Developments in Handwriting and Signature Identification in the Digital Age

Heidi H. Harralson

Series Editor: Larry S. Miller
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Preface ............................................................................................................................... vii

Chapter 1  Introduction ................................................................................................. 1
1.1  Key Concepts in Forensic Handwriting Examination ............................... 4
1.2  Forgery and Simulation ................................................................................. 6

Chapter 2  The Decline of Handwriting .......................................................... 9
2.1  The Need for Handwriting Instruction ................................................... 13
2.2  The Importance of Handwriting ............................................................... 15
2.3  Handwriting Instruction Methods .......................................................... 17
2.4  Influence of Learning Disabilities on Handwriting ................................. 19
2.5  Forensic Problems with Illegible and Printed Handwriting ..................... 22
2.6  Summary ................................................................................................. 24

Chapter 3  Advances in Handwriting Research and Technology ............ 25
3.1  Handwriting and Movement Disorders .............................................. 28
3.2  Handwriting and Psychiatric Disorders .............................................. 32
3.3  Other Factors Influencing Handwriting .............................................. 39
3.4  Handwriting and Simulation ................................................................. 42
3.5  Handwriting and Disguise ................................................................... 43
3.6  Handwriting and Neuro-technology .................................................... 45
3.7  Summary ................................................................................................. 47

Chapter 4  Digital and Electronic Handwriting ............................................. 49
4.1  The Electronic Signature Act .................................................................. 50
4.2  Applications for Electronic Signatures ................................................... 51
4.3  Security and Privacy Issues ................................................................... 53
4.4  Digital Technology .................................................................................. 54
4.5  Digital and Electronic Signatures ............................................................ 56
4.6  Digitization of Signatures: Optical Scanning and Facsimile ................. 59
### Table of Contents

4.7 Digital Tablets ................................................................. 60  
4.8 The Stylus and Other Writing “Instruments” .................. 61  
4.9 Handwriting Recognition Technology ......................... 65  
4.10 Automated Forensic Handwriting Analysis Technology ... 65  
4.11 Standardization ......................................................... 69  
4.12 Summary .................................................................. 70  

**Chapter 5  Forensic Analysis of Electronic Signatures** .......... 71  
5.1 Practical Application .................................................. 72  
5.2 E-signature Signing Process and Standardization .......... 74  
5.3 Technological Considerations .................................... 76  
5.4 Evaluating Static and Dynamic Handwriting Features ...... 83  
5.5 Forgery and System Attacks ....................................... 94  
5.6 Limitations ............................................................... 96  
5.7 Legal Implications .................................................... 105  
5.8 Proposed Methodology .............................................. 107  
5.9 Summary ................................................................ 111  

**Chapter 6  The Law, Science, and Handwriting Identification** ...... 113  
6.1 Forensic Science Reform ............................................. 113  
6.2 A Critical Review of Forensic Handwriting Examination .... 115  
6.3 Status of Forensic Handwriting Identification ............... 117  
6.4 Education and Training ............................................. 117  
6.5 Certification and Laboratory Accreditation ................... 118  
6.6 Proficiency Testing .................................................... 119  
6.7 Scientific Validity and Reliability ................................ 120  
6.8 Terminology and Methodology .................................. 121  
6.9 Advances in Handwriting Identification Technology ...... 121  
6.10 Legal Challenges to Scientific Admissibility ................. 123  
6.11 Summary ............................................................... 124  

**Glossary** ........................................................................ 125  
**References** ................................................................... 129
This book is part of a series published by Elsevier on specialized forensic topics. Because of its smaller, more focused subject matter, the format is ideally suited for updating our current knowledge of forensic handwriting identification.

The analysis of electronic signatures is an ever-growing trend requiring specialized research and new methodology by forensic practitioners. This text hopes to give some focus in this new area by defining misunderstood terms, identifying problems and challenges to forensic handwriting identification, and recommending methods of practice.

This book is the result of research that initiated at Prescott College in Arizona focusing on medical motor disorders and forgery. During my research work at Prescott College and the University of Arizona, I was introduced to handwriting movement software and the digital tablet. I would have continued my work on handwriting and motor disorders, but during a visit at the Norwegian Information Security Lab (NISlab) in Gjøvik, I was encouraged by professors at the laboratory to pursue research into the forensic study of electronic signatures. I consider this book a synthesis of my research work over the years at several different universities.

First, I want to thank Katrin Franke at NISlab in Gjøvik, Norway for initiating my interest in electronic signatures. I am grateful for the dedicated research work carried out by Bryan Found and Doug Rogers and their students, especially since much of their research is cited in this book. Many of the more recent concepts concerning handwriting identification theory have been developed by researchers at LaTrobe University in Australia.

I especially thank Hans-Leo Teulings, developer of MovAlyzeR movement analysis software system at NeuroScript, LLC. He has been an instructor, editor, and coauthor in many of my research publications and provided technical assistance in several of the chapters in this book. Without his years of expertise and generous assistance, I would not have been able to bridge the gap between the technical aspects of
electronically captured handwriting movement and its practical application in forensic science.

Finally, I extend appreciation to Larry Miller at East Tennessee State University, Department of Criminal Justice and Criminology. He is not only the editor of this book but has also been my mentor and research partner for many years. I am indebted to him not only for his inspirational research work on forensic bias and the technical aspects of forensic science, but also for inspiring me to academically challenge myself in the forensic field.

Research in electronic signatures is growing and the developing technology is taking several different directions. In a short period of time, this book will need to be revised to keep up with the latest research and technological innovations. I am looking forward to a future edition where I will have the opportunity to update the concepts in this emerging field.

Heidi H. Harralson
Introduction

1.1 KEY CONCEPTS IN FORENSIC HANDWRITING EXAMINATION
1.2 FORGERY AND SIMULATION

The purpose of this text is not to rewrite or even summarize all of the document examination literature that has been written since the early part of the twentieth century. Rather, the goal is to summarize and discuss the pertinent research and literature that represents significant development in bringing handwriting and signature identification into the digital age as well as the challenges presented in merging handwriting with digital technology. Some of the subject matter may seem to have little to do with digital technology, such as sections that discuss children’s handwriting training and development; yet this is an important topic as it establishes how handwriting is changing culturally (which has implications in the way handwriting experts examine handwriting), and how those changes may be by-products of the digital age in which we live.

Other books and published articles extensively discuss the process of forensic handwriting examination. Some of the classic texts such as Albert Osborn’s (1929) seminal work “Questioned Documents” include discussions about class characteristics of penmanship systems (such as the Palmer Method). More recent works such as Seaman Kelly & Lindblom’s (2006) text “Scientific Examination of Questioned Documents” (a revision of an older work by Ordway Hilton) discusses advances in technical areas such as identification of print process methods and analyzing computer-generated documents. While much of the material, even in older, classic works is relevant, it is important to update our collective knowledge in this specialized area as the way we write today and even the way in which we analyze handwriting scientifically has undergone fundamental changes. Research across several disciplines in computer science, medicine, neurology, and engineering has reshaped what we know about handwriting and contributed to new methods in its forensic analysis and identification.
Significant strides have been made in the scientific and legal acceptance of forensic handwriting identification. Proficiency studies on forensic handwriting experts’ accuracy rates in addition to empirical studies on the individuality of handwriting have helped to establish the field’s scientific acceptance. This acceptance has not come easily especially since handwriting identification was one of the first forensic disciplines to come under criticism by the legal and scientific communities.

Additionally, court rulings have also helped solidify the field’s acceptance in rulings such as the recent Pettus v. United States case in the District of Columbia Court of Appeals (2012). During trial, it was challenged that handwriting identification does not meet the trial court’s test of general acceptance of a particular scientific methodology. The challenge was supported by statements made by a report commissioned by Congress and published by the National Research Council of the National Academies of Science (2009) that criticizes pattern-based forensic evidence. However, the Court ruled that forensic handwriting examination satisfied the bedrock admissibility standard of Frye v. United States (1923), and the forensic document examiner’s testimony was admitted.

In defending the field’s scientific acceptance during court testimony, the document examiner cited many of the principles relied on by document examiners in the field. Rather than rewrite the accepted principles in questioned document literature, some of these principles will be discussed as needed in the various chapters under discussion, but some significant points are also discussed at the end of this section so that the reader will have a basic introduction to the subject. These points are summarized briefly for the reader in order to allow adequate digestion of information about forensic handwriting identification and point the reader to texts that delve deeper into these accepted and generally recognized principles.

The subject matter of this text all relates to handwriting examination, but it is a collection of research from different disciplines that can provide knowledge useful to updating our knowledge of forensic handwriting identification. Chapter 2 is a discussion about cultural changes in handwriting, initially discussing its purported “death” as reported in the media. Handwriting is not dead insomuch as it is transitioning with the advances of digital technology. The deterioration of handwriting is a product of both decreased classroom training and the increased use of text-based technological devices. Why handwriting training is decreasing, reasons why handwriting is important to the developing brain, and ways
in which teachers can introduce handwriting training to students is discussed. How the cultural changes in handwriting affect its forensic examination is reviewed including areas such as learning disabilities (which are increasing in the population), and how illegible or poorly formed handwriting and signatures have challenged handwriting identification. New methods introduced to the handwriting identification field may have resulted due to the occurrence of overly simplified signature styles which can present forensic examination challenges.

Significant advances have been made in understanding the connection between the brain and handwriting. Their resulting disorder as manifested in handwriting movement is the subject of Chapter 3. Much of this research has been developed with the aid of electronic technology by analyzing static features as well as the online, biometric movements of the tablet pen with handwriting movement captured by electronic handwriting recording software. The electronic capture of handwriting movement has revolutionized what we know about handwriting movement with much of the research originating from the medical and handwriting recognition fields. Handwriting movement research that has forensic relevance is reviewed for various health and psychiatric conditions in handwriting including related medications, the influence of alcohol in handwriting, specific forensic applications such as simulation or forgery, disguise, and other neuro-technological advances in handwriting sciences.

Electronic handwriting is introduced in Chapter 4, which defines different types of digital and electronic signatures. Much of the technology discussed in this chapter was introduced in Chapter 3 but is explored in greater detail through the hardware and software used in electronic signature technology. Different types of digital tablets, styluses and unusual “pens,” and other unusual methods used to capture electronic signatures are described and evaluated for their forensic relevance and the possible challenges they may present in handwriting identification. The digitization process of signatures is reviewed as well as an overview of handwriting recognition technology and the advent of automated forensic handwriting analysis.

The heart of the subject, Chapter 5, involves the forensic examination of digital and electronic signatures and handwriting. After introducing the types of electronic-capturing devices and methods employed in Chapter 4, Chapter 5 examines their use in relation to forensic examination and challenges associated with electronic interpretation of signatures
from both a hardware and software perspective, the variables involved with the way signers approach electronic devices, and how devices change natural handwriting. The diverse technology used for signature capture including poor and high-quality resolution capture presents challenges in forensic analysis. The need for standardization in electronic signature examination is obviously needed, but until that is realized, if ever, it is recognized that forensic examiners may need to approach these types of signatures conservatively. Recommended methods and standards for the forensic examination of electronic signatures are introduced. A recent court case involving a disputed electronic signature is reviewed as it highlights the challenges facing document examiners in the courtroom when examining and testifying in electronic signature cases.

Lastly, Chapter 6 examines recent developments in the scientific acceptance of handwriting as well as legal rulings and precedence concerning the legal acceptance of forensic handwriting identification. Starting with the challenges presented by a recent government report’s challenge to forensic science, an overview of how handwriting identification has successfully met scientific and legal challenges is presented through accreditation, proficiency testing, scientific validity and reliability research, standardization of terminology and methodology, and advances in computerized handwriting analysis.

A glossary is provided at the end of the text to assist the reader with highly technical terms related to digital and electronic signatures. The glossary is also provided to help with defining terms in the field as there is some confusion about what exactly a digital signature is, especially since it is a broad term covering several different “signature” modalities.

1.1 KEY CONCEPTS IN FORENSIC HANDWRITING EXAMINATION

In order for the reader to have adequate understanding of forensic handwriting examination, this introduction will serve as a summary to some of the most important principles recognized by document examiners. These key concepts will help the reader understand the principles of forensic handwriting identification.

One of the most important principles involves the handwriting variation of a single writer. It is a generally accepted handwriting principle
that no two handwritings or signatures are written exactly alike by the same person. If a handwriting expert finds an identical signature to the one that is being questioned, it is an indicator that one may be a copy of the other which may be based on a tracing, a copy, or a scan of one signature that is placed on another document (Fig. 1.1).

It is generally accepted that handwriting has a combination of features that are unique and identifiable for each writer. It is believed that not only are no two signatures written exactly alike by one person, but that no other person writes all the same features in the same way as another writer. This principle is also based on the examination of multiple handwriting features as this could not be supported if the examiner relied upon one or two handwriting features. Handwriting is not only unique but its various features are interrelated, creating a complex handwriting formula for each individual writer.

The principle that no two handwritings are written exactly alike is related to the concept that each writer has a natural range of variation. As such, handwriting is pattern based and rather than relying on isolated handwriting features, handwriting experts examine patterns in handwriting. In order to establish range of variation for a writer, the pattern needs to be established in a number of comparison samples. Rarely can an identification or elimination of a handwriting or signature be accomplished with one or even a few handwriting comparison samples. So, due to natural range of variation, multiple handwriting or signature samples are necessary in the examination. Because handwriting is not static and is subject to change over time or due to other variable conditions, handwriting samples written during a comparable time period and under the same conditions applying to the questioned writing material are also necessary (Fig. 1.2).
This naturally leads to the next point involving natural and unnatural handwriting. One of the first steps in a handwriting examination involves the assessment of the handwriting samples under inspection. The examiner needs to evaluate the samples and determine if they possess the characteristics of natural handwriting. Natural handwriting has an unimpeded flow of movement. Handwriting can be affected by adverse factors such as health, external circumstances, medications, alcohol, and other conditions. If the subject writing exhibits extraordinary characteristics or dysfluency, the examiner needs to determine if it can be compared to other samples that do exhibit natural characteristics and/or make a determination as to why the unnatural handwriting characteristics are occurring (which could also be related to forgery or simulation).

Document examiners rely on methodological standards to standardize their examination procedures. One method that has been extensively used is Analyze, Compare, and Evaluate (ACE). This method is used in the standard developed for handwriting examination published by the American Standards for Testing and Materials International, E2290-07a (2007). Other methodological standards have been published in forensic document examination literature and include rating scales and modular approaches (Found & Rogers, 1999; Slyter, 1995). The Scientific Working Group for Forensic Document Examination (SWGDOC) is administered by the Federal Bureau of Investigation (FBI) and the U.S. Department of Justice and publishes standards for government document examiners.

1.2 FORGERY AND SIMULATION

Technically, the widely used term “forgery” is a legal term which refers (for the purposes of handwriting identification) not only to the imitation of a handwriting or signature but also to the intent on the part of