

Comparing the Consistency of Handwriting after Six Month Duration amongst Young Adults

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Abstract: Forensic handwriting examination is a crucial part of the criminal justice system. Even though the handwriting of an individual is unique, it is subjected to undergo changes over time due to multiple reasons like age, practice, disease, external factors, etc. the present study helps in identifying the characteristics of an individual's writing which undergoes the least amount of changes and which can be relied upon during examination even with the passage of time.

The study was conducted on 200 respondents between the age group 18 to 25 yrs. out of which 100 were male and 100 female. From each respondent, two samples of handwriting were collected at different time duration. The first writing sample was collected on 3rd march 2022 and the second sample was collected on 6th September 2022 with a difference of six-month duration. Hence a total of 400 writing samples were collected for analysis. The handwriting samples were examined for consistency of individual characteristics which included, size of alphabets/words, rhythm, angulation, style of writing, and terminal strokes.

The study concluded that the handwriting of an individual undergoes variations with time. It was noted that the 'individual characteristics' in a person's writing remains same and are least affected by time. The style of writing was retained 100% by all the respondents followed by, rhythm of the writing 95.25%, slant & angulation 91.5% and terminal strokes 89.5%.

Keywords: FDE's, Questioned Documents, Forensic Handwriting Analysis, Handwriting.

1. INTRODUCTION

Writing is not a new concept there have been traces of symbols and drawings carved on caves as old as 64,000 years. Writing is a way to communicate with others. It is one of the most important features when memory cannot be relied on remembering facts. From signing in bank cheques to preparing day-to-day checklists writing is used everywhere. Writing is not an innate feature it is developed when taught. When a child is handed over a writing material they start to scribble. This scribble slowly starts in the formation of early handwriting under guidance. The early form of handwriting is often temporary. As the child grows old a lot of external features add to influence an individual's writing which includes influence by peers or teacher's handwriting, any neurological disease, hesitations, psychological state of mind, thinking ability, etc. Unlike fingerprints, handwriting is not persistent throughout life, a small or major amount of changes keep on occurring whenever an individual writes. These changes which are observed in writers writing are very important to differentiate original writing from forgery. This fact relays on the principle that no two handwriting can be written exactly alike twice hence each individual's handwriting in this universe is unique. Handwriting is a neuro-muscular activity that starts from the mind as a picture perception whereas the natural variation does not allow the exact replication of the image produced in the mind on the document due to its inevitable nature which ultimately results in the authenticity of the handwriting¹. To assess the degree of variation in an individual's writing within a certain duration of time it is important to know the extent of natural variation in their writing.

The concept of writing starts from a thought generated in our brain, through the activation of neurons it transfers the electrical impulse to the entire body through the fibres and the nervous system which further stimulates the muscles and bones of the hands to put forward the thoughts on the document.

Document examination is a wide area that covers the examination of a vast number of crimes including cheque forgery, suspected suicide notes, wills, property documents, and so on. Most of these offenses involve the examination of handwriting or signatures. Forensic handwriting examination requires a side-by-side comparison and analysis of the questioned and exemplars for establishing the fact whether the questioned writing was been written by a known writer². There are various handwriting features like strokes, rhythm, line quality, pen pressure, speed of writing, grammatical errors, and many more which are individualistic. These are often subconscious features and are of interest to Forensic Document Examiners (FDEs). The text of cursive nature, the similarity in the shape of individual characters, and the existence of different styles of writing are a few of the key concerns that make the task of recognition quite challenging³. The subconscious features are hard to resist and this is why a forgery or disguise can never be a perfect one. forensic handwriting analysis is usually a visual examination that is mostly based on scrutinizing the specific writing characters' shapes or character ligatures, therefore making analysis text reliant on, e.g., the textual content used while analysis⁴. Identification of the writer usually consists of two important steps including feature extraction, in which selective features are segregated from the written documents which need to be compared and the second step requires matching or classification during which a comparison is made between the features, and a conclusion is derived about the authorship⁵. Writing has become the utmost important evidence as thousands of criminal and civil cases are continuously arising, if writing cannot be proved as it often falls under the case of the old rule, then the case would be lost by the rights⁶.

II. MATERIALS AND METHODS

Writing can be executed not only through the movement of the hand but also under certain circumstances through the mouth, toes, wrist, etc. for this study only writings written by hands are considered. A total of 200 healthy respondents were chosen randomly for this study out of which 100 respondents were male and 100 were female between the age group of 18-25 years. Further, the samples were collected within a time gap of 6 months with the consent of the responders. As per the study objectives, 200 handwriting samples of the respondents were collected in March 2022 and 200 samples in September 2022. An equal number of samples were collected from both males and females before and after six months making a total of 200 i.e., 100 before and 100 after 6 months.

The handwriting of the subjects was collected through their copybooks and their written notes written in two intervals. The writing samples were scrutinized based on certain criteria, both the notes being written using ballpoint pen ink, recycled papers were avoided, and all the respondents were only right-handed. All the samples were written prior by the respondent's none of the contents were dictated. It is noted that dictated notes might be altered by speed, the consciousness of mind, purposeful modification of alphabets, and difference in perception of words or accent of the dictator.

The documents were analyzed for individual characteristics i.e., terminal strokes, letter size, style of writing, specific alphabets, slants and angulation, and rhythm. For the purpose of the study, the style of writing was divided into cursive, semi-cursive, and manuscript form, and terminal stroke was divided into tapering and blunt. For the purpose of comparison and analysis, a hand lens and digital microscope were used. The samples were subjected to examination where the individual characteristics of the respondents were carefully observed. For zooming the characteristics of writing a digital microscope and 'Hiview' software. The samples were observed under the magnification of 6324x4742 and the color compression was kept at RGB24.

III. RESULT AND OBSERVATION

The following are the observations made from the collected samples

Out of 200 respondents, an equal number of males 100 (50%) and females 100 (50%) were chosen (Table 1). A total of 400(100%) handwriting samples were collected out of which 200 (50%) samples from both males (25%) and females (25%) were collected on March 2022 and the remaining 200 (50%) samples from both male (25%) and female (25%) were collected in the month of September 2022.

The maximum number of respondents falls between the age group 18-20 yrs. i.e., 128 (64%) whereas 72 (36%) respondents were between the age group 21-23 (Chart 1). All the respondents 200 (100%) were chosen with an educational qualification above intermediate (Twelfth grade).

The following are the qualitative analysis done for the result

1. ERMINAL STROKES

While analysis it was noted that all the writings had two types of strokes, either blunt strokes or tapering strokes (fig. 1). 358 (89.5%) out of 400 (100%) samples retained the terminal stroke even after six months. 81 (20.25%) male respondents had prominent tapering terminal strokes before six months whereas after six months it was 84 (21%) of the respondents had tapering terminal strokes. 19 (4.75%) of the male respondents had blunt terminal strokes in their writing before six months whereas after six months 16 (4%) respondents retained blunt terminal strokes. Amongst female respondents, 97 (24.25%) of them had tapering terminal strokes before six months and 96 (24%) of them retained them after six months. While comparing the blunt terminal strokes amongst females 03 (0.75%) of them had it before six months whereas after six months it was noted that 04 (1%) of the respondents had a blunt terminal stroke. The most common type of terminal stroke was tapering stroke which occurred in most of the alphabets with upper and lower extensions. Amongst the sample, 358 samples had a tapering terminal stroke and 42 (10.5%) of the samples had a blunt terminal stroke. (Table 2)

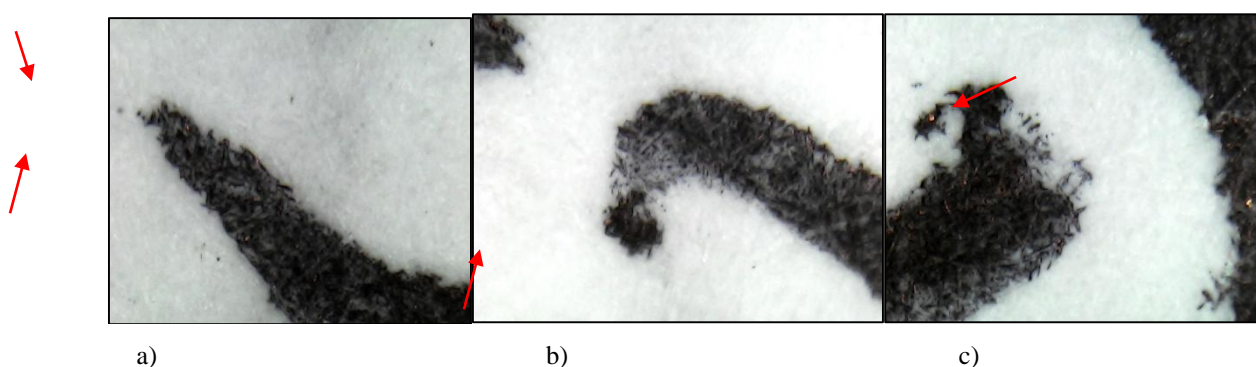


Fig. 1: Terminal Stroke using Digital Microscope, a) Tapering tip b) Blunt tip c) Blunt tip with abrupt ending

2. SIZE OF THE WRITING

The measurement of the words/alphabets was done using a micrometer. Amongst male respondents 115 (28.75%) writing samples had an increase in size over time whereas 85 (21.25%) respondent's samples had a decrease in writing size. Amongst female respondents 161 (40.25%) samples had an increase in size after six months, 38 (9.5%) samples writing size decreased over time while comparison, and 01 (0.25%) respondents had approximately the same size before and after six months. The size of writing amongst 276 (69%) of 400 (100%) samples had a gradual increase in six months (Table 3). Amongst 123 (30.75%) samples it was noted that the size gradually decreased with time and 01 (0.25%) respondent dint have any changes with the size of the writing (Fig 2). Further analysis suggested that females' handwriting was more 'clear' and 'neat' compared to male respondents. Out of 200

(100%), female samples 147 (73.5%) had 'clear' and 'neat' writing whereas amongst the male respondents out of 200 (100%) samples 33 (16.5) had 'clear' and 'neat' writing (Fig 2).

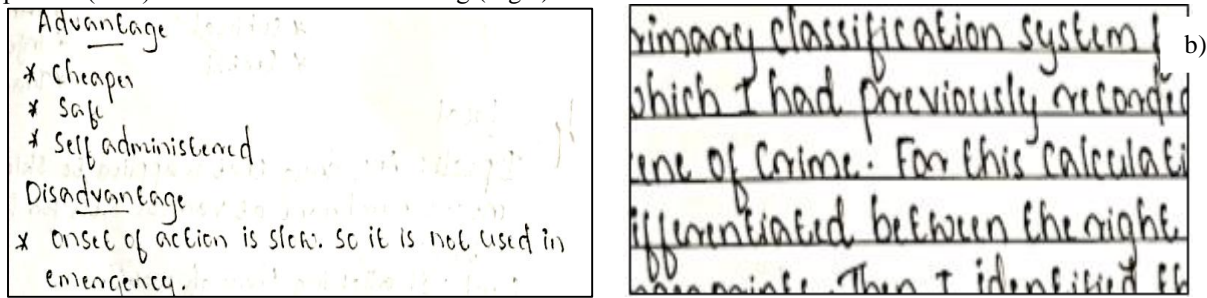


Fig. 2: sample collected by the same respondent showing increase in size of writing with time a) collected in March 2022 showing words in smaller size b) collected in September 2022 showing increase in size of writing

3. RHYTHM

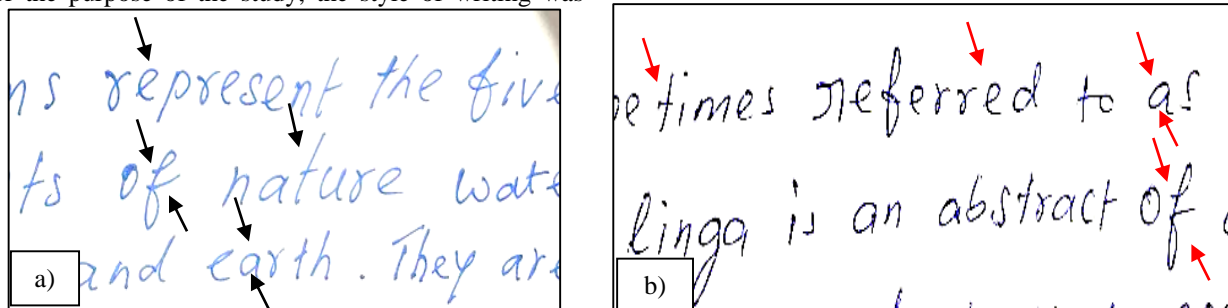
The rhythm of the respondents is one of the least affected characteristics of handwriting with time. It was noted through analysis that the rhythm more or less remains the same even after a six-month duration of time. 381(95.25%) out of 400 (100%) written samples had stability in rhythm (Fig 3).

Fig. 3: Rhythm, a) Sample collected from the respondent in March 2022 b) sample collected from the respondent in September 2022

4. STYLE OF WRITING

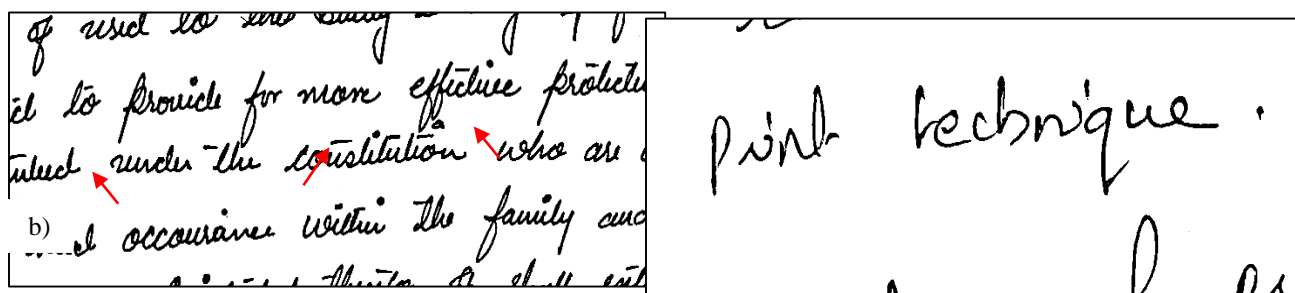
For the purpose of the study, the style of writing was

divided



into three types' manuscript, cursive and semi-cursive.

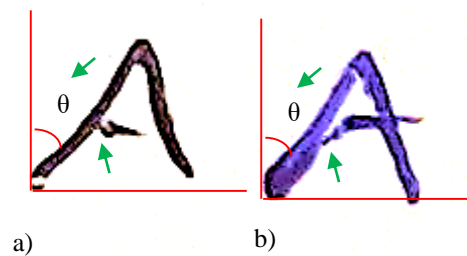
The following analysis showed that 400 (100%) out of 400 (100%) written samples had the same style of writing before and after six months. Irrespective of gender, the most common style of writing was semi-cursive where 392 (98%) samples fall in this category of writing, followed by a manuscript form of writing where 06 (1.5%) writing samples were and the least sample 02(0.5%) had cursive form of writing (Table 4). It was also noted that 196 (49%) of 200 (100%) male writing samples were semi-cursive and 04 (1%) of them had a manuscript form of writing. There were no male respondent samples who wrote in cursive form. Amongst females respondents 193 (48.25%) samples had a semi-cursive form of writing, 02 (0.25%) of the samples had a cursive form of writing and 02 (0.5%) samples had a manuscript form of writing (Table 5). (Fig 4)



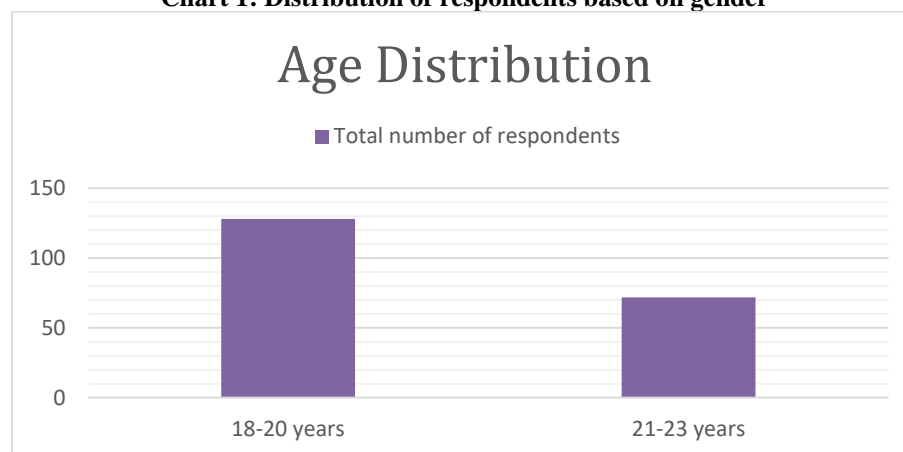
accepted by two or more men or groups or person or individual of a town city or country as a means of communication of informing ones ideas to others too particular matter or understanding or sending m

Fig. 4: Style of writing a) Cursive, b) Semi Cursive, c) Manuscript**5. SLANTS AND ANGULATION OF ALPHABETS**

Embellishments, designs and pictorial effects added to certain alphabets are unique to an individual. These specifications in writing certain alphabets make the writing of that person individualistic. 366 (91.5%) handwriting samples reproduced the same slant and angulation in alphabets with time (Fig.5). Amongst 34 (8.5%) samples it was noted that they had adopted a mixture of old and new alphabets.

**Fig 5: Alphabet representing angulation and specifications a) written in March 2022 b) written in September 2022****III (A). TABLES AND CHARTS****Table 1: Distribution of respondents based on gender**

Gender	Number of respondents
Male	100 (50%)
Female	100 (50%)
Total	200 (100%)

Chart 1: Distribution of respondents based on gender**Table 2: Comparison of consistency of terminal strokes with difference in time duration of six month**

Time duration	Terminal strokes				TOTAL
	Tapering end (male)	Blunt end (male)	Tapering end (female)	Blunt end (female)	
Before 6 months	81 (20.25%)	19 (4.75%)	97 (24.25%)	03 (0.75%)	200 (50%)
After 6 months	84 (21%)	16 (4%)	96 (24%)	04 (1%)	200 (50%)
TOTAL	165 (41.25%)	35 (8.75%)	193 (48.25%)	07 (1.75%)	400 (100%)

Table 3: Comparison of size of writing with gender

Gender	Size of writing			TOTAL
	Increase	Decrease	No change	
Male	115 (28.75%)	85 (21.25%)	00 (00%)	200 (50%)
Female	161 (40.25%)	38 (9.5%)	01 (0.25%)	200 (50%)

TOTAL	276 (69%)	123 (30.75%)	01 (0.25%)	400 (100%)
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Table 4: Comparison of style of writing with difference in time duration of six month

Time duration	Style of writing			TOTAL
	Manuscript	Cursive	Semi cursive	
Before 6 months	03 (0.75%)	01 (0.25%)	196 (49%)	200 (50%)
After 6 months	03 (0.75%)	01 (0.25%)	196 (49%)	200 (50%)
TOTAL	06 (1.5%)	02(0.5%)	392 (98%)	400 (100%)

Table 5: Comparison of style of writing with gender

Time duration	Style of writing			TOTAL
	Manuscript	Cursive	Semi cursive	
Male	04 (1%)	00 (00%)	196 (49%)	200 (50%)
Female	02 (0.5%)	02 (0.25%)	193 (48.25%)	200 (50%)
TOTAL	06 (1.5%)	02(0.5%)	389 (97.25%)	400 (100%)

IV. CONCLUSION

It is concluded from this study that even though an individual's handwriting undergoes drastic changes over time there are certain features that are retained subconsciously. These features are individualistic features in a writing. These features undergo the least amount of change with time and are the reliable source for determining authorship.

The most common type of terminal stroke was 'tapering terminal stroke' and this was dominant in both males and females. Irrespective of the time gap it was concluded that they undergo the least amount of change and are retained even after six months of time. The blunt terminal strokes were more frequent in male respondents than compared to female respondents.

The size was another important individualist feature which denoted that the maximum number of respondents had an increase in the size of writing after six months. The samples collected in the month of March 2022 had comparatively smaller writing sizes than the samples collected during September 2022. Maximum respondents had a 'clear' and neat writing after six months than the prior samples. The majority of the Female respondents had more 'clear' and 'neat' writing than compared to male respondents.

Rhythm in an individual's writing was consistent when the comparison of both handwriting samples, before and after six months. There were least or no variations found in rhythm in either gender.

The most common type of writing style was semi-cursive form whereas the least common style of writing was cursive. While analyzing the manuscript form of writing it was found that the majority of male respondents had this form compared to females. Whereas only female respondents had cursive writing. There were no changes observed over time with style of writing.

Embellishments, designs, and pictorial effects are unique to that person hence it was noted that these features were prominently present before and after six months. There were no changes in the angulation and slants of the alphabet. They are exactly imitated similarly with time with natural variations.

V. FUTURE SCOPE

No prior studies were conducted in this field of handwriting analysis where the consistency and reliability of an individual's writing were analyzed. Most of the studies were related to graphology whereas only a few studies exist with forensic handwriting examination. The handwriting of an individual undergoes various amounts of changes hence it is essential to analyze the actual degree of natural variation and to know features of writing that pass the test over time. In this context, the present study helps to conclude that even though there are external factors influencing an individual's writing, the subconscious features are retained.

VI. REFERENCES

1. Rana, A., and V. Saran. "A Comparative Study of Different Blood Alcohol Concentration Effect on Handwriting." *J Forensic Sci Criminol* 8, no. 1 (2020): 101.
2. Hicklin, R. A., Eisenhart, L., Richetelli, N., Miller, M. D., Belcastro, P., Burkes, T. M., ... & Eckenrode, B. A. (2022). Accuracy and reliability of forensic handwriting comparisons. *Proceedings of the National Academy of Sciences*, 119(32), e2119944119.
3. Husnain, M., Saad Missen, M. M., Mumtaz, S., Jhanidr, M. Z., Coustaty, M., Muzzamil Luqman, M., ... & Sang Choi, G. (2019). Recognition of Urdu handwritten characters using convolutional neural network. *Applied Sciences*, 9(13), 2758.
4. Bensefia, A., & Paquet, T. (2016). Writer verification based on a single handwriting word samples. *EURASIP Journal on Image and Video Processing*, 2016(1), 1-9.
5. Al-Maadeed, S., Hassaine, A., Bouridane, A., & Tahir, M. A. (2016). Novel geometric features for off-line writer identification. *Pattern Analysis and Applications*, 19(3), 699-708.
6. Osborn, A. S. (1911). Proof of Handwriting. III. LR, 6, 334.