



## Short Communication

## Effect of unusual writing instruments on handwriting characteristics

Akanksha Gangwar<sup>1</sup>, Nitin Pandey<sup>2\*</sup><sup>1</sup>Dept. of Forensic Science, Banaras Hindu University, Varanasi, Uttar Pradesh, India.<sup>2</sup>Dept. of Biosciences, Graphic Era Deemed to be University, Uttarakhand, India.

## Abstract

Handwritten evidence plays a crucial role in forensic investigations, especially in cases where documents are produced under unusual conditions. This study investigates the impact of unusual writing instruments, such as lipstick and kajal-stick, and unconventional surfaces, such as mirrors and tissue paper, on handwriting characteristics. A comparative analysis was conducted on writing samples obtained from 30 individuals under both normal and unusual conditions. The study highlights variations in line quality, slant, spacing, connections, and letter forms, while also noting features that remain consistent across conditions. The findings emphasize that while unusual conditions can distort handwriting, subconscious habitual features can still aid forensic document examiners in authorship determination.

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## 1. Introduction

Handwriting is a unique neuromuscular activity involving coordinated movements of bones, muscles, and the brain. In forensic science, questioned document examination relies on identifying class and individual characteristics of handwriting. However, in cases where documents are written using unusual instruments (lipstick, kajal-stick) or on unconventional surfaces (mirror, tissue paper), normal writing traits may be distorted, complicating the process of authorship determination. This communication summarizes a study conducted to evaluate such effects and assess the extent to which forensic analysis remains reliable.<sup>1,4</sup> Therefore, the present study has been carried out to study the variations in handwriting characteristics due to unusual writing instruments like lipstick and kajal-stick and unusual writing surfaces like mirror and tissue paper by analysing and comparing the unusual writings with the normal ones. In addition to this, an attempt has been made to find out the extent, to which a positive comparison between the writings, executed under unusual and normal writing conditions is possible. Handwriting is the neuromuscular phenomena in

which 27 small bones, 40 muscle and brain coordinates together and write with pen or pencil in a paper.

Handwriting analysis have two Main points:

1. A Determination of the hardware used to make the text. Ink, pen, pencil, typewriter are the type of hardware.
2. Visual examination of the handwriting characteristics of the document.

The three main principles of handwriting identification are:

1. No two skilled writers can exhibit identical handwriting even after giving them sufficient time and handwriting.
2. Even the same individual cannot write identical handwriting. There is some presence of variations that occur naturally and is called “natural variation.”
3. No writer can exceed their skills level. It means that we cannot expect a perfect form of handwriting even from a person who knows about the basics skills of handwriting.

\*Corresponding author: Nitin Pandey  
Email: [nitinpandey0219@gmail.com](mailto:nitinpandey0219@gmail.com)

## 2. Class and Individual Characteristics of Handwriting

A questioned document expert examines two elements viz, class and individual characteristics of handwriting to come to a conclusion regarding the authorship of handwriting. Lets learn in detail what these characteristics are all about.<sup>5-8</sup>

Class Characteristics are those writing features common to a group i.e. the common pattern of handwriting, letters, their shape which are limited to a group, age or language. In simple words, it is nothing but copy book format i.e a model which is taught to us when we learn the writing process which is almost similar to a class of people. Ex- Pen pressure, Style, Slant, Slope etc.<sup>9</sup>

### 2.1. Pen pressure

Weight or pressure unconsciously applied to the writing instrument during the act of writing. Writing produced with a nib pen will clearly show the effect of applying different amount of pressure to the writing instrument as it passes along the paper. The more pressure applied by the fingers and hand, the greater the tips of the nib will separate.

### 2.2. Pen presentation

It is the angle of the pen with the writing surface or with the line of writing. The best writing is produced when the angle is 45 degrees.

### 2.3. Slant/ slope

Slope is the inclination of the axes of letters relative to the perpendicular to the baseline of the writing. Slant can be

1. Vertical / Straight
2. Left/Backward
3. Right/ Forward

### 2.4. Speed

The amount of time it takes a writer to execute a handwriting. Speed can be fast, medium, slow and deliberate. Characteristics of Fast Writing.

1. Simplified Letter forms
2. Smooth Strokes
3. Proper Connections
4. I dots are jabbed and carelessly placed
5. T crossings are tapered or may be joined with the other word.
6. Endings are abrupt and Characteristics of Slow Writing
7. Laborious
8. T bars are carefully placed.
9. I dots are rounded and close to the stem.
10. Vertical Slant
11. Pressure is often monotonous

### 2.5. Skill

Skill is the ability/ expertise to do something. The act of writing is a skill learned through repetition until it becomes a habit. . The more an individual practices writing, the better the skill. Skill in handwriting can be categorized as, Poor, Medium/ Normal and Superior/ Good.

### 2.6. High skill

Rhythmic, fluid, artistic, embellished and pleasing to eyes.

### 2.7. Low skill

Laborious, Slow, not rhythmic.

*Spacing* – Spacing refers to the amount of space between letters, words and lines of writing. The rules of writing dictates one to two letter space between words. Sufficient space must be left between lines to prevent intermingling of upper and lower loops. Spacing is categorized into two –

1. Inter word (between) and
2. Intra word (Within)

*Alignment* – The baseline is the imaginary line or actual lines on which writing sits. Some writers stay above the baseline, some stay on the line and some goes below it.

1. Descending
2. Ascending
3. Uneven

*Line Quality* – Line Quality is defines as the smoothness, evenness, continuity, directness of strokes. Line Quality is the most important features in handwriting examination.

1. Good line quality is smooth, even, without tremors and written with speed.
2. Poor Line Quality is the result of slow writing which may indicate forgery or deliberate change in writing.

When forging, a person tries to draws the signature instead of writing. The art of drawing is slow and laborious process, resulting in tremulous strokes.

Individual characteristics, on the other hand, occur when a letter departs from its usual copybook form. These elements of writing constitute the basis of all handwriting identifications. Those particular aspects or features of writing that are peculiar to a specific writer. Ex- strokes, letter

Important handwritten messages are occasionally found during the exploration of various criminal cases, such as murder, suicide, kidnapping, threatening or terrorist actions, where the securitization and authorship of such messages alone plays a crucial role. Generally, with the presence of sufficient standards concluding authorship is not much difficult. But complications ensue, when there is a lack of

contemporaneous and similar writings for comparison. This difficulty adds up, when the suspected document is produced under unusual conditions, such as in a standing posture or by using surrounding available articles like lipstick, kajal as writing instruments and mirror, tissue paper as writing surfaces. The nature of unusual writing instruments and surfaces tend to affect the writing in several means, such as a thick nib of an instrument and a rough surface may conceal the important details of a person’s handwriting, making it difficult for the examiner to reach a conclusion. Examiner’s unfamiliarity about the effect of writing conditions on handwriting characteristics may render the establishment of identity of the questioned writing difficult.

Similar studies have been conducted earlier by different authors Kelly (1978), Demirci, Dogan, Erkol and Gunaydin (2009), Austin and Byard (2013), Behera, Rautji, Krishna, Kumar and Gupta (2014), Tarannum, Mishra, Prasad, Lawrence and Saran (2015), Tumram and Ambade (2015), Joshi and Garg (2015), Behera, Swain, Bhardwaj and Millo (2016), Tattoli, Gauselmann, Buschmann (2017), Cadola, Cuany, Weyermann and Marquis (2018) etc., which involved the examination of handwriting found on unusual surfaces like balloon, skin, bedsheet and wall. Regardless of this any organised study has not been published on handwriting examination, involving the documents made up with unusual writing instruments and surfaces as mentioned above.

Therefore, the present study has been carried out to study the variations in handwriting characteristics due to unusual writing instruments like lipstick and kajal-stick and unusual writing surfaces like mirror and tissue paper by analysing and comparing the unusual writings with the normal ones. In addition to this, an attempt has been made to find out the extent, to which a positive comparison between the writings, executed under unusual and normal writing conditions is possible.

3. Materials and Methods

Writing samples were collected from 30 individuals (9 males, 21 females, aged 21–30 years) under five conditions: normal pen-paper writing and writing with lipstick and kajal-stick on mirror and tissue paper. The subjects wrote a standard pangram (“Pack my box with five dozen jugs of hot water quickly”), signatures, and numerals (0–9). These samples were analyzed for handwriting features such as line quality,

slant, alignment, spacing, margins, letter forms, diacritics, and loop structures.<sup>10,11</sup>

All the writing samples executed with lipstick and Kajal-stick on tissue paper and mirror were analyzed compared with their respective writings written in Normal conditions to study the effect of unusual writing instruments and surfaces on writing features such As line quality, slant, relative height and ratio of letters, Alignment, spacing, margins, letter forms, consistency, Diacritics, omissions due to simplifications and area Enclosed by loops, eyelets and oval.



Figure 1: Shape of the nibs of lipstick and kajal-stick used for preparing writing sample

4. Results and Discussion

Significant variations were observed in handwriting under unusual conditions. Line quality was notably affected, with reduced rhythm and increased pen-lifts on tissue paper. Connections between letters decreased, particularly in soft-surface writings. Slant shifted towards right or left in a substantial portion of samples. Letter size was generally larger on mirror surfaces due to nib thickness and arm movement. Letter forms, such as ‘P’, ‘f’, ‘q’, and ‘x’, showed altered structures in over half the samples. Omissions of letter parts and filled loops were common on tissue paper. Despite these distortions, certain subconscious habits such as relative heights of letters, spacing, and alignment patterns remained consistent, enabling partial identification of writers.

The analysis of handwriting samples under unusual writing conditions revealed consistent disturbances in line quality, rhythm, retouching, and pen-lifts compared to normal writing. These variations were prominent when using lipstick and kajal-stick on soft surfaces such as tissue paper, while rough surfaces like mirrors caused less distortion.

Table 1: Comparative analysis of handwriting features under unusual conditions (%)

Writing Instrument / Surface	Rhythm (Less/Non-Rhythmic)	Retouching (Present)	Pen-lifts (Increased)	Remarks
Lipstick / Tissue Paper	63.33 + 33.33 = 96.66	40	96.67	Highly distorted, non-rhythmic, frequent pen-lifts
Lipstick / Mirror	16.66 + 0 = 16.66	13.33	16.67	Closer to normal, less distortion
Kajal / Tissue paper	73.33 + 20 = 93.33	23.33	93.33	Significant distortion on tissue surface
Kajal / Mirror	10 + 0 = 10	3.33	10	Minimal variation, more controlled strokes

The consolidated results indicate that soft surfaces (tissue paper) produced maximum handwriting distortions, including loss of rhythm, frequent pen-lifts, and extensive retouching. Rough surfaces such as mirrors showed comparatively better preservation of handwriting traits. Lipstick produced more distortion than kajal, likely due to its broader and softer nib. These findings highlight that unusual conditions impact handwriting differently depending on both the writing instrument and the surface.

## 5. Conclusion

The study concludes that unusual writing instruments and surfaces significantly alter handwriting features, potentially complicating forensic analysis. However, stable subconscious habits persist and can be used for authorship attribution when examined carefully. Forensic document examiners should account for such distortions and, whenever possible, obtain comparison samples under similar conditions to strengthen evaluations. From (qualitative as well as quantitative) analysis of various features included in the study, it follows that nature of the writing instrument and the surface Used for execution of the questioned writing does have A noticeable impact on several handwriting features. However, there still remain a number of inconspicuous repetitive features, which, being of sub-conscious Origin, are habitual and well beyond the knowledge and effective control of the writer. The FDE can very well evaluate those hidden features and, if found suitable and sufficient in a given case, can form an opinion regarding the authorship, depending on their evidential value. In practical situations, however, it is seen that establishment of authorship of a disputed handwriting may not be possible to achieve in each and every case. This is primarily due to non-availability of suitable and sufficient number of identifying characteristics for a wide variety of reasons which includes, among others, limited extent of the questioned writing, deliberate distortion and disguise by the perpetrator to mask his identity, poor legibility of written characters, non-availability of similar letters and combinations in the supplied standards for comparison, poor line quality of the questioned writing arising from his level of Education and skill, as well as nature of the writing instrument and the surface used to prepare the questioned document. However, keeping in view the complexity of such problems, it is suggested that, as far as possible, efforts may be made to supply, for comparison the standard Material containing similar letters and combinations produced under similar conditions as that of the questioned writing. Further, it must be kept in mind, that physical evidence comprising disputed documents produced under such unusual conditions needs careful handling and specialized investigation. A sensitive surface, like fragile soft surface should be preferably sandwiched between the cellophane sheets carefully to provide some stability and to preserve the evidence. Obviously, some of the documents, like writings on a wall or on human body parts, cannot be

directly transported to the laboratory. In such cases it becomes necessary to supply specialized photographs prepared by a professional document photographer, which are correct representation of the originals, and if felt necessary, the document examiner can be given opportunity to examine the original writings directly at the scene of crime.

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None.

## 7. Conflict of Interest

None.

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