Investigative Approach of Graphology to Determine Gender from Handwriting Analysis

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Abstract

The study of handwriting analysis to ascertain a writer's personality attributes is known as graphology. Handwriting of a person reveals a lot about individual's personality according to graphology. The science of questioned documents deals with documents-based evidence frequently at crime scenes. Determination of the gender of those anonymous letters can be a fruitful factor for the investigative agencies to narrow down the list of suspects. Identification of handwriting can be done based on evaluation of handwriting characteristics: class and individual. In this research we have conducted analysis on handwriting of 25 males and 25 females with sample size of 100 within the Moradabad region. Findings revealed various characteristics differences in the handwriting of both the genders. Alignment of males have been found less ascending than females that is 44% and 52% respectively. Flourishment of letters in both the genders have been found same that is 94%. There are various distinctive characteristics found that has been discussed in results with tables and pie chart. These findings can be very fruitful for the investigative agencies in determination of the gender in case of any offensive anonymous letter.

Keywords: *Anonymous letters, Crime Scene, Graphology, Handwriting etc.*

1. BACKGROUND

A person's writing abilities, including their signature, are the outcome of a confluence of mental, physical, neurological, and visual processes. Consequently, writing by hand requires sophisticated fine motor skills (Sen et al., 2023). With his work on "Accuracy in handwriting as related to school intelligence and sex, "Feder et al., 2007 also established the field of handwriting-based research. Additionally, the execution of a signature is a learned ability that arises from a brain impulse that aids in moving a writing tool on paper (Ferrer et al., 2017). He was the first to identify the relationship that exists between a person's sex, IQ (Intelligence quotient), graphological characteristics, and motor skills (*Influence of Neurodegenerative Diseases on Handwriting*, n.d.).

In criminal investigations, handwriting and signature analysis is crucial. On papers, an individual's signature serves as proof of identification (Gornale et al., 2021). One can observe this when interacting with the financial system. The person first learns how to write from a copybook, then over time, they hone their own writing style and traits (Richter, 2023). In civil as well as criminal trials, it is necessary to evaluate dubious and contested signatures (Dror et al., 2021). Forensic or contested signatures are sent to the handwriting expert for review; these must be contrasted with authentic or acknowledged signatures (Mazzolini et al., 2021). The examiner next takes characteristics from the authentic and fake texts to determine if the analyzed signatures have a common or distinct author (Thompson, 2023).

Writing authentication and writer recognition are two techniques that may be used to identify the author of a handwritten text (Remaida et al., 2020). The process of writer identification requires an expert to determine who wrote the

questioned handwriting or signatures (Souza et al., 2020). To determine whether two writing samples are by the same individual, writing verification is carried out by comparing them (Teng & Zhang, 2020). Apart from the person's gender, the handwriting can also provide evidence of the writer's age, handedness, ethnic background, and nationality (Rahmanian &Shayegan, 2021).

Male handwriting can be sloppy, rushed, spiky, skewed, unkempt, and sloping, whereas female handwriting is consistently found to be clean, round, tiny, well-organized, tidy, and composed of regular letters. Significant variations exist in the script of males and females. Two such variances are "circularity" and "delicacy-decorativeness," which are more common in the handwriting of females. It was also noted that male writing is "spiky" or "sloping," but female writing is "rounded" and "neat" (Azab et al., 2020). Since men and women have distinct gait patterns and methods of walking, one can often determine a person's sex by observing how they move (Bruening et al., 2020).

In a similar vein, a person's sex may be determined by the movement of their handwriting (Faundez-Zanuy et al., 2020). This research is focused on the distinguished traits of the handwriting which can be crucial in determination of gender of the author. Various characteristics of handwriting has been considered over here for the fruitful analysis of the differences in handwriting of different gender.

2. METHODS

The present study was conducted on the handwriting samples of 25males and 25 of females (**2 samples from each individual, total 100 samples**) from the region of Moradabad, Uttar Pradesh. The samples were collected by using simple random sampling method. It aimed to analyse the handwriting features of males and females. The materials required for the comparison of handwriting are magnifying glass for the enlargement of the diminished characteristics & protractor (Figure 1).

Figure 1. *Basic Instruments used for the analysis of handwriting characteristics; Protractor in the left and magnifying glass in the right.*

3. SAMPLE COLLECTION

The handwritten samples from 25 males and 25 females (**2 samples from each, Total 100 samples**) are collected randomly. The individuals were familiar with writings in English language. The individuals are of same age group of to avoid any natural deformity in handwriting like tremors and shakiness etc.

Also, all the individuals were of right-hand writers to exclude the chances of differentiation due to handedness. The samples are collected on a white A4 size sheet. Subject need to copy the paragraph (**The Class of 16 letter**) in their natural handwriting. The main purpose of choosing this letter is that it comprises the combination of alphabets and words together that are sufficient for the comparison of different handwriting characteristics. The sample of the following exemplar paragraph is represented in figure 2.

The handwriting samples were written with **blue ball point pen** in same condition. They were not allowed to change their pen, surface, and their writing position
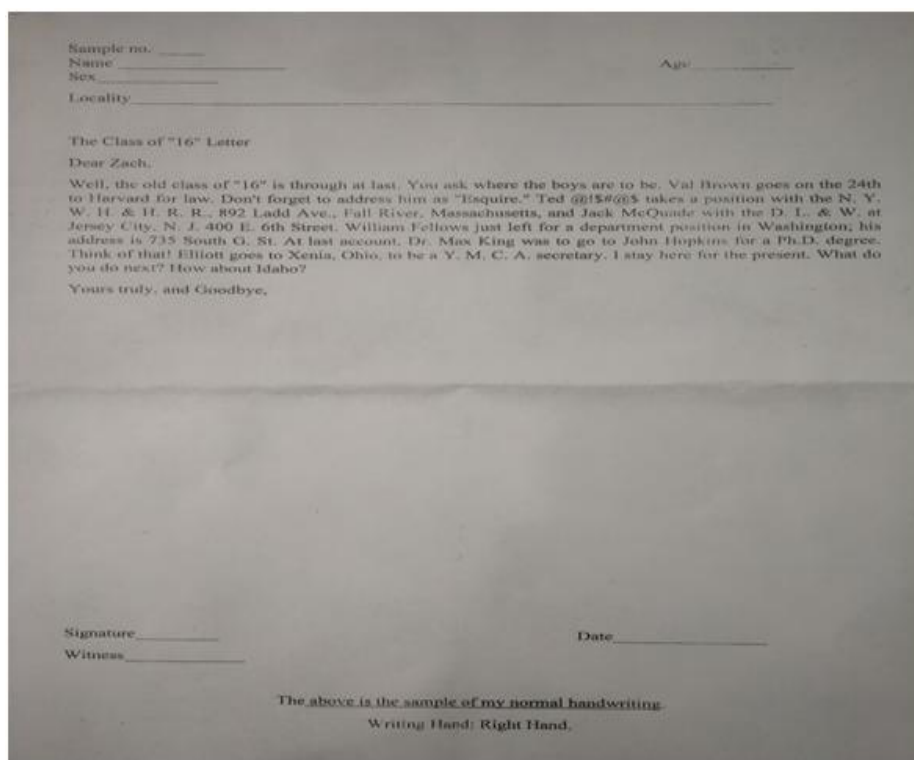
Figure 2. *The class of 16 letter exemplar paragraph*

4. STUDY AREA

Moradabad district is one of the districts of Uttar Pradesh state of India, and Moradabad city is the district headquarters. Moradabad city is situated in western U.P. (Uttar Pradesh) between 28°21´ to 28°16´ Latitude North and 78° 4´ to 79 Longitude East. Map of the study area has been showed in figure 3. Moradabad is known for its export of brass handicraft to other countries, and is also this called "Brass City" Or Peetal Nagri. Moradabad is situated on the banks of the Ramganga river at a distance of 167 km from the national capital and 344 km north-west of the state capital Lucknow. According to the 2011 census Moradabad city has a population of 887,871. It is the second most populated district in the state of Uttar – Pradesh. It has a sex ratio of 903 females for every 1000 males, and a literacy rate of 58.67%. Moradabad is a major industrial city and expert hub. Their handicrafts industries account for more than 40% of total handicrafts exports from India.
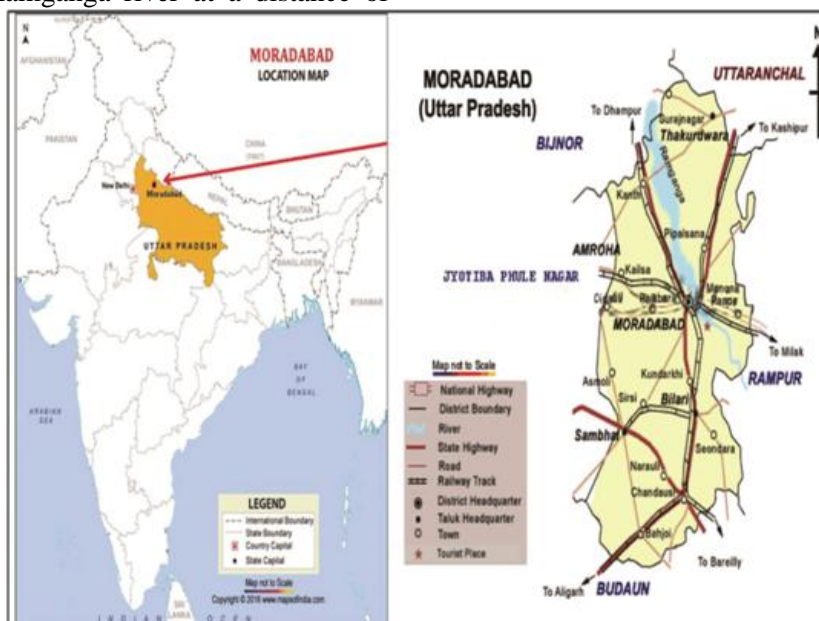

Figure 3. *Map of Moradabad district that was the area chosen for the research.*

5. ANALYTICAL CHARACTERISTICS

Handwriting samples were collected and examined using a microscope, magnifying glass, protractor, while keeping handwriting examination standards in mind. Handwriting characters that were analysed includes- **Alignment, Slant, Margin, Connecting Strokes, dot of i, flourish in letter d and loop in the** stem of letter d.

1. **Alignment:** The Alignment is the line of writing of the letters by a person. It can be ascending, descending, and straight.

2. **Slant:** Bending of the letters in a script forming the acute, obtuse, and straight angle.

3. **Margin:** The left and right portion of the paper sheet is called the margin of the paper. But here only the left margin is under consideration. The margin may be increasing on going down, it may be decreasing on going down the group, it may straight on going down the group.

4. **Connecting strokes**: The connection between the two letters of single word is known as the connecting strokes. The types are Garland, Arcade, Angle, Thread, No Strokes.

- **Garland:** In the garland, the connection is the form of "U" between the two letters of a word.

- **Angle:** In the angle, the connection form pointed angles.

- **Thread:** In the thread, there is no curves are formed between the letters but instead of it

the letters are connected by a thread like line joining the letters of a single words.

- **No Strokes:** In the no strokes type the letters are separated with each other. There is no connection between the letters.

5. **Dot of "i":** The dot of i could be form in many ways like, vertical, horizontal, circle & convex.

6. **Flourish in letter "d":** Flourish is the stroke present in the start of the letter "d".

7. **Loop in the stem of letter "d":** loop is present in the stem of the letter "d" and is formed by crossing the two lines at base of the letter and making the round.

8. RESULT

The writing study was objectively and exhaustively analysed in terms of both general and individual characteristics. The current study's results provide valuable knowledge about the diverse characteristics and features of handwriting of males and females.

The obtained results are mentioned below.

- **Connecting Strokes**- Out of 25, 15 males write without any connecting strokes which makes a frequency of 60% while in females 12 out of 25 which makes a frequency of 48% also write using no connecting strokes. Frequency of **garland, angle, thread** as connecting strokes is 24%, 12% and 4% in males respectively, on the other hand frequencies are in the order of 32%, 4%, 12%, and 4% respectively. The data of the same is represented in form of table 1 and figure 4.
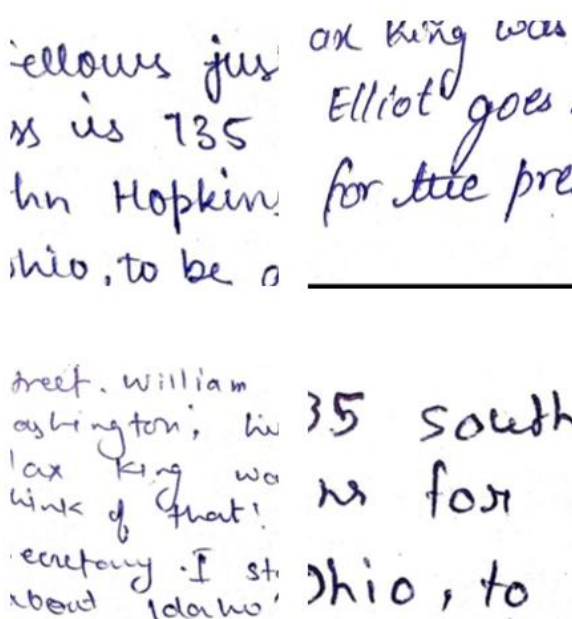

Figure 4. *Types of Connection Strokes: Garland, Angle, Thread and No stroke*

Table1. *Data showing the frequency of Connecting Strokes*

S. No	Feature	Males		Females	
	Strokes	No. of individual	Percentage%	No. of individual	Percentage%
1	Garland	6	24%	8	32%
2	Angle	3	12%	3	12%
3	Thread	1	4%	1	4%
4	No stroke	15	60%	12	48%

- **Alignment**- out of 25 males 11 males have ascending alignment which makes a frequency of 44% while in females 13/25 females have ascending alignment and the calculated frequency is 52%. However, frequencies of descending, straight and irregular alignment in males are 0%, 36%, and 20% on the contrary frequencies in females are in the order of 8%, 12% and 28%. The data of the same is represented in form of table 2& figure 5.

Table 2. *Data showing the frequency of Alignment*

S. No	Features	Males		Females	
	Alignment	No. of individual	Percentage%	No. of individual	Percentage%
1	Ascending	11	44%	13	52%
2	Descending	0	0%	2	8%
3	Irregular	9	36%	3	12%
4	Straight	5	20%	7	28%

Figure 5. *Types of Alignments: Ascending, Descending, Straight and Irregular*

- **Dot of "i"-** Out of 25, 11 males draw circle as i-dot and the calculated frequency is 44% while 13/25 females also make circle shaped i-dots. Frequencies of making vertical, horizontal and convex shaped i-dots in males are 9%, 1% and 4% on the other hand the order of frequencies is 48%, 0%, 0%, and 0% respectively. The data of the same is represented in form of table 3 &figure 6.

Table 3. *Data showing the frequency of Dot of i*

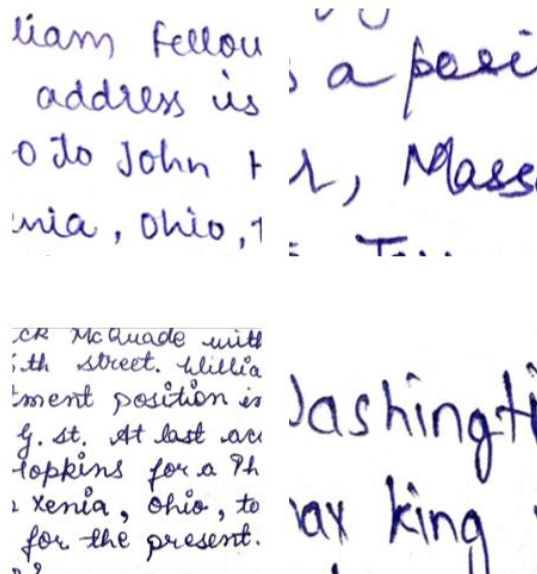| S. No	Features	Males		Females	
	Dot of "i"	No. of individual	Percentage%	No. of individual	Percentage%
1	Vertical	9	36%	12	48%
2	Horizontal	1	4%	0	0%
3	Circle	11	44%	13	52%
4	Convex	4	16%	0	0%

Figure 6. *Types of Dot of i: Vertical, Horizontal, Circle and Convex*

- **Margin of Left-** 15/25 males is found to have increasing margin and the calculated frequency is 60% while 7/25 females are found to write with increasing margin. Frequencies of having decreasing and irregular alignment in males are 12% and 25 while in females' frequencies be like 20% and 52/%. The data of the same is represented in form of table 4 and figure 7.

Figure 7. *Types of Margins: Decreasing, Increasing and Irregular*
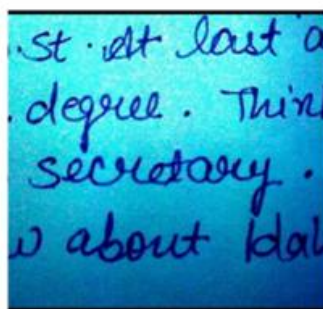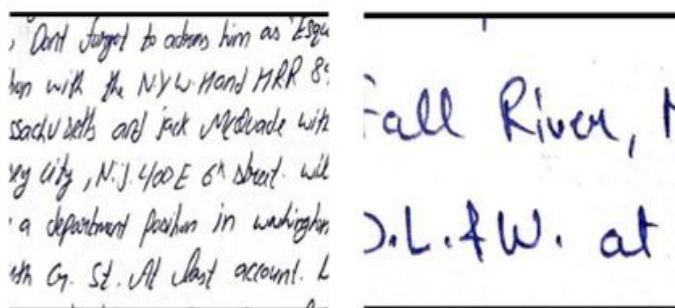
Table 4. *Data showing the frequency of Margin*

S. No	Features	Males		Females	
	Margin	No. of individual	Percentage%	No. of individual	Margin
1	Increasing	15	60%	1	Increasing
2	Decreasing	3	12%	2	Decreasing
3	Irregular	7	28%	3	Irregular

- **Slant**- 15/25 males have obtuse slant and makes a frequency of 60% while 12/25 females have obtuse slant and has a frequency of 20% Frequencies of having acute and straight slant are 28% and 12% in males respectively. On the other hand, in females' frequencies are in the order of 48% and 32%. The data of the same is represented in form of table 5 &figure 8.

Table 5. *Data showing the frequency of Slant*

S. No	Features	Males		Females	
	Slant	No. of individual	Percentage%	No. of individual	Percentage%
1	Acute	7	28%	12	48%
2	Obtuse	15	60%	5	20%
3	Straight	3	12%	8	32%

Figure 8. *Types of Slants: Acute, Obtuse and Straight*

Table 6. *Data showing the frequency ofFlourish*

S. No	Features	Males		Females	
	Flourish in "d"	No. of individual	Percentage%	No. of individual	Percentage%
1	Present	2	8%	2	8%
2	Absent	23	92%	23	92%

- **Loop in stem of "d"**- 17/25 males don't have loop in the stem of "d" and makes a frequency of 17% while in females the ratio is 14/25 and the frequency is 56%. While 8/25 males have loop in the stem of letter "d" and the ratio is 11/25 in females. The data of the same is represented in form of table 7 &figure 9.

Table 7. *Data showing the frequency of Loop*

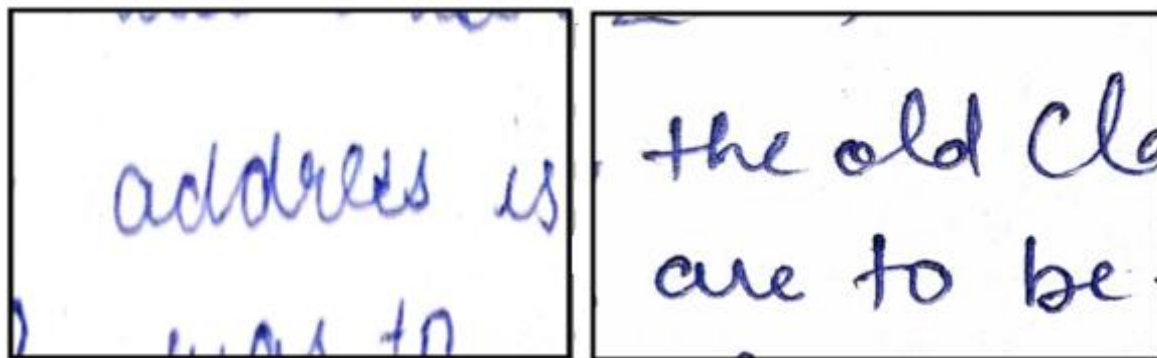| S. No	Features	Males		Females	
	Loop in stem of "d"	No. of individual	Percentage%	No. of individual	Percentage%
1	Present	8	32%	11	44%
2	Absent	17	68%	14	56%

Figure 9. *Flourishment and loop in d*

9. CONCLUSION

This research aimed at the dominant handwriting characteristics of both the genders. Handwriting has been considered as a neuro-muscular task that involves the combined use of nervous system and muscular system. Study of personality through handwriting analysis is called graphology. Graphology is a pseudo-science and is very helpful in forensic science. At crime scene, investigators often encounter anonymous letters that contains crucial information. To identify the author of anonymous letters, investigators must establish the gender of that letter to narrow down the suspects lists. By the help of various handwriting characteristics, we can establish the gender of the handwriting. These handwriting characteristics are alignment, connection strokes, margin, flourishment etc. Also, our research shows distinctive findings that shows difference in handwriting of males and females. Further vast study is needed to find the more concrete handwriting characteristics findings which can further establish the authorship of anonymous letters.

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