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# DISGUISED HANDWRITING AND SIGNATURES: A COMPREHENSIVE REVIEW

## *Abstract*

*The domain of disguised handwriting and signatures has been a significant area of research in evaluating questioned documents. It is one of the hardest domains in the field of document examination. An examiner's professional capability and competence are required to detect and identify disguises. Document examiners identify and analyze the class and individual characteristics in disguised writing to interpret the author's identity and the source of origin. Questioned document experts find it challenging to understand the unique attributes of disguised writing to determine authorship. The purpose of this review is to provide an outline of various characteristics of disguised writing of unique qualities of a writer. The main aim of the study is to bring out the methodology used to find the common characteristics, and the difficulties document examiners encounter in establishing authorship.*

***Keywords:*** *Forensic Science; Handwriting; Signatures; Disguise; Questioned Documents.*

## Introduction

Any item with signs, marks, numbers, or symbols meant to convey a meaning to someone is referred to as a document. Any document whose source or authenticity is questioned is considered a questioned document. Questioned Documents are essential as they are used in various contexts and for multiple reasons (Lindblom, 2006). The complexity and variety of problems presented to document examiners make questioned document examination a highly specialized and challenging field of study [Joshi et al., 2020]. Most Forensic Document Examiners spend significant time examining and comparing handwriting and signatures (Mohammed et al., 2011). Every person's handwriting style is unique and has a distinctive touch. It combines what we have been taught and our personalities (Sassoon and Briem, 1989). These writing characteristics can be easily identified in normal handwriting. The

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major goal of researching the secret elements of typical written words is to find the smallest, most minute details in the writing. The penmanship cannot be entirely distorted (John and Rao, 2021).

Handwriting and signature recognition raises several critical issues. Thus, the main objective of performing forensic investigation of Documents is to verify the writer's authenticity and authorship, which supports the investigation and its lies upon two fundamental principles.

· The first principle states the "Law of Individuality", which asserts that no two writers write precisely identically in a similar manner (Marsh, 2006).

According to this principle, writing is a unique trait produced by brain activity (Kapoor & Saini, 2017).

· Every person's handwriting varies naturally. The document examiner must learn how to distinguish between natural variance and a distinct author (Bhardwaj et al., 2019).

Handwriting and signature can be analyzed using two categories: class and individual characteristics. It is frequently possible to ascertain whether a suspected and known writing was composed by a similar person by carefully comparing, analyzing, and interpreting the class and individual features (Topaloglu and Ekmekci, 2017). Class characteristics are the common characteristics that include the main features such as the type of handwriting, the shape of the letters, the slope of writing, connections between letters, line position, spacing between the words, the relative dimension of the letter, capitalization, punctuation, etc. (Hilton, 1983; Carter, 1943). Individual characteristics are extremely rare and are difficult to replicate; it is helpful to concentrate the evidence into a single, reliable source (Carter, 1943). These traits would be unique to one writer and essentially the only thing needed to identify them (Sassoon and Briem, 1989). A document forensic investigator needs to concentrate on common individual characteristics such as arrangement, alignment, diacritics, hesitation marks, grammatical details, use of margins, spelling, pen pause, phraseology, retouching, etc. (Bird et al., 2010; Ling, 2002; Heinrich, 1934; Salls et al., 2013; Gupta, 2019). These characteristics aid the examiner in figuring out whether the document has been disguised, forged, or simulated (mimicked) (John and Rao, 2021).

FDE works on a variety of criminal cases including authorship determination and fixation. In the field of Forensic Science, questioned document analysis has a major concern on handwriting and signature examination (Koppenhaver, 2007). Every examiner of questioned documents has encountered a challenge when someone tries to cover up their handwriting and signature to conceal their identity (Konstantinidis, 1987).

The primary objective of this review is to compile and utilize all the

necessary and useful information from the disguised documents for the advancement in handwriting analysis.

## Disguise

Disguise is defined as a deliberate or willful modification of a person to alter one's natural writing to conceal identity (Koppenhaver, 2002; Harris, 1953; Leung et al., 1988). Disguised handwriting is a diversified act, it is necessary to examine its specific qualities to identify important individual characteristics of complex writing material (Gupta, 2019).

Disguised handwriting is most commonly used in situations such as in cheques, banknotes, kidnapping, threats, ransom, anonymous letters, blackmail tries, and similar documents created by disguisers who believe they cannot be identified by their changed handwriting (Levinson, 1983).

Even the most modern technology would assist the document examiner in determining who wrote the disputed document (John and Rao, 2021). When people look at someone's writing, the general appearance is most frequently the first thing they notice (Ellen et al., 2018).

Depending on a person's temperament, behavior, educational background, and level of expertise, different people may use different methods for handwriting disguise. It is often recognized that "disguise is inconsistent," meaning that certain aspects of a person's writing style remain visible through their attempts to conceal their handwriting (Ambre et al., 2016). The most popular method of disguise is one that tries to conceal the writer's identity without showing a prominent writing style (Harris, 1953).

This review contains inquisitive research on Americans (U.S.), Australians, Arabs, Swedes, Chinese, Malaysians, and Indians handwriting and disguise patterns as discussed in Table no. 01. Although the terminology of disguise differs by place, the features utilized to disguise remain consistent (John and Rao, 2021).

## Materials and methods

When it comes to document examination, there has been a rise in criminal activities. Many cases are pending in court because the techniques or tools employed to evaluate the contested document were unsuccessful, especially in a nation like India. An alternative of reviewing the documents must be implemented to resolve this problem (John and Rao, 2021).

The methodology for this review employs a systematic approach to identifying, selecting, and analysing relevant material to satisfy the study goals. The first phase involves doing extensive literature searches across numerous databases, including Scopus, PubMed, and Web of Science, utilizing keywords and search terms related to the research issue. The search technique was

meant to capture a wide spectrum of literature written within the previous decade to ensure relevance and currency. Following the literature search, the obtained publications were assessed using predetermined inclusion and exclusion criteria to determine which studies fit the review's objectives. The selected articles were thoroughly reviewed and data extracted, with major results, methodology, and outcomes synthesized and analyzed. The quality of the included studies was assessed to determine the evidence's robustness and dependability.

It is necessary to employ a variety of light sources, such as infrared or ultraviolet light, to look for any indications of overwriting or letter or word retouching. However, the "Visual Spectral Comparator" is the most practical tool for handwriting analysis. The main benefit of VSC lies in its non-destructive method. It assists in identifying the smallest similarity between the known samples. Comparisons between the admitted and questioned samples can be used to analyze handwriting that has been disguised. Therefore, to get a firm judgment and reduce error, it is required to utilize a variety of tools to identify the source of the disputed document (John and Rao, 2021).

**Results and discussion**

Document examiners face a difficult problem when it comes to examining disguised writings because these writings are odd and unnatural for an expert to handle. To find out how successfully the students could hide their handwriting, a study was conducted by Harris (1953). The majority of kids were found to be unable to hide their handwriting. Nevertheless, more than 10% of the pupils were successful in posing as someone else in their writing (Harris, 1953).

The study of Konstantinidis (1987) showed that according to the data, the majority adhered to what is thought to be the standard pattern of the most widely used disguise techniques, although there were some intriguing variations amongst the groups (Konstantinidis, 1987). To explore the complexities of disguised handwriting, Sharma et al. (2020), conducted a study that concluded that the alteration in slope or size would not affect the letter's style. Furthermore, a rightward slant is different from a leftward slant. Their writing appears congested due to the small spacing between the letters, and they won't change their writing style. The new generation is very smart and intelligent and uses master and unbreakable methods for committing disguises (Sharma et al., 2020). Gupta (2019) from her study, concluded that the author's identity could be verified scientifically in terms of disputed disguised cases (Gupta, 2019).

A lot of studies were also conducted on Chinese handwriting. Comparison research was conducted by Leung et al. (1987) to examine disguised Chinese handwriting and the result showed that of all the characteristics that

are changed when seeming disguised, the most noticeable ones are the easiest to change. It was also established that Chinese handwriting is easy to disguise because it is straightforward and unoriginal (Leung et al., 1987). To prove this point, Leung et al. (1988) conducted another study on Disguise Chinese handwriting and observed that the features most often changed in disguised Chinese handwriting are those that have the biggest influence on the writing's visual appearance, which is consistent with research on disguised English writing. Therefore, it is hypothesized that the psychology of hiding is fundamentally similar in both linguistic systems (Leung et al., 1988). Tsui (1997) observed that the overall pictorial effects and other writing features such as speed, style, alterations, change in stroke formation, and pen movements are found in the disguised writing (Tsui,1997).

Another study was conducted in Malaysia by Mohamed et al. (2011) performed a statistical analysis to identify the common characteristics among Malaysian's disguised handwriting. The outcomes demonstrated that handwriting is uniquely classifiable. The only things unaffected were word spacing and alignment (Mohamed et al., 2011). A study based on the probability of demonstrating the ability to distinguish between Egyptian Arabic disguise and natural handwriting was conducted by Mwaheb et al. (2017) that revealed a degree of deception, with a high mean among female students and a high mean among males in the FHE (Forensic Handwriting Examiner) group (Mwaheb et al., 2017). Similarly, while discussing the inspection of signatures, the first thing that comes to mind is if the signature in issue is "authentic or forged?" Many studies were carried out to provide multiple answers to this. One dynamic study was conducted by Mohammed et al. (2011) on various disguised parameters of disguised signatures and the study demonstrates that variations were shown in concealment behaviors and natural signatory styles that could be important in forensic signature analyses (Mohammed et al., 2011).

The most widespread tactic used in white-collar crime is the disguising of signatures. A unique case of disguised signatures implementing lateral expansion was studied by Misra et al. (2016). The result showed that the subject could not alter his characteristics with a few substitutions of letters or alphabets (Misra et al., 2016). Forensic document examiners (FDEs) encounter difficulties when dealing with concealed handwriting, as it is more likely to yield misleading and inconclusive authorship opinions than authentic writing. The study of Bird et al. (2010) observed a noticeable distinction between the examiner and the lay group. The research showed that the document examiners were more adept at identifying the disguised handwriting samples. Expertise from FDEs is conservative, with a greater percentage of ambiguous viewpoints expressed by FDEs. Consequently, the FDEs express a decreased proportion of misleading responses concerning works described as naturally composed or obscured (Bird et al., 2010).

**Conclusion**

For many years, people have been engaging in the illicit practice of disguising their handwriting. People strive to hide their handwriting because they are aware that it is not authentic, claiming that it does not belong to them. The majority of people are not aware of how to hide their handwriting. According to Pal and Rohatgi, a study was conducted on multilingual handwriting characteristics amongst the central Indian population which states that handwriting is a result of neuromuscular activity, and handwriting analysis follows the same principle regardless of the scripts. Their study also focused on that not only the class characteristics are sufficient for the identification of handwriting samples available in multiple scripts but individual traits are also required to specify the writer (Pal and Rohatgi, 2023). It is clear from the amount of research on disguised handwriting that nobody can conceal their handwriting completely. Even Forensic experts in different fields of forensic science would not be able to disguise their handwriting completely. The experts will be able to disguise their handwriting using only those methods of which they are aware for example changing slant, case, letter size, etc. (Upadhyay and Kumar, 2022). The author creates unnatural-looking letters or words by altering specific aspects of them. The writer may often instinctively return to their original composition while hiding their handwriting, or attempt to exaggerate the letters. There will be utter contradictions between the consistency in the words or letters. The techniques such as size, slant, and proportion changes, speed, alignment, pen pressure, and skills used for concealing are restricted to a small number.

According to the literature, an inaccurate disguise determination will be made when:

· Similar characteristics found in the texts under question and known handwriting samples are being attributed to two different authors while they are signs of one writer hiding behind a disguise (Harrison, 1962).

· A consistent and appropriate distinctive feature causes discrepancies across questions and specimens or documents that, when closely scrutinized but not thoroughly examined, are acknowledged to be real or well-known (Harrison, 1966; Ellen, 1997; Morris, 2020; Harrison, 1997).

· Morsris claims that the symptoms of disguised writing are often misinterpreted as a sign of incompetence or slowness on the part of the writer (Morris, 2020).

· The minor and consistent differences in the writing of a questioned and known writing belong to disguise, but they are, proof of different writers.

· The term "disguise" refers to the variations in qualities found in

writings, but it can also refer to other things like illness, the effects of alcohol, or external aspects like a writing surface or writing instrument.

Nonetheless, the ease with which one may tell if a document is disguised is that the people who created it were unaware of the traits that would make their handwriting appear different. It is often difficult for the document examiner to identify the document's drawbacks. This is due, in part, to the lack of natural samples and accepted samples, which prevents the examiner from identifying the writer's inherent variances. Another one is the absence of instrumentation for handwriting analysis.

To reach valid conclusions, future investigations involving disputed documents should employ non-destructive techniques like VSC. It is also important to use a variety of light sources, including transmitted, infrared, and UV light, to accurately draw conclusions that will be useful for later research.

### Future scope of the study

One of the challenging aspects of examining disguised writing is compiling all the handwriting characteristics from the ordinal writing that the writer attempts to alter in their writing style by modifying the letter forms, stroke patterns, etc. is one of the difficult parts of studying disguised writing.

The research will help examine and evaluate cases of master disguise. To observe the variances, originality, and distinctive features in master disguised cases, more investigation with a large number of samples is required. There is a need to identify and assess a few rarely hidden unconscious characteristics.

**Table No. 01 Details of the work done among several demographic population**

| S.NO. | Author | Abstract | Population | Year |
|-------|--------|----------|------------|------|
| 1. | Harris | An investigation was done to see how well the students could conceal their handwriting [Harris, 1953]. | Americans (U.S.) | 1953 |
| 2. | Konstantinidis | The study was conducted on disguised handwriting. The goal of the study was to investigate if there were any significant differences between the groups and which characteristics or techniques were most frequently concealed [Koppenhaver, 2007]. | Sweden | 1987 |
| 3. | Sharma et al. | The goal of this study was to identify the writer by analyzing a few examples of expertly disguised handwriting and comparing them according to specific personal traits [Sharma et al., 2020]. | Arab | 2020 |
| 4. | Gupta | The author aimed to examine several writing examples of master disguises and contrasted them with particular, distinctive features [Gupta, 2019]. | Indians | 2019 |

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| 5. | Leung et al. | Comparison research was conducted to examine disguised Chinese handwriting. For handwriting examination, statistical investigations were undertaken on several Chinese characters. Additionally, an effort has been made to determine how some significant characteristics of the Latinized and Chinese language systems relate to one another [Leung et al., 1987]. | Chinese | 1987 |
| 6. | Leung et al. | The paper showed that the analysis of the disguised characteristics showed that, in terms of the range of techniques used, the pattern was more complex than that of disguised English handwriting. Only nearly half of the over 30 disguise techniques were identical to English handwriting. According to the research, Chinese handwriting is likewise straightforward and unoriginal when it comes to deception [Leung et al., 1988]. | Chinese | 1988 |
| 7. | Tsui | The study carried out a comparison investigation on Chinese-Canadian disguised handwriting. The purpose of the research was to compare the characteristics of disguised handwriting from the previous investigation by Leung and Chung. Examining the handwriting showed other disguise techniques that were not disclosed in the earlier study [Tsui, 1997]. | Chinese-Canadian | 1997 |
| 8. | Mohamed et al. | A statistical analysis was done to identify the common characteristics among Malaysians' disguised handwriting. This study included a statistical and microscopic analysis of handwriting characteristics. The Pearson Chi-squared test was employed as a statistical approach to investigate the correlation between normal handwriting habits and age, gender, race, occupation, degree of education, and first educational system [Mohamed et al., 2011]. | Malaysian | 2011 |
| 9. | Mwaheb et al. | In this study, statistical analysis was performed using SPSS software to distinguish between the writings that showed a high mean degree of disguise in the FHE (Forensic handwriting examiner) group. In contrast, the student group displayed moderate disguise, indicating that being older will correlate with an increase in good skills for performing disguise [Mwaheb et al., 2017]. | Arabic | 2017 |
| 10. | Mohammed et al. | The study focused on examining whether there are any similarities or dissimilarities in dynamic characteristics such as size, duration, pen pressure, and velocity between the signing style of a signature (mixed, stylized, and text-based). The study also aimed to analyze if the signing style has an equal impact on authentic, disguised, and auto-simulation signatures [Mohammed et al., 2011]. | Americans (U.S.) | 2011 |
| 11. | Misra et al. | The study was done to understand the special disguising technique, which took the form of lateral expansion. The subject has covered up | - | 2016 |

| | | his signatures by expanding the alphabet laterally rather than using the more common overlapped alphabets [Misra et al., 2016]. | | |
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| 12. | Bird et al. | The study examines the FDE's capacity to decipher 140 pairs of naturally occurring and hidden inscriptions and their results are compared with those of a lay control group [Bird et al., 2010]. | U.S. and Australia | 2010 |

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