

Ethical Integration of Artificial Intelligence in Forensic Science: Prospects and Challenges

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Introduction

Humans have always strived for perfection by using their logic to improve knowledge and society. Aiming for perfection has led to ideas of resistance that could be called the genesis of crime in our society¹. To combat this, society has developed specialised rules and mechanisms. From relying on eyewitness testimony to embracing modern forensic science, the evolution of legal structures has been crucial in addressing crime.

Forensic science has improved law enforcement and legal processes by providing reliable tools, which has changed how justice is served. Yet, as technology becomes increasingly integral to our activities, criminals skillfully utilise it to their advantage². Their methods evolve, becoming more sophisticated, aimed at evading detection and ensuring smooth escapes.

Investigative agencies often use deception detective techniques (DDTs) as a last resort due to concerns over accuracy, error rates and human rights implications. However, the collaboration between AI and deception detection holds promise for revolutionizing forensic science and legal proceedings. This interaction can strengthen the accuracy and fairness of investigations, to eventually advance societal justice³.

Locard's Principle of Exchange establishes a fundamental link between individuals and their environments in the context of criminal investigations and profiling within an AI-assisted justice system. This principle contends that when two objects come into contact, there is a transfer of material, leaving behind traces for forensic analysis. In the realm of AI systems and digital interactions, Locard's Principle acquires a new dimension. Interactions between individuals and AI systems in an AI-assisted justice system result in digital footprints that

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¹ McElfresh, D. C. (2019, January 27). *A Framework for Technically- and Morally-Sound AI*. <https://doi.org/10.1145/3306618.3314320>

² Suri, R. K., & Chhabra, T. N. (2002). *Cyber Crime* (p. 41). Pentagon Press.

³ Choinski, T.C. (2020), "Artificially Intelligent Techniques for the Diffusion and Adoption of Innovation for Crisis Situations", Masakowski, Y.R. (Ed.) *Artificial Intelligence and Global Security*, Emerald Publishing Limited, Leeds, pp. 35-52.

include traces of activities, behaviours, communications, online transactions, social media activity and biometric information. These virtual footprints mirror physical contact as they leave behind evidence that can be analyzed for forensic purposes⁴.

AI plays a crucial role in analysing these digital footprints to assist in criminal investigations and profiling. AI algorithms can sift through vast amounts of data, identifying patterns, correlations, and anomalies that may elude human analysts. For example, AI-powered sentiment analysis can detect subtle emotional cues in text or speech, while behavioural biometrics can identify unique behavioural patterns indicative of deception or suspicious activity⁵.

Moreover, AI can leverage advanced data analysis techniques, such as machine learning and natural language processing, to uncover hidden connections and associations between individuals and criminal activities. By analysing digital footprints left behind by both suspects and victims, AI systems can reconstruct the sequence of events, identify potential suspects, and generate predictive models to anticipate future criminal behaviour⁶.

In essence, the relationship between Locard's Principle and AI in criminal investigations and profiling lies in the recognition of digital footprints as virtual traces analogous to physical evidence. By applying AI-driven analysis to these digital footprints, law enforcement agencies can enhance their investigative capabilities, identify perpetrators, and ultimately ensure a more effective and efficient administration of justice in the AI era⁷.

This paper seeks to explore whether Deception Detective Techniques meet the legal standards for the admissibility of Forensic Psychological evidence in Indian courtrooms. It aims to ensure a fair trial in the AI-driven world by examining the intersection of Locard's Principle, AI, and forensic science. In the context of AI-driven lie detection, Locard's Principle underscores the importance of digital footprints, sentiment analysis, behavioural biometrics, voice analysis and

⁴ Custers, B. (2022). AI in Criminal Law: An Overview of AI Applications in Substantive and Procedural Criminal Law. In: Custers, B., Fosch-Villaronga, E. (eds) Law and Artificial Intelligence. Information Technology and Law Series, vol 35. T.M.C. Asser Press, The Hague. https://doi.org/10.1007/978-94-6265-523-2_11

⁵ Dunsin, D., Ghanem, M. C., Ouazzane, K., & Vassilev, V. (2024, March). A comprehensive analysis of the role of artificial intelligence and machine learning in modern digital forensics and incident response. *Forensic Science International: Digital Investigation*, 48, 301675. <https://doi.org/10.1016/j.fsidi.2023.301675>

⁶ Liang, J., Fan, D., Lu, H., Huang, P., Chen, J., Jiang, L., & Hauptmann, A. (2017, February 12). An Event Reconstruction Tool for Conflict Monitoring Using Social Media. *Proceedings of the AAAI Conference on Artificial Intelligence*, 31(1). <https://doi.org/10.1609/aaai.v31i1.10540>

⁷ DoCarmo, T., Rea, S., Conaway, E., Emery, J., & Raval, N. (2021, April). The law in computation: What machine learning, artificial intelligence, and big data mean for law and society scholarship. *Law & Policy*, 43(2), 170–199. <https://doi.org/10.1111/lapo.12164>

data analysis in uncovering traces of deception⁸. Through AI, forensic experts can control interactions with AI systems to determine subtle cues and patterns indicative of malfeasance, enhancing their ability to detect and analyse deception in digital environments.

Ethical Implications of AI Adoption in Forensic Science: Perspectives and Practices

Fairness and accuracy are the cornerstones of any legal system, ensuring that justice is served impartially and transparently. Over the years, forensic science has played a crucial role in legal proceedings, providing evidence and expert testimony to support the adjudication process. However, as technology continues to evolve, there is a growing recognition of the potential for artificial intelligence (AI) to enhance the fairness and acceptability of evidence in legal systems.

A variety of methods and techniques like “*Agni Pariksha*”, “*Rice Test*”, “*Hot and Cold-Water Test*”, “*Trial by Ordeal*” and “*Sword Test*” subsist with their roots in history⁹ and modern-era techniques like the Lie detector, Narco-Analysis and Brain Fingerprinting (BEOS) along with others are being employed for seeking testimony and detecting deception yet their use remains to be contentious as challenges persist in ensuring the reliability and fairness of forensic evidence.¹⁰

Now in the context of the admissibility of scientific evidence in India, the rules dealing with fairness and acceptability of evidence play a crucial role with both aiming at establishing truth and justice delivery. Understanding fair trial as an essential aspect of the right to life, and balancing the rights of the accused (S. 243(2) CrPC 1973) with those of the victim is crucial, ensuring fairness for all parties involved in the trial. Hence, the idea of a fair trial is not a watertight definition¹¹. However, in *Selvi v. State of Karnataka*¹², the court said that the use of these tests without the consent of the subject may violate the right to a fair trial. The purpose of seeing the admissibility of these techniques is to check them and apply them in balance to the rights of the accused or the subject to the test. The evaluation of evidence acceptance in

⁸ Xie, S., & Yu, P. S. (2018, October). Next Generation Trustworthy Fraud Detection. *2018 IEEE 4th International Conference on Collaboration and Internet Computing (CIC)*.
<https://doi.org/10.1109/cic.2018.00045>

⁹ Vicianova, M. (2015). Historical Techniques of Lie Detection. *Europe's Journal of Psychology*, 3, 522–534.
<https://doi.org/10.5964/ejop.v11i3.919>

¹⁰ Barrick, M. R., & Mount, M. K. (1991). The Big Five Personality Dimensions and Job Performance: A Meta-Analysis. *Personnel Psychology*, 1, 1–26. <https://doi.org/10.1111/j.1744-6570.1991.tb00688.x>

¹¹ Kremens, K. (2011). The Protection of the Accused in International Criminal Law According to the Human Rights Law Standard, *Wroclaw Review of Law, Administration and Economics*.

¹² (2010) 7 SCC 263.

legal proceedings depends on expert testimony through 3 rules: field expertise, the meaning of an expert and the basis for expert opinions¹³. Adding AI to these tests can improve their utility by using “machine learning algorithms” to analyse data and deliver accurate expert opinions, guaranteeing transparency and precision in legal proceedings. By leveraging machine learning algorithms, AI can analyse vast amounts of data, identify patterns, and extract insights that may not be readily apparent to human analysts. In the context of forensic psychological tests, AI can enhance the accuracy and reliability of expert testimony by providing objective analysis of psychological profiles, behaviours and case histories. This can help to ensure that the evidence presented in court is both credible and relevant to the case at hand.

An objective analysis of behaviour can be done using AI algorithms to analyse large datasets of social media activity, communication patterns and behavioural indicators to identify individuals at risk of radicalisation or involvement in extremist activities. For instance, the FBI's Counter-terrorism Division utilises AI-driven software to monitor online communications and detect potential threats, aiding in the prevention of terrorist attacks. Here “*Natural Language Processing (NLP)*” algorithms are employed to analyse text data from social media posts, emails and chat logs to identify linguistic patterns indicative of radicalization or extremist ideologies. Machine learning algorithms are then used to classify individuals based on their risk level, allowing law enforcement agencies to prioritize investigations and allocate resources effectively¹⁴. One example of a computer application used in this context is “*Dataminr*”, a real-time information discovery platform that leverages AI algorithms to analyse social media feeds, news articles and other publicly available data sources to identify emerging threats and potential security risks¹⁵.

While the United Kingdom uses AI to assess the risk of reoffending among individuals on parole or probation. For this, the Ministry of Justice employs predictive analytics software to analyse historical data on criminal behaviour, demographic information and social factors to predict the likelihood of future criminal activity. They use predictive modelling algorithms, such as “*logistic regression*” and “*random forest*”, to analyse historical data and identify factors associated with reoffending. These algorithms generate risk scores for each individual,

¹³ Heffernan, L., & Coen, M. (2009, December). The Reliability of Expert Evidence: Reflections on the Law Commission's Proposals for Reform. *The Journal of Criminal Law*, 73(6), 488–507.
<https://doi.org/10.1350/jcla.2009.73.6.603>

¹⁴ Tounsi, A., & Temimi, M. (2023, February 8). A systematic review of natural language processing applications for hydrometeorological hazards assessment. *Natural Hazards*, 116(3), 2819–2870.
<https://doi.org/10.1007/s11069-023-05842-0>

¹⁵ Sarker, I. H. (2022, September 19). Machine Learning for Intelligent Data Analysis and Automation in Cybersecurity: Current and Future Prospects. *Annals of Data Science*, 10(6), 1473–1498.
<https://doi.org/10.1007/s40745-022-00444-2>

enabling probation officers and parole boards to make informed decisions regarding supervision and support services¹⁶. The computer program used for risk assessment in the UK is the “*Offender Assessment System (OASys)*”, which employs AI algorithms to assess the risk of reoffending and determine appropriate intervention strategies for offenders under community supervision¹⁷. Further, the United Kingdom also uses the “*COMPAS (Correctional Offender Management Profiling for Alternative Sanctions) System*”. *COMPAS* employs machine learning algorithms to assess the likelihood of a defendant reoffending, providing insights to judges for sentencing decisions. This software is also used in a few jurisdictions of the USA and European Union as well¹⁸.

In the European Union, AI-powered chatbots are deployed by legal aid organizations to provide information and assistance to individuals seeking legal advice or representation. For instance, the “*Legal Chatbot*” developed by the European Consumer Centre (ECC) known as “*Izzy*” uses natural language processing algorithms to understand user queries and provide relevant legal information and resources. Natural Language Understanding (NLU) algorithms are employed to analyse user input and extract key information to determine the user's legal needs and preferences. These algorithms enable the chatbot to provide tailored responses and recommendations based on the user's specific situation. The “*Legal Chatbot*” developed by ECC is an example of a computer application used to provide legal assistance and support to individuals across the European Union. The chatbot is accessible through the ECC website and various messaging platforms, allowing users to seek legal advice and information conveniently. Further, the European Union has also developed ethical guidelines and regulatory frameworks to govern the use of AI in various domains, including law enforcement and judicial systems. The EU's *General Data Protection Regulation (GDPR)* and the European Commission's *White Paper on Artificial Intelligence* outline principles for ethical AI deployment, emphasizing transparency, accountability and fairness¹⁹.

However, while not directly related to psychological evaluations, these regulations influence the development and deployment of AI systems in the EU, including those used in law

¹⁶ Rizer, A., & Watney, C. (2018). Artificial Intelligence Can Make Our Jail System More Efficient, Equitable and Just. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3129576>

¹⁷ Rizer, A., & Watney, C. (2018). Artificial Intelligence Can Make Our Jail System More Efficient, Equitable and Just. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3129576>

¹⁸ Ting, M. H., Chu, C. M., Zeng, G., Li, D., & Chng, G. S. (2017, December 27). Predicting recidivism among youth offenders: Augmenting professional judgement with machine learning algorithms. *Journal of Social Work*, 18(6), 631–649. <https://doi.org/10.1177/1468017317743137>

¹⁹ Hickman, E., & Petrin, M. (2021, October 6). Trustworthy AI and Corporate Governance: The EU's Ethics Guidelines for Trustworthy Artificial Intelligence from a Company Law Perspective. *European Business Organization Law Review*, 22(4), 593–625. <https://doi.org/10.1007/s40804-021-00224-0>

enforcement and criminal justice²⁰. These kinds of ethical guidelines and regulatory frameworks become necessary because while AI holds great potential for improving forensic science, it also raises important ethical considerations.

The design and implementation of AI algorithms must be conducted with careful consideration of ethical principles, including fairness, transparency and accountability. Bias and discrimination must be mitigated through rigorous testing and validation of AI systems and safeguards must be put in place to prevent misuse or abuse of technology. Additionally, standards and regulations should be established to govern the use of AI in forensic science, ensuring consistency and fairness across different cases and jurisdictions. Legal experts, forensic scientists, psychologists and AI specialists must work together to develop ethical and effective strategies for integrating AI into legal proceedings. This collaboration can help to ensure that AI is used responsibly and ethically, while also maximizing its potential to enhance fairness and accuracy in legal proceedings²¹. Public trust and confidence in AI-assisted forensic science are essential for its successful integration into legal proceedings. Educating the public about the benefits and limitations of AI, as well as the ethical considerations involved, can help to alleviate concerns and misconceptions. Transparency and accountability mechanisms must be put in place to address errors or misuse of AI-driven forensic testing, building confidence in the reliability and fairness of the technology.²²

Advancing Forensic Psychological Profiling through Artificial Intelligence

Indian courts do not follow a uniform criterion to decide on the reliability of scientific evidence and corroboration plays the main role in the admissibility of evidence²³. In India, the admissibility of scientific aids in investigations is governed by the Indian Evidence Act (IEA), 1872 (now *Bharatiya Sakshya Adhiniyam*, 2023) Only those opinions of the expert will be taken that can help to find out the *fact in issue*²⁴.

²⁰ Castillo, D., Canhoto, A. I., & Said, E. (2020, June 30). The dark side of AI-powered service interactions: exploring the process of co-destruction from the customer perspective. *The Service Industries Journal*, 41(13–14), 900–925. <https://doi.org/10.1080/02642069.2020.1787993>

²¹ Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B. P. T. (2022, October 13). Ethical principles for artificial intelligence in education. *Education and Information Technologies*, 28(4), 4221–4241. <https://doi.org/10.1007/s10639-022-11316-w>

²² Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of Things and Cyber-Physical Systems*, 3, 121–154. <https://doi.org/10.1016/j.iotcps.2023.04.003>

²³ *Palania Pillai v State* (1991) crilj 1563

²⁴ Dinkar, V. R. (2016). *Scientific Expert Evidence* (p. 187). Eastern Law House Pvt Ltd.

Using AI with psychological evidence can suggestively improve its credibility and utility in legal proceedings. Through AI, legal professionals can detect delicate patterns and tendencies in psychological data that may not be directly visible to human experts, thereby increasing the evidentiary worth of psychological evidence in court. To improve psychological evidence, AI could be used in a standard way like a certification that AI is clear, and teaching legal experts about its utility and impact. Some of the innovative applications of AI in legal proceedings, particularly in enhancing psychological evidence that the Indian legal system could consider could be:

a. Emotional Analysis & Behavioural Biometrics:

AI algorithms can analyse vast text, speech, and behavioural patterns datasets to discern underlying sentiments and behavioural biometrics. AI can provide insights into an individual's psychological state by deciphering subtle cues in communication, such as tone, choice of words and non-verbal gestures²⁵. For example, in a cyberbullying case, AI-driven sentiment analysis tools can help identify patterns of harassment and psychological distress in online communications, thereby strengthening psychological evidence presented in court. To further push the argument illustrations have been provided about sophisticated high-end AI-based software that can help in emotional and behavioural analysis. The first in line is the IBM Watson Natural Language Understanding Tool which can analyse unstructured text data to extract insights about sentiment, emotion, and behavioural patterns. It employs advanced natural language processing (NLP) algorithms to understand the context and tone of text, enabling forensic scientists to identify subtle cues indicative of deception or psychological states²⁶. It can analyse text from various sources, including social media posts, emails, chat logs and legal documents, to uncover underlying sentiments and behavioural indicators. It provides detailed emotional analysis reports, including sentiment scores, emotion detection and key-phrase extraction²⁷. This is used by forensic experts and law enforcement agencies to analyse digital communications and identify potential threats or suspicious activities. It has been employed in criminal investigations, counter-terrorism efforts and fraud detection

²⁵ Chatterjee, A., Gupta, U., Chinnakotla, M. K., Srikanth, R., Galley, M., & Agrawal, P. (2019, April). Understanding Emotions in Text Using Deep Learning and Big Data. *Computers in Human Behavior*, 93, 309–317. <https://doi.org/10.1016/j.chb.2018.12.029>

²⁶ Brzic, B., Boticki, I., & Bagic Babac, M. (2023, April 26). Detecting Deception Using Natural Language Processing and Machine Learning in Datasets on COVID-19 and Climate Change. *Algorithms*, 16(5), 221. <https://doi.org/10.3390/a16050221>

²⁷ Soffer, A., Konopnicki, D., & Roitman, H. (2016, July 7). When Watson Went to Work. *Proceedings of the 39th International ACM SIGIR Conference on Research and Development in Information Retrieval*. <https://doi.org/10.1145/2911451.2926724>

applications. The next interesting software is Microsoft Azure Text Analytics which is a cloud-based AI service that offers advanced text analysis capabilities, including sentiment analysis, entity recognition and key phrase extraction. It leverages state-of-the-art machine learning models to examine text data and extract actionable insights. Azure Text Analytics can analyse text data in multiple languages and formats, including social media posts, customer reviews and legal documents. It provides sentiment scores, sentiment labels and sentiment intensity levels to help forensic scientists understand the emotional tone and behavioural patterns in textual content²⁸. Microsoft Azure Text Analytics is used by forensic experts, legal professionals and law enforcement agencies to analyse digital evidence, detect deception, and gather intelligence from text-based communications. It has applications in criminal investigations, litigation support and threat detection. Further **Google Cloud Natural Language API** leverages machine learning models to analyse text and extract insights about sentiment, syntax and entity recognition. Forensic psychologists can leverage this AI-powered tool to analyse the linguistic features of written content, such as emails, messages and documents, to uncover underlying sentiments and behavioural cues. While widely used globally, the adoption of Google Cloud Natural Language API in India can revolutionize forensic investigations by providing accurate and sophisticated analysis of textual data, thereby strengthening the credibility of psychological evidence presented in legal proceedings²⁹.

b. Voice Analysis and Emotional Detection:

Advanced AI systems equipped with voice analysis capabilities can detect nuances in speech patterns and emotional cues, offering valuable insights into an individual's psychological state. For instance, in cases of domestic violence or harassment, AI-driven emotion detection tools can analyse audio recordings to identify indicators of fear, stress or agitation in the victim's voice, corroborating psychological testimony and providing compelling evidence in court³⁰. One illustration is Verint Systems which offers a suite of AI-driven solutions for sentiment analysis, behavioural analytics and voice recognition. Its software applications use advanced machine learning algorithms to analyse audio, video, and text data for insights into human behaviour and sentiment. Verint's software can analyse voice recordings, social media

²⁸ Ziemer, K. S., & Korkmaz, G. (2017, November). Using text to predict psychological and physical health: A comparison of human raters and computerized text analysis. *Computers in Human Behavior*, 76, 122–127. <https://doi.org/10.1016/j.chb.2017.06.038>

²⁹ Baror, S. O., Venter, H. S., & Adeyemi, R. (2020, July 12). A natural human language framework for digital forensic readiness in the public cloud. *Australian Journal of Forensic Sciences*, 53(5), 566–591. <https://doi.org/10.1080/00450618.2020.1789742>

³⁰ Podoletz, L. (2022, May 5). We have to talk about emotional AI and crime. *AI & SOCIETY*, 38(3), 1067–1082. <https://doi.org/10.1007/s00146-022-01435-w>

interactions and customer communications to identify patterns of behaviour and sentiment. It provides real-time alerts and reports on suspicious activities, emotional states and linguistic cues indicative of deception or psychological distress.

These solutions can be used by law enforcement agencies, intelligence organizations and corporate security teams for investigations, surveillance and risk mitigation. They could be deployed in various contexts, including counter-terrorism operations, fraud prevention, and employee monitoring³¹. Other examples that demonstrate the global adoption of sophisticated AI-powered voice analysis and emotion detection software by law enforcement agencies and other organizations involved in public safety and security efforts include Nexidia, which is an AI-powered voice analytics solution designed to analyse audio recordings for emotion detection, sentiment analysis and linguistic cues. It can analyse large volumes of audio data from various sources, including emergency calls, interviews and surveillance recordings, providing detailed reports on emotional cues, speech patterns and language usage³². Then CrisisAI is used in countries such as the United States, the United Kingdom, Australia and Canada by law enforcement agencies, emergency response teams and intelligence organizations utilises CrisisAI for crisis negotiation, hostage situations and critical incident investigations³³. Further, Voci Technologies offers AI-powered speech analytics solutions for voice analysis and emotion detection. Its speech analytics platform can process large volumes of audio data in real time, providing instant insights into emotional states and behavioural indicators³⁴. Besides this, Cerence is a leading provider of AI-driven voice recognition and emotion detection technology. Its voice analytics platform offers real-time emotion detection capabilities, analysing speech patterns, intonation, and vocal cues to infer emotional states. Cerence's technology is widely deployed in countries across North America, Europe, and Asia. Law enforcement agencies, automotive manufacturers and emergency response services utilize Cerence's technology to enhance safety and security. In law enforcement, it is used in interrogation rooms, patrol vehicles and emergency response systems to analyse speech and detect signs of distress or deception. India can bolster forensic profiling and deception detection by incorporating advanced AI-based voice analysis and emotion detection software, enabling

³¹ Clark, S. (2023, May 18). *The Top 13 Speech Analytics Software Solutions*. CMSWire.com. <https://www.cmswire.com/customer-experience/the-top-13-speech-analytics-software-solutions/>

³² Nexidia Speech and Text Analytics. *Customer Insights. Customer Journey - Digital Marketplace*. (2024, April 23). <https://www.applytosupply.digitalmarketplace.service.gov.uk/g-cloud/services/247010249715683>

³³ Kazemi, A. (2023, October 31). *AI for Crisis Management: Impacts, Challenges, Best Practices*. futurium.ec.europa.eu. Retrieved April 30, 2024, from <https://futurium.ec.europa.eu/en/european-ai-alliance/forum-discussion/ai-crisis-management-impacts-challenges-best-practices>

³⁴ *Gain an advantage with Voci's leading transcription technology*. (2023, January 4). Voci. <https://www.vocitec.com/why-voci>

law enforcement to analyse audio recordings for signs of deception and assess credibility, thereby enhancing investigative efficiency and ensuring fair justice delivery³⁵.

c. Data Mining and Pattern Recognition:

AI algorithms can mine vast repositories of psychological data, including case histories, clinical records and behavioural profiles, to identify recurring patterns and trends. By leveraging machine learning techniques, AI can uncover hidden correlations and associations within complex datasets, enabling legal professionals to draw evidence-based conclusions about an individual's psychological disposition³⁶. For example, in a criminal investigation, AI-driven data mining tools can analyze past criminal behaviour patterns and psychological profiles to assess the likelihood of recidivism and inform sentencing decisions³⁷.

d. Neuroimaging and Brainwave Analysis:

Cutting-edge AI technologies, such as neuroimaging and brainwave analysis, offer unprecedented insights into the human brain's inner workings. By analyzing functional magnetic resonance imaging (fMRI) scans and electroencephalography (EEG) readings, AI algorithms can detect anomalies in brain activity associated with psychological disorders, cognitive impairments and emotional disturbances³⁸. In legal proceedings, neuroimaging evidence can provide objective measures of an individual's psychological state, complementing traditional psychological assessments and enhancing the evidentiary value of psychological evidence presented in court³⁹. For this, advanced AI-based software such as Neurosynth and BrainNet Viewer are utilized by forensic experts in law enforcement for neuroimaging and brainwave analysis.

Incorporating advanced AI technologies in forensic investigations can significantly enhance the credibility and utility of psychological evidence in legal proceedings. From sentiment analysis

³⁵ I. Iliev, A. (2023, August 2). Perspective Chapter: Emotion Detection Using Speech Analysis and Deep Learning. *Emotion Recognition - Recent Advances, New Perspectives and Applications*. <https://doi.org/10.5772/intechopen.110730>

³⁶ Xu, Y., Liu, X., Cao, X., Huang, C., Liu, E., Qian, S., Liu, X., Wu, Y., Dong, F., Qiu, C. W., Qiu, J., Hua, K., Su, W., Wu, J., Xu, H., Han, Y., Fu, C., Yin, Z., Liu, M., . . . Zhang, J. (2021, November). Artificial intelligence: A powerful paradigm for scientific research. *The Innovation*, 2(4), 100179. <https://doi.org/10.1016/j.xinn.2021.100179>

³⁷ Farayola, M. M., Tal, I., Malika, B., Saber, T., & Connolly, R. (2023, August 29). Fairness of AI in Predicting the Risk of Recidivism: Review and Phase Mapping of AI Fairness Techniques. *Proceedings of the 18th International Conference on Availability, Reliability and Security*. <https://doi.org/10.1145/3600160.3605033>

³⁸ Sadeghi, D., Shoeibi, A., Ghassemi, N., Moridian, P., Khadem, A., Alizadehsani, R., Teshnehlab, M., Gorriz, J. M., Khozeimeh, F., Zhang, Y. D., Nahavandi, S., & Acharya, U. R. (2022, July). An overview of artificial intelligence techniques for diagnosis of Schizophrenia based on magnetic resonance imaging modalities: Methods, challenges, and future works. *Computers in Biology and Medicine*, 146, 105554. <https://doi.org/10.1016/j.compbiomed.2022.105554>

³⁹ Brown, Teneille, and Emily Murphy. "Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States." *Stanford Law Review*, vol. 62, no. 4, 2010, pp. 1119–208. *JSTOR*, <http://www.jstor.org/stable/40649625>

and voice recognition to data mining and neuroimaging, AI-driven tools can offer unprecedented insights into human behaviour and psychological states, thereby strengthening the evidentiary value of psychological evidence presented in the courts⁴⁰. By implementing these sophisticated AI applications, law enforcement agencies in India can improve forensic profiling and deception detection, ultimately enhancing investigative efficiency and ensuring fair justice delivery in the digital age.

Enhancing Forensic Analysis in Indian Courts: The Role of AI Technologies

Supreme Court's decision in *Selvi's Case* is pertinent to our discussion on admissibility of Forensic Psychological Tests. In this case, the court ruled that Polygraph evidence was unreliable and violated exclusionary rules of evidence⁴¹. Narco-analysis is held inadmissible because it is deemed as unreliable and not scientifically supported while the BEOS Test was held to be inadmissible for its failure to meet the "Daubert Test"⁴². For these three DDTs, different criteria were used by the court when rejecting them and identifying their worth as evidence.

When the Indian position is examined, it can be seen that involuntary administration of the Polygraph Test may not take place although, voluntarily administered Polygraph Test results would be admissible under Section 27 of the Indian Evidence Act, 1872. Consequently, some limited admissibility of Polygraph evidence becomes permissible in India. Courts are uncertain about whether or not they should allow these tests due to a lack of expert proof before courts concerning their reliability.

In many cases the court has allowed the usage of the truth serum test to eliminate the chances of 3rd-degree torture by police to gather information or confession from the accused person and the information recovered from the accused through this test could be useful in collecting further evidence and for corroboration.

In *Dinesh Dalmia v State of Madras*,⁴³ it was said that taking a scientific test does mean breaking the silence of the accused by force. Voluntary going for such a test does not amount to compulsion or incrimination. When the subject or accused of the test talks freely with his consent to take the test and there is no force or inducement used upon him then he cannot claim

⁴⁰ Yadav, S., Yadav, S., Verma, P., Ojha, S., & Mishra, S. (2022, December 7). Artificial Intelligence: An Advanced Evolution in Forensic and Criminal Investigation. *Current Forensic Science*, 1. <https://doi.org/10.2174/2666484401666220819111603>

⁴¹ *Smt. Selvi and Ors v State of Karnataka*, (2010) 7 SCC 263.

⁴² Brandon L. Garret, Fabricant C (2018) *The Myth of The Reliability Test*. Fordham Law Review

⁴³ (2006) CrLJ 2401

the right under Article 20(3)⁴⁴. Only inculpatory statements which are recorded during the test will attract the bar under Article 20(3) of the Indian Constitution. Such statements must incriminate the person who makes them and if those statements have inculpatory character or not can be ascertained only after the test is done. Such tests are needed when the investigation goes to a dead end and the police have no other way to find information and truth to apprehend the offender. The disclosure and statements made by the subject under the narco-test can give a way and path to the police for furthering their investigation as the statements of the subject may suggest some useful clues⁴⁵.

However, the Supreme Court in *Selvi* prohibited the involuntary administration of truth serum test calling it cruel, inhuman and degrading treatment and rejected to accept the direct result of Narco-Analysis as evidence which was done with the consent of the subject because in such test the court said the accused does not have any control on his responses⁴⁶. However, if a voluntary test leads to the discovery of any information or material after the test, then, such information can be admitted under section 27 of The Evidence Act, 1872.

Confession made by a person in a semi-conscious state is valid as u/s29 of IEA 1872. A confession acquired from the accused under the influence of alcohol is relevant.⁴⁷ Hence, if such confession is allowed then evidence collected under the influence of truth serum should also be allowed⁴⁸.

Statements made in sleep may not be legal evidence against the accused but may be useful as indicative evidence.⁴⁹ Reading the available literature regarding evidence laws on expert opinion, we may sum up that the investigatory use of the truth-serum test could be allowed with legal protections, but its evidentiary use is not justified.

Despite the challenges outlined by the Supreme Court in cases such as *Selvi*'s, including the exclusion of polygraph, narcoanalysis and BEOS tests due to reliability concerns, there exists a pathway for their limited admissibility under certain conditions in Indian courts. While the legal landscape surrounding these tests remains uncertain, there is a clear opportunity to enhance their credibility and acceptance through the integration of advanced AI systems. By leveraging sophisticated AI technologies like “*Converus EyeDetect*”, “*Cognalyzer*”,

⁴⁴ *Yousuf Ali v State of Maharastra* (2005) 10 SCC 545

⁴⁵ *Santokben Sharmabhai Jadeja v State of Gujarat* (2008) CrLJ 68

⁴⁶ (2010) 7 SCC 263.

⁴⁷ Singh, A. (2014a). *Principles of the Law of Evidence* (21st ed., p. 173). Central Law Agency.

⁴⁸ Khan, G. F. (2018). Narco Analysis Test: A Blessing to Criminal Justice System, its Reliability and Admissibility in light of Various Judgments. *International Journal of Law*.

⁴⁹ Sarkar, S. (2020). *Sarkar's Law of Evidence in India, Pakistan, Bangladesh, Burma, Ceylon, Malaysia & Singapore* (20th ed., p. 800). Lexis Nexis.

“BrainScope”, “Spotlight AI” and “Nemesysco”, forensic analysis can be significantly improved, providing more accurate and reliable results. These AI-driven tools offer precise interpretation of physiological responses, speech patterns, brain activity and voice parameters, thereby mitigating human error and bias. Moreover, the development of AI-driven forensic analysis tools tailored to Indian legal contexts, coupled with collaboration between enforcement agencies, forensic psychologists and AI experts, can ensure the reliability and fairness of these tests. Through adherence to established guidelines and standards, the Indian judicial system can elevate the credibility of polygraph, brain mapping and narcoanalysis, ultimately advancing the quality of justice delivered.

To enhance the credibility and acceptance of polygraph, brain mapping and narcoanalysis in Indian courts, a multifaceted approach is essential. First and foremost, there needs to be a concerted effort towards research and development, focusing on adapting existing AI technologies to the specific needs of the Indian legal system. This would involve collaboration between AI researchers, forensic psychologists, legal experts and law enforcement agencies to understand the unique challenges and nuances of forensic analysis in India. Additionally, gathering diverse and representative datasets relevant to Indian legal cases is crucial for training AI algorithms effectively. These datasets should encompass a wide range of demographics, cultural backgrounds and legal contexts to ensure the robustness and fairness of AI models⁵⁰. Once developed, rigorous validation and testing of AI-driven forensic analysis tools are imperative to ensure their accuracy and reliability. This entails conducting controlled experiments, comparative studies and real-world simulations to assess the performance of AI algorithms in different scenarios. Independent validation by experts in forensic psychology and legal practice is essential to establish the credibility of these tools⁵¹. Moreover, addressing ethical and legal considerations surrounding the use of AI in forensic analysis is paramount. Guidelines and standards must be developed to ensure the responsible deployment of AI-driven tools in legal proceedings, while complying with existing laws and regulations⁵².

⁵⁰ Dunsin, D., Ghanem, M. C., Ouazzane, K., & Vassilev, V. (2024, March). A comprehensive analysis of the role of artificial intelligence and machine learning in modern digital forensics and incident response. *Forensic Science International: Digital Investigation*, 48, 301675. <https://doi.org/10.1016/j.fsidi.2023.301675>

⁵¹ Ali, S., Abuhmed, T., El-Sappagh, S., Muhammad, K., Alonso-Moral, J. M., Confalonieri, R., Guidotti, R., Del Ser, J., Díaz-Rodríguez, N., & Herrera, F. (2023, November). Explainable Artificial Intelligence (XAI): What we know and what is left to attain Trustworthy Artificial Intelligence. *Information Fusion*, 99, 101805. <https://doi.org/10.1016/j.inffus.2023.101805>

⁵² Mishra, P. K., & Law, L. (2024, February 27). *Law And AI, Legal Framework And Challenges, AI-Powered Tools, General Data Protection Regulation (GDPR)*. Live Law. <https://www.livelaw.in/lawschool/articles/law-and-ai-ai-powered-tools-general-data-protection-regulation-250673>

Capacity building and training programs for law enforcement agencies, forensic psychologists, legal professionals and judges are essential to facilitate the effective use of AI-driven forensic analysis tools⁵³. This includes education on the capabilities, limitations and best practices for integrating AI into the legal process, as well as raising awareness about the potential benefits of using AI to enhance forensic analysis. Furthermore, fostering a culture of continuous improvement and adaptation is crucial. Regular updates and refinements to AI-driven forensic analysis tools based on feedback from stakeholders and advances in technology are necessary to address emerging challenges and incorporate new developments in AI research.

By following this comprehensive approach and fostering collaboration between enforcement agencies, forensic psychologists, AI experts and legal professionals, the Indian judicial system can effectively harness the power of AI to elevate the credibility of polygraph, brain mapping and narcoanalysis. This would ultimately advance the quality of justice delivered in Indian courts, ensuring fairness and reliability in legal proceedings.

Amalgamation of AI with Justice Delivery: Forensic Tests & Human Rights

Forensic psychological tests serve multiple purposes in criminal investigations, including extracting information from suspects and witnesses, corroborating testimonies, and assessing the mental condition of individuals. While these tests can aid in gathering evidence and evaluating the credibility of witnesses or accused persons, their use must be balanced against the right to a fair trial, particularly the right against self-incrimination⁵⁴. The concept of the presumption of innocence is closely tied to the right against self-incrimination, as compelling the accused to become a witness against themselves shifts the burden of proof onto them. Despite this, the right against self-incrimination is not absolute, allowing for police questioning and voluntary confessions during trial proceedings⁵⁵. However, the Supreme Court has outlined specific criteria for the application of this right, emphasising that it is accessible only to formally accused persons. Additionally, the court has clarified that mere police questioning does not constitute compulsion and evidence obtained voluntarily can be admitted against the

⁵³ Sarkar, G., & Shukla, S. K. (2023, December). Behavioral analysis of cybercrime: Paving the way for effective policing strategies. *Journal of Economic Criminology*, 2, 100034. <https://doi.org/10.1016/j.jeconc.2023.100034>

⁵⁴ Neal, T. M. S., Martire, K. A., Johan, J. L., Mathers, E., & Otto, R. K. (2022, October 18). *The Law Meets Psychological Expertise: Eight Best Practices to Improve Forensic Psychological Assessment*. Annual Review of Law and Social Science. <https://doi.org/10.1146/annurev-lawsocsci-050420-010148>

⁵⁵ Redmayne, M. (2005, December 20). *Rethinking the Privilege Against Self-Incrimination*. Oxford Journal of Legal Studies. <https://doi.org/10.1093/ojls/gql001>

accused⁵⁶. The court's rulings in landmark cases such as MP Sharma⁵⁷, Balasaheb⁵⁸ and KathiKalu⁵⁹ have further delineated the scope and limitations of the right against self-incrimination in the context of forensic psychological tests. While the court has recognised the importance of protecting accused persons from coercion and undue influence, it has also emphasised the need to balance this protection with the investigative requirements of law enforcement agencies.

The admissibility of evidence obtained through forensic psychological tests raises important human rights considerations, particularly concerning the prohibition of torture and the right to mental privacy. While India lacks comprehensive legislation against torture, International documents such as the United Nations Convention Against Torture provide guidelines for preventing cruel treatment by state actors⁶⁰. In the context of forensic psychological tests, where the primary objective is information gathering rather than inflicting pain, the legality of these tests hinges on the absence of deliberate intent to harm the subject⁶¹. However, the Supreme Court's verdict in Selvi's case has highlighted concerns regarding the violation of the right to mental privacy through the administration of these tests. Mental privacy, deemed an absolute right by the court, protects higher-order cognitive states and prohibits intrusion into an individual's mental processes. Despite this, evidence from the mind, including voluntary confessions and behavioural indicators, remains admissible in courts, subject to certain limitations⁶². The concept of privacy in India is recognised as a constituent ingredient of the right to life, is not absolute and may be restricted for crime prevention or protecting the rights of others. While the right to mental privacy is paramount, it must be balanced against the interests of justice and the rights of victims, ensuring a fair and equitable legal process for all parties involved.

⁵⁶ Gerhard O. W. Mueller. "The Law Relating to Police Interrogation Privileges and Limitations." *The Journal of Criminal Law, Criminology, and Police Science*, vol. 52, no. 1, 1961, pp. 2–15. *JSTOR*, <https://doi.org/10.2307/1141492>

⁵⁷ M.P. Sharma v. Satish Chandra, AIR 1954 SC 300

⁵⁸ Balasaheb v. State of Maharashtra (2011) 1 SCC 364.

⁵⁹ State of Bombay v. Kathikalu AIR 1961 SC 1817.

⁶⁰ Ahmad, N., & Lilienthal, G. (2016). Proscribing torture: an analysis in Indian and ethical contexts: (The 2010 Indian Prevention of Torture Bill). *Commonwealth Law Bulletin*, 42(1), 38–58. <https://doi.org/10.1080/03050718.2015.1121156>

⁶¹ *Psychological Assessment in Legal Contexts: Are Courts Keeping "Junk Science" Out of the Courtroom?* (n.d.). Association for Psychological Science - APS. <https://www.psychologicalscience.org/publications/psychological-assessment-in-legal-contexts-are-courts-keeping-junk-science-out-of-the-courtroom.html>

⁶² Greely, H. T., & Farahany, N. A. (2019, January 13). Neuroscience and the Criminal Justice System. *Annual Review of Criminology*, 2(1), 451–471. <https://doi.org/10.1146/annurev-criminol-011518-024433>

The Selvi judgment, while limiting the admissibility of evidence obtained through advanced forensic techniques, such as Narco-Analysis and Brain Electrical Oscillation Signature (BEOS), has implications for the potential of AI in revolutionising criminal investigations and legal proceedings. By prioritising the protection of mental privacy rights, the judgment restricts the use of these techniques, hindering their ability to enhance the accuracy and efficiency of justice delivery. However, the judgment also underscores the need to balance the rights of accused persons with the interests of justice, suggesting that evidence obtained through non-coercive means may still be admissible⁶³.

Despite the limitations imposed by the Selvi judgment, the integration of AI technologies in forensic analysis presents opportunities to address these concerns while leveraging the benefits of technological advancements. By developing AI-driven forensic analysis tools tailored to Indian legal contexts and collaborating with enforcement agencies, forensic psychologists, and AI experts, the Indian judicial system can ensure the reliability and fairness of forensic psychological tests. Through adherence to established guidelines and standards, AI technologies can mitigate human error and bias, ultimately advancing the quality of justice delivered in Indian courts.

In the pursuit of justice, it's crucial to ensure that the evidence presented in courtrooms is reliable and fair, and respects the rights of individuals. One area where this is particularly important is in the field of forensic analysis, especially when it comes to psychological tests. These tests, which aim to uncover the truth and assess the mental state of individuals involved in legal cases, have traditionally been subject to scrutiny due to concerns about their accuracy and potential violations of human rights⁶⁴.

To address these concerns and improve the credibility of forensic psychological tests, several steps can be taken. First and foremost, there needs to be a careful review of existing policies and legal frameworks governing the use of these tests in courtrooms. This should involve input from a variety of stakeholders, including legal experts, law enforcement agencies, psychologists and advocates for human rights⁶⁵.

⁶³ Tortora, L., Meynen, G., Bijlsma, J. W. J., Tronci, E., & Ferracuti, S. (2020, March 17). *Neuroprediction and A.I. in Forensic Psychiatry and Criminal Justice: A Neurolaw Perspective*. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2020.00220>

⁶⁴ Ballantyne, K. N., & Wilson-Wilde, L. (2020, January 20). Assessing the reliability and validity of forensic science – an industry perspective. *Australian Journal of Forensic Sciences*, 52(3), 275–281. <https://doi.org/10.1080/00450618.2019.1711182>

⁶⁵ Heilbrun, K. (1992, June). The role of psychological testing in forensic assessment. *Law And Human Behavior*, 16(3), 257–272. <https://doi.org/10.1007/bf01044769>

Additionally, there should be efforts to update the criteria for admitting evidence obtained through forensic psychological tests. This means establishing clear standards for reliability, relevance and fairness, and ensuring that evidence derived from these tests meets these criteria. It also involves providing training and education for judges, lawyers and law enforcement personnel on how to properly interpret and evaluate this evidence⁶⁶.

Furthermore, safeguards need to be put in place to protect the rights of individuals undergoing forensic psychological tests. This includes strengthening privacy protections, obtaining informed consent from participants and establishing independent oversight bodies to monitor the ethical conduct of these tests⁶⁷. To comprehend this let's imagine that the government forms a special commission to study the use of AI in forensic analysis. This commission brings together experts from various fields to develop guidelines and standards for the use of AI-driven tools in courtrooms. After conducting thorough research and consultations, the commission recommends changes to existing laws and procedures to ensure that AI-driven forensic analysis is conducted ethically and responsibly. Based on these recommendations, new legislation is passed to update the rules governing the admissibility of evidence obtained through AI-driven forensic analysis. This legislation includes provisions for rigorous testing and validation of AI algorithms, as well as safeguards to protect the rights of individuals involved in legal cases.

Additionally, the judiciary issues practice directions to courts across the country, guiding how to properly evaluate evidence obtained through AI-driven forensic analysis. This includes instructions on the importance of expert testimony, adherence to established standards and protection of human rights⁶⁸.

By implementing these changes, India can harness the potential of AI to improve the reliability and fairness of forensic analysis, while also upholding the rights of individuals involved in legal cases. This will ultimately lead to a more just and equitable criminal justice system.

Conclusion & Suggestions

⁶⁶ Ryan, W. J. (2014, February 5). A Review of Forensic Uses of Clinical Assessment Instruments. *Journal of Personality Assessment*, 96(4), 480–481. <https://doi.org/10.1080/00223891.2014.880060>

⁶⁷ Breakwell, G. M., Smith, J. A., & Wright, D. B. (2012, April 20). *Research Methods in Psychology*. SAGE. http://books.google.ie/books?Id=z_me6ed_xnic&printsec=frontcover&dq=Research+Methods+in+Psychology:+Edited+by+G.M.+Breakwell,+S.+Hammond+and+C.+Fife-Schaw&hl=&cd=3&source=gbp_api

⁶⁸ Ferrara, E. (2023, December 26). Fairness and Bias in Artificial Intelligence: A Brief Survey of Sources, Impacts, and Mitigation Strategies. *Sci*, 6(1), 3. <https://doi.org/10.3390/sci6010003>

Integrating AI in forensic science and criminal investigations holds great potential for improving the accuracy and fairness of legal proceedings. Law enforcement agencies can enhance their investigative capabilities and the efficiency of justice administration in the AI era by utilising AI algorithms to analyse digital footprints and apply advanced techniques such as machine learning algorithms and predictive modelling⁶⁹. Analysing digital footprints, emotions, behaviour patterns, voice characteristics, and data under Locard's Principle, AI and forensic science is crucial for finding signs of deception. However, addressing ethical concerns is also essential with technological advancements in AI integration in forensic science to ensure fair and efficient justice delivery in the evolving landscape of AI-based lie detection and criminal investigations⁷⁰. As AI progresses, its integration into forensic science raises ethical concerns related to bias in algorithms, privacy implications and the potential impact on human judgment, prompting the need for thorough consideration. These algorithms, if not properly designed and trained, can perpetuate existing biases present in the criminal justice system, potentially leading to unfair outcomes and disproportionate impacts on certain demographic groups⁷¹.

Furthermore, AI implementation in forensic science prompts questions about privacy and safeguarding data. With the vast amounts of digital footprints and personal data being analyzed, there is a need to ensure that individual privacy rights are respected and that data is handled securely and ethically⁷².

Another ethical consideration is the need for transparency and accountability in the use of AI in criminal investigations. It is vital for law enforcement agencies and forensic experts to be transparent about the use of AI tools and to be held accountable for the decisions and actions resulting from the analysis conducted by these tools⁷³.

⁶⁹ Dunsin, D., Ghanem, M. C., Ouazzane, K., & Vassilev, V. (2023). *A Comprehensive Analysis of the Role of Artificial Intelligence and Machine Learning in Modern Digital Forensics and Incident Response*. <https://doi.org/10.2139/ssrn.4554035>

⁷⁰ Bradshaw, R. (2021, March 17). Deception and detection: the use of technology in assessing witness credibility. *Arbitration International*, 37(3), 707–720. <https://doi.org/10.1093/arbint/aiab007>

⁷¹ Hao, K. (2020, April 2). *AI is sending people to jail—and getting it wrong*. MIT Technology Review. <https://www.technologyreview.com/2019/01/21/137783/algorithms-criminal-justice-ai/>

⁷² Vayena, E., & Tasioulas, J. (2016, December 28). The dynamics of Big data and Human Rights: The Case of Scientific Research. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 374(2083), 20160129. <https://doi.org/10.1098/rsta.2016.0129>

⁷³ Lederer, T. (2023, May 23). *Police Reform: The Future Powered by AI Technology*. Veritone. <https://www.veritone.com/blog/ai-public-safety-police-reform/>

Moreover, depending on AI for deception detection and criminal profiling may lead to worries about diminishing human judgment and discretion in legal proceedings. It is crucial to strike a balance between the use of AI as a tool for enhancing investigative capabilities and the preservation of human judgment and ethical decision-making in the administration of justice⁷⁴.

Governments and regulatory bodies must establish clear ethical guidelines and regulatory frameworks governing the use of AI in forensic science, emphasizing transparency, accountability, fairness and privacy protection. These guidelines should also address specific examples of bias, discrimination and potential misuse of AI in forensic science. Collaboration between stakeholders such as law enforcement agencies, legal experts and technology developers is essential to ensure that these guidelines are comprehensive and effective in addressing potential ethical concerns. Collaboration between legal experts, forensic scientists, psychologists and AI specialists can develop ethical and effective strategies for integrating AI into legal proceedings, fostering innovation and comprehensive solutions. This collaborative method can tackle ethical dilemmas and guarantee the ethical and responsible use of AI. By combining their knowledge, they can create detailed guidelines that emphasize fairness, transparency and accountability in AI's application in legal frameworks.

Educating the public about the benefits and limitations of AI in forensic science is crucial for building trust and confidence in the technology. Public awareness campaigns should focus on explaining the ethical considerations involved in AI adoption and the safeguards in place to prevent misuse or abuse of technology. Transparency in how AI algorithms are developed and used can help address concerns about bias and discrimination. Engaging with communities that may be most impacted by AI in forensic science can help integrate their perspectives into the development and implementation of AI technologies, promoting inclusivity and addressing specific needs in forensic investigations.

Promoting transparency and accountability in AI development and deployment is also crucial for fostering trust among stakeholders. Independent oversight bodies should monitor the implementation of AI technologies in forensic investigations to ensure adherence to ethical standards and legal requirements. Regular audits, clear guidelines for data collection and analysis and mechanisms for redress in case of errors should be implemented.

Continuous evaluation and improvement of AI algorithms in forensic science are necessary to enhance their accuracy, reliability and fairness. Collaboration with multidisciplinary teams of

⁷⁴ Barrington, S., & Farid, H. (2023, March 23). A comparative analysis of human and AI performance in forensic estimation of physical attributes. *Scientific Reports*, 13(1). <https://doi.org/10.1038/s41598-023-31821-3>

experts can provide valuable insights and perspectives to further enhance the development and implementation of AI algorithms in forensic science.

Hence, the integration of artificial intelligence (AI) in forensic science and psychological profiling presents both opportunities and ethical challenges. AI technologies can improve the fairness, accuracy and efficiency of legal proceedings by providing valuable insights into human behaviour and psychological states. However, concerns about bias, discrimination, and privacy must be addressed through rigorous testing and validation, as well as the implementation of ethical guidelines and regulatory frameworks.