A Comparative Study of Tamil Handwriting; To Determine the Sex of An Individual by Analyzing the Class Characteristics

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Abstract

Handwriting analysis is a subset of forensic science that deals with questioned documents. The main objective of handwriting analysis is to analyze, compare and evaluate handwriting characteristics to determine the sex of an individual. The class characteristics that were analyzed in this study are alignment, spacing, slant, line quality, pen pressure, movement, size, and speed of an individual's handwriting, the primary goal of this study is to determine the sex of an individual through handwriting analysis; thus, the total number of samples 200 in which 100 male and 100 female transitive Tamil handwriting samples were collected in the age group ranges from 20 to 40 on hp A4 sheet without any indentation marks on papers. All individuals are strictly asked to write with Rorito bright max ball pen. With the help of a Scale, Pencil, three folding magnifiers 10x (Micrometer), and a Pro illuminated magnifier 4x the sample was analyzed and interpreted the class characteristics between male and female. The alignment, spacing, line quality, and speed of males shows a significant difference than in females, and entered the data in the form coding system. The area of this study is some part of Puducherry. It would be helpful for the document examiner to proceed and take initiative in cases related to the determination of sex in male and female in forensic questioned document examination. By concluding this study, the sex can be identified by analyzing the Tamil handwriting.

Keywords: Class characteristics, Tamil writings, Analysis, Micrometre, Questioned document.

1 Introduction:

The arrangement of letters, characters, or symbols using writing which follows a specific pattern and is geared to interact with the other person is described as handwriting. Handwriting can easily analyze into two main categories they are class characteristics and individual characteristics. "(Sharma.B.R, 2013)" An individual's handwriting might be influenced by some crucial factors, such as gender, age, and ethnicity, but their writing style always reflects their unique personality. Determining if the scribe is male, female, or another type of person is the primary purpose of handwriting analysis. "(Sushma Upadhyay J. S., April 2017)" Documents that have been questioned are described as "Any Document regarding which some controversy has been raised or which is the subject of a probe. Handwriting may sometimes vary from health issues, due to physical illness, ataxia, schizophrenia, cramps, or neurological disorders. (Sushma Upadhyay J. S., July 2017) Each person's handwriting is evaluated according to a class characteristic,

including alignment, arrangement, line quality, spacing, slant of the letters and words, pen pressure, baseline, movement, size, and speed of the writing. Since a person's handwriting is a manifestation of their subconscious mind, whatever information gleaned from it is true and reliable. The fundamental tenet of handwriting analysis is that natural variation, sometimes known as the fact that no two people can write the same way or that a person cannot exactly replicate his or her handwriting, exists amongst individuals. (GOODENOUGH, 1945)Due to the digital age, handwriting character recognition may soon play a crucial role in helping machine learning researchers recover dynamic information. (Ranjeet Kumar, 2011) One of the essential pieces of evidence used to determine the legitimacy of a questioned document is handwriting. The geographical assessment certainly illustrates the age difference by examining the tremors and other characteristics. If the same person writes the same letter in various lines or words, they must make some adjustments to their writing, based on the individual character of their writings. (R.BabithaLincy, January 2019)Tamil is one the oldest and very interesting languages which plays a vital role in all our major parts of life. Albert Sherman Osborn was the first American to become well-known in the field of forged document analysis and questioned document inspection. The objective of this study is to establish who wrote the disputed document, detect fraudulent signatures, and determine whether a single writer prepared a batch of documents. He published Questioned Documents in 1910, and it is still in circulation and considered a classic work in the discipline of questioned document interpretation. Experts in the profession of graphology, which is stated as **"the study of handwriting especially for character analysis, are renowned as graphologists".** The first questioned document examiner was Mr. Hilton worked at the crime lab Chicago police department. According to the earliest handwriting analysis studies dating back to 1622, Camillo Baldi concluded that each person's writing is distinctive and that there is no writing that can be truly imitated.

2   Research Methodology

In this study, **200 writing samples from 100 males and 100 females were collected** on separate sheets without any indentation marks on an A4-sized page provided to a random respondent. An individual between the ages of 20 and 40 who are healthy and free of disease. The scripted writing that is being provided is 45 words long and is about Mahakavi Bharathiyar's life story. Each sample was taken and examined. Scale, pencil, three-fold 10x (Micrometer) magnification, and 4x Pro illuminated magnifier are used (Manual analysis). The different styles were given names using a coding system. All the samples were uploaded to Excel for statistical analysis. SPSS software is used for generating P values.

2.1   Inclusion criteria

A person who fluently knows to read and write Tamil, and healthy individuals, 20 to 40 years of males and females were included in this study.

2.2   Exclusion criteria

An individual who is not willing to participate and other language people are excluded.

2.3   Explanation of coding system

- **Alignment** – The coding system of alignment was done in 4 different styles
  - Ascending – (1), Descending – (2), Vertical – (3), Irregular – (4)
- **Spacing** – The coding system of spacing was done in 5 different styles
  - Equal – (1), Narrow – (2), Wide – (3), Normal – (4), Mixed – (5)
- **Slant** – The Coding system of slant was done in 3 different styles

- Right – (1), Left – (2), Vertical – (3)
- **Line Quality** – The coding system of line quality was done in 3 different styles
- Smooth – (1), Poor – (2), Desperate – (3)
- **Pen Pressure** – The coding system of pen pressure was done in 3 different styles
- High – (1), Low – (2), Medium – (3)
- **Baseline** – The coding system of baseline was done in 4 different styles
- On – (1), Above – (2), Below – (3), Mixed – (4)
- **Movement** – The coding system of movement was done in 4 different styles
- Finger movement – (1), Wrist movement – (2), Forearm movement – (3), Whole arm movement – (4)
- **Size** – The coding system of size was done in 3 different styles
- Small – (1), Medium – (2), Large – (3), Mixed-(4)
- **Speed** – The coding system of speed was done in 3 different styles
- Slow – (1), Medium – (2), Fast – (3)

The attached file contains the sample that was gathered and transferred to Excel for analysis.

Samples

The attached file contains, how the samples were examined.

Images

தமிழ் மாதிரி

மகாகவி பாரதியார், சின்னசாமி ஐயருக்கும், இலட்சுமி அம்மாளுக்கும்,1882 ஆம் ஆண்டு, டிசம்பர் மாதம் 11ஆம் தேதி, திருநெல்வேலி மாவட்டத்திலுள்ள எட்டயபுரத்தில் மகனாக பிறந்தார். இவர் 5 வயதிலேயே தன் தாயை இழந்தார். இவருக்கு 11வயது இருக்கும்போது இவரது கவிதைகள் பாடும் ஆற்றலையும் புலமையை பாராட்டி இவருக்கு பாரதி என்ற பட்டத்தை வழங்கினார் எட்டயபுர மன்னர் அன்றில் இருந்து இவர் பெயர் சுப்பிரமணிய பாரதியார் என்றானது

A sample copy is given to every participant

3   Result:

Following analysis of the 200 samples utilizing class characteristics, the software's output is tabulated as follows. **A person's sex can be determined by examining the crime scene's class characteristics.**

3.1   Alignment

The majority of the 200 samples are ascending and irregular. According to the Chi-square test results, there are significant differences between each subset: Ascending subsets differ by 0.63%, Descending subsets differ by 0.19%, Straight subsets differ by 0.48%, and Irregular subsets differ by 0.7%. And which has a total variation from analysis of 18.57% the variations. Meanwhile, the **p-value indicates <0.001.**
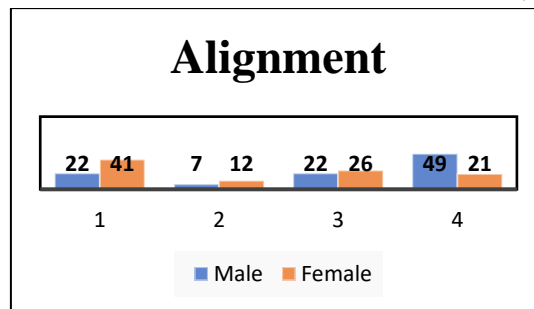
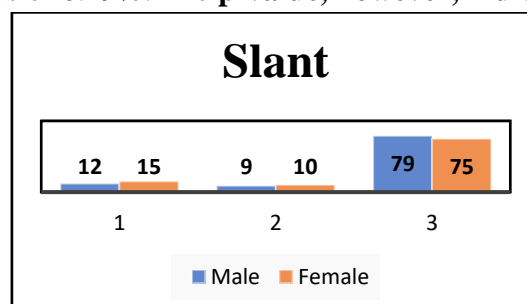**Graph 0.1: Alignment characteristics**

3.2   Spacing

There are 200 samples, largely wide and mixed. Chi-square test findings demonstrate a difference between each subgroup, with equal subsets showing a variation of 0.1%, narrow subsets of 0.52%, wide subsets of 0.67%, normal subsets of 0.01%, and mixed subsets of 0.7%. Additionally, this has a total variation rate from the analysis of 32.533%. The **p-value, however, is <0.001.**
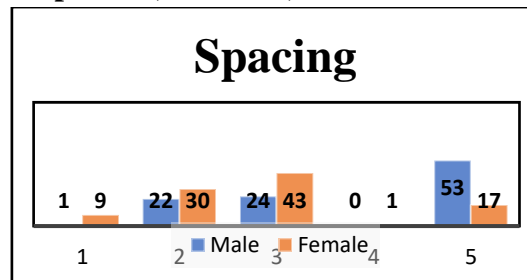
**Graph 0.2: Spacing characteristics**

3.3   Slant

 Slant hasn't varied all that much across 200 samples. The vertical variation is 1.54%, the left variation is 0.19%, and the right slant variation is 0.27% according to the Chi-square test results. And which has a total variation rate from analysis of 0.49%. The **p-value, however, indicates 0783**.

Graph 0.3: Slant Characteristics

3.4 Line quality

The line quality characteristics have both smooth and desperate showing variations in vast differences. The results of the chi-square test show that each subgroup differs, with smooth subsets exhibiting a variance of 1.43%, poor subsets of 0.1%, and desperate subsets of 0.47%. The total variance rate from the analysis for this is also 27.109%. Yet, the **p-value is <0.001**.
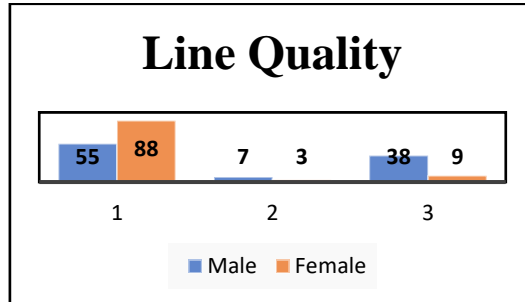
**Graph 0.4: Line quality Characteristics**

3.5 Pen Pressure

Let's look at the percentages based on the subset since pen pressure did not differ significantly from other class characteristics. The Chi-square test results showed that there was a 0.75% variation in the high subset, a 0.3% variation in the low group, and a 0.95% variation in the medium subset. And whose overall variance rate based on analysis is 1.729%. However, the **p-value shows 0.421.**
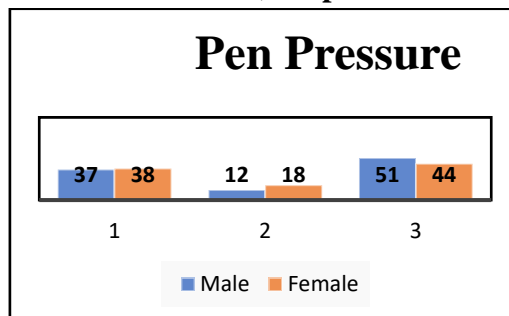
Graph 05: Pen Pressure Characteristics

3.6 Baseline

Out of 200 samples, the baseline analysis produced positive results, revealing that the subsets on, above, and mixed are more variable than the subset below. The results of the chi-square test showed that there is a difference between each subgroup, with the on subsets showing a variation of 0.54%, the above subsets of 0.67%, the below subsets of 0.17%, and the mixed subset of 0.60%. The total variance rate from the analysis for this is 33.551%. Conversely, the **p-value is <0.001.**
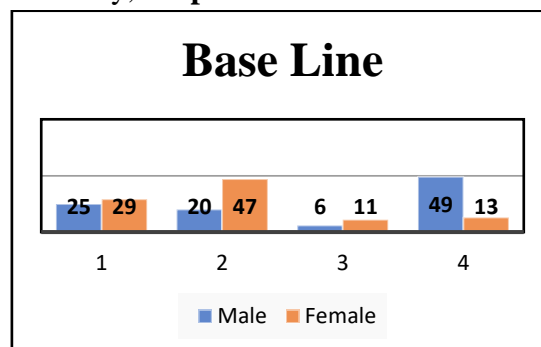
Graph 0.6: Baseline characteristics

3.7   Movement

While samples are being collected, movement is being seen with the naked eye. This method did not reveal many differences from other class characteristics; therefore, we can view the percentages based on the subset. Since children were not included in this study, all participants were adults, and everyone moved their wrists while writing. The Chi-square test findings show that the whole arm movement is 1%, the wrist movement subset has 1.97%, the forearm movement subset has 0.02%, and the finger movement subset has 0%. And which has a 3.046% overall variance rate from the analysis. However, the **p-value shows 0.218**.

Movement

	1	2	3	4
Male	0	100	0	0
Female	0	97	2	1

■ Male ■ Female
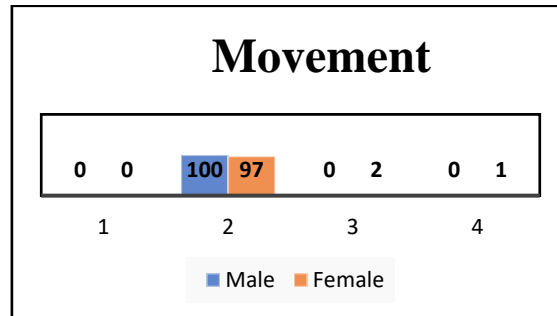
Graph 0.7: Describe the Movement characteristics

3.8   Size

The micrometer and magnifier examine the gathered samples' size properties. According to the Chi-square test results, the small group illustrates 0.72% variation, the medium subset reveals 1.2% variation, and the large subset exhibits 0.08% variation. And which has a 0.089% overall variation rate calculated by analysis. Overall size characteristics have a **p-value of 0.957.**

Size

	1	2	3
Male	0	37	59
Female	0	35	61
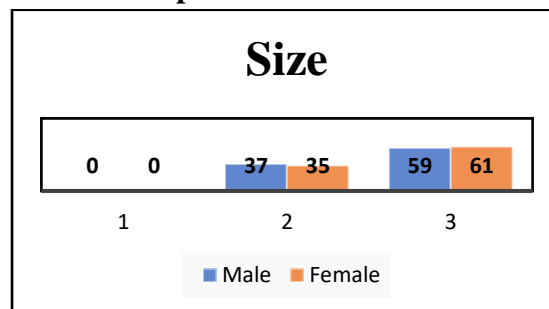
■ Male ■ Female

Graph 0.8: Describes the Size Characteristics

S. No	Class Characteristics	Subset as per coding system	Male	Female	P value
1	Alignment	1	22	41	
		2	7	12	
		3	22	26	
		4	49	21	**<0.001**
		Total	100	100	
2	Spacing	1	1	9	
		2	22	30	
		3	24	43	
		4	0	1	
		5	53	17	
		Total	100	100	**<0.001**
3	Slant	1	12	15	
		2	9	10	
		3	79	75	
		Total	100	100	0.783
4	Line quality	1	55	88	
		2	7	3	
		3	38	9	
		Total	100	100	**<0.001**
5	Pen pressure	1	37	38	
		2	12	18	
		3	51	44	
		Total	100	100	0.421
6	Baseline	1	25	29	
		2	20	47	
		3	6	11	
		4	49	13	
		Total	100	100	**<0.001**
7	Movement	1	0	0	
		2	100	97	
		3	0	2	
		4	0	1	
		Total	100	100	0.218
8	Size	1	37	35	
		2	59	61	
		3	4	4	
		Total	100	100	0.957
9	Speed	1	14	55	

2	67	27		
3	19	18		
Total	100	100	**<0.001**	

3.9   mentioned table explains the results that been have generated (Table 0.1)

3.10   Speed

The speed study of 200 samples revealed that the medium and fast subsets are more diverse than the slow subset. The results of the chi-square test showed that there is a difference between each subgroup, with the slow subsets exhibiting a variance of 0.69%, the medium subsets of 0.94%, and the fast subsets of 0.37%. Finally, this has a total variance rate from the analysis of 41.411 percent. However, the **p-value is <0.001.**
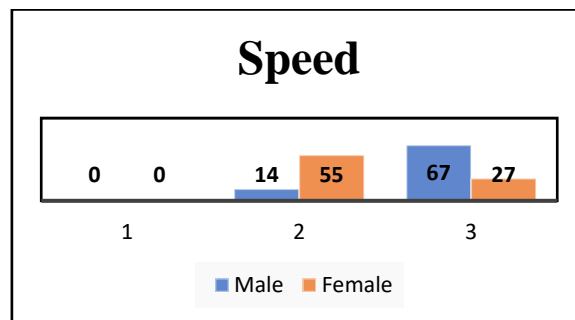
Graph 0.9: Speed Characteristics

4   Observation and interpretation of this study:

4.1   Alignment

Alignment of writing means a word that is written at a specific angle on a horizontal sheet is called an alignment. Some may be practiced with different plain surfaces- like notes under the paper that they write, writing pads, or papers under their writing samples, coming to this study the surface was the plain table. So, this may also affect the alignment of writings. These components may show the difference between males and females. By interpreting this study of alignment characteristics, the irregular subset of males shows more difference than females. So, by evaluating an unknown document, **by analyzing the class characteristics of the unknown or known documents the irregular subset shows variations.** With this, the document can be evaluated.

4.2   Spacing

Spacing of writing shows variations in male and female because usually the spacing between one line to another line will be equally spaced for best writing. If the connecting stokes are present in writings, the amount of spacing is not analyzed properly. In this study Tamil handwriting was analyzed so, there is no connecting stokes between two letters. The narrow, wide, and mixed subset analysis samples have shown more variations in spacing characteristics, the mixed subset shows more variations in males and fewer variations in females. Thus, by analyzing the 200 samples males have more variations than females. **The spacing characteristics variations depend on the person's hand and concentration.** A mixed subset shows more variation, by analyzing mixed characteristics the difference can be easily analyzed.

4.3 Slant

As per the education council studies proved that the slant of the writers must be in rightward slant. In this study, the slant characteristics show mostly vertical slants because they don't deviate from their original forms. Thus, in this study the language is Tamil so the slant of Tamil writings is mostly in vertical slant. The variation will not be seen between males and females. **There is no greater difference between males and females in slant characteristics**. With slant characteristics in Tamil writing the difference will not be preferably chosen.

4.4 Line Quality

Sometimes the quality of the surface differs and the pen`s nib will be affected. These characteristics are mostly identified by the flow of stokes in the pen nib and thickness of stokes, usually, males use more thickness while writing. **Thus, concluding that the line quality of males is showing shakier and not well-ended.**

4.5 Pen Pressure

There is an equal percentage of male and female pen pressure among 200 samples. Regarding pen pressure properties, there was no difference between them. A person is very slightly different throughout. The person's weight and psychological condition are also influenced by pen pressure, which is one of those factors. The age of an individual and the type of pen used while writing can be determined by examining pen pressure in a lab with the right tools. **The gender of an individual will not be determined by manually analyzing pen pressure characteristics.** Pen pressure will be assessed with the aid of more recent technologies, and results will be produced in an appropriate manner. The measurement of pen pressure characteristics, however, will reveal differences between male and female users of the technology.

4.6 Baseline

The baseline often relies on our psychological condition. The person is constant and focused while writing if the baseline is even and stable. Baselines are simple to interpret and analyze. Lines were drawn under the writings once the samples were collected to determine if they were ascenders (above the line) or descenders (below the line). Although they generally lie in the same direction. The surface and the writers' positions have an impact on them. The writing of the people will be recognized by evaluating the alignment of the writings while drawing imaginary lines on the regular or unruled sheet for examination. **The baseline difference will be assessed by analyzing the mixed subset.**

4.7 Movement

Writing trends are influenced by a person's age and occupation. When a young child or an elderly person writes for the first time, they will use three fingers, and these three fingers will indicate the tremors and pen pressure that expose the person's age. For the greatest writing, an adult uses wrist movement. The 200 male and female samples that were gathered in this study show no common differences. Since the samples are written by people in the 20 to 40 age range, all writers have used their wrists and forearms. While writing, wrist movement is observed and evaluated.

4.8 Size

Based on the aforementioned findings, there aren't any significant differences in the size characteristics between the samples of males and females that were obtained. **Male and female writing is not smaller, medium, or larger in size; instead, examination reveals equal variability in both**.

4.9 Speed

The samples' hesitation marks served as an analysis of the writings' speed. Most female writers take their time to ensure perfect alignment in their writing. Males may not write slowly because they have stronger muscular motion, which causes high brain impulses and stimulates the brain to write more quickly. **The majority of the writing in this study is medium to fast.**

5 Conclusion

It is concluded that determining a person's gender based on class characteristics is not particularly difficult. With the aid of the samples that were collected, some class characteristics were analyzed. Comparing, analyzing, and evaluating the collected Tamil handwriting may reveal a substantial difference in the whole study. **Alignment, spacing, line quality, baseline, and speed were among the nine characteristics that could recognize between male and female handwriting.** In alignment characteristics, the **irregular** subset of males is more dominant than females. In spacing characteristics, the **mixed** subset shows more dominance in males than in females. In line quality, by analyzing the **desperate** subset we can conclude that males are more dominant than females. In baseline characteristics, the **mixed** subset of males is more dominant than females. Speed characteristics, with hesitation, mark the **fast moment** of writing are identified. These characteristics help us illustrate the difference by validating this study. As the outcome, this study's analysis reveals a **positive variation**. **With this study by analyzing Tamil writing the sex can be determined.**

Usually, 46 muscles and 26 bones were activated while writing. Since more than a century ago, forensic document examination findings have been recognized by courts of law; but, in recent years, attorneys and judges have begun to question the authenticity and trustworthiness of handwriting opinions. This might thus act as corroborated evidence with the standards list.

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