Research Paper

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A Comparative Analysis of Handwriting Traits of Twins and Siblings

Forensic Science

KEYWORDS : Forensic document examination, questioned document examination, handwriting analysis, handwriting of twins, handwriting of siblings

*** Mr JOGINDER SINGH** — PhD Scholar, Affiliation: Department of Anthropology, Delhi University, Delhi – 110007, India

Prof. M.P. SACHDEVA — Professor, Affiliation: Department of Anthropology, Delhi University, Delhi – 110007, India

ABSTRACT

Forensic document examination often requires differentiation between two handwritings that appear identical. The aim of this study is to identify such handwriting characteristics that are often different even in highly similar handwritings, like in case of twins and siblings. For this study, handwriting samples were obtained from twenty-five pairs of twins and siblings each. These handwriting samples were analysed and compared on the basis of ten class and six minute handwriting characteristics through manual examination. Additionally similar letter formations were identified between handwritings of twins and siblings.

As a result of this research, the most and least frequently occurring similar handwriting characteristics were identified. Graphs were plotted to reveal the frequency of occurrence of various similar class and minute handwriting characteristics. Practical implication of this finding is that a standardised priority order for scrutiny of handwriting characteristics can be developed to enable swift and accurate differentiation of highly similar handwritings during questioned document examination.

Also, the similar letter formations were categorised into two kinds, those that seemed to be consciously acquired and those, which seemed to be non-consciously acquired. Through this, inference was drawn regarding influence of environment and genetics on handwriting, respectively.

1. INTRODUCTION

Determination of similarities and dissimilarities between two handwritings is fundamental for identification of writer through forensic document examination. In cases when the writers are not distinguishable by their physical appearance, like in case of identical twins, they are distinguishable by a forensic analysis of their handwriting [5, 14]. Handwriting is such a unique and individualized characteristic of a writer, that even the handwriting of twins, who were so much alike in appearance, was found to be not ordinarily alike at all through a study by Galton [4]. Even though the handwritings of twins were distinguishable due to dissimilarities, they displayed remarkable similarity in various handwriting characteristics, as found by Boot through a research on handwriting of identical and fraternal twins [2]. Identical twins' handwriting was also analysed on graphological parameters by Seeman and Saudek and noteworthy similarities in their handwriting were found [11]. Consequently a series of comparative researches were undertaken that revealed monozygotic twins possessed greater similarity in handwriting as compared to dizygotic twins [15]. The predominance of differences was slightly less in the group of monozygotic twins as compared to dizygotic [3].

The same-sex twins also demonstrated greater similarity in comparison to opposite sex twins and twins in general had greater similarity in their handwriting than siblings [8]. A computer based algorithmic analysis of handwriting characteristics of twins and siblings by Sri Hari *et al* also validated that the handwriting of twins was less discriminable than non-twins [12].

The reasons for similarity in handwritings were attributed to shared environment as well as genetic make-up by Stevens [13]. He found that the similarity between the members of the family was much more as compared to similarity in handwritings of the control groups [13]. But even in the case of identical genetic make-up and same family surrounding, school and teachers, the handwritings of twins can be differentiated and the differences in handwritings get more pronounced with progressing age [1].

The purpose of this research was to identify such handwriting characteristics that are frequently different even in highly similar handwritings and substantiate the reasons responsible for the similarity with evidences. The extent of similarity as also dissimilarity in handwriting of twin pairs and sibling pairs on account of various specific handwriting characteristics [6, 7, 9, 10] was determined. The focus of the study was conducting an in-depth qualitative analysis of handwriting samples of twins and siblings.

2. MATERIAL AND METHODS

Hundred handwriting samples were collected from twenty-five pairs of siblings and twins each from Delhi, India. The writers were educated in English medium schools wherein all subjects' text-books and the medium of instruction is English. Each handwriting sample comprised of "The London Letter-one of the most popular handwriting exemplar in forensic document examination, a Pangram- The quick brown fox jumps over the lazy dog", the English alphabets 'A-Z' in upper and lower case. Those twin and sibling pairs were selected who were above the age of fifteen, literate and comfortable in writing English. Rationale of setting the selection criteria was to ensure the maturity and fluency in handwriting.

A methodical document examination procedure was especially devised for analysis of these handwriting samples. The analysis was divided into three subsequent levels.

At the first level of examination, the handwriting samples of each sibling and twin pair were examined, compared and scrutinized on the basis of *class* characteristics, as listed in Table 1. The number of *class* characteristics that showed similarity between each pair was noted and thereby percentage of similarity was calculated. Only those samples, which demonstrated a similarity of 60%, i.e. 6 or more similar *class* characteristics, were further analyzed at the second level.

Table 1. : *Categorisation of class characteristics for analysis*

S. No.	CLASS CHARACTERISTICS	CATEGORIES			
1.	Type of lettering	Printing	Cursive	Composite	-
2.	Movement	Finger	Wrist	Wrist-cum-finger	Forearm
3.	Speed	Slow	Moderate	Fast	-

4.	Skill	Poor	Average	Good	-
5.	Slant	Forward	Vertical	Backward	Mixed
6.	Alignment	Ascend-ing	Hori-zontal	Descend-ing	Irregular
7.	Spacing	Narrow	Medium	Wide	-
8.	Legibility	Good	Poor	-	-
9.	Line quality	Poor	Medium	Good	-
10.	Form	Rounded	Angular	Oval	-

At the second level of examination, the *minute* characteristics, as listed in table 2, between sibling and twin pairs were examined and compared only for those samples that qualified for second level. The number of *minute* characteristics that showed similarity between each pair was noted and thereby percentage of similarity was calculated. All *minute* characteristics excluding *inclination of terminals* were specifically defined for this research.

Table 2. : *Categorisation of minute characteristics for analysis***.**

S. No.	MINUTE CHAR-ACTERISTICS	CATEGORIES			
1.	Position of i/j-dot	Leftward	Above	Right-ward	-
2.	Shape of i/j-dot	Dotted	Ticked	Circular	Caret
3.	Position of t-cross-bar horizontally	Left	Middle	Right	-
4.	Position of t-crossbar vertically	Low	Mid	High	-
5.	Inclination of Terminals	Down-ward	Horizon-tal	Upward	-
6.	Terminal strokes of g/y	Blunt	Tapering	Flying	-

At the third level of examination, every letter of all the handwriting samples was scrutinized to determine the number of *similar letter formations* between each sibling and twin pair. For instance, if a pair showed *similar letter formations* of letters *r, t, s*, then the number of *similar letter formations* would be 3. Likewise, *similar letter formations* were noted for all the 50 pairs of samples.

After the examination, graphs were plotted to reveal the frequency of occurrence of various similar *class* and *minute* handwriting characteristics for all the 50 pairs of twin and sibling samples. The graphs for similar *minute* characteristics of handwriting were plotted only for those samples that qualified the second level of examination. The handwriting characteristics were represented on the *x-axis* of the graph. And the *y-axis* represented the number of samples of twins or siblings possessing similarity on account of these characteristics.

3. RESULTS AND DISCUSSION

Siblings and twins demonstrated similarity in their handwriting at all levels of examination, as listed in table 3. However the similarity in handwriting of twins was greater when compared to the siblings at each level.

Table 3. : *Percentage Similarity between Twins and Siblings*

CHARACTER-ISTICS	TWINS	SIBLINGS	EXEMPLARS ANALYZED
Class Characteristics	66.8%	61.2%	25 pairs Twins & 25 pairs Siblings
Minute Characteristics	61.2%	56.83%	19 pairs Twins & 17 pairs Siblings
No. of Similar Letter Formations	3	1.76	25 pairs Twins & 25 pairs Siblings

Average similarity of *class* characteristics was computed for all the 50 pairs of samples at the first level of examination. The average similarity of *minute* characteristics was computed only for those, which qualified for the second level. Total 19 pairs of twins qualified while 17 pairs of siblings qualified for this second level of examination. All the 50 pairs of samples were also analyzed to spot *similar letter formations* at the third level of examination, and an average was computed separately for twins and siblings.

Twins demonstrated greater similarity in all the three levels of examination i.e. *class* characteristics, *minute* characteristics as well as in number of *similar letter formations.*

Then graphs were plotted to represent the frequency of occurrence of *class* (Figure 1, Figure 2) and *minute* (Figure 3, Figure 4) characteristics similarity between twins and siblings, and inferences were drawn. The most frequently occurring similar *class* characteristics were same for both twins and siblings –*Alignment and Legibility*. The least frequently occurring similar *class* characteristic for both twins and siblings was also same - *Slant*. In case of *class* characteristics, *Alignment* was found to be similar in 23 twins and 22 siblings, i.e., 45 out of total 50 pairs of samples. *Legibility* was similar in 24 twins and 20 sibling pairs respectively, which means a total 44 out of 50 pairs of exemplars demonstrated similarity in *Legibility* The *Slant*, which had the least similarity, was common in merely 8 twins and 7 siblings i.e. 15 out of 50 pairs of samples.

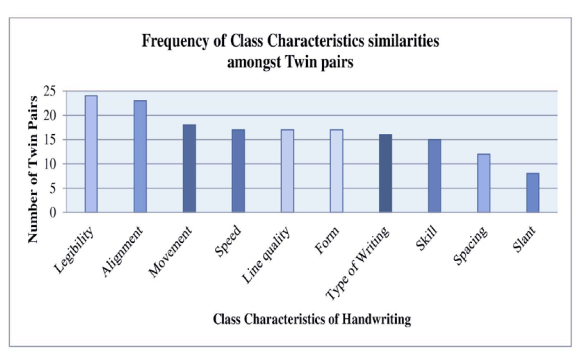

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Figure 1. : *Graph represents the most and least frequently occurring similar class characteristics amongst twin pairs.*

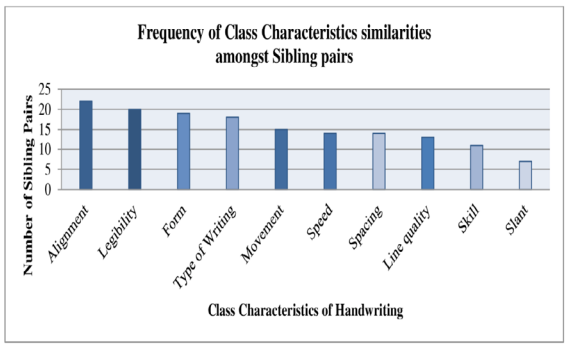


Figure 2. : *Graph represents the most and least frequently occurring similar class characteristics amongst sibling pairs.*

Out of 25 pairs of twins and siblings each, 19 pairs of twins and 17 pairs of siblings, i.e. 36 out of total 50 pairs, had qualified for further study of *minute* characteristics. The most frequently occurring similar *minute* characteristic observed for twins was - *Position of t-crossbar vertically,* which was similar in 15 out of 19 pairs of samples. The most frequently occurring similar *Minute* characteristic observed for Siblings was –*Terminal strokes of g/y, which* was similar in 13 out of 17 pairs of samples. The least frequently occurring similar *Minute* characteristics for both twins and siblings was same - *Position of i/ j dot.* It was found similar in 7 twins and 6 siblings, i.e. 13 out of total 36 pairs of samples.

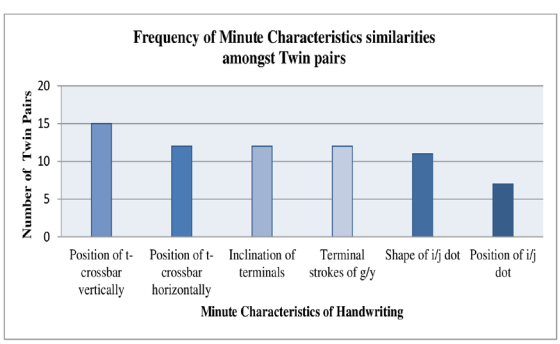


Figure 3.: *Graph represents the most and least frequently occurring similar minute characteristics in twin pairs.*

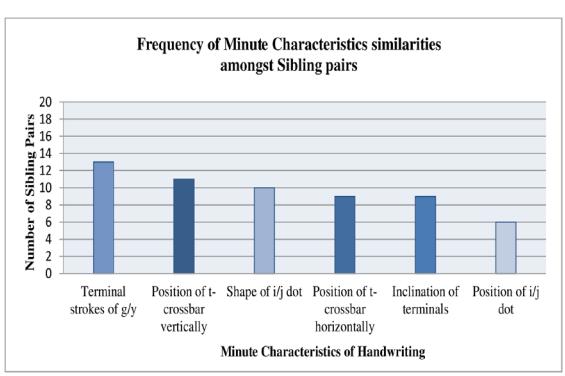


Figure 4.: *Graph represents the most and least frequently occurring similar minute characteristics in sibling pairs.*

The crucial inference from the above graphs is that *Slant* and *Position of i/j dot*, showed least similarity. Thus these two characteristics could be used as key identification features to differentiate between handwritings of any two individuals, in forensic document examination.

Similar letter formations were spotted in all the samples of 25 pairs of twins and siblings. This data was analyzed to determine the reasons for similarity demonstrated in handwriting of twins and siblings. These s*imilar letter formations* were categorized into two kinds.

The first category (Figure 5) belonged to such *similar letter formations* in the handwriting of twins and siblings that appeared to be imitated from each other, like similarity in stylized depiction of an alphabet, extended formation of strokes, embellished formation of letters, etc. As these features appeared to be deliberately imitated by the writers, it was inferred that they were *consciously acquired* handwriting characteristics. This indicated towards environmental influence on handwriting. The writers, twins or siblings in this case, could have imbibed these handwriting characteristics from the surrounding environment which includes family, education institutions, and peer group. The second category (Figure 6) belonged to such letter formations that did not show any signs of imitation, yet they were similar. They showed similarity in terms of their inconspicuous and miniature details, commencement of strokes, finishing of strokes etc. As these *similar letter formations* did not show any signs of imitation, therefore it was inferred that handwriting characteristics were *non-consciously acquired.* This indicated towards genetic influence on the handwriting. The similar genetic make-up of the writers, twins or siblings in this case, could have resulted in the similarity in handwriting. Similarity in case of siblings and twins is due to the aforesaid environmental and genetic factors. As twins share their genetic make-up as well as environment more than siblings so this explains the greater similarity in their handwritings.

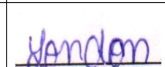
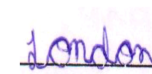
S No.	Illustrations of Similar Letter Formations in Sibling and Twin Pairs Consciously Acquired Characters indicating Environmental influence	
1)		
2)		
3)		
4)		
5)		
6)		
7)		

Figure 5. : *Resemblances in the overall details of the letter formations identified amongst twins and siblings handwriting pointing towards consciously acquired writing habits of the writers. 1, 2, 3) Similarity in embellishment of letters 'A', 'H', 'K' respectively 4) Two pen operational formation of letter 'Q' 5) Presence of two big loops in numeral '2' 6) Similarity in the pattern followed in the formation*

of letter 'e' 7) Similarity in the thorough details of word 'London' showing complete sign of imitation.

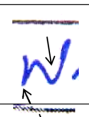
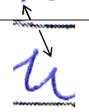
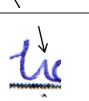
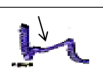
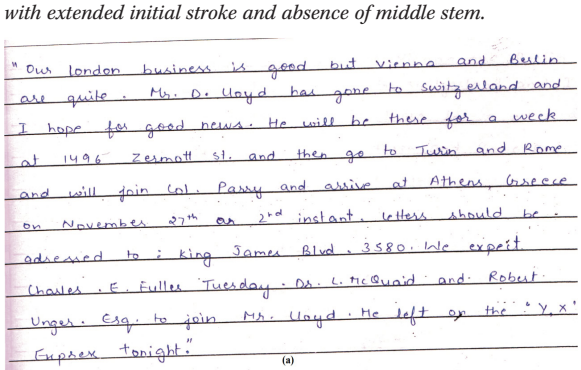
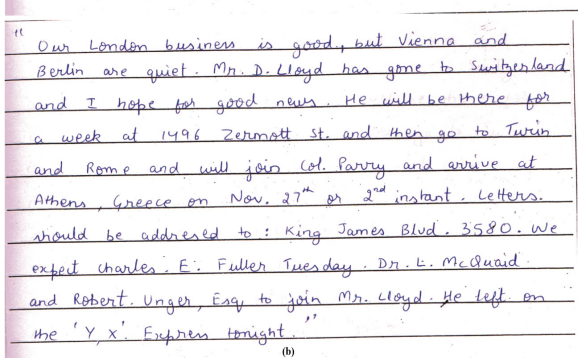
S No.	Illustrations of Similar Letter Formations in Sibling and Twin Pairs Non-consciously Acquired Characters indicating Genetic influence	
1)		
2)		
3)		
4)		
5)		
6)		
7)		

Figure 6. : *Resemblances in the miniature details (indicated by the arrows) of letter formations identified amongst twins and siblings handwriting pointing towards non-consciously acquired writing habits of the writers 1) Overall similar pattern of 'to' with the presence of ligature, open 'o' and its slight tapered finish 2) Extended and Tapering finish of '8' 3) Extended horizontal commencement of letter 't' 4) First half of letter 'w' is narrow with angularity at the base and the second half is broad with slightly curved base 5) Formation of letter 'h' with its angular shoulder not attached to its vertical staff giving the appearance of small letter 'u' 6) Streamlined cursive 'r' with the tapered finish 7) Slurred formation of letter 'm' with extended initial stroke and absence of middle stem.*



"Our London business is good but Vienna and Berlin are quite. Mr. D. Lloyd has gone to Switzerland and I hope for good news. He will be there for a week at 1496 Zermott St. and then go to Turin and Rome and will join Col. Parry and arrive at Athens, Greece on November 27th or 2nd instant. Letters should be addressed to: King James Blvd. 3580. We expect Charles. E. Fuller Tuesday. Dr. L. McQuaid and Robert Unger, Esq. to join Mr. Lloyd. He left on the 'Y, X' Express tonight."

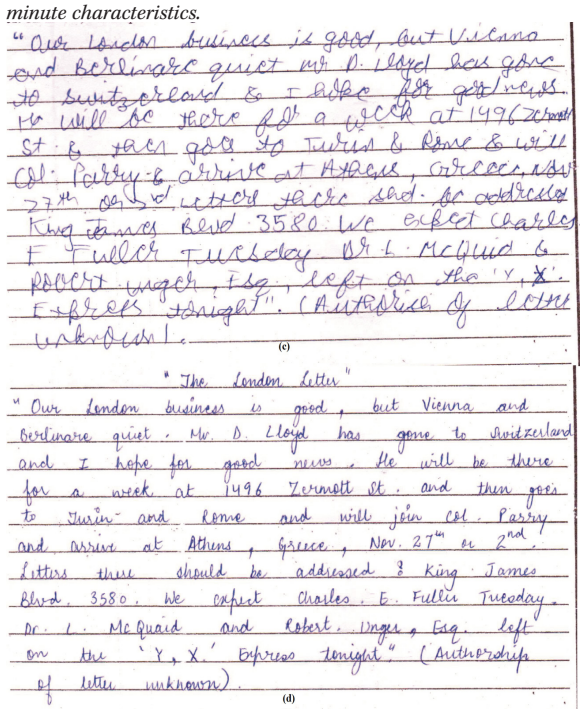
(a)



"Our London business is good, but Vienna and Berlin are quiet. Mr. D. Lloyd has gone to Switzerland and I hope for good news. He will be there for a week at 1496 Zermott St. and then go to Turin and Rome and will join Col. Parry and arrive at Athens, Greece on Nov. 27th or 2nd instant. Letters should be addressed to: King James Blvd. 3580. We expect Charles. E. Fuller Tuesday. Dr. L. McQuaid and Robert. Unger, Esq to join Mr. Lloyd. He left on the 'Y, X' Express tonight."

(b)

Figure 7. : *Handwriting samples (a) & (b) of a twin pair showing maximum similarity out of all samples, in terms of both class and minute characteristics.*



"Our London business is good, but Vienna and Berlin are quiet. Mr. D. Lloyd has gone to Switzerland & I hope for good news. He will be there for a week at 1496 Zermott St. & then goes to Turin & Rome & will join Col. Parry & arrive at Athens, Greece, Nov. 27th or 2nd. Letters should be addressed to King James Blvd. 3580. We expect Charles F. Fuller Tuesday. Dr. L. McQuaid & Robert Unger, Esq., left on the 'Y, X' Express tonight". (Authorship of letter unknown).

(c)

"The London Letter"

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(d)

Figure 8. : *Handwriting samples (c) & (d) of a sibling pair showing minimum similarity out of all samples in terms of both class and minute characteristics.*

4. CONCLUSION

From the analysis of handwriting of 25 pairs of twins and siblings, a total of 100 samples, it was found that both twins and sibling pairs demonstrated similarity in their handwriting characteristics. The average similarity in their *class* characteristics as well as *minute* characteristics was more than 50%. Out of the two, twins demonstrated greater similarity as compared to siblings. The average similarity amongst twins was 5.6% more in case of *class* characteristics and 4.37% more in case of *minute* characteristics. The average *similar letter formations* were also more in case of twins than siblings. Handwritings of most twins as well as siblings showed similar *Alignment and Legibility.* Out of all the 50 pairs of samples analysed, 23 twin and 22 sibling pairs had similar *Alignment* and 24 twin and 20 sibling pairs had similar legibility respectively. The *Slant* was similar only in 8 twin and 7 sibling pairs out of 50 pairs of samples analyzed. *Position of i/ j dot* was similar only in 7 twin and 6 sibling pairs out of 19 twin pairs and 17 sibling pairs analyzed, which had qualified for second level of examination. So the handwriting characteristics that would be most helpful in differentiation of handwriting of twins, siblings or individuals are - *Slant* and *Position of i/j dot.*

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