

Forensic study on the effect of atypical surfaces and writing instruments on handwriting characteristics

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Abstract

Handwriting examination is becoming a captivating field nowadays, as there are numerous cases where handwriting is not written on a usual surface – i.e., paper, with a conventional writing instrument – i.e., pen. However, while it is interesting to analyze these types of handwriting samples, most forensic document examiners find it difficult due to the effect atypical surface and writing instrument have on handwriting characteristics. Thus, a systematized study has been carried out on documents prepared on unconventional surfaces such as cardboard, cloth piece, and blackboard, with uncommon writing instruments such as lipstick, kajal, and chalk. Correspondingly, studies were carried out on writing samples provided by 40 individuals using the conventional pen/paper as well as unconventional cardboard/kajal, cardboard/pen, cloth/pen, cloth/lipstick, cloth/kajal, and board/chalk combinations. Various handwriting features were examined and compared among aforementioned combinations, and changes in handwriting characteristics were reported. Those could be due to the atypical writing instruments and surfaces which conjointly impact the overall identity of the handwriting and expert's conclusions thereon.

Keywords: handwriting examination, unusual surface, lipstick, handwriting features.

Introduction

So far, forensic document examiners (FDEs) have been rather accepting of the novel challenges and complications introduced by non-traditional documents which are not made with pen and paper. However, the biggest one is typically the examination of handwriting written on unusual surfaces such as cloth, cardboard, and blackboard, with non-conventional writing instruments such as lipstick, kajal, and chalk. This area of expertise is of utmost importance because such solutions are very common in cases of suicide, since the person committing suicide may want to hide the evidence from the suspect (meaning the person who abet the victim to do such an act) but at the same time share that information with a loved one or the law enforcement officials. The commonly encountered writing surfaces exhibiting the evidence in cases of suicide are skin, mirror, wall, cloth, tissue, or anything available in the vicinity.¹

The utilization of unusual surfaces and instruments is more prominent in cases of suicide because the usual surface (paper) and common writing instrument (pen) are not usually available in the vicinity. Thus, the individuals opt for the atypical surfaces, due to their easy availability and resistance to destruction.² It is evident from earlier studies that the overall pictorial appearance of the handwriting on unfamiliar surfaces is influenced by the limited availability of the space and awkwardness faced by the writer while inscribing on the unique and unknown surface with the new writing instrument.³

The utilization of unique writing tools and surfaces tends to have an impact on writing in numerous ways. For example, a thick and broad nib and a rough surface may hide crucial handwriting features, which make it challenging for the FDE to examine the document without awareness

¹ A. Kaur, M. Threja, R.K. Garg, "Forensic examination of handwriting transcribed on an unusual surface (human skin)", *Problems of Forensic Sciences* 117, 2019, pp. 5–18.

² M.C. Joshi, R.K. Garg, "Examination of writing on an unusual surface in a suicide case: Dead persons do tell tales – conduct a forensic investigation for the cause of humanity and justice", *Problems of Forensic Sciences* 101, 2015, pp. 50–59.

³ R.W. Byard, "Evidence of premeditation in skin messages in suicide", *Journal of Forensic Sciences* 61, 2016, no. 2, pp. 566–568.

of how the unknown surface and instrument are affecting the hidden features of handwriting.⁴ Comparable studies have been done by several other authors.

In the present study, lipstick, kajal, chalk, and ball point pen were used by the writers to inscribe on unusual surfaces such as cloth, board, cardboard, and paper. It was evident after analyzing and comparing the handwriting that the surface and writing instrument had affected the overall pictorial appearance of the handwriting, but there are peculiar features which make the comparison of writing on different surfaces with different writing instrument possible.

Materials and methodology

Handwriting samples for the present study were obtained from 40 individuals (20 males and 20 females) between the ages 20–35 from the RIMT University Campus. The chosen subjects were skilled writers and well-versed with the handwriting process. Each one of them was asked to write “A grumpy wizard makes a toxic brew for the jovial queen” on three non-conventional substrates – i.e., cardboard, board, and cloth piece, with chalk, kajal, lipstick, and ball point pen (Figure 1). Each individual wrote on four surfaces, including paper. Thus, 240 samples were collected overall (Table 1).

Table 1. Number of samples collected on different surfaces

Writing instrument	Writing surface				Total
	A4 sheet	Cloth	Cardboard	Board	
ball point pen	40	40	40	–	120
lipstick	–	40	–	–	40
kajal	–	40	–	–	40
chalk	–	–	–	40	40
Total	40	120	40	40	240

⁴ M. Threja, K. Saini, M. Singh, “A study of the effect of unusual writing instruments and surfaces on the handwriting characteristics”, *Problems of Forensic Science* 118, 2019, pp. 123–140.



Figure 1. Writing instruments

All samples were photographed with a 24MP digital camera (Sony). The samples on the board were photographed immediately because they could be easily erased with a duster. Later on, each sample was compared with the writing of the same individual on paper using ball point pen.

Results

The handwriting samples were analyzed and compared to determine the differences and similarities in the handwriting made on unusual surfaces with unusual writing instruments. At first, features such as line quality, slant, relative height, and alignment were taken into account. Additionally, individual characteristics such as letter forms, shape and formation of diacritics, omission of letters or parts of a letter, area enclosed by loops, and capitalization of letters were considered for the purpose of examination.

Features of handwriting analyzed:

Line quality. The line quality of the handwriting is the combination of numerous handwriting features such as rhythm, retouching and overwriting, pen lifts, connections, and nature of initial and terminal strokes.⁵ The variation in these factors helps the FDE to judge the line quality of the given sample.

Rhythm. It can be classified as smooth, intermittent, and jerky. It is evident from Table 2 that the rhythm is jerkier and more intermittent

⁵ A.S. Osborn, *Questioned Documents*, New York 1929.

in the lipstick/cloth combination. The rhythm of handwriting is mostly smooth in pen/cardboard and chalk/board combinations (Figure 2).

Table 2. Variation in rhythm (percentage of samples)

S.NO.	Writing instrument/ surface	Characteristics		
		Rhythmic	Less rhythmic	Non-rhythmic
1.	lipstick/cloth	7.50	67.50	25.00
2.	kajal/cloth	25.00	57.50	17.50
3.	ball point pen/cloth	85.00	15.00	–
4.	pen/cardboard	82.50	17.50	–
5.	chalk/board	45.00	50.00	5.00

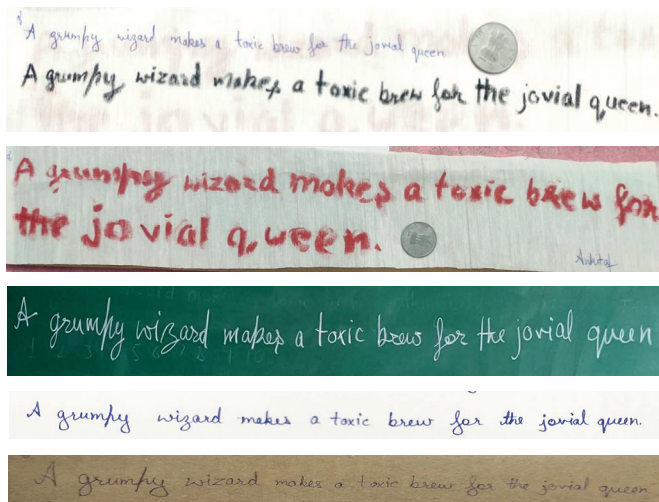


Figure 2. Variation in rhythm

Retouching and overwriting.⁶ It is evident from Table 3 that retouching similar to pen/paper is present in all of the handwritings; additional retouching and overwriting also appears in 32.5% of the lipstick/cloth combination samples (Figures 3 and 4).

⁶ R.A. Huber, A.M. Headrick, *Handwriting Identification: Facts and Fundamentals*, Boca Raton, FL 1999.

Table 3. Variations in retouching and overwriting (percentage of samples)

S.NO.	Writing instrument/surface	Characteristics	
		Natural	Additional
1.	lipstick/cloth	67.50	32.50
2.	kajal/cloth	72.50	27.50
3.	ball point pen/cloth	87.50	12.50
4.	pen/cardboard	82.50	17.50
5.	chalk/board	77.50	12.50

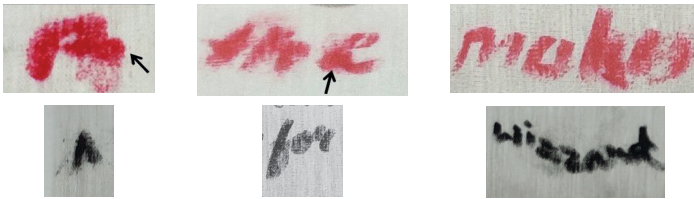


Figure 3. Presence of retouching in handwriting written on cloth piece with lipstick and kajal

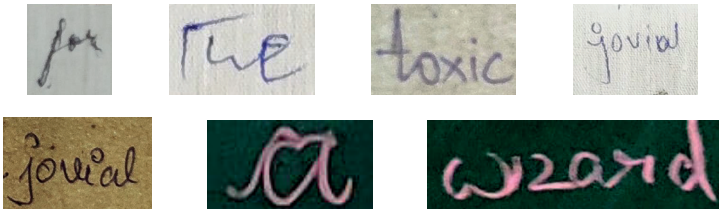


Figure 4. Presence of retouching in handwriting on a cloth piece with ball point pen, on a board with chalk, and on cardboard with ball point pen

Pen lifts.⁷ Pen lifts ultimately affect the frequency of connections in the line of handwriting (Figure 5). The number of pen lifts increased in 92.5% of lipstick/cloth and 90% of kajal/cloth samples (Table 4).

Connections.⁸ Connections among the various strokes of handwriting vary from acute angles to broad curves. From Table 5, it is evident that the number of connections decreased as the subject wrote with an atypical writing instrument (Figure 5). The results revealed that there are

⁷ O. Hilton, *Scientific Examination of Questioned Documents*, New York 1982.

⁸ R.A. Huber, A.M. Headrick, op. cit.

fewer connections in the writings with lipstick and kajal than the ball point pen (Table 5).

Commencing and terminal strokes. The nature of commencing and terminating strokes here depends upon the thickness of the writing instrument. For this reason, the maximum blunt initial and terminal strokes are present in the lipstick/cloth rather than other combinations. The surprising fact is that even in the case of chalk/board, most strokes are fine and flying (Table 6).

Table 4. Variations in pen lifts (percentage of samples)

S.NO.	Writing instrument/surface	Characteristics	
		Similar	Increased
1.	lipstick/cloth	7.50	92.50
2.	kajal/cloth	10.00	90.00
3.	ball point pen/cloth	75.00	25.00
4.	pen/cardboard	70.00	30.00
5.	chalk/board	72.50	27.50

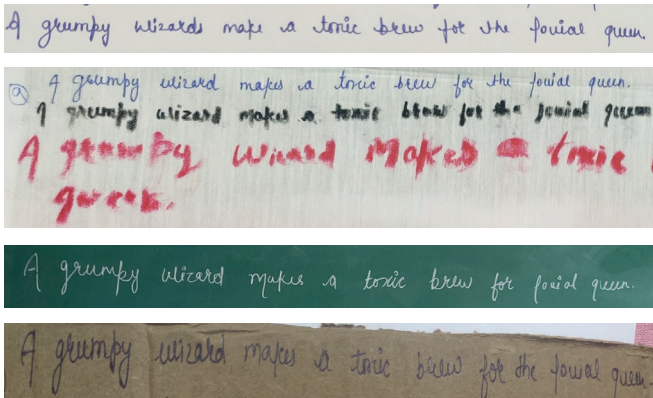


Figure 5. Variations in the number of pen lifts and connections

Slant. Variation in slant is more evident in lipstick/cloth and kajal/cloth samples (Figure 6). The variation in slant is from backward to forward especially in case of writing with lipstick. In most cases, the writing on board is vertical. There is little difference in the slant in writing inscribed on cardboard.

Table 5. Variations in connections (percentage of samples)

S.NO.	Writing instrument/surface	Characteristics	
		Similar	Decreased
1.	lipstick/cloth	5.00	95.00
2.	kajal/cloth	27.50	72.50
3.	ball point pen/cloth	82.50	17.50
4.	pen/cardboard	85.00	15.00
5.	chalk/board	62.50	37.50

Table 6. Variations in nature of commencing and terminal strokes (percentage of samples)

S.NO.	Writing instrument/surface	Characteristics	
		Fine and flying	Blunt
1.	lipstick/cloth	5.00	95.00
2.	kajal/cloth	35.00	65.00
3.	ball point pen/cloth	82.50	17.50
4.	pen/cardboard	85.00	15.00
5.	chalk/board	70.00	30.00

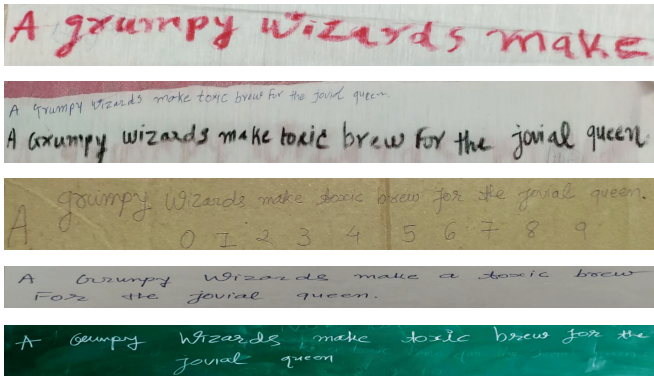


Figure 6. Variation in slant (retracted towards both sides)

Relative height.⁹ Letter combinations ‘ds’ from the word *Wizards*, ‘to’ from the word *toxic*, ‘fo’ from the word *for*, ‘al’ from the word *jovial*, and ‘qu’ from the word *queen* were chosen for determining the variations

⁹ A.S. Osborn, op. cit.

in relative height and proportion. The height was measured with a template scale with parallel lines, each 1 mm apart. The size of handwriting is larger in the case of lipstick/cloth, kajal/cloth, and chalk/board combinations, but the relative height and proportions remained similar in each case irrespective of the surface or the instrument because it is a habitual characteristic.

Alignment.¹⁰ It can be classified as ascending, descending, horizontal, and mixed. Compared to normal handwriting, the alignment was very similar in writings with pen and kajal on cloth, but affected in writings with lipstick on cloth. No major changes in alignment were observed in writings with pen on cardboard (Figure 7); however, some appeared in the case of writing on board with chalk due to the change in writing posture and movement.

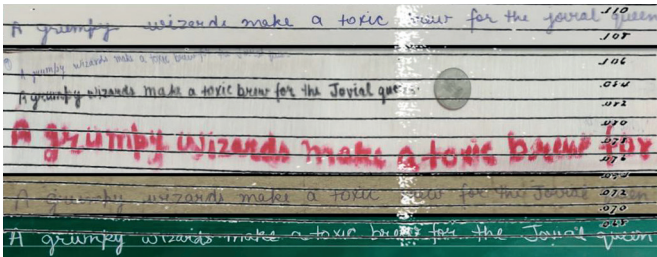


Figure 7. Variation in alignment

Letter formations.¹¹ For analyzing the effect of handwriting surface and handwriting instrument on letter formations, four letters were selected i.e., 'f,' 'g,' 'j,' and 'A.' The highest numbers of deviations are there in lipstick/cloth samples (Figures 8 and 9).



Figure 8. Change in form of the letter 'f'



Figure 9. Variation in form of the letter 'j'

¹⁰ W.R. Harrison, *Suspect Documents: Their Scientific Examination*, London 1996.

¹¹ R.A. Huber, A.M. Headrick, op. cit.

Diacritics.¹² In the present study, i-dots were considered and analyzed qualitatively, regarding their frequency, shape, and position. Shapes of the i-dot such as a circle, semicircle, or coma, used in writings performed in normal conditions, were observed to be simplified into a dot in samples written on atypical surfaces with atypical instruments (Figure 10). On a cloth surface filled circles were observed due to the thickness of the writing instrument.



Figure 10. Variation in the 'i-dot' diacritic mark

Omission of letters and parts of letters.¹³ The presence of omission of letters and parts of letters is evident on unusual surfaces especially in the case of lipstick/cloth handwriting due to the simplifications made under abnormal conditions (Figure 11). The highest percentage of omissions was present in lipstick/cloth samples (67.5%), and the lowest (12.50%) – in chalk/board samples (Table 7). No omissions were observed in the case of pen/cardboard samples.

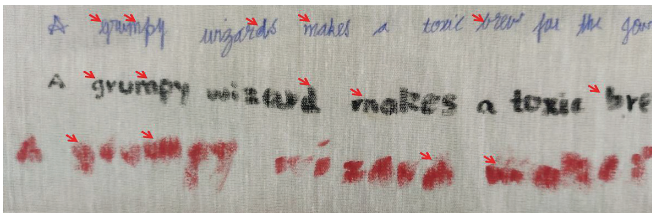


Figure 11. Omission of letters and parts of letters in lipstick and kajal handwriting

¹² Ibid.

¹³ Ibid.

Table 7. Presence or absence of omission of letters and parts of letters (percentage of samples)

S.NO.	Writing instrument/surface	Characteristics	
		Present	Absent
1.	lipstick/cloth	67.50	32.50
2.	kajal/cloth	35.00	65.00
3.	ball point pen/cloth	–	100.00
4.	pen/cardboard	–	100.00
5.	chalk/board	12.50	86.50

Capitalization of letters. Capitalization was found to be present in even normal writing samples of some individuals, which indicated their individual habit. A comparison of the writings on unusual surfaces with normal writing samples revealed that capitalization was introduced in 34.21% of the samples written with lipstick on cloth and in 25% of the samples written with kajal on cloth (Figures 12, 13, and 14). No capitalization was observed in cardboard/pen handwriting. Only two samples of board/chalk handwriting showed capitalization.



Figure 12. Capitalization of letters in handwriting on cloth with lipstick



Figure 13. Capitalization of letters in handwritings on cloth with kajal



Figure 14. Capitalization of letters in handwritings on board with chalk

Area enclosed by loops and eyelets. Comparison of writings transcribed on cloth, board, and cardboard with writings on usual surfaces revealed a contraction of area bordered by loops, eyelets, and ovals in

about 82.5% of the samples written on cloth with lipstick and in 70% of the samples written on cloth with kajal (Figures 15 and 16). There is no significant change in the area enclosed by loops, ovals, and eyelets in writings on board and cardboard (Table 8).



Figure 15. Variation in the area enclosed by an oval in the letter ‘a’

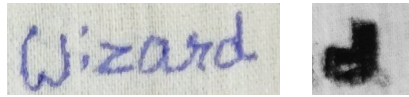


Figure 16. Variation in the area enclosed by an oval in the letter ‘d’

Table 8. Variation in area enclosed by loops and eyelets (percentage of samples)

S.NO.	Writing instrument/surface	Characteristics	
		Similar	Dissimilar
1.	lipstick/cloth	12.50	82.50
2.	kajal/cloth	30.00	70.00
3.	ball point pen/cloth	100.00	–
4.	pen/cardboard	100.00	–
5.	chalk/board	90.00	10.00

Discussion

All the samples were analyzed and compared in terms of the effect unusual surfaces and atypical handwriting instruments have on handwriting characteristics such as: slant, size, proportions, line quality, connections, diacritics, etc. Due to an unusual surface or instrument, the appearance of the handwriting can differ from the typical pen/paper handwriting; still, many of the recurring identifying features of normal handwriting remain unaltered, which can help answer the question of common authorship.

A prominent cause of deviations in handwriting features is the fragility and roughness of the handwriting surface (cloth and cardboard).¹⁴

¹⁴ M. Threja, K. Saini, M. Singh, op. cit.

Furthermore, the holder's grip, thickness of the nib (lipstick and kajal), the writer's position, and writing movement also affect the overall appearance of the handwriting. All these factors can contribute to changing well-arranged handwriting into a clumsy one.

While examining the collected samples, it was observed that the highest quantity of deviations in all the handwriting features was observed in the cloth/lipstick and cloth/ kajal combinations. The possible reason behind these divergences is the interaction between the two surfaces along with the thickness of the writing instrument nib as well as irregular surface. We are well-acquainted with the nature of the usual writing instrument (pen) and handwriting surface (paper), but not with many atypical ones. This is why awkwardness can be found in writings on unusual surfaces.

The size and spacing of the handwriting are influenced by the nature of the surface and the instrument used.¹⁵ However, the present study made it clear that the relative size always remains identical, and the spacing changes depending on the available space.

Conclusion

In the course of the study, it was observed that the characteristics of writing on cloth, cardboard, and board show evident deviations, but some particular individual features still remain unaffected – particularly the relative size, letter formation, and the nature of commencing and terminal strokes. Such features can help in comparing handwriting present on atypical surfaces written with atypical instruments and normal writing. It was concluded that if writing features are original, undisguised, clear, and collected within a short period, it is possible to give a definite opinion regarding the authorship, irrespective of the complications induced by unusual surfaces or unusual writing instruments. The findings of this research reveal that numerous factors play a significant role in the analysis of writing, such as: surface features (texture, color, nature), writing instruments (width of nib, texture of the writing instrument, color of ink), writing posture, and writing movement.

¹⁵ J. Levinson, *op. cit.*

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