

# Comparison of Handwriting of Accustomed and Unaccustomed Hand of Individuals and Ascertaining Their Identifiable Parameters

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## Abstract:

In an effort to conceal their identity, writers often try to change their usual handwriting to disguise. Many times, a master disguise is created through the act of writing with an unaccustomed hand. Due to a sudden loss of pen control and motor skills, the handwriting's pictorial appearance changes in disguise to the point where the writers assume success and becomes convinced that the disguised handwriting, they have produced cannot be linked to them when compared to their typical genuine writing style. In the present study, samples of handwriting from a number of people were collected, both from their accustomed and their unaccustomed hand. An effort was made to identify those individual features that managed to withstand the dangers of disguise and could be useful in correctly ascertaining the authorship of such disguised handwriting in comparison to one's normal handwriting. A detailed study of spacing between the letters and words, specific connecting stroke, certain letters formation and most importantly the positioning of the signatures below the paragraph written by selected subjects has been carried out. Despite pictorial dissimilarities, it has been observed that, there are some subconscious characteristics that are rarely concealed and may serve as the basis for their relationship with a particular writer or serve as an idea for future research.

**Keywords:** Handwriting, Disguise, Accustomed Hand, Unaccustomed hand, Individual Characteristics, Authorship identification

## 1. Introduction

Handwriting is an acquired skill that can be neither cultivated nor abandoned at will. The development of natural handwriting becomes so instinctive that it doesn't need any conscious direction, especially at the point of graphic maturity [1]. All of the master handwriting patterns that are learned and practiced are permanently ingrained in the brain, and when writing, the human hand physically produces them on paper using its muscular system. Natural handwriting is virtually automatically produced since it is a neuromuscular controlled motor activity; the writer should instead focus on what they are writing rather than how they are writing [2,13,18].

Once a writer's writing habits are improved, it is more challenging for them to successfully conceal their own handwriting or to forge someone else's. Some of the writers continue to try to conceal their handwriting, despite

the difficulty of doing so consistently, maybe in an effort to conceal their identity in the event of a subsequent denial [3]. Not only are these instances common, but people are also embracing novel means of disguising themselves, chief among them being: a change in slant, a change in size, a substitution of letter shapes, the use of block capitals, writing with the opposite hand, writing backwards, writing with a broad tip pen, or a change in writing speed [4,14]. There are some well-documented characteristics of disguised writings, such as line quality problems, that can be used to assess whether or not the handwriting is real [5]. Harrison published eight general guidelines for disguising that are still applicable today and are still followed by forensic document examiners.

### 1.1. Handwriting with accustomed and unaccustomed hand

The use of an unfamiliar hand can significantly alter a person's handwriting features, which has important implications for forensic investigations that rely on handwriting analysis to identify the author of a document [6,15]. Inconsistent the slower, less fluid writing of the unfamiliar hand may result in connecting strokes, margins, and word spacing, making it more challenging for forensic handwriting experts to definitively identify the author. The consistency and distinctiveness of the writing are also affected, with the untrained hand's handwriting being less so [4,6].

Some authors view poor handwriting as a useful disguise that can be used to conceal their identity. This happens while writing with the opposite hand or an unfamiliar hand because the writer loses rhythm and muscular control. Most of the time, the writer likes to use the unaccustomed hand as a mask since the pictorial effect created by unaccustomed-hand writing differs significantly from that of the accustomed hand. Harrison has since reported that writing produced by the unaccustomed hand will generally bear little resemblance to writing produced by the dominant hand; and about 5% (one in twenty) of the people going for disguise chose writing with the unaccustomed hand as the preferred mode of disguise because it produced an unrecognizable handwriting [3,5,16].

### 1.2. Class and Individual Characteristics of handwriting

Class characteristics are those writing qualities common to a group i.e., the common pattern of handwriting, letters, their shape which are limited to a group, age or language. In simple words, it is nothing but copy book format i.e., a model which is taught to us when we learn the writing process which is almost comparable to a class of individuals (kids in school of a particular region) Individual characteristics, on the other hand, emerge when a letter deviates from its standard format [17,19,20]. All handwriting identifications are based on these elements of writing, those traits or characteristics of writing that are unique to a particular writer.

## 2. Background

In 1993, Dawson, G.A., concentrated on identifying handprints made with an unfamiliar left hand. A case study and demonstration of the accurate identification of handprints made with the left hand that was not used to it. Only typical right-hand handprints were given to the document examiner as comparison samples. Along with the key elements contributing to the identification, the characteristics of a handprint made with an unfamiliar hand are discussed. [7].

In 2008, Soison, A., et al. collected familiar and unfamiliar handwritings from the primary school instructors in Bangkok and conducted a comparison research of habitual left and right handwritings of the same person. Slant, broad letter and narrow letter sizes, typical letter and space sizes, alignment, and height were the features that were investigated. A video microscope was used to measure these characteristics. 32 primary school teachers from Bangkok, Thailand were chosen at random for this study. Each case had two kinds of information: regular handwritten data and irregular handwritten data. Seven aspects of the handwriting were looked at. [8].

A Statistical Examination of Common Characteristics for Disguised Handwriting Among Malaysians was conducted in 2011 by Mohameda, R., et al. A statistical and microscopic analysis of handwriting traits was reported in that study. The normal handwriting of 60 respondents was evaluated, and the characteristics of the letters "a","e","g","y","d","f","h","o","E," and "D," as well as the grapheme "th," were divided into class characteristics (script kinds, letter size, slant, angularity alignment, and word spacing) and individual

characteristics. 50 additional handwritings were sought in order to compare the disguised and regular handwritings. To ascertain the association between race, gender, age, initial educational system, education level, and occupation with the typical handwriting tendencies, the Pearson Chi-squared test, a statistical method, was used. [9].

In 2016, Anita, O.J., concentrated on mirror writing, a characteristic of writing with an unfamiliar hand. The mirror image style of writing was thoroughly investigated. The character types that appear in mirror image form the most were observed. There were gender disparities in the propensity to write in mirror image form. The impact of numerous variables, like the placement of a character (letter) in a word and whether a writer is dictating or transcribing a document, is also discussed. The character "t" was discovered to be the one that is most frequently written in mirror image form. 50 men and 50 women, all right-handed, who were proficient writers and college and university students, provided the handwriting samples for this study. None of the participants had a condition that would have impaired their ability to coordinate their muscles or their brains. [10].

In 2021, Rani, A., et al. identified the author of concealed handwriting written using an unfamiliar hand. In that study, samples of several people's handwriting from both their normal hand and an unfamiliar hand were obtained, and an effort was made to find out and identify those features that managed to withstand the dangers of disguise and might be useful to accurately identify the authorship of such disguised handwriting when compared to one's normal handwriting samples. The, letter shapes, connecting strokes between letters and t-crossings penned by various authors have all been thoroughly studied. [11].

### **3. Materials and Methods**

A standard text in writing of Right Hand and Left Hand of the same individual was collected for the purpose of study. A total of 200 writing samples from 50 random individuals ( $50 \times 2 \times 2 = 200$ ) samples were collected from the people within the age group of 18-50 years on plain A4 white paper. Appropriate writing instrument, Magnifying glass, Digital Microscope (50 x to 1000 x magnification), Light source, Computer System with MS Office, Nikon DSLR 3100 camera were utilized for sample analyses. This study was conducted in accordance with ethical guidelines, and informed consent was obtained from all participants before the study.

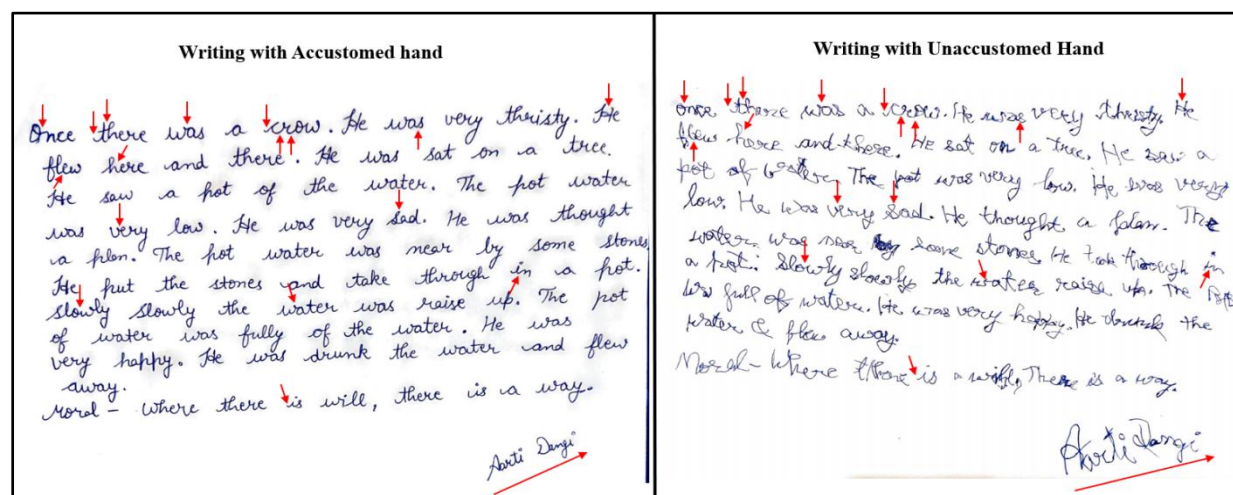
### **4. Results and Discussion**

The samples were analysed using magnifying glass (5x), Digital Microscope (50x-1000x) and image enlargement by comparing individual writings written with both hands (accustomed and unaccustomed) for the specific individual characteristics such as spacing between the letters and words, writing slant, writing alignment, line quality, tremors, specific connecting strokes, certain letters formations and most importantly the positioning of the signatures below the paragraph.

While conducting handwriting examination, the class and individual characteristics were identified for further comparison and analysis by using AACE (Analysis of Known, Analysis of Unknown, Comparison of Known and Unknown, and Evaluation) strategy.

#### **Examples of Samples Analysed:**

##### **Sample 1a: Writing Sample of an Individual from Accustomed and Unaccustomed Hand**



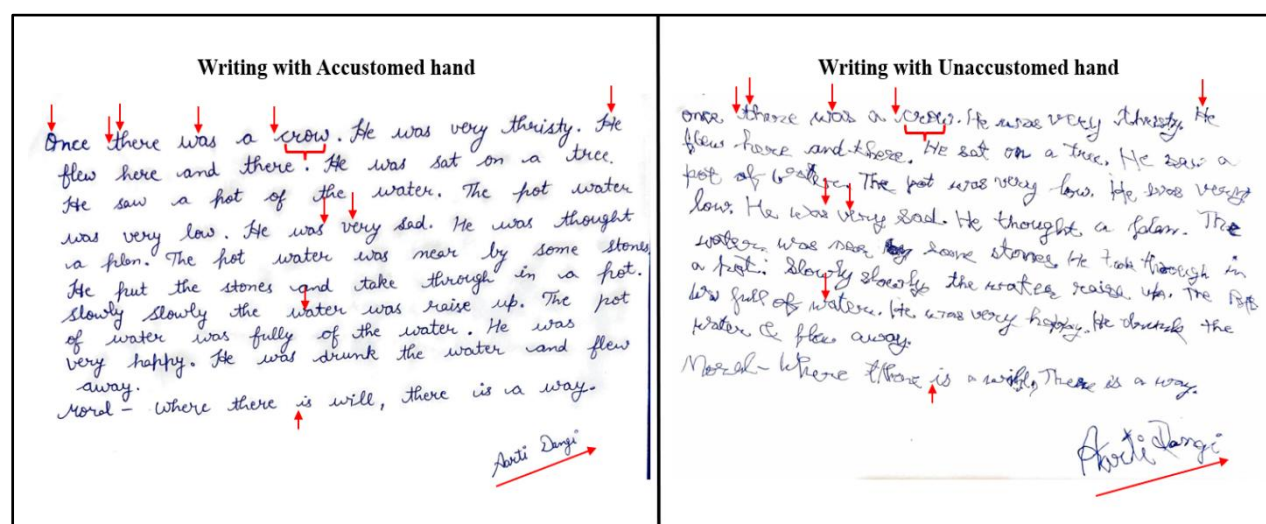
#### Differences observed: -

- Alignment: - The alignment in accustomed hand handwriting sample is uphill (ascending) whereas, in unaccustomed hand handwriting sample it is downhill (descending).
- Slant: - The slant in accustomed hand handwriting sample is vertical to right whereas, in unaccustomed hand handwriting sample it is mixed.
- Line Quality: - The line quality in accustomed hand handwriting sample is good whereas, in unaccustomed hand handwriting sample it is poor.
- Tremors: - Absence of tremors or hesitation marks in accustomed hand handwriting sample whereas, in unaccustomed hand handwriting sample there is a presence of tremors and hesitation mark.
- Patching: - Absence of patching in accustomed hand handwriting sample whereas, in unaccustomed hand handwriting sample there is a presence of patching.
- Overall Pictorial Appearance: - The overall pictorial appearance is found to be good in accustomed writing sample whereas, in unaccustomed hand handwriting sample it is deteriorated.

#### Similarities observed: -

- Spacing: - Both the sets of samples (accustomed and unaccustomed) show similar spacing between the words and letters.
- Connecting stroke: - Both the sets of samples (accustomed and unaccustomed) show consistent garlanded stroke in between word 'crow', 've', 'wa', etc.
- Certain letter formation: - The formation of letter 's', 't', 'H', initial stroke of letter 'c' and 'i' are in similar fashion at several places in both the sets of samples (accustomed and unaccustomed)
- Position of signature: - Both the sets of samples (accustomed and unaccustomed hand) show similar position of signature and uphill/ascending alignment.

**Sample 1b: Another writing of same individual from Accustomed and Unaccustomed Hand for consistency examination**



### Differences observed: -

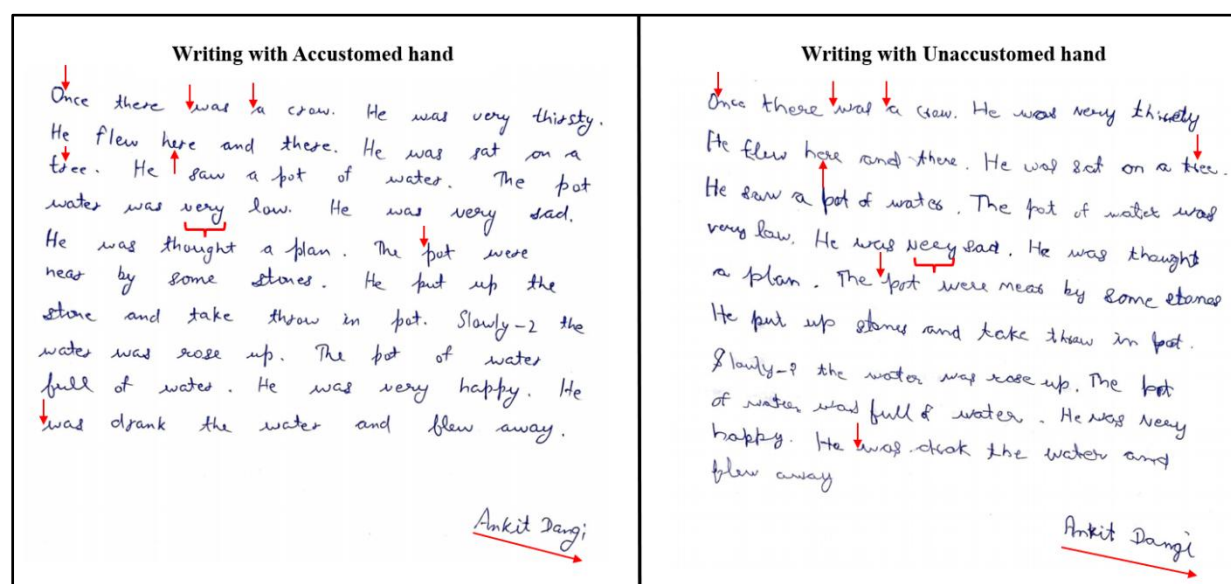
- **Alignment:** - The alignment in accustomed writing sample is uphill (ascending) whereas, in unaccustomed writing sample it is downhill (descending).
- **Slant:** - The slant in accustomed writing sample is vertical to right whereas, in unaccustomed writing sample it is mixed.
- **Line Quality:** - The line quality in accustomed writing sample is good whereas, in unaccustomed writing sample it is poor.
- **Tremors:** - Absence of tremors or hesitation marks in accustomed writing sample whereas, in unaccustomed writing sample there is a presence of tremors and hesitation mark.
- **Patching:** - Absence of patching in accustomed writing sample whereas, in unaccustomed writing sample there is a presence of patching.
- **Overall Pictorial Appearance:** - The overall pictorial appearance is found to be good in accustomed writing sample whereas, in unaccustomed hand handwriting sample it is deteriorated.

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- **Position of signature:** - Both the sets of samples (accustomed and unaccustomed hand) show similar position of signature and uphill/ascending alignment.

### Sample 2a: Writing Sample of one more Individual from Accustomed and Unaccustomed Hand





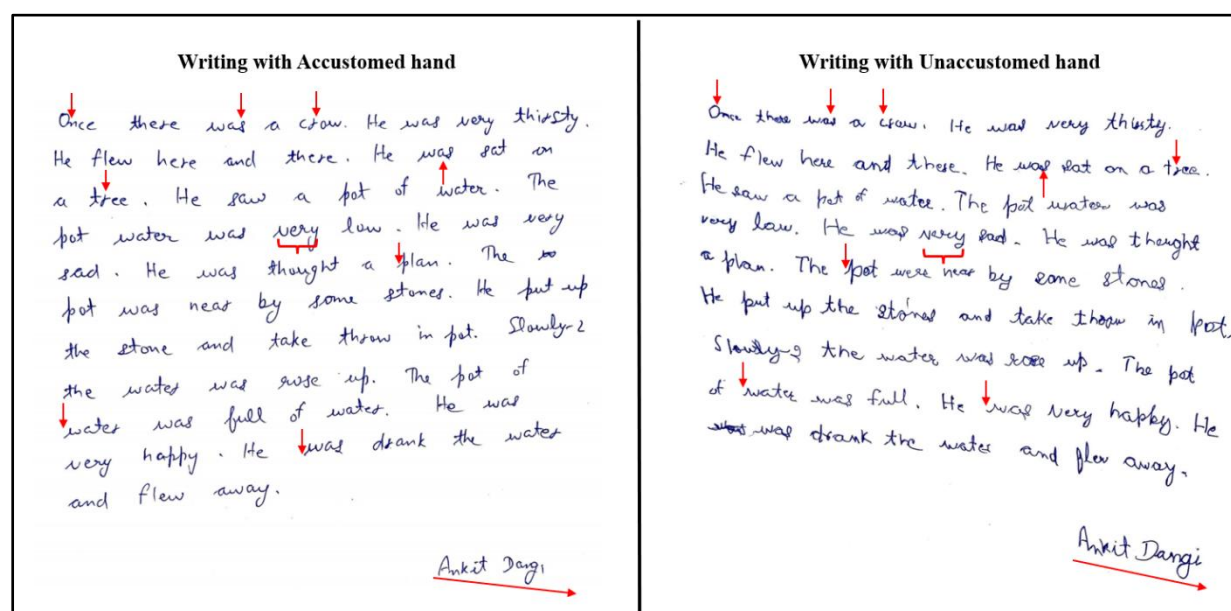
#### Differences observed: -

- Alignment: - The alignment in accustomed writing sample is downhill (descending) whereas, in unaccustomed writing sample it is mixed.
- Slant: - The slant in accustomed writing sample is vertical to right whereas, in unaccustomed writing sample it is mixed.
- Line Quality: - The line quality in accustomed writing sample is good whereas, in unaccustomed writing sample it is comparatively poor.
- Tremors: - Absence of tremors or hesitation marks in accustomed writing sample whereas, in unaccustomed writing sample there is a presence of tremors and hesitation mark.
- Patching: - Absence of patching in accustomed writing sample whereas, in unaccustomed writing sample there is a presence of patching.
- Overall Pictorial Appearance: - The overall pictorial appearance is found to be good in accustomed writing sample whereas, in unaccustomed hand handwriting sample it is deteriorated.

#### Similarities observed: -

- Spacing: - Both the sets of samples (accustomed and unaccustomed) show similar spacing between the words and letters.
- Connecting stroke: - Both the sets of samples (accustomed and unaccustomed) show consistent garlanded stroke in between word 'very', 'er', 'On', etc.
- Certain letter formation: - The formation of letter 'r', initial stroke of letter 'a', 'p' and 'w' are in similar fashion at several places in both the sets of samples (accustomed and unaccustomed)
- Position of signature: - Both the sets of samples (accustomed and unaccustomed hand) show similar position of signature and downhill (descending) alignment.

**Sample 2b: Another writing of same individual from Accustomed and Unaccustomed Hand for consistency examination**



#### Differences observed: -

- **Alignment:** - The alignment in accustomed writing sample is downhill (descending) whereas, in unaccustomed writing sample is mixed.
- **Slant:** - The slant in accustomed writing sample is vertical to right whereas, in unaccustomed writing sample it is mixed.
- **Line Quality:** - The line quality in accustomed writing sample is good whereas, in unaccustomed writing sample it is comparatively poor.
- **Tremors:** - Absence of tremors or hesitation marks in accustomed writing sample whereas, in unaccustomed writing sample there is a presence of tremors and hesitation mark.
- **Patching:** - Absence of patching in accustomed writing sample whereas, in unaccustomed writing sample there is a presence of patching.
- **Overall Pictorial Appearance:** - The overall pictorial appearance is found to be good in accustomed writing sample whereas, in unaccustomed hand handwriting sample it is deteriorated.

#### Similarities observed: -

- **Spacing:** - Both the sets of samples (accustomed and unaccustomed) show similar spacing between the words and letters.
- **Connecting stroke:** - Both the sets of samples (accustomed and unaccustomed) show consistent garlanded stroke in between word 'very', 'er', 'On', etc.
- **Certain letter formation:** - The formation of letter 'r', initial stroke of letter 'a', 'p' and 'w' are in similar fashion at several places in both the sets of samples (accustomed and unaccustomed)
- **Position of signature:** - Both the sets of samples (accustomed and unaccustomed hand) show similar position of signature and downhill (descending) alignment.

According to the objective of the study the class and individual characteristics of an individual's handwriting from accustomed and unaccustomed hand showed number of variations. The variations were mainly observed in writing alignment, slant, line quality, introduction of tremors, and patching. These were the most influenced

characteristics when writing with unaccustomed hand. However, there were certain individual characteristics those remain unchanged and provided a positive identification and comparison of the writer in respect to accustomed and unaccustomed hand. These characteristics were spacing between the letters and words, specific connecting stroke, certain letters formation and most importantly the positioning of the signatures below the paragraph also it was observed that the alignment of the signatures does not changed at all in both the sets (accustomed and unaccustomed) of handwriting samples.

The results of the study showed significant similarities in handwriting characteristics between the accustomed and unaccustomed hands of the participants. It was observed that the writing produced by the unaccustomed hand was less fluent with relatively slower speed than that produced by the accustomed hand. This is possibly due to the poor and untrained muscular coordination with the unaccustomed hand. However, the existence of the specific similarities proves that handwriting is brain writing and it is difficult to change certain individual characteristic features.

**Table 1: Shows the variations and similarities in the handwritings of individuals through an unaccustomed hand**

Sample No.	Sample Sub-Division	Pictorial Appearance	Alignment	Slant	Line Quality	Tremors	Patching	Spacing	Connecting Stroke at specific letters	Formation of specific letters
1	1a	Deteriorated	Changed	Changed	Poor	Introduced	Present	Similar	Similar	Similar
	1b	Deteriorated	Changed	Changed	Poor	Introduced	Present	Similar	Similar	Similar
2	2a	Deteriorated	Changed	Changed	Poor	Introduced	Present	Similar	Similar	Similar
	2b	Deteriorated	Changed	Changed	Poor	Introduced	Present	Similar	Similar	Similar
3	3a	Deteriorated	Changed	Changed	Poor	Introduced	Present	Dissimilar	Similar	Similar
	3b	Deteriorated	Changed	Changed	Poor	Introduced	Present	Similar	Similar	Similar
4	4a	Deteriorated	Changed	Changed	Poor	Introduced	Present	Dissimilar	Similar	Similar
	4b	Deteriorated	Changed	Changed	Poor	Introduced	Present	Dissimilar	Similar	Similar
5	5a	Deteriorated	Cha	Cha	Poor	Intro	Pres	Diss	Similar	Similar



		ed	nged	nge d		duce d	ent	imil ar		
	5b	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Pres ent	Diss imil ar	Similar	Similar
6	6a	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Pres ent	Simi lar	Similar	Similar
	6b	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Pres ent	Simi lar	Similar	Similar
7	7a	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Abs ent	Simi lar	Similar	Similar
	7b	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Abs ent	Simi lar	Similar	Similar
8	8a	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Abs ent	Simi lar	Similar	Similar
	8b	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Abs ent	Simi lar	Similar	Similar
9	9a	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Pres ent	Simi lar	Similar	Similar
	9b	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Pres ent	Simi lar	Similar	Similar
10	10a	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Pres ent	Simi lar	Similar	Similar
	10b	Deteriorat ed	Cha nged	Cha nge d	Poor	Intro duce d	Abs ent	Simi lar	Similar	Similar

As observed in the present study, various connecting strokes between letter ('a' and 't', 'o and 'f', 'i' and 's', 'e' and 'r', 't' and 'h', 'a' and 's') have individual similarities for both accustomed as well as unaccustomed hands. However, it has been seen that connections in accustomed handwriting were fluent, whereas the unaccustomed handwriting exhibits hesitations, abrupt directional changes, unsure movements, and tremors but in the range of natural variations in genuine handwriting and as a habitual characteristic feature of the same writer. These variations were possibly due to unfamiliar hand's poor neuromuscular coordination, which would explain the inferior 'finger' writing action in the disguised writing. This is in line with Huber and Headrick's [12] assertion that writing with the non-dominant hand exhibits a loss of skill and fluency as well as a reduction in speed,

which may lead to a worsened line quality, writing tremors, abrupt changes in pen pressure, and a lack of connections between the letters.

In terms of formation of letters, few of them like 'a,' 'k,' 'f,' 'w,' 's,' 'h,' and 'p' – were specifically examined and compared. These letters were extracted from the same word in both accustomed and unaccustomed handwritings to compare formation and style and see whether the writing varies as the hand changes or not. The majority of the letters in writing by an unfamiliar hand were discovered to be similar fundamentally to the writing by a familiar hand, but the letters displayed variations in the form of hesitations, large letter sizes, angular strokes, and deteriorated formation as the writer may not be accustomed to write with the opposite hand.

While considering the alignment and slant both acclimated and unfamiliar handwriting show a constant change. This could be as a result of the unaccustomed hand's poor neuromuscular coordination again, the angle at which the participants were writing, exhibits inferior 'finger' writing movement in their handwriting. The person had minimal control over their hands while writing with an unfamiliar hand, which prevented them from writing normally. There were two possibilities that may occur:

- An unusual hand movement resulted in a lengthier vertical letter stroke.
- The letter-writer attempted to use the baseline as a guideline when composing letters.

However, it has been seen that connections in writing done by accustomed hands are fluent, whereas writing done by unfamiliar hands exhibits hesitations, abrupt directional changes, unsure movements, and tremorous strokes.

## 5. Conclusion

In an effort to conceal their authorship, a writer may switch to a hand with which they are not familiar in the belief that this will result in a dramatic change in the writing's look and will be difficult to identify. Such acts are commonly encountered in several cases of disguises including anonymous and pseudonymous letters. However, such a writer is unaware that by doing so, they have added a highly unique element to their writing, indicating that the writing hand has been altered to carry out the masquerade. As a matter of fact, handwriting is a neuromuscular processes and is being regulated by the brain. Scientifically it has been proven that handwriting is "Brain Writing" and one has to make serious efforts for years to changes one's style of acquired writing. The present study has efficiently showed that irrespective of changing the accustomed hand, the habitual characteristics can still be identified that will lead to the identification of penmanship. Certain features like slant, alignment, line quality may give an entirely different pictorial appearance to the handwriting, however, unique habitual characteristics like connecting strokes, spacing between letters and words, specific letter formation, positioning of signatures can still provide substantial clue to draw a possible conclusion on authorship of an individual.

**Future Scope:** The study will be beneficial for the future researchers who want to study the uniqueness indisguised writing of different languages and their *intense* examinations.

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