ISSSES
中瑞证据科学国际研讨会

5th International Symposium on Sino Swiss Evidence Science

CURRENT CHALLENGES

for Evidence Science and Judicial Proof

7—9 SEPTEMBER 2025

CHENGDU, CHINA

UNIL | Université de Lausanne

University of Lausanne

Faculty of Law,
Criminal Justice
and Public Administration
School of Criminal Justice

China University of Political Science and Law

Institute of Evidence Law and Forensic Science

中国政法大学证据科学研究院

Sichuan University

Law School

四川大学法学院

Symposium Statement

Welcome to Chengdu (China) !

The 5th International Symposium on Sino Swiss Evidence Science 2025 (5th ISSSES) will be held at Sichuan University in Chengdu (China) from Sunday 7 to Tuesday 9 September 2025. The symposium will provide a forum to discuss the current breakthroughs and new directions in the field of evidence science. The symposium is jointly organized by the School of Criminal Justice of the University of Lausanne (UNIL, Switzerland) and the Sino Swiss Evidence Science Research Center (SSESRC), chaired by Professor Wenhua Peng, Dean of the Institute of Evidence Law and Forensic Science, China University of Political Science and Law (CUPL, Beijing).

The ISSSES Scientific Organizing Committee is composed of Professors Baosheng Zhang, Zhong Zhang, Zhiyuan Guo and Yuanfeng Wang from the China University of Political Science and Law (Beijing), Professor Weimin Zuo from the Sichuan University (Chengdu) as well as Professors Christophe Champod and Alex Biedermann from the University of Lausanne (Switzerland).

The Symposium topic is **Current Challenges for Evidence Science and Judicial Proof** and will promote the interchange of ideas between Chinese and Swiss lawyers, scientists, academics and their foreign counterparts. The symposium will provide a platform where leading scholars from China as well as other overseas countries will share their experience and expertise in the field of evidence science. Their perspective on the advancement of the administration of justice in an interdisciplinary perspective will be of interest to scholars and researchers from both forensic science and evidence law.

The 5th ISSSES is supported by:

- The "Double First-Class" University Plan
- The "2011 Plan" of China – Collaborative Innovation Center of Judicial Civilization
- The "111 Plan" of China – Evidence Science Innovation and Talent Base

On behalf of the Hosts and Sponsors, we are delighted you are joining us for the 5th International Symposium on Sino Swiss Evidence Science 2025 (5th ISSSES). We are looking forward to fruitful exchanges on evidence and proof for the administration of justice through an interdisciplinary and international exchange.

Baosheng Zhang, Zhong Zhang, Zhiyuan Guo & Yuanfeng Wang
China University of Political Science and Law

Weimin Zuo
Sichuan University

Christophe Champod & Alex Biedermann
University of Lausanne

ISSSES
中瑞证据科学国际研讨会

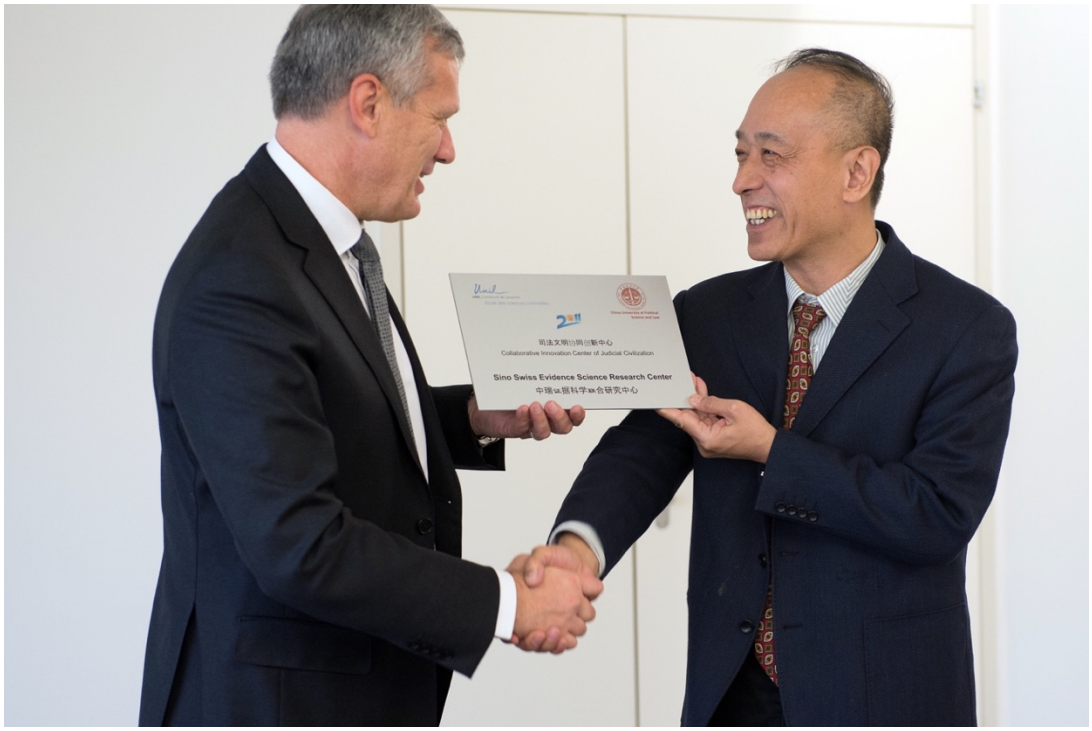
Symposium Programme

Day 1 Sunday September 7th 2025 Opening Ceremony	
Chair: Prof. Yuanfeng Wang, Institute of Evidence Law and Forensic Science, CUPL	
Beijing **08:30**	**Lausanne** **02:30**
Opening Speech Prof. Wenhua Peng, Dean of the Institute of Evidence Law and Forensic Science, China University of Political Science and Law	
08:40	**02:40**
Opening Speech Prof. Christophe Champod, Director of the School of Criminal Justice, Vice-Dean of the Faculty of Law, Criminal Justice and Public Administration, University of Lausanne (Switzerland)	
08:50	**02:50**
Opening Speech Distinguished Prof. Weimin Zuo, Former Dean of the Law School, Sichuan University	

Keynote Speech 1

Chair: Prof. Wenhua Peng, Dean of Institute of Evidence Law and Forensic Science, CUPL

Beijing	Lausanne
09:00	**03:00**
From Low-Information Traces to High-Accuracy Hits: A Forensic Multimodal Biometric Framework Prof. Christophe Champod, Director of the School of Criminal Justice, University of Lausanne (Switzerland)	
09:45	**03:45**
Way to Enhance the Reliability of Forensic Expertise Prof. Baosheng Zhang, Institute of Evidence Law and Forensic Science, China University of Political Science and Law	
10:30	**04:30**
Group Photo & Break (15 min)	
10:45	**04:45**
Integrity in Criminal Procedure Prof. Paul Roberts, School of Law, University of Nottingham (UK)	
11:30	**05:30**
Jigsaw Puzzle or Corroboration? A Study on Chinese Criminal Judges' Fact-Finding through Evidence Analysis Distinguished Prof. Weimin Zuo, Former Dean of the Law School, Sichuan University	
12:15	**06:15**
Break (2h)	



Unit 1 Rethinking Evidence Interpretation and Proof Standards: Trust, Bias, and the Changing Paradigm

重审证据解释与证明标准：信任、偏误与范式转型

Chair: Prof. Zhong Zhang, Institute of Evidence Law and Forensic Science, CUPL

Beijing	Lausanne
14:15	**08:15**
Trust Crisis in Forensic Medical Testimony—Empirical Analysis of the Unified Model in Shanghai Prof. Bangda Chen, School of Criminal Law and Justice, East China University of Political Science and Law	
14:30	**08:30**
Cognitive Bias in Interpretations of Scientific Evidence A Study Based on Representative Criminal Cases in China Associate Prof. Suhao Chen, College of Humanities and Social Sciences, Nanjing University of Aeronautics and Astronautics	
14:45	**08:45**
Conceptualising (un-)interpretability in expert evidence Prof. Alex Biedermann, School of Criminal Justice, University of Lausanne	
15:00	**09:00**
From Authenticity to Credibility: A Subjective Turn in the Paradigm of Evidence Evaluation Jiayuan Zhang, Ph.D., KOGUAN School of Law, Shanghai Jiao Tong University	
15:15	**09:15**
The Perfection of Standard of Proof Under the Background of the Revision of Criminal Procedure Law Prof. Peiquan Xiao, School of Criminal Justice, China University of Political Science and Law	
15:30	**09:30**
Discussion	
15:45	**09:45**
Break (15 min)	

Keynote Speech 2

Chair: Prof. Fei Zheng, Institute of Evidence Law and Forensic Science, CUPL

16:00	**10:00**
Promoting Forensic Science Excellence from a Regulatory and Policy Perspective: Lessons from the UK Prof. Gillian Tully, King's College London (UK)	
16:45	**10:45**
Forensic Evaluative Opinion in China: Research and Case Application Prof. Guiqing Wang, Director-General, Forensic Science Association of China	
17:30	**11:30**
Discussion	

Day 2 Monday September 8th 2025

Unit 2 Intelligent Transformation and Technical Standards in Forensic Evidence Analysis

司法证据分析的智能转型与技术标准建构

Chair: Associate Prof. Bing Li, Institute of Evidence Law and Forensic Science, CUPL

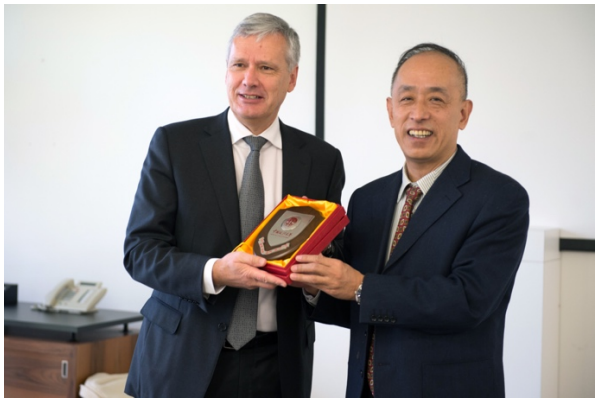
Beijing	Lausanne
08:30	**02:30**
A Comparative Study of Screening Characteristics of Laser Printed Documents Xingzhou Han, Institute of Forensic Science, Ministry of Public Security	
08:45	**02:45**
Extraction of writing features from electronic signatures for comparison Chi Keung Li, Chief Chemist, Government Laboratory of the Government of the Hong Kong Special Administrative Region	
09:00	**03:00**
Magneto-Optical Imaging for the Examination of Security and Questioned Documents Carrie Polston, Ph.D. (Senior lecturer), School of Criminal Justice, University of Lausanne (Switzerland)	
09:15	**03:15**
Paradigm Shift of the Evaluation of Forensic Voice Evidence in China Prof. Cuiling Zhang, Dean of the Institute for Intelligent Justice, Southwest University of Political Science and Law	
09:30	**03:30**
Forensic Science Technical Specifications for Fingerprint Image Quality Assessment Based on Visual Artificial Intelligence Wei Wang, Liaoning Provincial Police	
09:45	**03:45**
The Comparative Study on the Performance between Traditional and AI-based AFIS in Same Source and Close Non-Matches Shuo Li, Ph.D., School of Criminal Investigation, Southwest University of Political Science and Law	
10:00	**04:00**
Discussion	
10:15	**04:15**
Break (15 min)	

Unit 3 Foundations and Frontiers of Evidence Reasoning: From Cognitive Forensics to Procedural Safeguards

证据推理的基础与前沿：从认知取证到程序保障

Chair: Associate Prof. Jing Lin, Institute of Evidence Law and Forensic Science, CUPL

Beijing	Lausanne
10:30	**04:30**
Collection and Examination of Evidence in China's Cybercrime Cases: Challenges and Solutions Prof. Zhiyuan Guo, College of Criminal Justice, China University of Political Science and Law	
10:45	**04:45**
Toward a more fundamental understanding of cognitive forensics: Research paradigm and conceptual framework Assistant Prof. Ning He, Law School, Hunan University	
11:00	**05:00**
Beyond Individualization: Extending the Principle of Forensic Identification to Strengthen the Probative Value of Temporal Evidence Tianruomei Chai, Ph.D., Department of Criminal Investigation, Beijing Police College	
11:15	**05:15**
More than argument and story: five domains in reasoning with evidence Yukun Luo, Ph.D., Institute of Evidence Law and Forensic Science, China University of Political Science and Law	
11:30	**05:30**
A Study on the Dynamic Coordinative Regulation of Children's Testimony: Procedural Convergence and Rights Protection of Evidence Collection, Examination and Determination Zemin Yan, Ph.D., School of Criminal Justice, China University of Political Science and Law	
11:45	**05:45**
Discussion	
12:00	**06:00**
Break (2h)	



Unit 4 Innovations in the Forensic Identification of Emerging Materials and Digital Traces

新兴物证与数字痕迹的法庭识别创新路径

Chair: Wei Ji, Engineer, Institute of Evidence Law and Forensic Science, CUPL

Beijing	Lausanne
14:00	**08:00**
Identification and digital quantification of drugs using surface-enhanced Raman spectroscopy based on flexible substrates Prof. Rui Huang, School of Criminal Investigation, Southwest University of Political Science and Law	
14:00	**08:15**
One Step at a Time: Reassessing Acquired Characteristics of Shoe Soles Using 3D Data Malou Den Harder, Ph.D. student, School of Criminal Justice, University of Lausanne (Switzerland)	
14:30	**08:30**
Research on the Dilemmas of Automotive Electronic Data Forensics Bo Wang, Ph.D. student, Institute of Evidence Law and Forensic Science, China University of Political Science and Law	
14:45	**08:45**
Solutions to Traffic Accidents of Intelligent Connected Vehicles Based on Electronic Data Xiaodong Xu, Engineer, Institute of Evidence Law and Forensic Science, China University of Political Science and Law	
15:00	**09:00**
Identification and Forensic Examination of Novel Writing and Printing Substrates Carrie Polston, Ph.D. (Senior lecturer), School of Criminal Justice, University of Lausanne (Switzerland)	
15:15	**09:15**
Discussion	
15:30	**09:30**
Break (15 min)	

Unit 5 Interpreting Core Forensic Evidence: Reliability, Limitations, and Courtroom Communication

核心法庭证据的解释路径：可靠性、局限性与法庭表达

Chair: Prof. Yuanfeng Wang, Institute of Evidence Law and Forensic Science, CUPL

Beijing	Lausanne
15:45	**09:45**
Reviewing error rates in forensic handwriting examination: A comparative study Raymond Marquis, Ph.D. & Sébastien Crot, Ph.D. student, School of Criminal Justice, University of Lausanne (Switzerland)	
16:00	**10:00**
Can textile fibres in the respiratory tract help to determine the cause of death? Prof. Geneviève Massonnet et al., School of Criminal Justice, University of Lausanne (Switzerland)	
16:30	**10:30**
DNA in the courtroom: recommendations regarding interpretation? Tacha Hicks, Ph.D., School of Criminal Justice, University of Lausanne (Switzerland)	
17:00	**11:00**
Discussion	

Closing Ceremony

Chair: Prof. Weimin Zuo, Former Dean of the Law School, Sichuan University

17:15	**11:15**
Closing Speech Prof. Christophe Champod, Director of the School of Criminal Justice, University of Lausanne (Switzerland)	
17:30	**11:30**
Closing Speech Prof. Baosheng Zhang, Institute of Evidence Law and Forensic Science, China University of Political Science and Law	

Day 3 Tuesday September 9th 2025

Workshops at Sichuan University & Chengdu Public Security Bureau

Beijing	Lausanne
09:00	**03:00**
The new standard "ISO 21043-4:2025 Forensic sciences, Part 4, Interpretation": a brave new world? Christophe Champod and Alex Biedermann, School of Criminal Justice, University of Lausanne (Switzerland) Yuanfeng Wang, Institute of Evidence Law and Forensic Science, China University of Political Science and Law	
ISO 21043-4 from the perspective of forensic voice comparison Ricky Chan, School of English, The University of Hong Kong Bruce Wang, Department of English and Communication, The Hong Kong Polytechnic University	
15:00	**09:00**
Onsite discussion: the Forensic Science Laboratory in Chengdu Public Security Bureau Chair: Sicheng Huang, Dean of the Forensic Science Laboratory in Chengdu Public Security Bureau	
17:00	**11:00**
Closing Speech Prof. Weimin Zuo, Former Dean of the Law School, Sichuan University	

The new standard "ISO 21043-4:2025 Forensic sciences, Part 4, Interpretation": a brave new world?

Workshop coordinators: Alex Biedermann, Christophe Champod, Yuanfeng Wang

Abstract

Following decades of calls for improvements to forensic science at practical and theoretical levels, an internationally agreed series of forensic science standards has recently been published: the *ISO 21043 Forensic Sciences* standard series. The scope of Part 4, "Interpretation", of this standard is as follows:

> "This document specifies requirements and provides recommendations for the interpretation of observations to reach opinions that answer questions that are relevant for decision making in investigations or legal proceedings. This document states requirements that are applicable to all forensic disciplines. This document states requirements that apply when the opinion is based directly on human judgement and when the opinion is based on interpretation through a statistical model. This document is applicable to interpretation that occurs at a scene, within a facility, or within a judicial setting."

This workshop aims to critically examine and discuss the contents of this standard, comparing them with previous recommendations and established principles of evaluative reporting in forensic science. The workshop will begin with short introductory presentations by the coordinators, after which there will be a discussion with the audience. The discussion will encourage interdisciplinary and transnational perspectives from China, Europe and the UK. To enable an informed discussion, all workshop participants are invited to read the *ISO 21043 Forensic Sciences, Part 4, Interpretation* document in advance. Participants who would like to give their own short "lightning talk" (5–10 minutes, with or without slides) at the workshop should contact the coordinators.

At the end of this workshop, the participants will:

- Know about the requirements and recommendations of the *ISO 21043 Forensic Sciences, Part 4, Interpretation* Standard that are intended to ensure the quality of the forensic science process.
- Understand the similarities and differences with respect to previous recommendations and established principles of evaluative reporting in forensic science.
- Be able to engage in critical discourse about the advantages and disadvantages of standardisation initiatives in forensic science, as well as the challenges related to the practical implementation of standards.

Abstracts

(in alphabetical order according to last name)

Cognitive Bias in Interpretations of Scientific Evidence
A Study Based on Representative Criminal Cases in China

Suhao Chen, Associate Prof.

College of Humanities and Social Sciences, Nanjing University of Aeronautics and Astronautics, Nanjing, China

Scientific evidence, which is always indirect, requires interpretation to establish facts in a case. A key characteristic of such interpretations is that they occur after scientific examinations and may lead to multiple possible conclusions. Scientific evidence is typically reported as a likelihood ratio rather than as a definitive result, which judicial officers often expect, making interpretations more challenging. A study of criminal cases in China reveals that cognitive biases—such as appeal to authority, hindsight bias, prejudgment, and information confusion—are common in interpreting scientific evidence, with their influence growing stronger when evidence is uncertain or contradictory. To counter these biases, correction mechanisms can employ empirical rules, structured reasoning and AI-assisted systems. Improving interpretation skills is akin to mental gymnastics, and its effectiveness depends on safeguarding the right to confrontation to strengthen argumentation. While AI-assisted systems can play a pivotal role in interpreting scientific evidence, human discretion and free evaluation remain indispensable regardless of technological advancements. In the AI era, the role of human-in-the-loop must be considered for rule-making and evidence evaluation, as progress in this area could advance theoretical schemes for the interpretation of scientific evidence.

Beyond Individualization: Extending the Principle of Forensic Identification to Strengthen the Probative Value of Temporal Evidence

Tianruomei Chai, Ph.D.

Department of Criminal Investigation, Beijing Police College

Temporal information serves three core functions in judicial proof: trace spatiotemporal localization, construction of the evidence chain, and causal determination. However, its probative value is constrained by the dilemma of individualization association. Time, as a universal measure, lacks intrinsic directionality toward specific individuals and struggles to associate with a particular subject independently. To address this, the study extends the dimensionality of the identification theory, integrating the behavioral pattern stability theory from life-course criminology with the four-dimensional trajectory quantification method based on Minkowski's spacetime framework. At the individual dimension, this approach constructs a dynamic identity profile through the specificity of spatiotemporal combinations traversed. At the crime dimension, it achieves criminal pattern recognition via sequential analysis of modus operandi. Ultimately, this yields a three-layer proof architecture of "Trace-Individual-Crime", extending identification theory from traditional trace-source comparison to behavioral sequence recognition, providing a scientific pathway to overcome the bottleneck of associating temporal information with individuals.

Trust Crisis in Forensic Medical Testimony —— Empirical Analysis of the Unified Model in Shanghai

Prof. Bangda Chen [1] & Suyan Qian [2]

[1] *Professor of Law, School of Criminal Law and Justice, East China University of Political Science and Law, Shanghai*

[2] *Legal Counsel of Ningbo Orient Wires & Cables Co. Ltd., Ningbo, Zhejiang.*

Due to its lack of credibility, neutrality and authority, the trust crisis existing in the Chinese forensic medical system is harmful to the effect of medical dispute resolution. The phenomenon of trust crisis can be manifested in the following aspects: the high rate of multiple-test and appeals, the large number of complains and petitions against forensic testimony, patients' reluctance to seek for service from the Medical Society and the negative public confidence of forensic medical system. The reasons have multiple aspects: apart from the limitations of forensic medicine, the information asymmetry, the dominance of the Medical Society in the identification system, the unbalance between specialty and neutrality, and the controversial process of appointing an expert or a forensic institution all lead to the problem. Solutions to the problem of the trust crisis are multiple. We should promote the reform the forensic medical system, regulate the appointment process of experts and forensic institutions, establish the mechanism of challenge, enhance the education and popularization of public health knowledge, accelerate the communication between patients and forensic experts, design new methods for experts to testify in court, strengthen the information disclosure, and clarify the circumstances of re-identification.

Collection and Examination of Evidence in China's Cybercrime Cases: Challenges and Solutions

Prof. Zhiyuan Guo

College of Criminal Justice, China University of Political Science and Law

Cybercrime has become a global problem in recent years. With the growth of cybercrime, Chinese legislature and judicial authorities have issued a series of legal documents to regulate the handling of cybercrime cases. Due to its special features, cybercrime cases are processed differently from those in traditional criminal cases. This paper focuses on the collection and examination of evidence in cybercrime cases. According to the current legislations on the handling of cybercrime cases in China, there are four key issues deserving exploration: by what procedure the police collect evidence directly from the internet service providers, how the investigators interview or interrogate witnesses via telecommunication, to what extent technical investigation can be used in cybercrime cases, and whether sample evidence collection is scientific. All these issues have legal roots and have caused controversy in practice. This paper will examine these issues in the context of academic debates in China. With regards to the evidence examination, is there any difference between cybercrime cases and traditional cases? This paper will explore this issue from what to examine and how to examine it. Academic debates will be considered, and practical problems will be addressed. In Part I, an introduction to the legal framework for the handling of cybercrime cases in China will

lay the groundwork. Part II will discuss the four key issues of collecting evidence in cybercrime cases. Part III will explore what and how to examine the evidence, mostly electronic evidence, in cybercrime cases. Part IV will conclude the paper with some preliminary recommendations for future legislative reforms in this area.

Toward a more fundamental understanding of cognitive forensics: Research paradigm and conceptual framework

Ning He, Assistant Prof.

Law School, Hunan University, Changsha, China

Cognitive forensics has become a new emerging field of forensic science over the last two decades. Most of the research focuses on arguing for the existence, adverse effects and sources of expert bias and exploring approaches to mitigate it. However, several metaphysical questions that may form the foundation of this field, may have been neglected. This communication seeks to explain the research paradigm and conceptual framework of cognitive forensics. Firstly, cognitive forensics represents the evidence-led forensic science paradigm that differs fundamentally from forensic intelligence. Secondly, the core theoretical framework of cognitive forensics is the division of fact-finding function based on Bayesian decision theory, in which the role of fact-finders is to evaluate posterior odds and prior odds, and forensic experts are in charge of determining likelihood ratio.

Reliability of Forensic Expert Opinions under the Likelihood Ratio Paradigm: A Paradigm Shift and Challenges in Evidence Science

Yiwen Ge & Mingyang Hao , Jungang Lv

Procuratoral Technology and Information Research Center, Supreme People's Procuratorate, Beijing 100144, China

Within the judicial system, forensic expert opinions, as one of the statutory forms of evidence, hold significant implications for judicial fairness. With the advancement of the "trial-centered" litigation system reform, higher demands have been placed on the scientific validity and probative force of forensic forensic expert opinions. Currently, the application of forensic expert opinions in China faces multiple practical challenges, such as insufficient argumentation, ambiguous quantitative hierarchies, and inadequate substantive review, all of which undermine the reliability of forensic forensic expert opinions and the efficacy of judicial proof. The likelihood ratio (LR) method, as a paradigm shift in evidence evaluation, offers a scientific pathway to address these issues. Rooted in Bayesian probability theory, it quantifies the degree to which evidence supports a proposition, transforming forensic forensic expert opinions from qualitative to quantitative assessments. This approach has demonstrated significant application value in DNA analysis, handwriting identification, voiceprint verification, and other fields. However, the application of the LR framework in judicial evidence science also encounters challenges, including cognitive limitations, technological disparities, and biases toward DNA evidence. To address these challenges, future solutions must be explored through a collaborative governance lens. This includes constructing a

scientifically oriented review system for forensic expert opinions by incorporating international standards, enhancing scientific scrutiny, promoting the application and refinement of the LR framework, accelerating foundational research and database development, and strengthening technical evidence review mechanisms to improve judicial efficiency. Through these measures, the reliability of forensic expert opinions can be elevated, advancing evidence science and addressing contemporary challenges in judicial proof, thereby safeguarding judicial fairness and efficiency.

Identification and digital quantification of drugs using surface-enhanced Raman spectroscopy based on flexible substrates

Prof. Rui Huang [1,2,3,4] & Yi Zhou [1,3,4]

[1] *School of Criminal Investigation, Southwest University of Political Science and Law, Chongqing 401120, China*
[2] *Forensic Science Center, Southwest University of Political Science and Law, Chongqing 401120, China*
[3] *Engineering Research Center for Smart Justice of the Ministry of Education, Chongqing 401120, China*
[4] *National Research Center for Drugs Control and Governance, Chongqing 401120, China*

The international and domestic drug abuse situation remains severe and complex, with prominent substitution abuse issues involving addictive substances such as narcotic and psychotropic drugs. Current detection technologies fail to effectively address the false-negative challenges caused by complex practical factors. To tackle this, this study focuses on three most prevalent abused narcotic and psychotropic drugs—heroin, cocaine, and etomidate. A flexible surface-enhanced Raman spectroscopy (SERS) substrate was fabricated through surface self-assembly to meet the demand for rapid drug detection in diverse complex field scenarios. Furthermore, the digital surface-enhanced Raman spectroscopy (dSERS) strategy was introduced, which successfully resolved false-negative issues in forensic drug detection caused by low concentrations, polydrug interactions, and complex matrix interferences through large-area SERS sampling, intensity threshold setting, and digital probability calculation. The integration of flexible SERS substrates with the dSERS strategy not only fulfills on-site rapid detection requirements but also effectively addresses false-negative challenges, providing a universal new solution for detecting narcotic and psychotropic drugs in anti-drug enforcement practices.

A Comparative Study of Screening Characteristics of Laser Printed Documents

Xuezhou YU [1] & Jinlin LIN [1] , Yuanli HAN [2] , Xingzhou HAN [3]

[1] *School of Investigation, People's Public Security University of China, Beijing 100038, China;*
[2] *Key Laboratory of Evidence, China University of Political Science and Law, Beijing 100088;*
[3] *Institute of Forensic Science, Ministry of Public Security, Beijing 100038, China*

Laser printers are gaining popularity in everyday work and life, but they have also become a common tool for criminal activities. Traditional document inspectors have relied on color "tracking codes" to inspect color laser-printed documents. However, recent software developments that can remove these codes have posed new challenges for document inspection. This paper presents an

experimental study on the mesh characteristics of color laser-printed documents, exploring the nuances of mesh morphology, spacing, area, and angle. The research was conducted on various brands and models of printers, and different image resolutions were selected for sample production. By observing and comparing the print dot characteristics of the same section, the study aimed to uncover the underlying patterns of mesh features in laser-printed documents. The research reveals that the dot characteristics of the same laser printer exhibit relative stability across different printing time. Moreover, when the same printer is used to print images of varying resolutions, the differences in screening characteristics are negligible. Conversely, distinct brands and models of printers yield diverse dot patterns, dot spacing, dot areas, and mesh angles. Notably, the dot pattern and mesh angle characteristics serve as highly valuable identifiers, particularly in the context of "same-machine" identification. This research underscores the feasibility of utilizing mesh features to differentiate laser-printed documents, thereby offering novel inspection strategies for the authentication of color laser-printed documents.

The Comparative Study on the Performance between Traditional and AI-based AFIS in Same Source and Close Non-Matches

Shuo Li, Ph.D. [1] & Ran Chang, M.Sc. [2], Wanting Wang, M.Sc. [2]

[1] *School of Criminal Investigation, Southwest University of Political Science & Law, Chongqing 401120, China*
[2] *Criminal Investigation Division of the Beijing Municipal Public Security Bureau, Beijing 100038, China*

With the optimization of recognition algorithms and the expansion of database scale, the field of fingerprint examination has gained new developmental opportunities while still facing challenges such as close non-matches. To further investigate the performance differences in same source and close non-matches (CNMs) among current Automated Fingerprint Identification Systems (AFIS), 32 sets of 256 simulated latent fingerprints were prepared in this study (based on pre-existing samples with high-level CNMs) for query experiments in System A (traditional algorithm-based AFIS) and System B (deep learning algorithm-based AFIS). It was demonstrated that System B achieved a 47.7% same source identification rate, significantly surpassing System A by 31.6%, while enabling fully automated feature annotation. Although deep learning algorithms improved low-quality fingerprint recognition through fused feature representation, inter-class similarity caused by database expansion remain notable. System B exhibited a lower CNMs risk rate (3.5%) compared to System A (10.2%), with both systems showing coexistence of CNMs in candidate queues (System A: 2.7%; System B: 2.3%). These findings emphasize the necessity for examiners to enhance discrimination capabilities for CNMs and advocate for optimized collaborative verification models balancing "algorithmic screening & expert review" to ensure forensic accuracy. It provides empirical insights for advancing fingerprint evidence verification workflows in the era of intelligent forensics.

More than argument and story: five domains in reasoning with evidence

Yukun Luo, Ph.D.

Institute of Evidence Law and Forensic Science, China University of Political Science and Law

The method of reasoning with evidence is one of the core domains of evidence law research. It is generally believed that the methods of reasoning with evidence are mainly divided into two categories: the method of argument and the method of story, as well as hybrid theory that combine the two. However, these two methods are not the whole of the process of reasoning with evidence, and some domains are either covered by them, or overlooked. Douglas Walton successfully separated explain from argument, while the former aimed at resolving facts that were accepted but not understood by the audience, and the latter aimed at making the audience accept the facts in questioned. Roger Schank's story schemes and Ashley's case-based reasoning model indicate that there is another dimension in the method of story: matching and analogy. Chaïm Perelman's New Rhetoric enlightens us that reasoning with evidence should not only justify oneself and not fall behind in argumentation and comparison, but also persuade the audience. Therefore, reasoning with evidence consists of five domains: explaining observation, causal narrative, argumenting story, matching and analogy, and rhetorical persuasion. By systematically combining these five domains, a "two-poles and three-dimensions" (2P-3D) hybrid theory is established.

Research on the Dilemmas of Automotive Electronic Data Forensics

Bo Wang (Ph.D.student) [1,2] & Yuanfeng Wang [1] , Lili Guo [2] , Lu Zhao [2] , Kunlin Yang [2]

1. School of Institute of Evidence Science, China University of Political Science and Law
2. Institute of Forensic Science, Ministry of Public Security, Beijing, China

Automotive electronic data forensics plays a crucial role in modern legal investigations. However, it confronts numerous challenges. Technically, the rapid development of automotive electronics leads to the deep integration of advanced driver-assistance systems and other systems with complex networks. Component communication is encrypted, and some systems are closed, impeding the connection of forensic devices and increasing the difficulty of evidence acquisition.

Legally, there is an absence of unified standards for the collection, storage, and admissibility of automotive electronic data. Regional regulations vary, causing confusion in cross-border cases. The legality of evidence is in dispute, and the boundaries of privacy protection during forensics are ambiguous.

Regarding data characteristics, vehicle data is voluminous and fast-changing. Transient data is prone to loss, and due to the open-source nature of some software, data can be easily tampered with, making authentication and integrity verification complex.

In response to these challenges, the cultivation of interdisciplinary talents is urgent. It is necessary to train professionals who are proficient in electronic data forensics techniques, familiar with automotive electronic architectures, and knowledgeable about legal provisions and forensics practices. This will ensure the effectiveness and reliability of automotive electronic data in judicial proceedings.

Forensic Evaluative Opinion in China: Research and Case Application

Guiqiang Wang, Research Fellow
Director-General, Forensic Science Association of China

A transition is currently underway in the forensic science community from the traditional categorical opinion paradigm to an evaluation-based opinion paradigm. Within this new framework, the likelihood ratio (LR) serves as a quantitative measure of the evidentiary value of forensic findings and is widely regarded as the gold standard for interpretation. This presentation will cover the following aspects: [1] a brief overview of evaluative opinions versus traditional categorical opinions; [2] a review of recent advancements of research on LR-based evaluation methods in China, covering both feature-based and score-based approaches across various physical evidence types, including DNA, voice, faces, fingerprints, barefoot impressions, footwear prints, firearm marks, glass, explosives, handwriting, and questioned documents; [3] an introduction to the practical application of evaluative opinions in real casework in China; and [4] a discussion on the pathway toward implementing this paradigm shift within China's forensic science community.

Forensic Science Technical Specifications for Fingerprint Image Quality Assessment Based on Visual Artificial Intelligence

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The NFIQ (NIST Fingerprint Image Quality) standard has been globally adopted for two decades, yet critical adaptability gaps persist in forensic operational workflows—particularly in human-machine collaborative tasks like AFPIS based Latent/Ten-print Visual Comparison operation (LT-VC). To address these limitations, a novel industry standard (CFIQ1.0, Cognitive Fingerprint Image Quality) aligned with ISO/IEC 29794-1:2024 has been developed. By integrating visual representation learning and spatial weighting reconstruction technologies, CFIQ1.0 establishes a domain-specific quality framework that systematically bridges the gap between visual operational requirements in forensic AFPIS (Automatic Fingerprint & Palm-print Identification System) and AI-driven solutions. Key innovations include:

1.Domain-specific quality definition and quality component models,
2.Quantifiable quality assessments via mapping and scoring matrices,
3.Crowd-sourcing-based Fidelity Analysis /Utility Participated Normalization anchored in visual annotation driven datasets from AFPIS LT examiner communities.
Based upon artificial intelligence, this standardization project fills critical gaps in forensic quality assessment standards and pioneers a new human-centric paradigm extensible to multimodal forensic biometric databases (fingerprint/palmprint/face/iris) .

The Perfection of Standard of Proof Under the Background of the Revision of Criminal Procedure Law

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In criminal proceedings, the standard of proof for conviction is a thread running through the process of proving, and is the last hurdle to ensure the quality of criminal cases, which is of great significance in preventing the occurrence of wrongful cases. Under the background of advancing the trial-centered reform of criminal procedures, this reform requires not only the substantiation of trial procedures, but also the substantiation of convictions. The essence of the substantiation of convictions lies in the establishment and strict performance of the standard of proof, which should conform to objective rules. China's legislation on the standard of proof for conviction has revolved around the standard of which the facts in criminal cases should be proven without doubt, changing from the "all evidence should be clear, conclusive and undoubted" standard to the "facts are clear, the evidence is hard and sufficient" standard during the whole process. In judicial practice, it is common for a court to pass an acquittal where the standard of proof for conviction has not been met. In order to realize the substantiation of convictions and to give full play to the role of the standard of proof in determining the quality of a conviction, effective measures should be taken to refine the interpretation of the standard of proof. These measures should adhere to the standard of conviction, implement the principle of "presumption of innocence", and strengthen the system of reasoning in judgments.

Solutions to Traffic Accidents of Intelligent Connected Vehicles Based on Electronic Data

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By studying the types of electronic data in traffic accidents involving intelligent connected vehicles, this paper proposes identification methods for the existence, authenticity, and functionality of electronic data based on different case requirements, aiming to enhance the accuracy of accident scene reconstruction and the reliability of evidence in traffic accidents involving intelligent connected vehicles. Background: With the continuous increase in the market share of intelligent connected vehicles, the probability of traffic accidents also increases accordingly. Compared to traditional fuel vehicles, the causes of traffic accidents involving intelligent connected vehicles are more complex, bringing new challenges to traffic accident investigations. Methods: According to the criteria for determining the existence of electronic data, we summarized the sources, types, contents, and storage methods of electronic data from 9 kinds of intelligent connected vehicles. We proposed the methods and procedures for obtaining evidence of different types of electronic data from these vehicles. Combining the criteria for determining the authenticity of electronic data

and the authenticity of audio-visual materials, we suggested comprehensive identification methods based on data attributes, video attributes, voiceprint attributes, and simulation experiments to verify the authenticity of the electronic data from intelligent connected vehicles. We also proposed, based on the functional criteria for determining electronic data and combined with practical cases from China and abroad, comprehensive identification methods such as code analysis, algorithm comparison, hardware detection, and road experiments to test the functional safety and expected functional safety of intelligent connected vehicles. Conclusion: The study of the existence, authenticity, and functionality of electronic data in Intelligent Connected Vehicles can effectively enhance the accuracy of accident scene reconstruction and the reliability of evidence in China's Intelligent Connected Vehicle traffic accidents.

A Study on the Dynamic Coordinative Regulation of Children's Testimony: Procedural Convergence and Rights Protection of Evidence Collection, Examination and Determination

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Children's testimony in child abuse cases often plays a more critical role in the discovery of the facts of the case and, in many cases, has become the primary evidence. However, for the sake of child protection, the admissibility of child testimony should be evaluated through the three parts of evidence collection, examination, and determination, forming a chain-like organic whole. Regarding the questioning of child witnesses, the setting and techniques employed during the questioning process may have a more significant impact on the children's testimony. For example, the conflict between the Chinese Criminal Procedure Law and the Law on the Protection of Minors regarding the presence of female staff shows that gender-based role conflicts may undermine the legitimacy of testimony. Another example is that the presence of a suitable adult may also be rendered ineffective in practice due to factors other than legal provisions. Regarding the examination of children's testimony, in China, child witnesses generally do not appear in court for examination. However, there is still a lack of specialised procedural settings for cases where the child witness appears in court to testify. Regarding the examination and determination of children's testimony, China still lacks examination and determination standards and rules that differ from those for adult witness testimony, based on the unique characteristics of child witnesses and the examination of testimony in court. It should be recognised that the best protection for children is not to avoid them testifying in criminal cases but rather to consider building a synergistic path of "effective questioning - protection in court - credible assessment" to promote the transformation of the child testimony into refined proof and to provide a systematic solution for legislation and judicial practice.

A Study on Quantifying the Individuality of Fingerprints and the 3D Feature Distribution of Minutiae

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The hypothesis of fingerprint individuality remains unconfirmed, controversially affecting the scientific foundation of fingerprint identification. This study proposes a quantitative model for fingerprint individuality and investigates the three-dimensional (3D) distribution patterns of minutiae. This model considers the position and direction of fingerprint minutiae as three-dimensional (3D) feature variables. We extracted three-dimensional feature data for minutiae from 56,812,114 fingerprints based on the Automated Fingerprint Identification System (AFIS). Following data calibration, translation to the preset range, and error correction based on set rules, we statistically analyzed the distribution density of minutiae. We developed algorithms to calculate the individuality scores of pixel points in a three-dimensional statistical area and the fingerprint individuality scores. Experimental results reveal systematic distribution patterns in fingerprint minutiae, demonstrating symmetric density correlations for corresponding finger positions of left and right hands. Significant density variations are observed across the five primary fingerprint types (whorl, left loop, right loop, arch, mixed pattern) with distinct core point distribution characteristics identified for each pattern type. Furthermore, minutiae exhibit Y-axis symmetry in both spatial and quantitative distribution across orientations, while vertical angular ranges display congruent distribution patterns. The individuality scores distribution for pixel points in the three-dimensional statistical area and the fingerprint individuality scores are sufficiently robust to distinguish between different fingerprints. This work provides novel insights into the unresolved question of fingerprint individuality while establishing a statistical foundation for refining AFIS scoring mechanisms and likelihood ratio evidence evaluation frameworks.

Paradigm Shift of the Evaluation of Forensic Voice Evidence in China

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With the advancement of Artificial Intelligence(AI) technology and the development of forensic data science, the evaluation of forensic evidence is undergoing a paradigm shift internationally. The traditional paradigm of forensic evidence evaluation based on the professional experience and subjective judgment of experts being replaced by a new paradigm based on probabilistic reasoning and quantitative evaluation. This presentation will introduce the core elements of the new paradigm including：（1）adopting the logical framework of likelihood ratios；（2）quantitative

evaluating of the value of evidence using relevant data, quantitative measurement, and statistical models; (3) empirical testing of validity and reliability under case conditions. The development of research on this new paradigm of forensic voice evidence in China will be reported. Typical case examples will be also introduced to demonstrate its application and significance.

From Authenticity to Credibility: A Subjective Turn in the Paradigm of Evidence Evaluation

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Reflections on the authenticity of evidence are essentially a continuation of the critique of the objectivity of evidence. Currently, there are some misconceptions in China's academic circles regarding the authenticity of evidence, which are mainly manifested as: emphasizing necessary inferences, advocating corroborative proof methods, and pursuing objective truth. These tendencies have plunged judicial proof into a predicament of objectification. The attributes of evidence are not primary properties in the formal cause sense, but functional properties in the final cause sense, which are the criteria for evidence review. However, there is a clear discrepancy between the qualitative evaluation attitude towards authenticity review in normative expressions and the practice of evaluating evidence authenticity in a quantitative manner in judicial practice, which highlights the contradiction between authenticity expression and practice. Authenticity, as a conceptual product in simple scenarios, can no longer adapt to the needs of complex fact-finding systems. It can neither solve the practical urgency of fact-finding nor address the challenges of uncertainty and error risks. Moreover, its crude corroborative review standards cannot provide refined tools for judicial proof. Therefore, we need to achieve a paradigm shift from the evaluation of evidence authenticity to the evaluation of credibility in theory, guiding evidence evaluation from ontology to epistemology, from the metaphysical thinking of either true or false to the dialectical thinking of both true and false, and from the fact correspondence of the object-oriented approach to the logical correspondence of the subject-oriented approach.

Special Academic Contribution

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Way to Enhance the Reliability of Forensic Expertise

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Abstract There are three primary approaches to enhancing the reliability of forensic expertise: first, strengthening quality control throughout the examination process, which encompasses emphasizing the role of pre-assessment, improving the chain of custody for testing materials, piloting reforms in the likelihood ratio quantitative evaluation method, and maintaining the neutrality of forensic science institutes and practitioners; second, refining the presentation and cross-examination of forensic expertise in the trial, including ensuring forensic practitioners testify in court and enabling attorneys to guide expert assistants in cross-examination; third, enhancing judges' capabilities in reviewing the reliability of forensic expertise.

Keywords Forensic Expertise, Reliability, Quality Control, Presentation and Cross-examination, Review

1. The Significance of Reliability of the Forensic Expertise for Accurate Fact-Finding

In the trial, the accuracy of fact-finding depends not only on the quantity of relevant evidence obtained, but also on the reliability of evidence. As a result, the U.S. Federal Rules of Evidence (FRE) 702 sets up the admissibility standards for expert testimony which considers "relevance and reliability"1. Similarly, Article 97 of the Supreme People's Court(SPC) Interpretation of PRC Criminal Procedure Law enumerates ten criteria for forensic expertise review, among which "(3)……whether the testing material is reliable", and "(6) whether the process and methodology

[1] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.718.

of the examination comply with the normative requirements of relevant professional fields", constitute provisions addressing the reliability of forensic expertise; and "(8) Whether the forensic expertise is relevant to the facts of the case", constitutes a requirement of relevance.

Compared to traditional evidential reasoning based on witness testimony, "analyze investigative objects such as fingerprints and blood Project" off improved technology significantly enhances the probative value of physical evidence"2.The reliability of forensic expertise depends not only on the "reliable principles and methods", but also on "the expert has reliably applied the principles and methods to the facts of the case",3that is "scientifically valid reasoning and reliable methodology".4 According to the latest data from the "Innocence Project" of the U.S. NYU School of Law, over half of wrongful convictions result from the "misapplied forensic science": (1)Unreliable or invalid evidence. Methods once widely accepted but have been revealed weaknesses in their scientific foundations by DNA testing include bite mark analysis, hair comparisons, fingerprint analysis, etc. (2) Misleading expert testimony. Practitioners exaggerated the connection between the crime scene evidence and the person of interest, mischaracterized exculpatory results as inconclusive, or downplayed the limitations of the forensic science method they had used. (3) Mistakes and misconducts of practitioners. Practitioners made mistakes when performing well-supported forensic methods in a laboratory, fabricated results to bolster the prosecution's case against an individual or hidden exculpatory evidence."5 Each of these factors reflects a deficiency in the reliability of forensic expertise. Therefore, the U.S. Supreme Court held that "Rule 702 confides to the judge some gatekeeping responsibility in deciding questions of the admissibility of proffered expert testimony", "the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand."6 In the same way, Article 97 of SPC Interpretation of PRC Criminal Procedure Law explicitly sets forth requirements for reviewing the reliability of forensic expertise, including the reliability of the chain of custody of testing material, whether the examination process and methods compliance with professional standards, and whether the forensic expertise conflicts with other evidence. However, Chinese judges still show a limited ability to review and evaluate the reliability of forensic expertise in the trial. For instance, survey data by Professor Chen Xuequan indicates that, "as being gatekeepers to the authenticity of evidence, the confidence rate of Chinese judges in the DNA evidence submitted by the prosecution is as high as 99.65%."7 In the context of Chinese trial, it is obviously an urgent task to dispel the superstition about forensic expertise and explore the methods to improve their reliability.

2. Improve the Reliability of Forensic Expertise through Management Innovation

Promoting management innovation to enforce quality control over forensic science institutes and their activities—including the producers, production conditions, process of production, and quality

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[2] Gustav Radbruch, *Introduction to Law* (Chinese Version), Trans. Jian Mi, Law PRESS 2013, pp.174-175.

[3] US Federal Rules of Evidence 702(c)(d)

[4] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.781.

[5]Innocence Project, **Misapplication of Forensic Science**, *Innocence Project*, https://innocenceproject.org/misapplication-of-forensic-science/ (last visited Apr. 30, 2025).

[6] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.720.

[7] Xuequan Chen, "To regard the Probative Value of DNA Evidence Scientifically," Tribune of Political Science and Law, 50-61(2010).

of forensic expertise—is a crucial approach to improving the reliability of forensic expertise. Problems present in Chinese forensic examination—such as the neglect of examination process report, the ambiguous expression of forensic expertise, the weaken of forensic practitioners' sense of responsibility, and even instances of fraudulent examination—are all related to the imperfect management system. One of the fatal problems is that the management concept of the General Rules for Forensic Examination of the Ministry of Justice (thereafter referred to as "General Rules of MoJ") is backward, which hinders the innovation of the forensic examination system. This is reflected in two aspects: on the one hand, as stipulated in Article 4, the general requirements for forensic examination to abide by laws and regulations are too broad and lack specific regulations on the particularities of such activities; on the other hand, as stipulated in Article 23, it is limited to the technical standards such as national standards, industry standards and technical norms that the experts should follow, but lacks regulations on the basic principles of forensic examination.

To improve the quality of forensic expertise through management innovation, we can draw on the principles of balance, logic, robustness and transparency established in the ENFSI Guideline for Evaluative Reporting in Forensic Science (ENFSI Guideline), to promote the renewal of the management concept of forensic examination in China, and take balance, logic, reliability and opening as the basic principles of forensic expertise in China. The innovative significance of the balance principle to the concept and system of forensic examination lies in that it requires that "The findings should be evaluated given at least one pair of propositions: usually one based upon one party's account of the events and one based upon an opposing party's account of the events"8.If no alternative can be formulated, the value of the forensic findings should not be given assessed. In that case, forensic practitioners should state clearly that they are not reporting upon the value of the findings.9The principle of logic requires that forensic practitioners should not present the probability of litigation claims (based on specific findings and background information) like a lawyer does, but the probability of the findings (given specific litigation claims and background information). This prevents the conflation of their role with that of attorneys or prosecutors. The principle of reliability requires that the findings must be evaluated and cannot vary from person to person. The principle of opening requires that evaluative reports must reach conclusions through a process of argument and be comprehensible to judges and attorneys.10

Promoting innovations in examination management based on the above principles, thereby improving the reliability of forensic expertise, specifically entails the following measures:

2.1. The significance of pre-assessment (Contract Review)

In China, there is a lack of pre-assessment for forensic examination, which often leads to a situation where forensic expertise cannot be given. Accordingly, introducing the pre-assessment at the stage of accepting the mandate will become a starting point for the renewal of forensic examination concepts and institutional innovation.

First, pre-assessment allows the forensic practitioner to avoid the dilemma of being unable to give a forensic expertise. Through the pre-assessment stage, the forensic institutes and practitioners can

[8] ENFSI *Guideline for Evaluative Reporting in Forensic Science*, p.10.
[9] Standards for the formulation of evaluative forensic science expert opinion, Association of Forensic Science Providers, Science and Justice 49 (2009), pp.161-164.
[10] Baosheng Zhang and Junyao Yue, "On the Construction of Basic Principles of Judicial Appraisal in China—A Comparative Analysis Based on Sino-European Forensic Science Standards," Journal of Xiamen University, 2022, No. 6, pp. 122 ff.

preliminarily evaluate whether the testing materials given by the mandating authority or party are suitable for standardized tests. By "specify main potential findings from scientific examinations of the items submitted"11, forensic practitioner must inform the mandating authority or party when forensic examination cannot be helpful for distinguishing different propositions, which reflects a rigorous scientific attitude. Accordingly, Article 14 of General Rules of MoJ for the review of mandate matters, it needs to be supplemented while practitioners find that they cannot draw a clear conclusion based on the testing materials and samples, should declare to the mandating authority or party the limitations of the existing forensic science techniques to avoid falling into the dilemma mentioned above.

Secondly, pre-assessment enables practitioners to take part in setting the mandate matters for examination and to request supplementary testing materials. For instance, when the quality of testing material is insufficient to meet the requirements for identifying the suspect's identity, forensic practitioner can negotiate with the mandating authority or party to have an exclusionary identification of the suspect, rather than simply refuse to examine or issue an inconclusive forensic evaluative report. This helps to improve the reliability of forensic expertise.

2.2. The Chain of Custody for Testing materials

Typically, the mandating authority or party should be responsible for the authenticity of the testing materials. This is in line with the principles of division of labor and efficiency. However, if the forensic science institute has sufficient reasons to doubt the reliability of the materials source, it may refer to ENFSI Guideline 3.7, which advises to enquiry such as the submission format, container, or packaging.12Similar, besides the regulations about the chain of custody for testing material from Articles 12 to 15 of General Rules of MoJ, technical standards such as the Specification of Mitochondrial DNA Testing for Forensic Purpose (SF/ZJD0105008—2018) have more specific requirements: "Establish protocols for the transportation, receipt, disposal, protection, storage, retention and/or clearance of samples. Records should be made for processes such as receipt, internal transfer, disposal, retention, return and clearance to ensure the integrity and traceability of the records." 13 The above regulations aim to prevent negative factors such as the loss, mix-up and contamination of samples that affect the reliability of the forensic examination. However, there is a lack of a procedure for identification and authentication of the testing materials in the trial.

2.3 The Neutrality of Forensic Science Institutes and Practitioners

The "neutrality" of forensic science institutes and forensic practitioners also influence the reliability of forensic expertise. One defect of the expert witness system is that experts, who are paid by the parties and appear in court to serve their interests, are inevitably somewhat biased, such as: (1) Conscious bias, whereby experts may deliberately accommodate their employers; (2) Unconscious bias, namely the inherent tendency of individuals to serve their employers; (3) Selection bias, whereby attorneys deliberately choose experts who align with their own views. 14For instance,

[11] ENFSI *Guideline for Evaluative Reporting in Forensic Science*, p.7.
[12] ENFSI *Guideline for Evaluative Reporting in Forensic Science*, p.8.
[13] Technical Specification for Judicial Appraisal (SF/Z JD0105008—2018), Section 4.1(e).
[14] Xiju Zhao, "Expert Testimony, New Scientific Theories, and the Role of the Judge: Focusing on the Daubert Standard in American Law," Evidence Science, 2010, Vol. 18, No. 1, p. 30.

attorneys tend to preferentially select experts favorable to their side, even may preemptively hire experts whose testimonies are unfavorable to them to prevent them from testifying for the other party. 15Some courts in the United States have found other factors relevant in finding whether expert testimonies are sufficiently reliable to be considered by the trier of fact, include "whether the expert has adequately accounted for obvious alternative explanations"16. This precisely reflects the principle of balance in the ENFSI Guideline, which requires that "the practitioner does this by considering the findings in relation to at least two competing propositions. Often the propositions are established from the prosecution and defense positions."17In summary, only by implementing the principle of balance can the neutrality be guaranteed.

The issue of neutrality in Chinese forensic science institutes and practitioners primarily concerns two aspects: first, the non-neutrality of forensic science institutes established within investigative authorities, characterized by the confusion of roles and identities between forensic practitioners and investigators, as well as a top-down and closed management system, which readily results in a lack of independence and neutrality of these institutions and further bias in their forensic expertise. 18Second, in the setting of mandate matters in criminal cases, different propositions from the prosecution and the defense are not afforded equal treatment by forensic science institutes. Pursuant to Article 146 of the PRC Criminal Procedure Law, the mandating authorities of the "appointed or engaged" forensic examination are the public security organ or the people's procuratorate, while the appointees should be their internal forensic science institutes. Pursuant to Article 148 and Section 1 of Article 197, only the investigative authority is entitled to initiate forensic examinations and function as the mandating authority by submitting the "grounds for examination" (as stipulated in Article 97 of the SPC Interpretation of the Criminal Procedure Law), while suspects and victims may only submit applications for "supplementary examination or reexamination." Pursuant to Article 11 of General Rules of the MoJ, forensic science institutes shall only accept forensic examination mandating from case-handling agencies. This inequality in the right to start examination causes the setting of the mandate matters solely based on the prosecution's account of the events, without considering the defense's alternative account of the events, thereby potentially turning forensic examination into a tool of criminal investigation. For instance, in the cases of Du Peiwu19 and Nian Bin20, the defense's alternative account of the events was entirely excluded from the forensic practitioners' consideration.

To address the prosecution-defense inequality in the examination initiation procedure and the setting of mandate matters for examination, where only the prosecution's account of the events are considered and the defense's alternative account of the events are disregarded, we suggest drawing on the principle of balance, to amend General Rules of MoJ with two revisions: First, for situations that "forensic science institutes shall not accept examination mandating matters" listed in Article

[15] Fangfang Luo, "From 'Scientific Spokesperson' to 'Client's Advocate': The Historical Evolution of Expert Witnesses and an Examination of the Current Situation in China," Evidence Science, 2013, No. 4, pp. 504–505.
[16] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.733.
[17] ENFSI *Guideline for Evaluative Reporting in Forensic Science*, p.11.
[18] Zhichun Du and Daming Sun, "Current Major Issues and Reform Proposals in the Field of Judicial Appraisal in China," China Forensic Science, 2017, No. 3.
[19] Jiao Yan, "Du Peiwu: From Police Officer to Death Row Inmate, and Back to Police Officer", December 13, 2002, Source: China Lawyer Network, http://bbs.tianya.cn/post-law-197984-1.shtml, last accessed January 30, 2023.
[20] See Criminal Incidental Civil Judgment of the Higher People's Court of Fujian Province (2012) Min Final criminal trial No. 10.

15, add an item that "In the mandating matters, where there is only specific proposition made by the mandating authority but no alternative proposition made by the defense party", to achieve equality between the prosecution and the defense in the initiation of forensic examination. Second, following Article 16, which stipulates that "The forensic examination entrustment letter shall specify…the mandating matters and the basic case related to the examination", add a new rule to embody the principle of balance: "When a forensic science institute signs an entrustment letter with a mandating authority or party, it should understand the basic case related to the examination, listen to the opinions of both prosecution and defense, and know well their claims from both sides." If these two revision suggestions can be adopted by the Ministry of Justice, the issue of the "neutrality" of forensic science institutes and practitioners, which is the key factor for the reliability of forensic expertise, will be fundamentally improved.

2.4 Explore Expression of the Likelihood Ratio for Forensic Findings

The mode of expression of forensic findings is a crucial factor influencing their reliability. In China, forensic expertise exposes This leads to overly abstract and imprecise expressions of forensic findings in practice. These expressions can be classified into two categories: "affirmative" and "negative" (for example, "This fingerprint is/is not from the same finger as the right thumb fingerprint of a certain individual."). There are four types: "affirmative and negative"; "tendency affirmative and tendency negative" (for example, "tends to support that X and Y are or are not paternal half-siblings"); "cannot exclude" (for example, "cannot exclude that the deceased individual has congenital heart disease (atrial septal defect)"); and "unable to provide an forensic expertise" (for example, "the mental state of the suspect individual at the time of the incident cannot be evaluated").

In the expression of forensic expertise, affirmative and negative types, along with tendency affirmative and tendency negative types, constitute the primary modes of expression in China. Such absolute and simplistic affirmations or negations may cause an overestimation of the probative value of the evidence. 21The prevalence of this expression is attributable to the absence of the balance principle in Chinese forensic examination standards; refer to the following Table.

The requirements for the expression of forensic expertise in National Standards listed above, on the one hand, are excessively abstract, such subjective and tendency-based expressions, lacking corresponding likelihood ratio magnitudes, are susceptible to the forensic practitioner's subjective state or bias, thereby hindering reliable evaluation; on the other hand, they require only the expression of the extent to which the mandating authority or party's proposition is supported by the findings, but entirely neglected the extent to which the alternative proposition is supported by the findings, thus contravening the principle of balance. Therefore, the likelihood ratio quantification-control method for the entire examination process, as outlined in the ENFSI Guidelines, should be adopted. It is necessary to assess the advantages and disadvantages of expressing the likelihood ratio of forensic expertise. Some fields such as document examination, trace type, and DNA testing can be pilot for the LR reform, and with summarized experience for more fields of forensic examination.

[21] Hua Guo, "The Expression System and Construction of Judicial Appraisal Results—An Application of Bayesian Theorem in Appraisal," China Forensic Science, 2020, Issue 3 (Total No. 110), pp. 1–7.

Table1: Requirements for the Expression of Forensic Expertise in Selected National Standards

Standard Category	Requirements for the Expression of Forensic expertise
Specification for Forensic Identification of Handwriting (GB/T 37239-2018)	Includes three categories: definitive, non-definitive, and inconclusive. Non-definitive comprise highly probable, very probable, and probable. "Highly probable identical, **tend to believe** identical" and "the likelihood of identity is relatively high."
Specification for Forensic Identification of Stamp Impression (GB/T 37231-2018)	
Specification for Forensic Examination of Printed Documents (GB/T 37232-2018)	1. The testing material and Sample **tend to be** produced by copying on the same electrostatic copier. 2. The testing material **does not tend to be** produced by copying on a specific electrostatic copier (the Sample electrostatic copier).
Specification for Forensic Examination of Altered and Damaged Documents (GB/T 37238-2018)	Includes affirmative/negative; tendencies toward affirmative /negative; and inability to decide. e.g 1. The handwriting on the testing material **tends not to be** directly handwritten; 2. **It is unable to be decided** whether the handwriting on the testing material is directly handwritten.
Specification of Parentage Testing (GB/T 37223-2018)	Includes exclusion of paternity and support of parentage, employing a quantitative indicator whereby the cumulative **probability of exclusion is no less than** 0.9999.

The LR is essentially the ratio of the probability that the findings support proposition of the prosecution and the alternative proposition of defendant. It measures the weight of the evidence based on two mutually exclusive assumptions, namely the plaintiff hypothesis and the defendant hypothesis. Therefore, LR is the probability that the findings support proposition of mandating authority/the probability that the findings support the alternative proposition of defense.22

LR requires a precise numerical measure for the reliability of forensic expertise. It makes up for the inability of judges to "freely evaluate" scientific evidence and "provides a fame work for understanding the harm of using prior beliefs in fact-finding, and also a normative argument as if one were needed for further efforts to eliminate subjective prior belief, prejudice, and bias from the fact-finding process"23.Certainly, the promotion of expressing the LR of forensic expertise must also consider its inherent limitations. For instance, the LR expression heavily depends on databases; however, "the major barrier to wider use of this reporting method…is that most forensic disciplines do not have adequate databases from which to make such estimates, and that statistical modeling may be complicated by the lack of statistical independence of critical features observed when making comparisons."24This limitation is more prominent in China, so it is necessary to strengthen the supporting construction of the database. Another limitation is that the LR

[22] Di Lu, "Discussion on Forensic Expertise——Analysis of 23 Cases", in Chang Lin, Ed. Case Study of Forensic Science——Selection of the First "Dingyong Cup" Excellent Forensic Science Reports, China People's Public Security University Press, 2008, p.102.

[23] Sean P. Sullivan, "A Likelihood Story: The Theory of Legal Fact-Finding," 90 U. Colo. L. Rev. 1 (2019).

[24] William C. Thompson, "How Should Forensic Scientists Present Source Conclusions?" 48 Seton Hall Law Review 773 (2018).

expression may lead to errors such as "Defense Attorney's Fallacy" and "Prosecutor's Fallacy"25 Therefore, it is necessary to strengthen the research and training of statistical methods, so that forensic practitioners and judges may have a correct understanding of the meaning of likelihood ratio.

3. Methods for Proving the Reliability of Forensic Expertise

3.1 Enhancing the Reliability of Forensic Expertise Presentation

During the trial, the party giving the forensic expertise bears the burden of proof concerning its reliability. The demonstration of the reliability of forensic expertise typically employs two methods: the first is to prove the reliability of the source of the testing materials. When the opposing party challenges the authenticity of the testing material, the prosecution side has burden of proof for its identification or authentication. Pursuant to Article 71 of the SPC Interpretation of the Criminal Procedure Law: "The evidence that has not been verified by court investigation procedures such as the presentation, identification and cross-examination, shall not be used as the basis for a verdict." The term "identification" here refers to a necessary method for the presentation of forensic expertise, whereby the obtainer and custodian of testing materials shall authenticate the reliability of the source of testing material based on their personal knowledge. The second is to prove the reliability of the examination process and method. Article 192, Paragraph 3 of the PRC Criminal Procedure Law provides: "Where the prosecutor or a party or the defender or litigation representative thereof raises any objection to a forensic expertise, the forensic practitioner shall testify before court if the people's court deems it necessary." This primarily refers to the forensic practitioner testifying in court about the reliability of the forensic expertise by applying specialized knowledge. The above two methods of evidence presentation—namely, employing personal knowledge to prove the reliability of testing material and using specialized knowledge to prove the reliability of the examination process and method—are complementary within the trial.

3.2 Cross-Examination on the Reliability of Forensic Expertise

The cross-examination on forensic expertise, like on other evidence, "is to discredit a witness before the factfinder……, by suggesting doubts to the witness, ……weaken the testimony"26. The forensic practitioner does not need to disclose he/she "reasonably rely on those kinds of facts or data in forming an opinion on the subject" (U.S.FRE 703), "but the expert may be required to disclose those facts or data on cross-examination" (U.S. FRE 705)

Concerning the procedures for cross-examination, Article 71 of the PRC Civil Procedure Law stipulates that "evidence shall be presented in court and cross-examined by the parties", while Article 61 of the PRC Criminal Procedure Law provides that " witness testimony may be used as a basis for a verdict only after it has been cross-examined and verified in court by the prosecutor, the victim, the defendant, and the defense counsel", thereby establishing the fundamental principle that evidence shall not be admitted without undergoing cross-examination.

Compared with the civil forensic science system established by the Civil Procedure Law, the criminal forensic science system established by the Criminal Procedure Law has the problem of a

[25] Butler, John M. *Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers*. 2nd ed. Burlington, MA: Elsevier Academic Press, 2005, p.500.
[26] Black's Law Dictionary，8th ed, 2009 Thomson Reuters, p.433.

"dual-track system": pursuant to Article 82 of the PRC Civil Procedure Law, "the parties may apply to the people's court to call persons with specialized knowledge to appear in court and provide opinions on the forensic expertise rendered by the forensic practitioner or professional issues." This indicates that expert assistants and forensic practitioners possess equal status in Chinese civil litigation, and the opinions of expert assistants are of the same evidential effect as those of forensic practitioners, which is analogous to expert testimony under the U.S. FRE 702. However, pursuant to Article 197, Paragraph 2 of the PRC Criminal Procedure Law, in Chinese criminal trial, defense's expert assistants may only "provide opinions on the forensic expertise rendered by prosecution's forensic practitioners" but not "on professional issues". This inequality between the prosecution and the defense in inquisitorial system of forensic science will lead to the drawback of excessive concentration of power. Therefore, it will have an important impact on the cross-examination of forensic expertise, if we promote the transformation of criminal expert assistants into the role of expert witnesses: firstly, after the return of expert assistants to "expert witnesses", it will fundamentally solve the problem that expert assistants might play a dual litigation role of being both a lawyer and an expert witness in the trial, that is, as a "lawyer" while being in cross-examination of the prosecution's forensic practitioners, and as an "expert witnesses" while testifying in court to provide forensic expertise for the defense. This confusion of role oversteps the litigation duties of lawyers and prosecutors. Secondly, with the elimination of the dual-track system between defense's expert assistants and prosecution's forensic practitioners in criminal cases, both forensic practitioners and expert assistants will revert to their original role as expert witnesses. 27Drawing upon the expert witness of the common law system, it will not only promote equality between the prosecution and the defense in the criminal procedure but also helps to constraint on the judges' power.28

The scope of cross-examination of forensic expertise encompasses provisions such as U.S. FRE 702(a)-(d), the four Daubert factors, and the ten criteria in Article 97(1)-(10) of the SPC Interpretation of the PRC Criminal Procedure Law. The 2016 Report of the President's Council of Advisors on Science and Technology (PCAST) distinguishes the standards of forensic science as two types of scientific validity, which correspond to the legal standards in FRE 702: (1) "foundational validity" correspond to FRE 702 (c), which requires the forensic expertise be based on "reliable principles and methods," and (2)"validity as applied" correspond to FRE 702 (d), which requires forensic expertise to have "reliably applied the principles and methods."29Chinese scholars have conducted a systematic study on errors in forensic examination from aspects such as "instrument errors", "methodological errors", "cognitive bias errors" and "human errors". Among them, "instrument error" and "methodological error" fall under the category of "foundational validity" issues, while "human error" and "cognitive bias error" belong to the category of "validity as applied" issues.30

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[27] Qiuhong Xiong, "The Reconstruction of China's Forensic Science System," Legal and Commercial Studies, 2004, Issue 3, p. 39.

[28] Baosheng Zhang and Shuai Dong, "The Role Transition of Criminal Expert Assistants to Expert Witnesses in China," Legal Studies, 2020, Issue 3, p. 173.

[29] PCAST. Report to the President, Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods (Sept.2016) p.43.

[30] Guiqiang Wang: "An Analysis of Errors in Physical Evidence Examination," Criminal Technology, 2017, Issue 6, p. 434.

4. Improve Judges' Ability to Review the Reliability of Forensic Expertise

4.1 The Review of Foundational Validity for Forensic Expertise

In recent years, many forensic science methods that were once widely used have begun to be questioned. Someone even said that "we learn that what was once regarded as truth is myth, and what was once accepted as science is superstition."31 One of the main reasons for this situation is that for different disciplines of forensic science, the reliability of their theories and methods also varies. "Although some of the techniques used by the forensic science disciplines...are built on solid bases of theory and research, many other techniques have been developed heuristically. That is, they are based on observation, experience, and reasoning without an underlying scientific theory, experiments designed to test the uncertainties and reliability of the method, or sufficient data that are collected and analyzed scientifically."32 Obviously, the reliability of the forensic expertise derived from forensic science methods with weak theoretical foundations or lack reliability experiments will be subject to greater doubts. Another reason for scientific superstition is that one often regards science as correct, unwilling to admit that there might be a rate of error in the findings that serve as scientific evidence. U.S. FRE 702(c) and (d), as well as the four Daubert factors addressing the scientific validity of expert evidence. Among these, factor ③— "Whether, in respect to a particular technique, there is a high 'known or potential rate of error' and whether there are 'standards controlling the technique's operation"'33—is of significance for the reliability review of the forensic expertise. It is worth the following two analysis:

First, how to assess the "known or potential error rate" of a particular technique? As mentioned above, the confidence rate of Chinese judges in DNA evidence given by the prosecution is as high as 99.65%; this superstition may stem from the insufficiency of scientific literacy of legal practitioners and their ignorance of the nature of science. As Popper said, "The criterion of the scientific status of a theory is its falsifiability, or refutability, or testability. "34"Every serious test of a theory is an attempt to refute it. Testability is therefore the same as refutability, or falsifiability."35 Therefore, in order to enhance judges' ability to review the reliability of forensic expertise, it is necessary to strengthen the cultivation of scientific knowledge and scientific spirit in legal education, and break students' superstition regarding scientific evidence. Judges should inquire about forensic practitioners about the error rate of using this forensic technique in court. If the error rate is extremely high, they should be particularly cautious when admitting the forensic expertise. Simultaneously, with respect to "instrument error" and "methodological error," these issues should not only be the focus of cross-examination by attorneys and expert assistants but also serve as critical factors for judges when reviewing the reliability of forensic expertise.

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[31] Koen, Wendy J., and C. Michael Bowers, eds. *Forensic Science Reform: Protecting the Innocent*. 1st ed. San Diego: Academic Press (Elsevier), 2016, p.92.

[32] National Research Council, Committee on Identifying the Needs of the Forensic Sciences Community. *Strengthening Forensic Science in the United States: A Path Forward.* Washington, DC: National Academies Press, 2009, p.128.

[33] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.728.

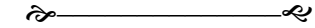
[34] Popper, Karl. *Conjectures and Refutations: The Growth of Scientific Knowledge*. 2nd ed. London & New York: Routledge Classics, 2002 (1st ed. 1963)., p.37.

[35] Popper, Karl. *Conjectures and Refutations: The Growth of Scientific Knowledge*. 2nd ed. London & New York: Routledge Classics, 2002 (1st ed. 1963), p.197.

Secondly, how should we find the "standards controlling the technique's operation"? At present, there are more than five hundred standards of forensic science in China, including national standards, industry standards, and technical specifications—covering fields such as forensic pathology, forensic clinical medicine, forensic identification of document, examination of trace, forensic identification of audio-visual materials and electronic data. 36 The standards of forensic science are essentially self-regulatory norms. Their control over the quality of forensic identification is more effective than legal regulations. Judges, with specialized training, will be able to employ these forensic science standards as quantitative benchmarks for reviewing forensic expertise, and decide their reliability based on whether they meet the standards. Therefore, Article 97 of the SPC Interpretation of the Criminal Procedure Law should be revised as: "(6) whether the process and methodology of the examination comply with relevant professional standards and requirements", among them, the content related to the enhancement of forensic science "standards" has been added.

4.2 The Review of "validity as applied" for Forensic Expertise

The reliability issues arising from the application of forensic science correspond to the provision in U.S. FRE 702(d), which requires that "the expert has reliably applied the principles and methods to the facts of the case." These issues may involve "human error" and "cognitive bias error" by forensic practitioners. In this case, "a court may conclude that there is simply too great an analytical gap between the data and the opinion proffered"37, and should review "whether the expert has unjustifiably extrapolated from an accepted premise to an unfounded conclusion"38. "Human error" refers to mistakes or faults caused by human factors, such as improper selection of methods and usage of instrument, operational errors, sample mixing error, data recording inaccuracies, clerical error, or printing mistakes. "Cognitive bias error" refers to examination errors arising from the psychological and cognitive factors of the forensic practitioner. Both can be reviewed under the "validity as applied" of forensic expertise. For example, in Nian Bin case, 39the "iron pot," a crucial piece of testing materials, was given for forensic examination in August 2006; but surprisingly, its forensic findings had already been reported on July 31. This "human error" about the time completely invalidates the reliability of the forensic expertise.



[36] Ning Zhang, Wanfeng Zhai, Feng Hua (corresponding author) et al.: "A Comparative Study on the Current Status and Development Trends of Forensic Science Standardization at Home and Abroad"," Criminal Technology, 2021, Vol. 46, No. 1.
[37] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.724.
[38] Ronald J. Allen, Eleanor Swift, David S. Schwartz, Michael S. Pardo, and Alex Stein, *An Analytical Approach to Evidence: Text, Problems, and Cases*, Sixth Edition, Published by Wolters Kluwer in New York，2016, p.733.
[39] See Criminal Incidental Civil Judgment No. 10 (2012) issued by the Fujian Provincial Higher People's Court.

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Figure 1 1st ISSSES Conference (January 2015, Haikou, China)

Figure 2 2nd ISSSES Conference (September 2016, Lausanne, Switzerland)

Figure3 3rd ISSSES Conference (June 2016, Hangzhou, China)

Figure 4 4th ISSSES Conference (September 2022, online & offline)

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