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A comparative study of handwriting characteristics in three generation of a family in Haryanvi population

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***Abstract*---**Background: Since evolution handwriting is one of the most efficient acquired characteristic by any individual. It is an amalgamation of nature and nurture. Learning begins prenatally, and children are not only "ready to learn" but already actively learning from the time they are born. Parents lay the foundation stone of their child's pre-writing skills. Moreover, genes also play a crucial role in determining certain characteristics of handwriting. Result: The present study focuses on determination of similarities in handwriting among three generations in 100 families through analysis of pre-defined class characteristics. It was observed that the "Alignment" of handwriting show high level of similarity in two generations whereas the "Movement" was the only handwriting characteristics that show high level of similarity in all the three generations. Conclusion: Therefore, to conclude it can be inferred that the father-son relationship (grandfather & father or father & son) depicts majority of similarities in the handwriting characteristics which might be due to the dominance of male gene.

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Keywords---handwriting similarities, genetic influence, class characteristics, forensic document analysis, image enhancing.

Introduction

The handwriting of an individual is considered as the written speech which is particular and specific to an individual. It is an attained skill and a composite perceptual motor task, sometimes referred to as a neuromuscular task [1]. Each individual has its own peculiarity in handwriting formation, such characteristics include: type of movement, line quality, speed and skill, rhythm, spacing between letters, word and line, slant, alignment, connecting strokes, size and proportions of letters, pen pressure, pen hold, pen position and pen shading and coordination of writing muscles [2, 3]. Handwriting is a continuous or flowing task, not one of discrete or separated actions. A steady progressive change can be observed in handwriting of all the individuals with the passage of time [4, 5].

The extent of the change will depend on a number of factors: the amount of writing done within the particular time lapse and during life time, temporary or permanent alteration in physical and mental of the writer (whether suffering from any disease that can affect the neuromuscular coordination or intoxication of alcohol or any drug), and the particular stage in the life of the individual. The extent of change in signature may differ from that in extended writings of the same individual [4, 5]. For these reasons, writing standards obtained for comparison purpose must be as comparable and contemporaneous as possible. It is a fact that the handwriting is controlled by the muscular movement of the hand which in turn is controlled by neuromuscular coordination of the brain. From the previous studies, it is evident that during the two extremes of the life, childhood and old age, handwriting of an individual exhibits different handwriting patterns according to the articulacy of their muscular movement correlated with brain [6,7, 8]. Therefore, the features of the handwriting which are not permanent in support to the age, counters more value in the detection of age of the writer.

Previous studies have depicted the possibility of hereditary influence with respect to similarities in handwriting. The results were positive for two generations in most of the cases. These studies have been performed on different languages such as English, Gurmukhi etc. [1, 9]. Tobria et.al. (2021) conducted a similar study was conducted to observe the influence of heredity on handwriting characteristics among parent and their progeny (Father, mother, daughter and son) of 50 families, the study showed that maximum similarities were present in father and son [10]. Earlier studies depict that examination in majority of case are conducted the through standard manual techniques. However, other methods of examination are also successful in determination of heredity influence among individuals. Srihari.et.al. (2008) conducted a study in which handwriting samples of twins were compared by an automatic handwriting verification system [11]. The contemporary work concerns with handwriting similarities between the three generation of a family on the basis of predetermined handwriting class characteristics in English Language. The study also focuses on determining the number of families with similarities among two generations (grandfather-father,

grandfather-grandson, father–son) and families with similarities among three generations(Grandfather-father-son) [12, 14, 19].

Material and Methods

Sample collection

The samples were collected from the native population of Haryana in English Script. A total of 300 samples from 100 families were collected consisting of three samples per family and including three generations viz. Grandfather, Father, and Son with the aim to determine genetic influence in handwriting of the same family members. The samples were collected with a written consent of the subject without any other extraneous influencing factor. The families were selected randomly irrespective of the caste and only male candidates were considered for this study, with no physical disability and no previous history of any mental illnesses.

The samples were collected on A4 size 75 GSM sample record sheets as shown in figure 1. Every record sheet consisted of a pre-set standard paragraph in English Script. The paragraph was replicated by every family member using a NATRAJ CLASSIC *Fine blue ball point pen.

Sampling Procedure

Simple random sampling method was used during the collection of samples. The goal of the study was explained to all the subjects, and their prior consent was obtained. The families were denoted as family-1 (F1), Family-2 (F2) and so on. Further, the members of the family were denoted as G, F and S for Grandfather, Father and Son respectively. For instance, the samples of Family-1 are denoted as (F1/G, F1/F, F1/S).

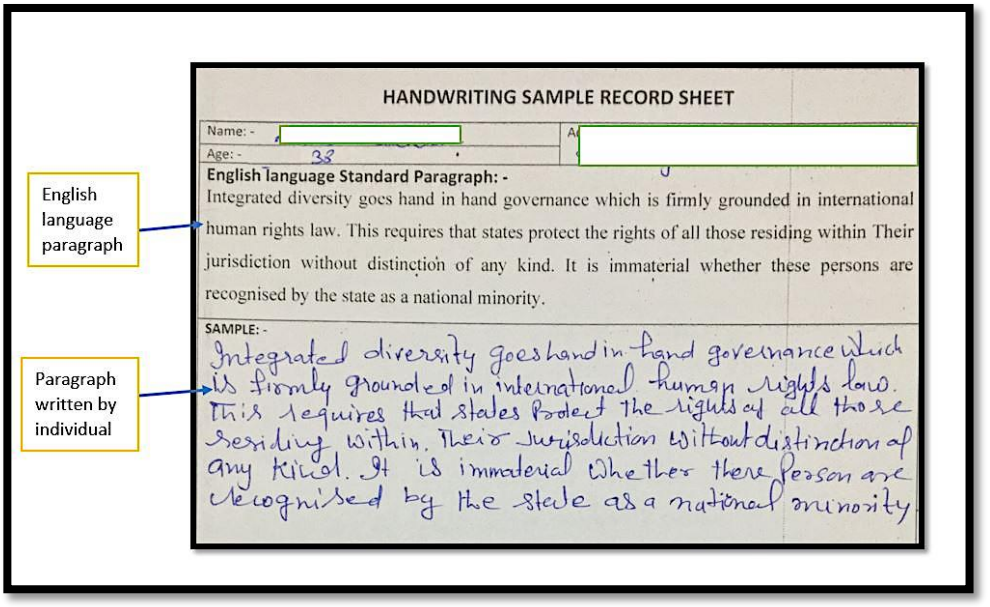


Figure 1: Sample Record sheet consisting of Standard English Language paragraph and replicated paragraph written by the subject with the provided writing instrument and substrate.

Sample Analysis

Firstly the collected samples were photographed and scanned under 150 dpi using Canon PIXMA MG 2577s Printer. Secondly the samples were analysed for class and individual writing characteristics using ZEBROC Double Glass 10X High Power Magnifying Glass. Some of the frequently observed characteristics were considered including Movement, Speed, Alignment, Slant, Spacing, Line Quality & Style were analysed. All the characteristics were segregated into further sub categories as shown in table 1.

Table 1: Handwriting characteristics class categorization

Sr. No.	Class characteristics	Sub-Categories			
1	Movement	Finger (FM)	Wrist (WM)	Finger Cum Wrist (FWM)	Forearm(FoM)
2	Speed	Relatively Slower (RS)	Medium (MedS)	Relatively Faster (RF)	-
3	Alignment	Ascending (AA)	Horizontal (HA)	Descending (DA)	Irregular (IA)
4	Slant	Forward (FS)	Vertical (VS)	Backward (BS)	Mixed (MiS)
5	Spacing(Between Words)	Narrow (NS)	Medium (MS)	Wide (WS)	-
6	Line quality	Superior (SLQ)	Inferior (ILQ)	-	-
7	Style	Cursive (CS)	Copy book		

			(CBS)		

Sample examination was done by comparing the handwriting samples of the family members. A hand lens of 10X magnification was used to examine the class characteristics of handwriting. Further, the images of the samples were taken and observed using image enhancement features.

- Movement: Motion of hand (including finger, wrist, forearms) during the sample collection was observed physically and recorded for further establishment for the movement of handwriting.
- Speed: The speed of handwriting was determined by observing the start and end stroke of the letters and words as well as consistency and fluency of connecting stroke and formation of letter throughout the paragraph which was then again checked through the recorded videos.
- Alignment: The alignment of the handwriting is measured by drawing an imaginary base line on which writing stands. If the writing moves upward i.e. above the base line, it is considered to be ascending alignment and if its move down below the base line, it is considered to be descending alignment. Some of the handwriting stand with base line, it is considered to be Horizontal alignment. Any irregularities concerning base line in uneven manner is opined as irregular alignment.
- Slant: The slant of the handwriting is recognised with the help of base line. If the inclination of the axis of the letters are at approximately 90 degrees to the baseline it was opined to be vertical, if left or right it was considered to be backward and forward respectively.
- Spacing: A standard 15cm scale was used for measuring the distance between words i.e. spacing between the words. The following measurement parameter was used to categorise spacing in all the samples: Narrow spacing (>0.5 cm), medium spacing (<0.5 cm) and Wide spacing (<1.0 cm).
- Line quality: The handwriting sample that were written with optimal speed, evenness and without any tremors and hesitation were considered to be of Superior Line Quality (SLQ), on the contrary, if handwriting depicts relatively slower speed, unnatural pen pauses, unevenness, tremors, and hesitations then it was considered to be of Inferior Line Quality (ILQ).
- Style: The handwriting which shows consistent connecting strokes or garland formation throughout the paragraphs was considered to be cursive Handwriting. On the contrary, the handwriting with limited or no connecting strokes were considered as copy book form of handwriting.

On the basis of above-mentioned parameters, all the handwriting samples were analysed, compared and genetic influence was traced as shown in Figure 2.

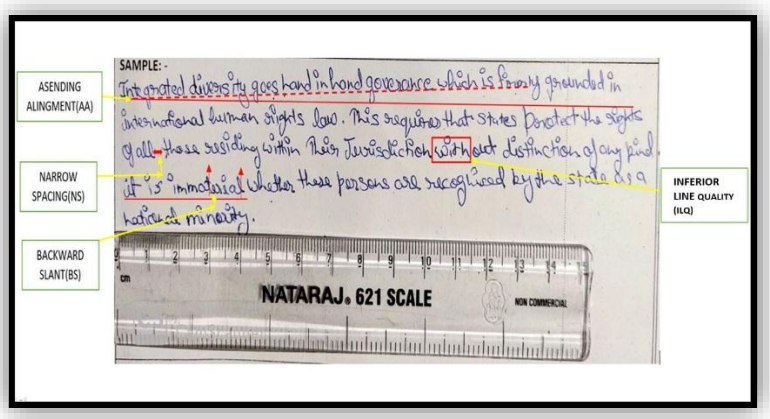
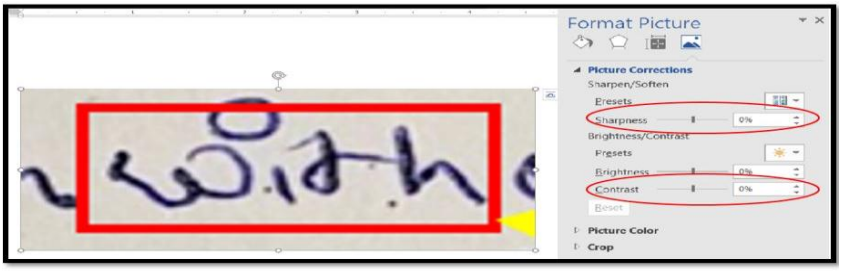
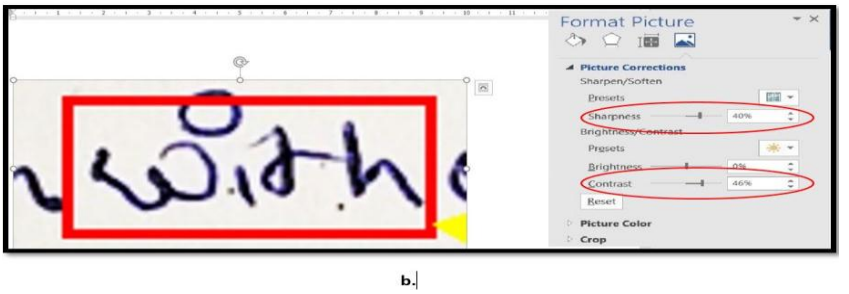


Figure 2: Handwriting sample examination including the analysis of alignment, spacing, line quality, and slant

Apart from examination using magnifying lens, all the sample were also subjected to image enhancement in the computer system for more clarity and examination of minute handwriting characteristics. The adjustment of sharpness percentage and contrast percentage of the images provide superior quality of image leading to better study of handwriting characteristics. The sharpness and contrast were increased by 40% to 50% to provide best possible results that enable the examiner to study the characteristics as shown below in Figure 3a and 3b.



a.



b.

Figure 3a: Image of the handwriting sample without any enhancement; 3b: Enhanced image of the handwriting sample with a sharpness at 40% and a contrast at 46%

Observations and Results

According to the observations given in table 2, it was seen that 77% of families depicted three generation similarities index and comparatively only 23 % of family show two generation similarity index in respect of movement characteristic of handwriting. Among two generation match, the variations were found to be as Grandfather to Father (25%), Grandfather to Grandson (26%), and Father to Son (15%).

Table 2: Data depicting two and three generation match in handwriting characteristics of 100 families

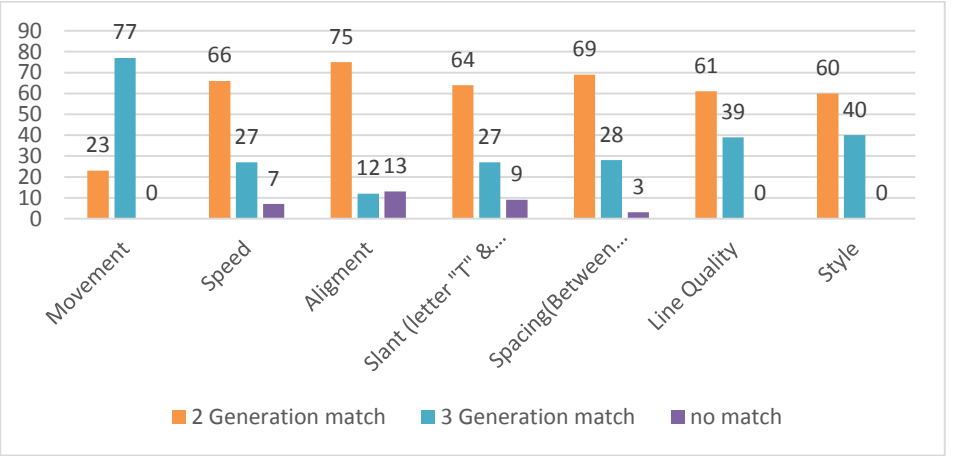
Parameters	Two Generation Match (%)				Three Generation Match (%)	No Match (%)
	GF+F	GF+GS	F+S	Total		
Movement	1	7	15	23	77	0
Speed	25	26	15	66	27	7
Alignment	33	29	13	75	12	13
Slant (letter "T" & "L")	19	21	24	64	27	9
Spacing(Between Words)	25	14	30	69	28	3
Line Quality	28	17	16	61	39	0
Style	27	26	7	60	40	0

In case of the speed of handwriting in different families only 27% depicted three-generation match whereas the similarity index was 66% in two generation matches. The speed of handwriting in two generation match varies as follows: Grandfather to Father (25%), Grandfather to Grandson (26%), and Father to Son (15%). The highest similarity index of 75% in two generation match was obtained for 'Alignment' of handwriting with intra-sample variation as follows: Grandfather to Father (33%), Grandfather to Grandson (29%), and Father to Son (13%). On the contrary, only 12% of families exhibited similarity in alignment in case of three-generation match.

In handwriting, the Slant of letters 'T' & 'L' shows high similarity of 64% in two generations, which are Grandfather to Father (19%), Grandfather to Grandson (21%), and Father to Son (24%). On the contrary, only 27% of families show similarities in three generations. Two-Generation similarity index of spacing between the words was found to be 64%, which includes Grandfather to Father (25%), Grandfather to Grandson (14%) and Father to Son (30%) whereas only 28% of families show three-generation similarity.

The similarity index of line quality in case of two generation match was around 60% including, Grandfather to Father at 28%, Grandfather to Grandson at 17% and Father to Son at 16% whereas only 39% of families show three-generation match. 60% of families depict similarities in style of handwriting in two generation with variation as, Grandfather to Father (27%), Grandfather to Grandson (26%), and Father to Son (7%). On the contrary, the three-generation match was found

to be only at 40%. A comparative data of genetic lineage for observed class characteristics among 100 families have been depicted in graph 1.



Graph 1: Comparative data of 2 & 3 Generation match of class characteristics between 100 families

Discussion

Handwriting is created by a person on any surface with the help of writing instruments like pen, pencil etc. Much Previous research conducted on genetic influence of handwriting between twin, Parents and their offspring. They show some genetic influence between generation. Monozygotic twins show some genetic and environmental influence in handwriting [19]. A study was carried out on siblings to check the genetic influence in handwriting. After the study It was found that the siblings show genetic influence from their parent in handwriting [19, 21]. In our study we had taken 100 families. From each family we have three male members (Grandfather, Father, Grandson) from different generation [22, 23]. After analysis its was observe that father-son show high level of similarities in handwriting on the basis of class characteristic of handwriting.

Conclusion

The present study focuses on hereditary influence among family members on the basis of predefined handwriting characteristics. The observations clearly indicate that the movement of pen while writing was one of the characteristics with high inheritance rate in case of comparison between three generations. However, in case of comparison between two generations, alignment of handwriting depicted a significant level of similarity. Furthermore, it was found that the father-son relationship (grandfather & father or father & son) depicts majority of similarities in the handwriting characteristics which might be due to the dominance of male gene. Therefore, it can be concluded that the significant level of similarity indicates that genes does play a crucial role in transmission of handwriting characteristics between generations.

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List of Abbreviations

FM	Finger Movement
FWM	Finger cum Wrist Movement
WM	Wrist Movement
FOM	Forearm Movement
RS	Relatively slower
MedS	Medium Speed
FaS	Fast Speed
AA	Ascending Alignment
DA	Descending Alignment
HA	Horizontal Alignment
IA	Irregular Alignment
FS	Forward Slant
VS	Vertical Slant
BS	Backward Slant
MiS	Mixed Slant
NS	Narrow Spacing
MS	Medium Spacing
WS	Wide Spacing
SLQ	Superior Line Quality
ILQ	Inferior Line Quality
CS	Cursive Style
CBS	Copy Book Style

References

1. Saini M, Srinivasan A, Kapoor AK (2015) Inheritance of Handwriting Feature. Int J of Engineering and Sci 4;01-05
2. Cheng N, Lee G K, Yap BS et al (2005) Investigation of class characteristics in English handwriting of the three main racial groups: Chinese, Malay and Indian in Singapore. J of Forensic Sci 50;01-08
3. Saini k, Kaur N. (2015) Forensic Examination of Class Characteristics in English Handwriting of the Three States: Andhra Pradesh, Punjab and Kashmir in India. Arab J of Forensic Sci & Forensic Med 1;1034-1047
4. Kam, M, Gummadidala K., Fielding G (2001) Signature authentication by forensic document examiners. J of Forensic Sci 46;884-888

5. Mehta M k (1972) Identification of handwriting and cross-examination of experts. Bombay
6. Leaver, W L (2006) Introduction to forensic document examination. In The Forensic Laboratory Handbook. Humana Press;223-248
7. Kramer E, Lauterbach C E (1928) Resemblance in the Handwriting of Twins and Siblings. The J of Edu Research 18;149-152
8. Deepani V, Kapoor A K (2018) Variability in Human Handwritings: An Indian Understanding. Int J of Humanities and Social Sci 7;27-32
9. Turner J , Sidhu R, Love J (2007) A preliminary study investigating class characteristics in the Gurmukhi handwriting of 1st and 2nd generation Punjabis. Sci & Justice 48;126-132
10. Tobria M, Singhal K, Kumar V et.al.(2020) Forensic study on inheritance and variability of handwriting feature amongst English language writers. J of Punjab Acad of Forensic Med and Toxicology 20;28-33
11. Srihari S, Hunag C, Srinivasan H (2008) On the Discriminability of the Handwriting of Twins. J of Forensic Sci 53;430-446
12. Saini M, Kapoor A K (2015) Impact of heredity and environment in familial similarity of handwriting. Int J of Computer and Electronics Research; vol.4(1);01-09.
13. Morris R, Morris R N (2000) Forensic handwriting identification: fundamental concepts and principles. Academic press Inc
14. Kiran P, Sridhar D (2017) A study to determine the inheritance pattern of characteristics of handwriting between parents and off springs. J of Forensic Sci & Criminology 5;01-07.
15. Kam M, Wetstein , Conn R (1994) Proficiency of professional document examiners in writer identification. J of Forensic Sci 39;5-14
16. Gupta S, Kumar P, Sharma B K et al (2015) Age determination of male's writers through certain handwritings characteristics. Int J of Multidisciplinary Res and Development 2; 451-455.
17. Sorate P, Kanwal N k, Malhotra M (2017) Comparison of various writing characteristics of Hindi and Marathi languages of Devanagari origin. Int J of Innovative Sci, Engineering & Tech 4;147-151.
18. Tyagi N, Sankhla M S, Kumar R (2018) Qualitative Analysis of Class Characteristics Individual Belonging to Northern India Handwriting Samples Written in Devanagari Script. J of Forensic Sci and Criminal Investigation 9;01-05.
19. Ahuja P, Chaudhary P K, Manve P et al (2018) Study of genetic and environmental influence on handwriting of monozygotic twins. Indian J of Sci Res; 20;17-21
20. Coll R., Fornés A, Lladós J (2009) Graphological analysis of handwritten text documents for human resources recruitment. In 2009 10th International Conference on Document Analysis and Recognition;1081-1085.
21. Saini K, Kaur M (2019) Forensic study on the effect of age and illness (Parkinsonism) on handwriting characteristics. Egypt J Forensic Sci 9; 24
22. Thomas MW, Rajan S K (2019) Genuine handwriting variations in 10 years: a pilot study. Egypt J Forensic Sci 9; 49
23. Sharma B, Vajjey K, Bashir R, Raghuraghavendra s. Analysis of Master Disguised Writing with the Aid of Specific Individual Writing Characteristics. *International Journal on Emerging Technologies*. 2022;11(2):116-119.