the use of algorithms.*

Furthermore, despite privacy being a normative concept founded in legal traditions, 'privacy is increasingly becoming a technical concept' due to advances in how personal data is used and analysed, and technical developments designed to mitigate privacy harms.¹³⁵ However, 'decisions on rights safeguards, taken in contexts of technology design, are not constitutive of law. Law intervenes ex-post to articulate and ascertain whether the scope of protection of a fundamental right has been correctly formulated.'¹³⁶

The lie detector growing up

Legal rules of evidence and due process held back the early lie detector proponents. Yet their reformist legal realism ambitions were not totally thwarted. Limitations on use of lie detector testimony in court did not prevent use of the lie detector *outside court* forging ahead, in particular for the assessment of evidence, vetting potential employees, and in fraud investigations.

'Although the results of polygraph examinations may not accompany testimony, they have been used in everyday police work [in the US] since Vollmer introduced them in Berkeley 1921. The utility of using polygraphy in police work lies in the procedure's ability to induce truthful incriminating statements from suspects. Jurors judging the reliability of the confession would not be privy to this tactic or exposed to the prejudicial effect of learning that a machine had been used in determination of truth. Thus, in the courtroom, polygraphy is kept behind the scene.'¹³⁷

¹³⁰ Aletras N, Tsarapatsanis D, Preotiuc-Pietro D, Lampos V. 2016. Predicting judicial decisions of the European Court of Human Rights: a Natural Language Processing perspective. PeerJ Computer Science 2:e93 <https://doi.org/10.7717/peerj-cs.93>.

¹³¹ Aletras et al. was critiqued for its behaviourist approach in Pasquale F, Cashwell G., 'Prediction, persuasion, and the jurisprudence of behaviourism' (2018) *Univ. Toronto Law J.* 63–81.

¹³² See for instance Kleinberg J, Lakkaraju H, Leskovec J, Ludwig J, Mullainathan S. 'Human decisions and machine predictions' (2017) NBER Working Paper no. 23180. National Bureau of Economic Research, Cambridge, MA.

¹³³ Kleinberg, Jon and Ludwig, Jens and Mullainathan, Sendhil and Sunstein, Cass R., 'Discrimination in the Age of Algorithms' (February 5, 2019). Available at SSRN: <https://ssrn.com/abstract=3329669> or <http://dx.doi.org/10.2139/ssrn.3329669>.

¹³⁴ n113.

¹³⁵ Kobbi Nissim and Alexandra Wood, 'Is privacy *privacy*?' (2018) *Phil. Trans. R. Soc. A* 376 (2128).

¹³⁶ N. van Dijk, A. Tanas, K. Rommetveit & C. Raab 'Right engineering? The redesign of privacy and personal data protection' (2018) *International Review of Law, Computers & Technology*, 32:2-3, 230-256.

¹³⁷ n34.

The 1960s and 1970s in the US saw widespread use of the lie detector, not only in police investigations, but for pre-employment screening in both public and private sectors, with other countries including Japan, China, Israel and Korea starting their own programmes.¹³⁸ Increasing concern about potential abuses following a report from the US House of Representatives Office of Technology Assessment,¹³⁹ led to the 1988 Employee Polygraph Protection Act: “An Act to prevent the denial of employment opportunities by prohibiting the use of lie detectors by employers involved in or affecting interstate commerce.”¹⁴⁰ Introduced by President Reagan to control and regulate the use of polygraph machines by employers in private practice, it had both significant limitations and exemptions for its use. While the Act sought to prohibit the use of polygraphs, its many exemptions in reality meant that the most controversial uses were still permissible. This included polygraph use by Governmental Agencies¹⁴¹ to test potential employees, any expert or consultant involved with counter intelligence and use by employers to test with respect to drug offences or drug investigations. It also had no impact on ongoing criminal justice uses.

Regulatory lessons for machine learning

The utilitarian value of the polygraph within criminal justice, irrespective of its reliability or validity, is championed by Warner, a special agent of the FBI. ‘Confessions, admissions...and additional information of investigative value gained through...testing come about due to the *utility* of the polygraph and the determination of the examiner, irrespective of the instrument’s reliability or validity.’¹⁴² Confessions come about following the ‘mere suggestion’ of testing. Warner asks ‘Your child is abducted and investigators come to you and say, “We have a suspect who we will be giving a polygraph to.” Would you be so bold as to reply, “The polygraph technique is unreasonable, find my child another way?”’¹⁴³

This question demonstrates the temptation of the polygraph, and other technologies that promise important insights. Most parents would not answer in the affirmative, in case the polygraph test *might* be right. But from the perspective of the rule of law, it is the wrong question. It suggests an alternative legal system that is not accessible, clear or predictable, and one which may infringe fundamental rights without clear and valid justification. There are effectively two systems running in parallel: one in relation to criminal court proceedings, in which expert testimony is admitted only if based upon a scientifically valid foundation relevant to the issue at hand, and one which runs parallel to the court system without such constraints, based on realist and utilitarian principles.

We risk a similar situation arising in respect of modern machine learning. Indeed, in the challenge by Eric Loomis to the use of the COMPAS risk assessment tool in his sentencing, the Wisconsin Supreme Court stated that the sentencing court ‘would have imposed the exact same sentence without it. Accordingly, we determine that the circuit court’s consideration of COMPAS in this case did not violate Loomis’s due process rights,’¹⁴⁴ creating a ‘troubling paradox.’¹⁴⁵ Why use the assessment if its relevance or necessity cannot be demonstrated? Does this statement suggest the court acting in

¹³⁸ n32.

¹³⁹ US Congress (1983) *Scientific Validity of Polygraph Testing: A Research Review and Evaluation – A Technical Memorandum*. Washington D.C. Office of Technology Assessment, OTA-TM-H-15.

¹⁴⁰ Employee Polygraph Protection Act of 1988, Pub. L. No. 100-347, 102 Stat. 646(1988).

¹⁴¹ n140, s7 ‘No Application to Governmental Employers – This Act shall not apply with respect to the United States Government, any State or local government, or any political subdivision of a State or local government.’

¹⁴² William J. Warner, ‘Polygraph Testing: A Utilitarian Tool’ 74 FBI L. Enforcement Bull. 10 (2005).

¹⁴³ n142.

¹⁴⁴ *State v. Loomis* 881 N.W.2d 749 (Wis. 2016).

¹⁴⁵ John Villasenor and Virginia Foggo, ‘Algorithms and sentencing: What does due process require?’ March 21, 2019, *Brookings TechTank* <https://www.brookings.edu/blog/techtank/2019/03/21/algorithms-and-sentencing-what-does-due-process-require/>.

the same way as the parent of the abducted child? *It might work and so we might be missing out if we exclude it.*

The use of machine learning, especially when backed by commercial interests, is likely to expand to fill whatever gap is available. As well as for purely commercial decisions, we already see private sector predictive tools and emotion or deception detection marketed for use in hiring decisions, fraud detection, immigration and other screening, decisions that come with high-stakes for individuals.¹⁴⁶ In terms of governance and regulation, focus to date has been on data protection, individual rights, privacy and ethics. Guided by the early polygraph experience, and giving consideration to the way that admission of scientific findings and expert testimony in court is assessed, this paper proposes the development and application of appropriate '*scientific validity*' and *relevance* standards for AI and machine learning. These would be constructed for specific criminal justice contexts (investigative, offender management, risk-assessment and so on), and to include the presentation of results (to ensure these are not presented as 'something more'), thus moving to red-line restrictions to prevent AI morphing problematically.¹⁴⁷ The author has previously called for the development of a framework around the use of automated facial recognition as a trigger for intervention and in an evidential concept, bearing in mind the officer's over-arching decision-making prerogative.¹⁴⁸ Such standards could augment the work of existing oversight bodies,¹⁴⁹ and complement Hildebrandt's proposal for preregistration of machine learning research design¹⁵⁰ and Nemitz's call for a precautionary legal framework around artificial intelligence, and the generalisation for AI of regulatory principles found in specific bodies of law,¹⁵¹ namely here those relating to the admission of expert evidence. Much could be learned from issues that have arisen from the use of forms of scientific evidence, such as forensics, in particular understanding of caveats, interpretations and methodologies,¹⁵² measurements of reliability and validity,¹⁵³ and communication of uncertainty.¹⁵⁴

Conclusion

The polygraph machine cannot 'detect lies'; it merely records bodily changes, and human interpretation of its results is required for any diagnosis of deception. Neither can a machine

¹⁴⁶ See for instance Javier Sanchez-Monedero, 'The politics of deceptive borders: 'biomarkers of deceit' and the case of iBorderCtrl' (2019) [arXiv:1911.09156](https://arxiv.org/abs/1911.09156).

¹⁴⁷ A recent example from the UK regarding the polygraph: Offender Management Act 2007 s30 states that evidence obtained by the polygraph, including any statement made by the released prisoner and physiological reaction of the released prisoner, may not be used in any proceedings against a released prisoner for an offence. The Polygraph Rules 2009 set out examiner qualification requirements and various procedural requirements regarding the test and relevance of the questions asked.

¹⁴⁸ Kyriakos N. Kotsoglou and Marion Oswald, 'The long arm of the algorithm? Automated Facial Recognition as evidence and trigger for police intervention' (2020) *Forensic Science International: Synergy* <https://www.sciencedirect.com/science/article/pii/S2589871X20300024#!>.

¹⁴⁹ Such as the West Midlands Police and Crime Commissioner and West Midlands Police Ethics committee: <https://www.westmidlands-pcc.gov.uk/transparency/ethics-committee>.

¹⁵⁰ n79.

¹⁵¹ Paul Nemitz, 'Constitutional democracy and technology in the age of artificial intelligence' (2018) *Phil. Trans. R. Soc. A*.

¹⁵² Carole McCartney 'Streamlined forensic reporting: Rhetoric and reality' *Forensic Science International: Synergy* 1 (2019) 83-85.

¹⁵³ 'Reliability and validity of forensic science evidence' Hal S. Stern, Maria Cuellar and David Kaye *Significance* April 2019 vol 16 issue 2.

¹⁵⁴ 'What does a match mean? A framework for understanding forensic comparisons' Robin Mejia, Maria Cuellar, Dana Delger and Bill Eddy *Significance* April 2019 vol 16 issue 2.

learning tool independently 'predict' risk or a person's future; rather real-world experience is reduced to variables and an algorithm trained to detect patterns or similarities based on probabilities. The interpretation of the output as a prediction or contribution to a 'risk' assessment should be a human one.

This paper has drawn analogies between two technologies in the 'twilight zone' of their development, utilisation and acceptance. When considering how we should respond to the increasing use of machine learning within criminal justice, and elsewhere, lessons can be learned from the early lie detector: from its deployment in a 'quest for certainty'¹⁵⁵ by a society concerned about human inadequacies and a crime prevention agenda; from the attempt to individualise the machine's conclusions based on comparison with the behaviour of others; from the downplaying of the role of human interpretation. Both technologies support a reforming legal realist approach, thus raising questions for key principles of the rule of law. The lie detector experience shows us that, despite a ban on its use in some contexts, it will continue to be deployed in others due to a belief in its utility, whether or not it 'works'. If we are not to find ourselves in a similar position with respect to machine learning, we must develop an oversight framework based upon a combination of scientific validity and relevance standards, fairness principles and the role of the legitimate human decision-maker. Father Brown wisely said that 'no machine can lie...nor can it tell the truth';¹⁵⁶ if we remember that machines are just that – machines – and cannot make the decisions which in our legal systems should be reserved for human judgement and discretion, then we will be half way there.

¹⁵⁵ Mireille Hildebrandt, 'The Artificial Intelligence of European Union Law' (2020) *German Law Journal* 21(1) 74-79.

¹⁵⁶ n31.