CHAPTER 17
Forensic Document Analysis, Photographic and Video Analysis, and Voice Identification and Linguistics
IV. Physical Properties in Evidence

Chapter 17: Forensic Document Analysis, Photographic and Video Analysis, and Voice Identification and Linguistics

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Chapter 17.1: Forensic Document Analysis

Learning Goals and Objectives

Documents play important roles in legal applications. In this chapter, you will need to understand the following concepts:

- What is questioned document analysis (QD);
- What are the different types of document analyzed;
- What is the underlying scientific basis of questioned document analysis;
- What methods do QD analysts employ;
- What types of information can be gained through a questioned document analysis;
- What are the limitations of questioned document analysis.

Introduction

Words are important. While many animal and plant species can communicate in some fashion with each other, the ability to use the learned skill of language to reveal to others our thoughts and ideas is at the heart of what makes us uniquely human. We can use words and language to convey both concrete and abstract information that a listener that has never heard or even thought about before. But words also can quickly and effectively impart not only factual information and observations to others, but just as easily can convey our personal thinking, emotions, aspirations, discoveries, and ideas. You’ve probably never heard anyone say “the sleeping yellow kangaroo” but yet by reading these words you can quickly understand and imagine what the words mean.

Sometimes, however, the manner that we choose to communicate may be almost as important as the thoughts themselves. Over time, humans have developed many creative ways in which to extend and expand our ability to communicate with others far away - a development process that continues today. Verbal language first provided us with the ability to rapidly communicate with those in the immediate neighborhood, a skill clearly of survival value – “Look out for the mastodon!” or “this is how to make fire.” Later, written language allowed us to communicate with others far distant from us and to record information and ideas for future reference. As our needs and desires grew, so did the development of more complex forms of language and communication. Language has deepened, however, into far more than just a tool of communication to become something quite intimately associated with our individual and collective identities, perceptions and cultures. The study of language is referred to as linguistics, and increasing forensic linguistics is an important tool for several types of investigations.
Handwriting, and later printing, provided humans with the ability to communicate easily across space and time. Today, we read equally well the words from writers who produced their works last week, last century or even last millennium. But handwriting also holds information quite personal beyond the actual words. Looking at the unconsciously produced subtle features of handwriting can help to identify the author of a particular document. Similarly, we can look at these same handwriting features and determine that a document was not produced by the attributed author but instead by some “hidden” author - a forger.

Graphic forms of communication, such as paintings and drawings, developed long ago and allowed early humans to add individualism to the process of communication while sharing subtle personal information. Beautiful works from many thousands of years ago, such as that shown in Figure 17.1.2, demonstrates the ability of early humans to tell stories in graphic form. These forms of expression progressed into various forms of artwork, growing out of the simple embellishment of utilitarian objects and experimentation with images into items made solely for their beauty and the feelings that they evoke in others. Today, these graphic forms of communication and expression extend to include both traditional forms of art and imagery as well as photographic, video and digital art. We are often greatly influenced by photographic and video images with almost instant access to visual media produced from across the world. Given the availability and ease of use of computer photographic and video altering software, how do we know that what we are looking at is real (Figure 17.1.3)? Therefore, a key forensic question that is increasingly being asked is whether images are authentic or somehow modified?

Given the central place of various forms of written, oral, and graphic communication in the world today, it is not surprising that these means of expression can play a significant role in forensic investigations. Criminal behavior can sometimes be tracked through a trail of

Figure 17.1.2. Petroglyphs allowed early man to record events and ideas in personal styles such as in these cave paintings from at least 10,000 years BCSE (www.crystalinks.com/petroglyphs.html).

Figure 17.1.3. (Top) a composite photograph of Sen. John Kerry seemingly sharing the podium with Jane Fonda at a 1970s anti-war rally. The picture appeared during Kerry’s 2004 residential run. The top composite was actually made up of a June 1971 image of Kerry preparing to speak to a Peace Rally in New York (Bottom left) with an August 1972 image of Jane Fonda from a Miami Beach, Florida political rally (bottom right) (www.wadelaube.com/blog/world-press-photo-disqualifies-winning-photographer/).
communications, people alter visual and graphic items with the intent to defraud or influence, and voice data can be used to identify a particular person. The choice of specific language constructions (grammar, syntax, modulations, etc.) can tell much about the user: are they a native speaker, are there hidden meanings in their words, and what was their frame of mind when using the words. Even the mode of communication (e.g., written, oral, photographic, digital, etc.) that someone chooses to use may provide valuable insights to an investigation.

In this chapter we will explore the forensic aspects of various forms of human communication through the analysis of questioned documents, altered visual imagery, and aspects of forensic linguistics.

**Questioned Documents**

Documents form the basis of a large part of our communication, providing permanent records of our thoughts, actions and transactions. They have especially been important for millennia in recording legal, personal, and financial information. Because of the value placed upon the contents and validity of these documents, forgeries that provide false information and give “unfair” advantage to a forger are also quite common. **Forgery** is defined as the act of preparing or altering a document, signature, financial certificate, work of art, or other valued item with the intention to defraud, damage or cheat – in other words, to make someone believe that the work was made by a person other than the forger. Clearly, it is of great interest to be able to unambiguously detect and expose these forgeries as frauds in order to avoid their intended damage and deceit.

In forensic science, the term “questioned document” refers to any document over which there is some legal dispute regarding its origin, authenticity, or authorship. Such documents might include financial checks, currency, wills, anonymous letters, agreements, passports, personal identification records, receipts, and many others. The task of determining whether a document is authentic or a forgery usually falls to a questioned document examiner, an expert skilled in the methods of detecting fraudulent written or printed evidence. The field encompasses many components of document analysis but includes handwriting analysis, signature authenticity, and examination of a variety of printed materials.

**Handwriting Analysis**

Handwriting is defined as a person’s individual style of writing with an implement, such as a pen or pencil. The underlying premise of analyzing a sample of handwriting to determine its authorship is the idea that a person’s handwriting is unique to them. When we first learn and practice handwriting as children, we are taught by copying examples provided by our teachers as closely as possible to the example. Through repetition and practice, the act of forming letters and words becomes an unconscious behavior pattern, such as walking or riding a bicycle. As we become more proficient in writing, we develop our own personal writing styles that, while varying somewhat over time and even within a single document, present distinguishable features that allow for the identification of the author of the document. Under the best circumstances, experts believe that the uniqueness provided by handwriting analysis may be as individualistic as our fingerprints.

Teachers use instructional writing models, called copybooks (Figure 17.1.4). Many copy book styles exist and the choice of which one to use for instruction varies by

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*Figure 17.1.4. A sample copybook in the Zaner-bloser writing style commonly taught beginning in about the 1960s (http://typeindeth.com/2011/05/partnering-type-with-graphology/).*
local preferences and which styles are in “vogue” at the time when we learn. Two of the most common today are the Palmer and Zaner-Bloser styles. Because the particular choice of copybook used as the model changes by location and time, a person’s handwriting depends upon when and where they first learned to write (Figure 17.1.5). In other words, the particular writing models that we learned from gives rise to the basic style characteristics of our writing. Understanding this variation can give insight into when and where the author of a document first learned to write.

The goal of handwriting analysis is usually to either discover information about an unknown author of a handwriting sample (e.g., ransom or threatening letter) or to compare it with a known source to determine if the documents were written by the same hand (e.g., a forgery). It is really two separate questions that a document analyst deals with: who wrote a document and/or who didn’t write it.

A person’s handwriting usually displays a number of features that collectively help to individualize their work, called individual characteristics. Their handwriting depends upon their training, physiology (fine motor skills), and characteristic personal preferences. While it is typical for people to share several individual features in common, it is highly unlikely that they will share in common the dozens of these characteristics found in a document.

Individualizing features are often divided into four main categories: form, arrangement, quality and content. Some of the key features analyzed for each of these four categories include:

**Form:**

- **Handwriting style:** Generally, there are three basic styles of handwriting: block, script, and cursive (Figure 17.1.6). Block capital writing uses all upper case (capital) letters that are upright and separated from one another. This is a style often adopted by children just learning to write and is generally the easiest to read and learn. In contrast, script handwriting uses both upper and lower case letters that are not joined together and resembles most a printed text (when

![Figure 17.1.5. Handwriting examples based upon different copybooks can help to identify the place that an author first learned to write](http://citeseerx.ist.psu.edu).](http://news.bbc.co.uk/2/hi/7907888.stm)

![Figure 17.1.6. Handwriting styles: Block (top), script (center), and cursive (lower) above printed text](source JTS).

![Figure 17.1.7. Handwriting examples showing variations in the shapes of the letters and the slope of the writing](http://news.bbc.co.uk/2/hi/7907888.stm)
someone is asked to “print” their name, this is the style most often used). This is often a style that people default to when they are most concerned with legibility. Cursive writing is a style for rapid writing in which most of the letters in a word are joined together, leaving spaces only between words. A number of variants of these basic styles have been developed although today the script style is becoming more common. An individual may also blend these styles together, resulting in a style that incorporates elements of cursive and script in their handwriting. A person may also switch between these styles within a document or even within a given sentence.

- **Shape of the letters**: The formation of individual letters has enormous variation in the roundedness or sharpness of each character. Some examples are shown in Figure 17.1.7. A person may also form a letter differently depending where in a word the letter occurs.

- **Slope and line locations of the writing**: Individual letters may be sloped forward, vertical or backwards relative to the direction of the writing (Figure 17.1.8). The text may also conform tightly to a straight line (including on a provided line as well as above and below the line), slant upwards, downwards or almost randomly oriented. The direction of pen movements and strokes can usually be determined from the writing, allowing a differentiation between left-handed writing from right-handed writing. For example, counterclockwise circular strokes, such as in the letters “o” and “a”, indicate right-handed writing while clockwise indicates a left-handed author.

- **Rhythm of the writing**: When writing normally, a person may display a certain rhythm or lack of rhythm (arrrhythmia) in their style of forming letters and words (Figure 17.1.9). Rhythm most often refers to a regular repetition or “periodicity” of various writing elements, such as word and letter spacing and the visual “flow” of the words on a paper. Features such as the start and end of each letter or word, the pressure on the paper, connectedness of the writing, and the visual flow all contribute to the rhythm of the writing. Handwriting involves the movement of the writer’s hand across the page coupled with small motor movements of the hand. The coordination of these movements often follows a pattern that the writer has developed through practice and individualization. Lack of rhythm may indicate problems with motor control or result from certain disease states. Many scientists believe that handwriting may be an early indicator of a person’s psychological and physiological state. Handwriting in elderly people often degrades due to problems with their fine muscle control and shakiness. Other conditions that are thought to be observable in a person’s handwriting include Parkinson’s disease, brain damage, alcohol abuse, schizophrenia, Alzheimer’s, arthritis, heart disease, and several others. People with schizophrenia, for example, show a higher tendency to display writing with strange letter formations, nonsensical words, confusing or illegible text, and rhythmic
disorganization of lines and words.

- **Size of the writing**: The size of the letters, including the relative size of the different letters within a word and the extensions on the letters (the parts of a letter extending below the line or projecting upwards, such as found in the letters “g”, “t”, “h”, and “f”), are important individual features. For example, what is the proportion of the “short” letters (e.g., a, c, o, and u) compared with the taller letters (e.g., t, h, f, and l). Additionally, are the round letters disproportionately wide relative to other letters?

**Arrangement:**

- **Spacing of the letters, words, and lines**: Both words and letters may range from very closely spaced and packed together to more spread out on the page. The closeness of the lines of text and the width of the margin on the page are also important characteristics. When tightly spaced, the writing from one line may be overlapped with the writing on the following line. It is also usually possible to discern the sequence of the writing, which strokes came first, next and so on.

**Quality:**

- **Pressure and thickness**: The downward pressure and the thickness of the lines, often a function of the pen employed, are characteristics of the writer. Analysts look for the smoothness of the lines and try to gage the speed of writing from pressure and thickness of the lines. Slower writing may be a valid indication for a forgery where the writer goes slowly to mentally copy a exemplar of someone’s signature. Pauses in writing, sometimes evident from breaks in the writing or places where the pen has been removed from the paper and then restated can also indicate a forgery.

**Content:**

- **Grammar, Spelling, and syntax**: The spelling, grammar, capitalization and punctuation used in a document helps to reveal the preferences, background and training of the author. For example, in the famous example of the ransom note in the Lindberg kidnapping case, the grammar and spelling in the document provided important information about the kidnapper (a German immigrant):

"Dear Sir! Have 50000$ redy with 25 000 $ in 20 $ bills 1.5000 $ in 10$ bills and 10000$ in 5 $ bills. After 2-4 days we will inform you were to deliver the Mony. We warn you for making anyding public or for notify the Police the child is in gut care."

**Forensic Document Analysis v. Graphology**

Forensic document examination deals with identifying individualistic characteristics in a person’s handwriting and comparing these features between documents to come to a conclusion about the authorship of a questioned document. Graphology, in contrast, has nothing to do with identification but rather tries to make a connection between the features of a person’s handwriting and their personality or character traits. The two fields use very different methods and for quite different purposes. Graphology is today considered without scientific support. In a large 1992 study, the analysis of over 200 scientific studies concluded that graphology as unable to predict any kind of personality trait on any known personality test (published in The Write Stuff: Evaluations of Graphology--The Study of Handwriting Analysis, edited by Barry L. Beyerstein and Dale F. Beyerstein, Prometheus Books, 1992). While graphology has been shown without scientific merit, people still rely upon it for important decisions. For example, it has been reported that in France roughly 70 percent and in the US between 5 and 10 percent of companies use graphology for hiring decisions.
The most commonly encountered questions in handwriting analysis deal with determining the authorship of a document. The key questions generally may be framed in two possible ways: were two documents written by the same hand (identification) or were the two documents written by different people (forgery). Answering these questions requires a comparison of the questioned document with handwriting examples known to have been written by the purported author of the document. The analyst usually places the conclusions from their analysis into one of nine categories: (1) identification (highest degree of confidence that the handwriting belonged to the ascribed author), (2) highly probable, (3) probable, (4) indications (some evidence for similarities exist but the connection is not relatively weak), (5) no conclusion (unable to make a determination), (6) indications did not (some dissimilarities exist but the evidence is not strong), (7) probably did not (the two documents likely did not come from the same author), (8) strong probability did not (almost certain that the two documents do not match), and (9) elimination (the two documents were definitely written by different authors). These nine levels help to quickly relate the confidence level that the analyst has in their conclusions on the authorship of a questioned document based upon the physical evidence available.

Handwriting analysis is a slow and time-consuming process that is built upon the examiner’s study and experience of the ways that people form letters and words. When comparing two documents to determine if they were written by the same person or not, individual characteristics are the most important elements to identify – especially dissimilarities. While a single particular handwriting feature may appear in common in the handwriting of many people, it is highly unlikely that two people would share many individual features in their handwriting. As more and more characteristic features are identified, the more likely it is to uniquely identify or rule out one person as the author of a document. Likewise, as more dissimilarities are noted, the more likely it is that the two documents came from different people.

The process usually begins by locating comparison writing samples of known authorship, referred to as **exemplars**, and carefully sorting through both the exemplars and questioned document to locate and

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**Figure 17.1.10.** A letter comparison table showing the range of variation in an exemplar of a person’s writing (www.cdp.bham.ac.uk/Other_research/scribal_identification/index.htm).

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**Request Exemplars and the Law**

The US Supreme Court has ruled in a number of key instances that it is legal to require handwriting exemplars from a suspect, with or without their permission. These decisions have said that taking these samples, even before a lawyer is appointed for a suspect, does not violate a suspect’s 4th (Gilbert v. California, 1967) or 5th amendment rights (US v. Mara). The Court has ruled that that handwriting of a person is an “identifying physical characteristic outside its [the 5th amendment’s] protection.” They have also said that requiring an exemplar did not constitute an unreasonable search and seizure, such that the person’s 4th amendment rights are not violated in requiring a handwriting exemplar.
study any individual characteristic features. The collection of as many comparison examples of known authorship leads to greater certainty in the analyst’s conclusion. One of the biggest problems frequently encountered comes when dealing with a relatively short questioned document or scarce exemplars where not enough variation can be detected for a valid comparison. The authors of questioned documents often work diligently to disguise their handwriting by using block letters, unnatural writing styles (sometimes changing hands), carefully copying exemplars, and using forced writing methods. These factors make the analysis of authorship particularly difficult.

There are natural variations in a person’s handwriting that occur all the time, even in the same sentence. Because of these natural modifications, a significant number of exemplars are needed to give an understanding of the range of this variation. Finding exemplars, however, may be a difficult problem and can require some careful investigation.

Exemplars usually fall into two categories: request and non-request samples. **Non-request** samples are those that were written under “natural” conditions, usually before the person’s writing was of any legal interest. Examples written close to the time that the questioned document was written are preferred, although usually a person’s handwriting doesn’t change much over time. Non-request exemplars are preferred whenever possible. **Request** samples are those that are provided by a suspect when asked - at times when they usually know that their handwriting is under scrutiny. In these cases, great care must be taken not to influence a writer’s handwriting, such as not showing them the questioned document to copy. When taking the exemplars, it is highly desirable to take repeated samples over time, with breaks in between writing sessions. This procedure makes it more difficult for a person to consciously and consistently alter their writing styles. Examiners must be very cautious and aware of the possibility of simulation in requested exemplars. **Simulation** refers to an attempt by someone to disguise their handwriting. Often, however, it is possible to determine if simulation has occurred, either in the exemplar or in the questioned document, especially in longer documents.

**Figure 17.1.1.** Letter comparison table for handwriting analysis. The questioned document is on the left and the exemplar on the right while the letter of comparison is shown in the middle (www.cdp.bham.ac.uk/Other_research/scribal_identification/index.htm).
Questioned document analysts use a variety of techniques and methods to compare the individual characteristics of documents. One of the most common methods involves the construction of comparison tables. In this process, the examiner begins by taking each and every letter in the document, one at a time, and building a table showing the natural variations in the letters. When they first encounter a letter, they enter the letter’s style into the table. The next time that they encounter that particular letter, they compare it to the previous entry and add it to the table if it shows a variation. For example, every time that the letter “a” appears in the document it is compared to all the variations of “a” found in the comparison table. Each time they encounter the same letter they must decide if it is the same or a different variant – different variants are added to the table while similar ones are not. A sample comparison table for a document is shown in Figure 17.1.10. This table shows that they examiner found three kinds of “a”s, one “b” and three different “e” variants, for example. There are also a number of tables that must be prepared – one for capital letters, one for letters found at the beginning or end of a word, one for letters within a word, one for script letters, and so on – each with its own set of variants. Additionally, tables for numbers and punctuation are also needed. In actual practice, the examiner takes a digital photograph of the document and copies a digital image of each letter variant into the table, rather than hand drawing it, so as to have an exact replica of the letter in the comparison table.

The process of preparing the

Hitler Diaries: A Case of Questioned Exemplars

In 1983, the German magazine Stern was offered the exclusive rights to publish the previously unknown diaries of Adolph Hitler. These unknown diaries, in sixty-two volumes, supposedly had been smuggled out of East Germany after their discovery in a wrecked WWI airplane and told a very different story about Hitler’s leadership and knowledge of World War II that previously understood. For example, it showed Hitler to be a more generous and understanding person who had little knowledge of the atrocities carried out by the Third Reich. Stern paid 10,000,000 Marks for the journals and announced the discovery and their intent to publish the writings.

Before publication of the diaries, however, Stern needed first to verify their authenticity beyond the simple anecdotal information surrounding their discovery. Stern submitted samples of the diaries, along with exemplar’s of Hitler’s handwriting from the German Federal Archives, to two of the most respected handwriting experts in the world. Both of these experts determined that the exemplars and the diaries positively matched. This news, rather than settling the debate, actually sparked a heated public discussion among historians, publishers and scientists about the diaries origins. To provide more evidence for their claim of authenticity, Stern decided to subject the diaries to further testing. Chemical analysis of the diaries, however, showed beyond a doubt that the paper, ink and glue in their construction were definitely post-WWI materials and that the diaries were forgeries. So, hope could the handwriting experts get it so wrong.

As it turns our, the experts got it mostly correct, with one small twist. The forger, Konrad Kujau, had been a prolific forger of Hitler’s works for many years, including books, papers, signatures, and paintings. His works were so widespread that when the exemplars were chosen from the National Archives, these too had been forged by Kujau. The experts were actually comparing the diaries against fraudulent exemplars by the same forger. So, the exemplars and the diaries were actually written by the same person – Kujau and not Hitler. Eventually, scrutiny of the diaries with other Hitler writings, coupled with discrepancies in historical information they contained, further supported the forgery claim. Kujau and his accomplish were ultimate found and convicted of their crimes. It all shows how important good exemplars are?

(Picture www.time.com/time/specials/packages/article/0,28804,1931133_1931132_1931123,00.html)