

Study on Cross-Linguistic Features Between Dravidian and English Scripts for Forensic Questioned Document Examination and Authorship Attribution

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Abstract

This paper presents the influence of Dravidian language and its acquired characteristics on the secondary language. In this paper the three Dravidian languages, namely, Tamil, Malayalam and Telugu were considered for studying the regional language features on English language (secondary language). The present study has been conducted by taking handwriting exemplar of 565 subjects and focus has been made on the Handwriting features of secondary language due to primary language. The main objective of the work is to observe what effect, if any, between two well-known scripts of the Handwriting of the same subject is carrying. The observations of this paper have shown that writer carrying the individual characters from the primary language while writing the secondary language. Handwriting and its uniqueness are a result of our subconscious mind and the same is observed in this study where the writer has picked up his or her frequently used individual characters from his or her primary language into the English script. This study will be useful in proving the authorship of questioned document where only one of the handwriting samples is available (i.e., either Regional or English) and the other handwriting's authorship needs to be identified.

Keywords

Dravidian language, Tamil Script, Questioned documents, Regional language effect, Telugu Script, Malayalam Script.

1. Introduction

As per eighth schedules of Indian constitution Malayalam, Telugu and Tamil are the recognized official language along with other nineteen languages. The languages Malayalam, Telugu, Tamil and Kannada are also known as the Dravidian language. As per the *Annemarie Verkerk* of the Max Planck Institute for the Science of Human History the study of Dravidian languages is treated as the crucial study for understanding prehistory in Eurasia, as they played a significant role in influencing other language groups (Sridhar 1981). Extending the same with a view of how Indian classical scripts can affect the writing skill of the person who learns English as their second or third language, the present study is conducted. The present study encompasses the breadth and depth of research on how the native language can affect the handwriting of an individual.

As the twenty-three Dravidian languages speak in the different part of South Asian countries, therefore, the Dravidian language can be considered as the fourth or fifth largest speaking language in the world. The majority of the Dravidian languages are mainly concentrated in southern and central part of the Indian subcontinent. Looking into the geological perspective the language spread from south to the Vindhya Mountains across the Deccan Plateau all the way to Kanyakumari. However, the Dravidian language family has four subgroups namely Kannada, Malayalam, Tamil, and Telugu. These four Dravidian languages serve as the basis for establishing the four different states of India such as Karnataka, Kerala, Tamil Nadu and Andhra Pradesh (Read 2010).

The major Dravidian scripts used today are mainly associated with the Kannada, Telugu and Malayalam and Tamil languages. All these are phonologically based, and are written from left to right. Historically, they derive from a South Indian branch of the Brahmi script, used in India from around 250 BCE. The Brahmi script is also the ancestor of scripts used in North India at the present time, such as Devanagari. The script of Tamil Nadu and Kerala show in them many features which are common among them. A cursive variety of Tamil script, called *Vatteluttu*, was used between the eighth and fifteenth centuries, and is said to be still used by the Muslim Mappillas of Malabar for writing Malayalam (Pal et al. 2006).

If we look back in the history of Dravidian language, excessive concern and devotion is shown towards the regional language because the natives of that language, thought that there is a threat to that language from various sorts like the influx of loan words from Sanskrit, and later from other foreign languages (Schiffman 2008).

Of the total population of India, 96.71% have one of the Scheduled languages as their mother tongue; the remaining 3.29% is accounted for by other languages. As per the latest census report of India, which was conducted in the year of 2011, strength of a Dravidian language speaker is presented in Table 1.

Table 1. Strength of Dravidian language (Agrawal and Khanduja 2015)

Sl.No.	Dravidian language	Strength
1	Tamil	6,90,26,881
2	Telugu	8,11,27,470
3	Malayalam	3, 48, 38,819
4	Kannada	4, 37, 06, 512

The motive of the present study is to investigate and confine the scope of the multi-dimension investigation and fix the owner of English handwriting in case we have a regional script of that writer or vice versa. In this study, different features have been taken into consideration in the analysis of handwriting samples from three different Dravidian languages namely Tamil, Telugu and Malayalam. In order to analyze the handwriting of the Dravidian language, the sample subject of Tamil, Telugu and Malayalam languages were taken as 165, 200 and 200 respectively. Based on the handwriting's observations one can easily understand the effect of native language on writing skill of the English language. In other words, this study will demonstrate how special characters influence the writer in the second language of his or her native language. This paper

consists of six different sections, in which the first section represents the introduction of the work which is followed by the background of the study in the second section. A Third section of the paper presents about the basic understanding of Dravidian language which is followed by the fourth section that discuss the methodology of the research work. Thereafter, the fifth section of the paper deals with the results and discussion and the last section of the paper give the conclusions of the present research work.

Background of the Study- Literature Review

The build of Human hand is incomparable which includes the constellation of bones, joints, veins and muscles. The physical bonding among these parts bring about as how the human hand works. Human hand till date is highly complicated and tender mechanism of working. A Human hand consists of 27 bones which work together with 40 muscles to give rise to any work assigned to it (Baksa et al. 2018). Handwriting is an acquired skilled referred to as a neuromuscular task. Experienced writing motions are so casual that the writer does not show any interest in its ramification. It can be said that handwriting is one of the best results that the human race has achieved from his hand (Harralson and Miller 2017).

Depending on one's geographic location, he or she was taught of various copybook styles of penmanship, such as the Palmer and Zaner–Bloser methods. During the initial stage of learning, attention was provided on the alphabetically correct writing skill, but when the individual matures his or her writing deviated from the copybook style. Afterwards, his or her writing mainly focuses on what is required to be written rather than how it should be written (Santangelo and Graham 2016).

In general pencil writing requires more finger action when compared to pen writing. This statement will be more justified in its meaning whenever any person writes with the free arm motion (Schwellnus 2012). Normally, to hold the pencil while writing more effort is required than the pen. As a result of this more pressure will be produced, on the paper, by the pencil handwriting over the pen. It was observed that whenever any writer writes with a pencil, then his or her handwriting will be rougher than the pen. This is mainly due to high adhesive force between paper and pencil (Tawney 1967).

There are many factors available for recognizing the handwriting of an individual. Out of which few factors having significant weightage on the writing skill over the others. Here, the writing conditions under which any person produced the writing are also an important aspect which may affect his or her handwriting. In this sense, a highly skilled writer can also produce inferior handwriting if the writing conditions are unfavorable (Hilton 1984).

Out of different writing feature the commencing stroke present in the starting point and the terminal strokes present at the ending point are the key features of the handwriting analysis. According to Questioned Document by Albert S Osborn the different types of curves produced by the writer are Circular, Angular, Oval and Elliptical (Sagar et al. 1996).

There is enough information that indicates that the letter formation by an individual depends on his or her shape sensing capability and the reaming features of the handwriting. If we take the example of the global precedence effect, then the writer needs to understand the shape formation first than the complexities of the alphabets which may later be infused in his or her handwriting

(Srihari et al. 2002). Once the person acquires the confidence on his or her handwriting thereafter the individual charters in writings are difficult to evade. There can be a confusion by an individual if he has only the knowledge of shape and not its orientation, for example b and d are both having loops on their main body but the meaning and identity of the letter bare totally different (James and Engelhardt 2012).

One of the studies conducted on the effect of inter-language in the Germanic language writing shows that the position of the alphabet A in a particular line is more influenced among writer of Germanic language (Grohmann 2005). Another Study has been conducted on similar arena shown that the bilingual writer follows a specific pattern when compared to the single language speaking writer (Haeberli 2012). In (Kaushanskaya, Yoo, and Marian 2011) it was observed that the vocabulary and the literacy rate of bilingual writer was more than the unilingual writer. A study performed by (Malmasi and Dras 2017) shown that the pronunciation of the particular language affects the interlanguage handwriting features.

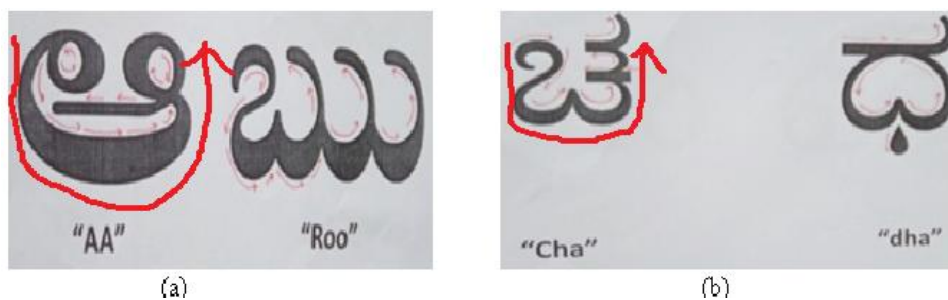
In India, according to the Central Advisory Board 1957 it was recommended that there should be three language formula in which English should be compulsory at the secondary stage along with Hindi as the second language and third language can be writers' regional language or mother tongue. This policy was implemented in all the states in India. With the advancement in technology and need to cope up with the society English language interfering in the Dravidian languages acquisition of second language became necessary with this reason the people now-a-days have become multilingual, which means at least one person knows two languages. Another reason is because Indian subcontinent is a diverse land with multiple languages and to bring together all segments there was need of one common language which helps them to communicate with their neighbors. Since, the Indian continent has been under the rule of English people for almost more than 250 years. Therefore, this has been an additional advantage for an adopting English writing skill in Dravidian language (Parshad et al. 2016).

Cross-linguistic transfer, native language interference and interlanguage errors, are some of the terms for referring to the concept that individual of particular languages incorporates during the letter formation when using a second language. Cross-linguistic influence refers to the concept that language learners will rely on experience from their native language to compensate for weaknesses in their target language. All native language analyses rely on the theories central to cross linguistic interference that is a person's native language is their strongest and so they will rely on that language's structure to compensate for weaknesses in their target language here being English. When the native language and target language have different language structures, the resulting language may contain cross-linguistic transfers (Milom 2019).

Basic Understanding of Tamil, Telugu and Malayalam Dravidian Writing

There is a Dravidian language that has some similarity with other Dravidian language while writing. For instance, the Telugu and Kannada have the similar pattern of pen movement during initial strokes running from upwards to downwards and it ends with the terminal stroke of the same letter from downwards to upwards which can be seen in Figure 1. In Figure 1, the red line is marked that represent the movement of pen direction, i.e., from top to bottom to top.

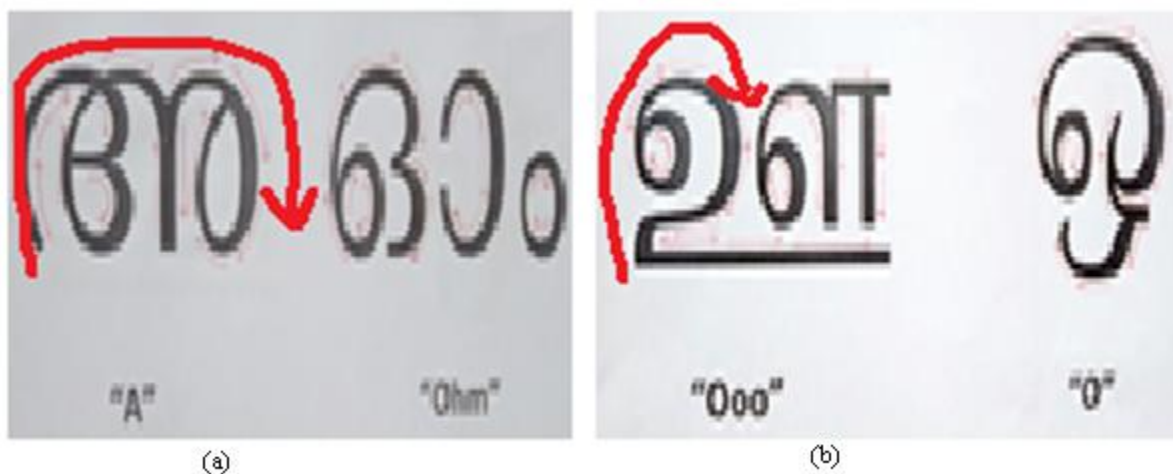
Figure 1. Movement of pen direction in (a) Telugu and (b) Kannada Dravidian language



However, during writing the script of Telugu and Kannada have almost same pen movement. But there are few differences can be observed while writing some characters. For example, when the alphabets are super scribed in Telugu with (~) like 'ఱ' whereas in Kannada script the alphabets seems to be strikes out on the top with " " like 'ಚ'.

At most of the time, the movement of pen direction in Malayalam and Tamil has the similarity in initial strokes running from downwards to upwards and ultimately the terminal stroke of same alphabet is formed from upward to downwards which is demonstrated in Figure 2.

Figure 2. Movement of pen direction in (a) Malayalam and (b) Tamil Dravidian language



As discussed in the above paragraph about Telugu and Kannada handwriting the movement of the pen in Malayalam and Tamil are also appeared to be partially same because of the many similarities between their words. This can be explained by the characters 'ന' and 'ள' of Malayalam and Tamil. Here, one can observe that the movement of pen in both characters are following the bottom to top pattern which ultimately end up downwards.

Further, there are different parameters that need to be considered before analyzing the scripture of any language. To study the features of handwriting the two vital parameters, namely, class and individual characteristics which play a significant role is required in the scripture analysis. The class characteristics depend on the pattern or appearance of language, whereas the individual characters depend on the writer of the language that he or she acquires during his or her learning

process. The handwriting of any two languages should be compared on the basis of some definite parameters which are given in Table 2.

Table 2. Handwriting characters for comparing the handwriting (Tomai, Kshirsagar, and Srihari 2003)

Sl. No.	Parameters	
	Class characteristics	Individual characters
1	Pictorial affect	Pen Pressure
2	Rhythm	Shading
3	Style	Pen Pause
4	Movement	Pen Lift
5	Pen Position	Starting and Ending Stroke
6	Line Quality	Hesitations
7	Skill	Re-touching
8	Tremors	Embellishment
9	Spacing	Abbreviations
10	Alignment	Placings
11	Punctuation	Slope

2. Materials and Methods

The study of inter-language effect on handwriting skill was performed on three different Dravidian language, namely, Tamil, Telugu and Malayalam. The handwriting exemplar had been collected from the subjects aged between 15-35 Years who are the native of Tamil Nadu, Andhra Pradesh and Kerala which represents the Tamil, Telugu and Malayalam Dravidian language respectively. However, these languages are the part of the peninsular region of the Indian subcontinent. Here, the three considered states are differing in the spoken language and the written script which helps in increasing the viability of the study. While collecting the writing sample it was kept in mind that the subject's first language or mother tongue should native language.

During the study materials used were Blank A4 size paper (for collecting the handwriting samples), Canon EOS 3000D (for the photography of the handwriting exemplar), Protector (for calculating the degree of slope and slant of the word and alphabet), Measuring scale to calculate the spacing between words and line.

All the subjects were asked to sit in a comfortable position and provided two blank A4 size white sheets to give handwriting samples, writing was taken separately one page reflect their regional script whereas the other page shows English handwriting. Both the handwriting (one English and One regional script) is taken from the same subject. The matter was dictated at medium speed so that people don't get a chance to modify writing and their natural handwriting is produced. The dictated article was written with ball point pen in a comfortable position, sitting on table and chair.

The total samples collected were 565 from three different Dravidian speaking writers. Out of which 165, 200 and 200 samples belong to the Tamil, Telugu and Malayalam scripts respectively. All 565 samples were examined based on the major principles of handwriting

examination and observations were made accordingly. While collecting, writing samples of Regional and English language for all three Dravidian languages, it was made sure that the writer should provide the handwriting exemplar in his or her comfortable posture. During the analysis of the handwriting exemplar of all collected samples, the class character and individual characteristics were taken into consideration (based on Table 2). Out of which the minimum of 10 characters were chosen for inter script comparison as these characters were easily identifiable. Therefore, in the results and discussion section, the 10 characters from each script have been used to demonstrate the handwriting influence of Dravidian writing on the English handwriting.

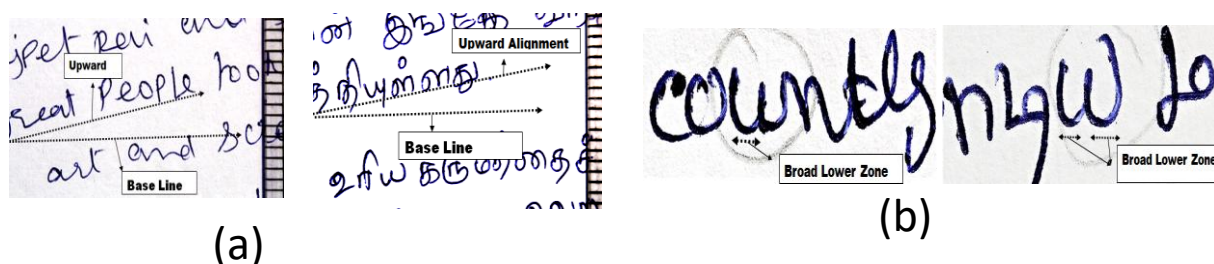
3. Results and Discussion

Since, the visual result presentation in the manuscript for 565 handwriting exemplars is difficult to show thus only 10 comparable characters were considered in this discussion. Therefore, the 10 figures of handwriting exemplar from each considered Dravidian language are shown in this section from Figure 3 to Figure 17. Here Figure 3 to Figure 7 shows the handwriting exemplar of Tamil handwriting exemplar whereas the Figure 8 to Figure 12 presents the Malayalam handwriting exemplar. Similarly, the Figure 13 to Figure 17 represents the Telugu handwriting exemplar. Also, in each figures the samples of two different subjects are shown in the form of Figure (a) and Figure (b).

4. Observation of Tamil Language

The handwriting exemplars of Tamil Dravidian language are shown in Figure 3 to Figure 7. In which, the Figure 3 shows the slant and lower zone analysis of two Tamil subjects where in the Figure 3 (a) represents the English and Tamil handwriting wherein the first portion is English and the second portion is Tamil script. Here in Figure 3 (a) the both handwriting shows the similar character, i.e., the upward alignment with respect to the baseline. Whereas the Figure 3 (b) shows the lower zone of both handwriting which is found to be a broad in a shape.

Figure 3. Slant and lower zone analysis of two Tamil subjects



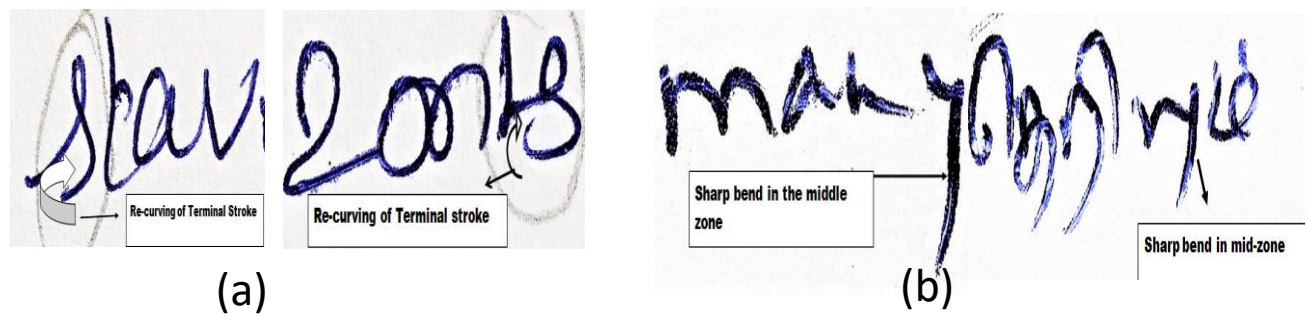
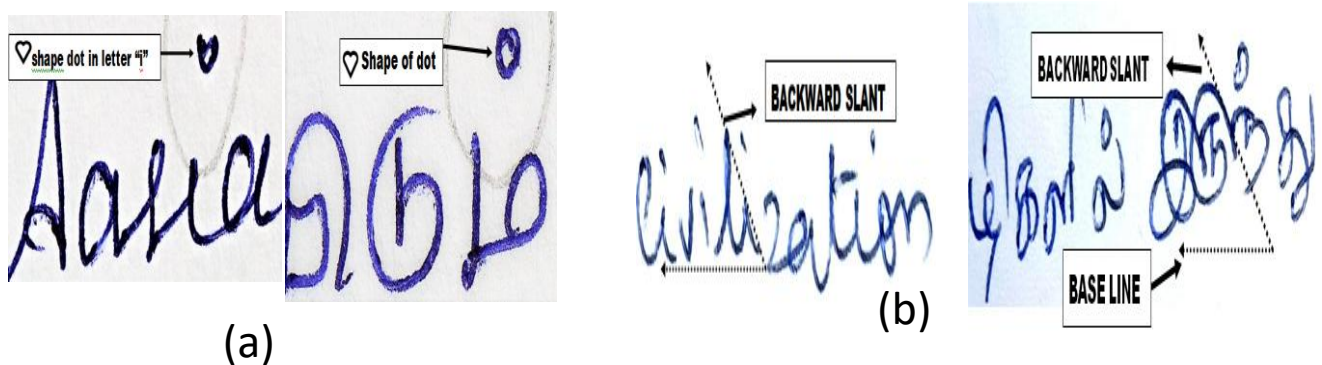


Figure 4. Terminal stroke and mid zone analysis of two Tamil subjects

In Figure 4 shows the terminal stroke and mid zone analysis of two Tamil subjects in which it can be observed that the terminal stroke in the Figure 4 (a) is recurving inside the main body. Next, in Figure 4 (b) the mid zone is observed with a sharp bend.

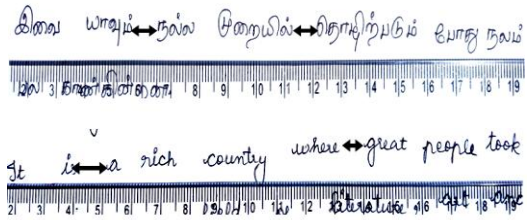
Figure 5. i dot formation and slant analysis of two Tamil subjects



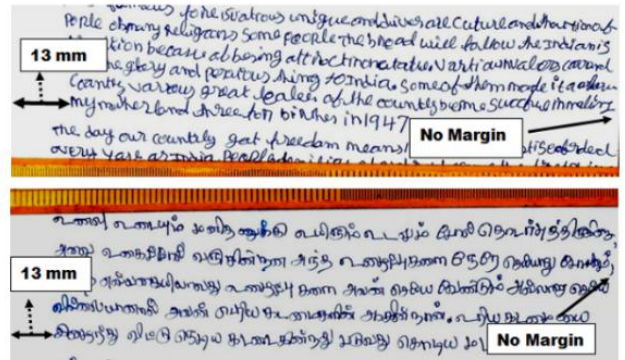
As shown in Figure 5 (a) i-dot shape character can be observed to have a unique shape in both the script. This indicates that a writer is carrying his or her unique character from his or her primary language to the secondary language. This is happening due to his or her acquired unique character during the learning process. In the same sense, writer carrying the backward slant in both the language as shown in Figure 5 (b).

Since, a person develops a unique character during his or her learning process in primary languages, the same individual characters are also reflected in his or secondary language. For example, while providing a spacing between the words in a primary language the same pattern is carried by an author in the secondary language too which is depicted in Figure 6 (a). As depicted in Figure 6 (b) it is clearly visible that the writer has a wider left margin in both the script and there is no margin left on the right side of the page.

Figure 6. Spacing and page margin analysis of two Tamil subjects

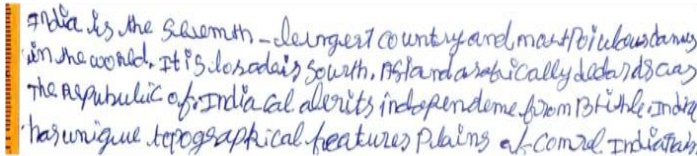
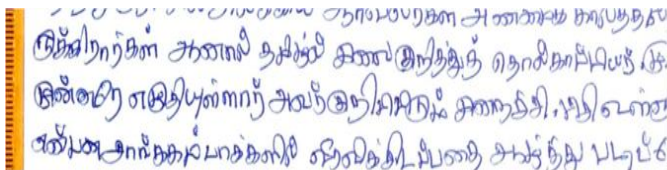


(a)

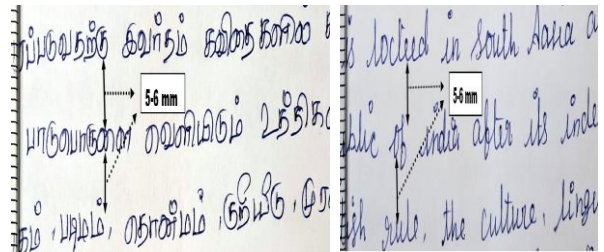


(b)

Figure 7. Pictorial appearance and interline spacing analysis of two Tamil subjects



(a)



(b)

As visible in Figure 7 (a) the pictorial appearance of the handwriting is clumsy and unorganized which shows a poor writing skill of the individual. Further, the Figure 7 (b) shows the character of even inter line spacing between the two scripts is found out to be same. The overall representation of the salient features which are taken into the consideration for the analysis of Tamil and English script is presented in Table 3.

Table 3. Salient features taken into consideration for Tamil subjects

Figure Number	Features in Tamil Subjects	
	A	b
1	Alignment	Lower Zone
2	Terminal Stroke	Mid Zone
3	i – dot formation	Slant
4	Word Spacing	Margins
5	Pictorial Affect	Interline Spacing

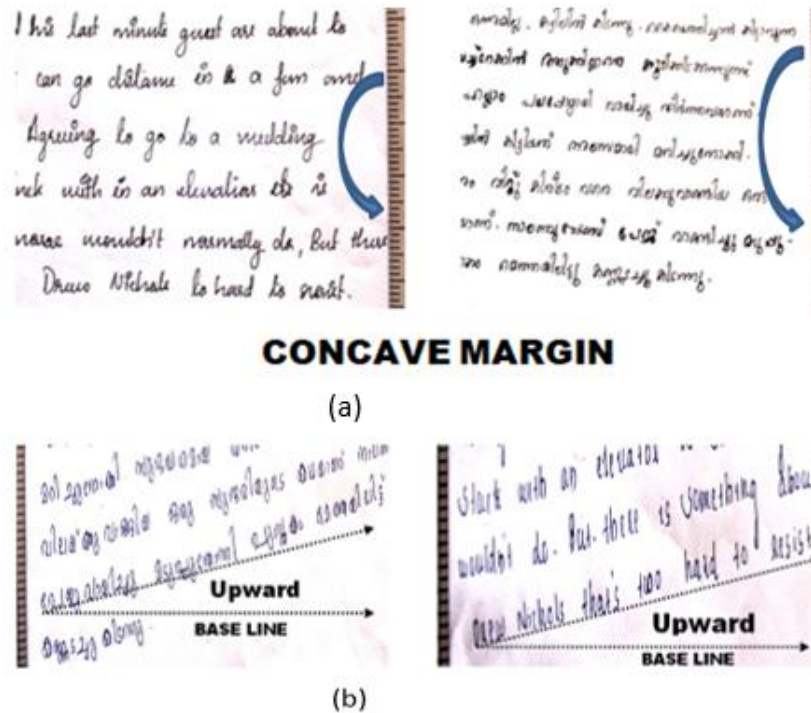
5. Observation of Malayalam Language

In this section the images displayed are the result of observation done on the Malayali script influence on English script. As shown in Figure 8 (a) the first half portion is in Malayalam script, whereas the other half is in English script of the same individual. During similarity examination, it was found that the writer has common character of conical letter formation while making the ‘M’ shape character in both the handwriting. It was also observed in Figure 8 (b) that the writer has the habit of making the loop elliptical in shape of all the lower zone loops-based words in the primary language and the same is carried in the secondary language.

Figure 8. Shark tooth formation and inter lower zone analysis of two Malayali subjects



Figure 9. Concave Margin and Upward alignment analysis of two Malayali subjects



Here in Figure 9 (a) we observed that the individual shows unique feature of leaving a concave margin on the right hand of the page for both the script, while the handwriting of individual in Figure 9 (b) has upward slant with respect to baseline. Subsequently, on the basis of same size and shape of both scriptures it can be observed that the pictorial appearance of the individual handwriting is same in both languages which is depicted in Figure 10 (a). The Figure 10 (b) shows that the person maintains the same spacing between words when the two scripts is examined.

Figure 10. Pictorial appearance and inter word spacing of two Malayali subjects

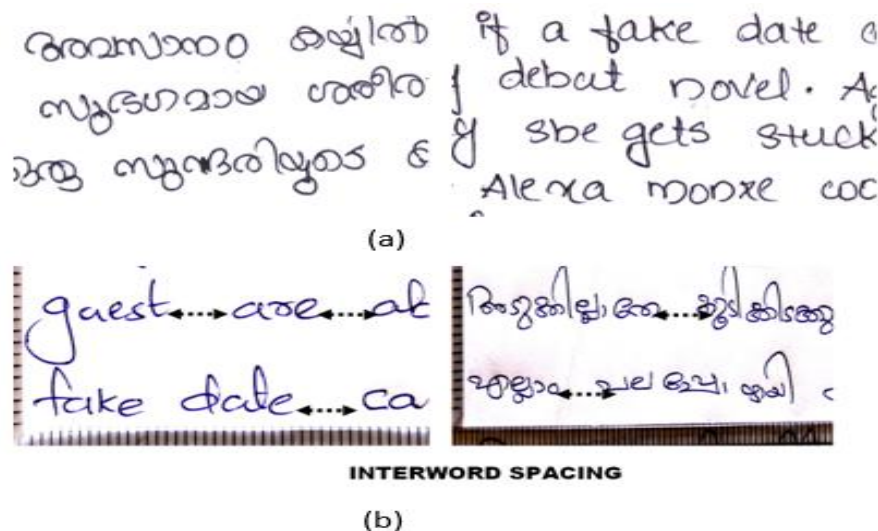
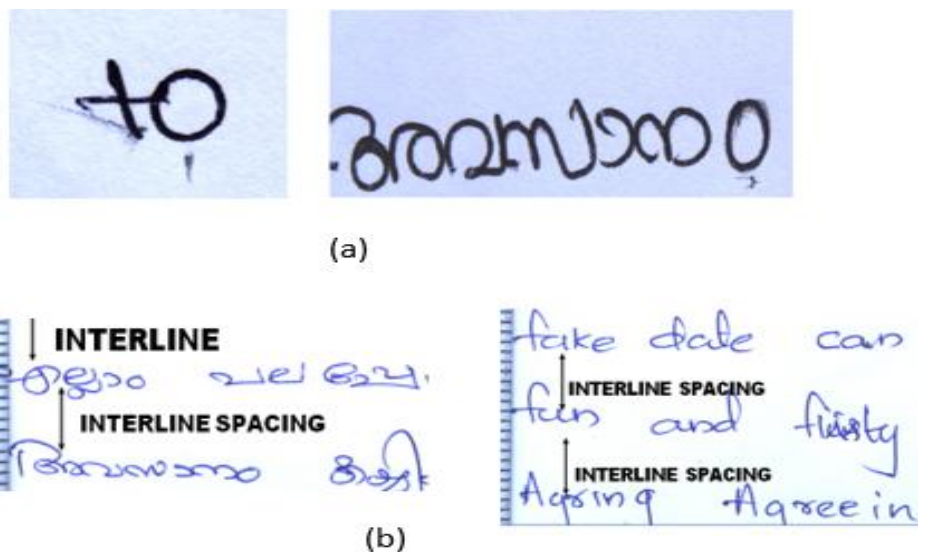
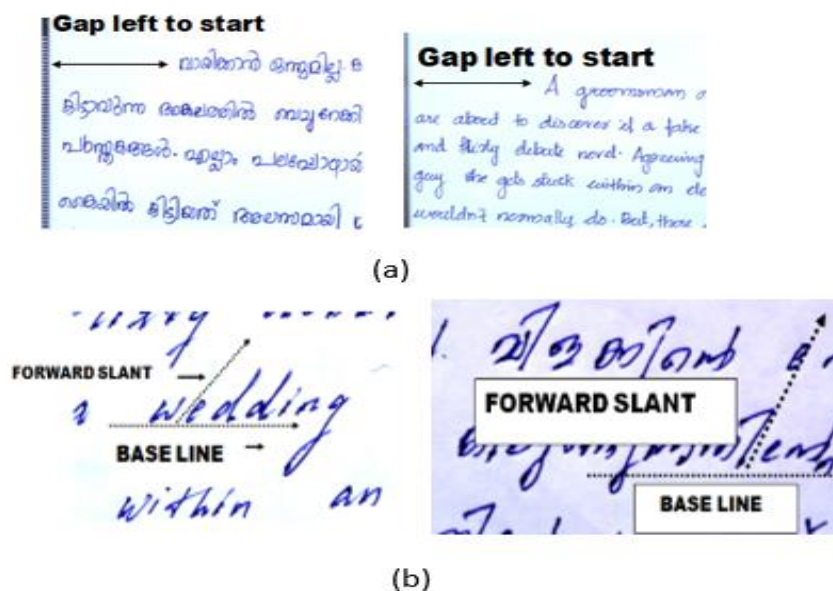


Figure 11. Punctuation mark and inter line analysis of two Malayali subjects



The writer shows the placement of punctuation mark in the form of dot at the base of the letter which is in 'O' shape as seen in Figure 11 (a). The writer shows the character of even interline spacing between two scripts that is about 6 mm. In Figure 12 (a) it is clearly visible that the writer has made a wide margin on the left side of the paper while writing the first line of paragraph this character is similar in both handwriting. Whereas in Figure 12 (b) There is a forward slant observed in the handwriting of the individual irrespective of what language he or she is writing.

Figure 12. Paragraph margin and slant analysis of two Malayali subjects



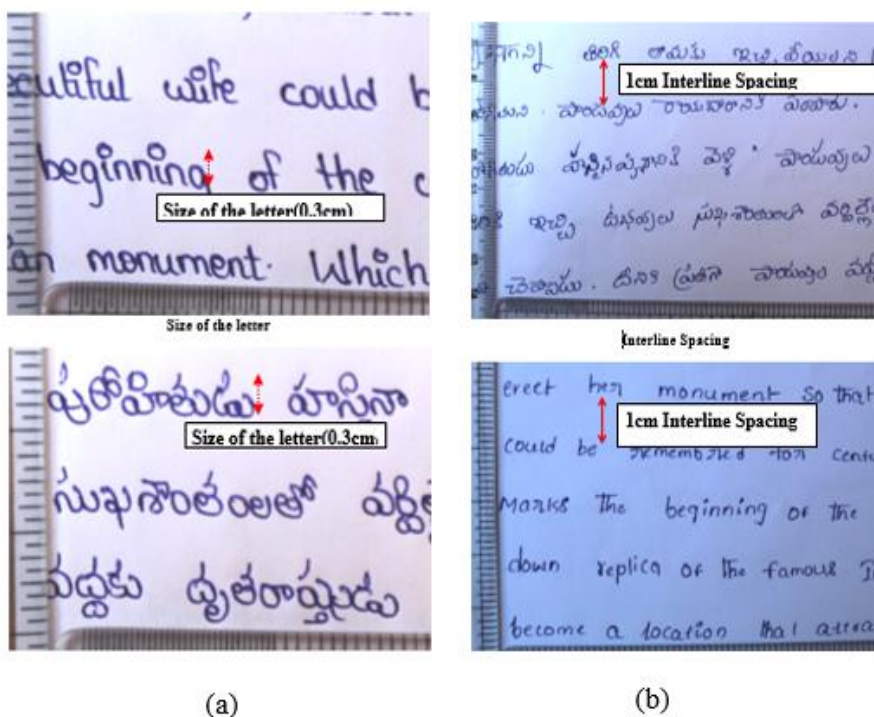
The features used while making the observation of Malayalam and English script comparison from Figure 8 to Figure 12, which is as similar of Table 3 of section 5.1, is tabulated in Table 4.

Table 4. Salient features taken into consideration for Malayalam subjects

Figure Number	Features in Malayalam Subjects	
	A	b
1	Shark tooth	Lower zone
2	Page Margin	Slant
3	Pictorial appearance	Inter-word spacing
4	Punctuation	Interline
5	Paragraph Margin	Slant

5.3 Observation of Telugu Language

Figure 13. Size of letter and interline spacing of two Telugu subjects



As like the Tamil and Malayalam, similar parameters were also used in the analysis of Telugu handwriting which played a key role in the identification of the Handwriting of Telugu writers and result obtain is displayed in this section. As we can observe in Figure 13 (a) the writer has developed the skill of writing even size letters in both Telugu and English script, whereas in the Figure 13 (b) the writer has kept even spacing between lines (i.e., interline spacing) which was recorded to be 1 cm. In Figure 14 (a), the even spacing between the words can be observed by the writer in both script and the spacing between the words is observed approximately at 0.5 cm.

The Figure 14 (b) shows the placement of punctuation mark in the form of full stop, for this particular individual, which is exactly in the center of the word, but the placement of a full stop is generally at the bottom of the last word.

Figure 14. Inter-word spacing and punctuation mark of two Telugu subjects

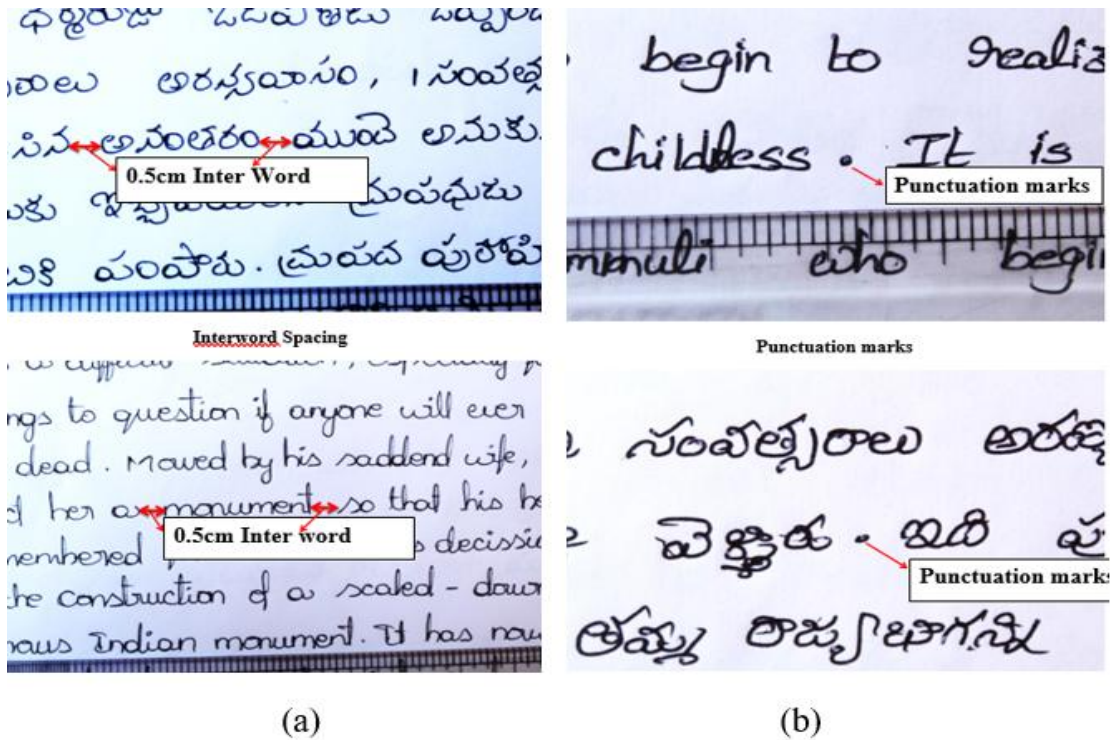
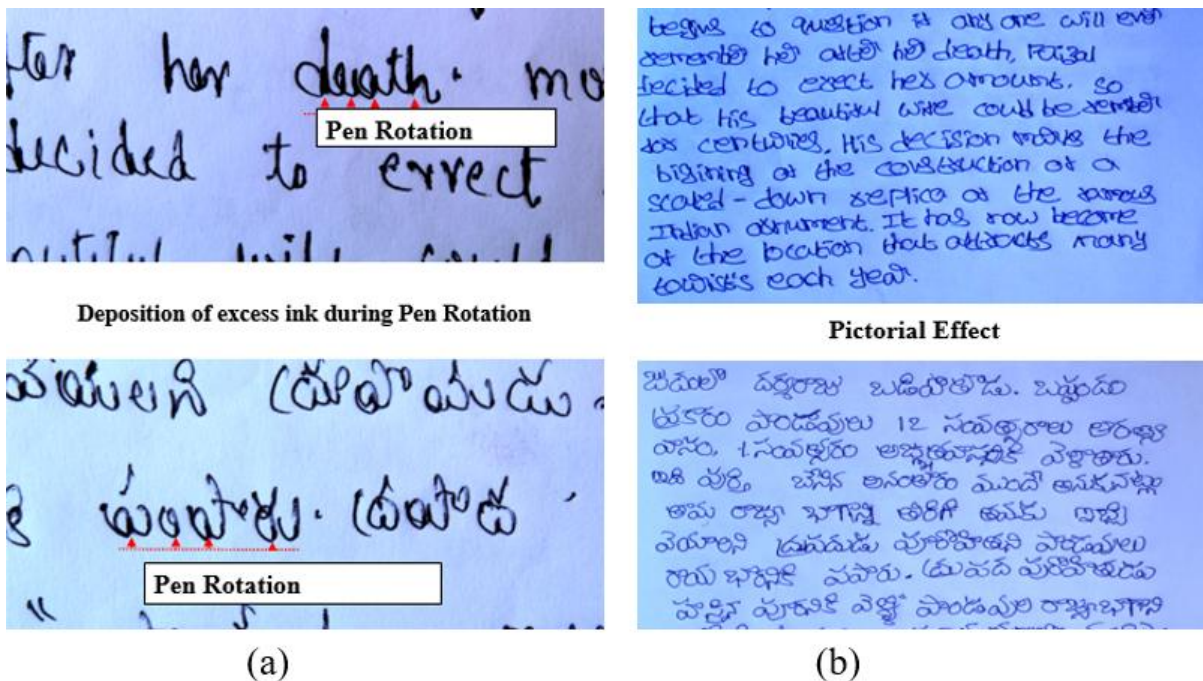


Figure 15. Ink deposition and pictorial effect of two Telugu subjects



In Figure 15 (a) there is a unique style of handwriting can be observed by the writer. Out of 100 Telugu handwriting this individual handwriting subject shows the special style of handwriting where the writer has the tendency to show ink deposition at the base of lower zone of words. This unique style may be developed because the writer has the habit of pen rotation while writing within its axis which results in ink deposition at the base. In Figure 15 (b) the writer shows poor skill of handwriting as a result the pictorial appearance is rough and disorganized. As shown in Figure 16 (a) it is observed that the slant of words is on the left side which mean when the alphabets are written they are tilted towards left side when studied with respect to its baseline. The observation of Figure 16 (b) shows that the lower zone of the alphabets (which form loops) is showing broad base or flat base of loops.

Figure 16. Slant and broad base of lower zone in two different Telugu subjects

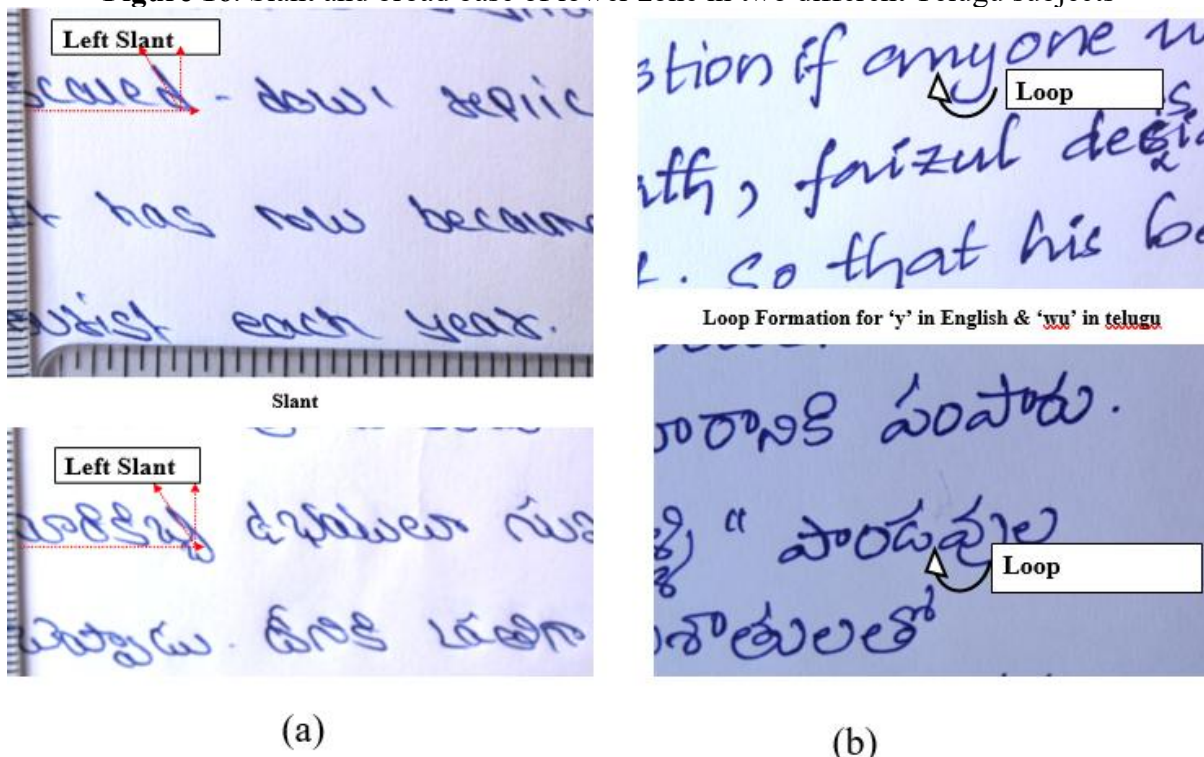
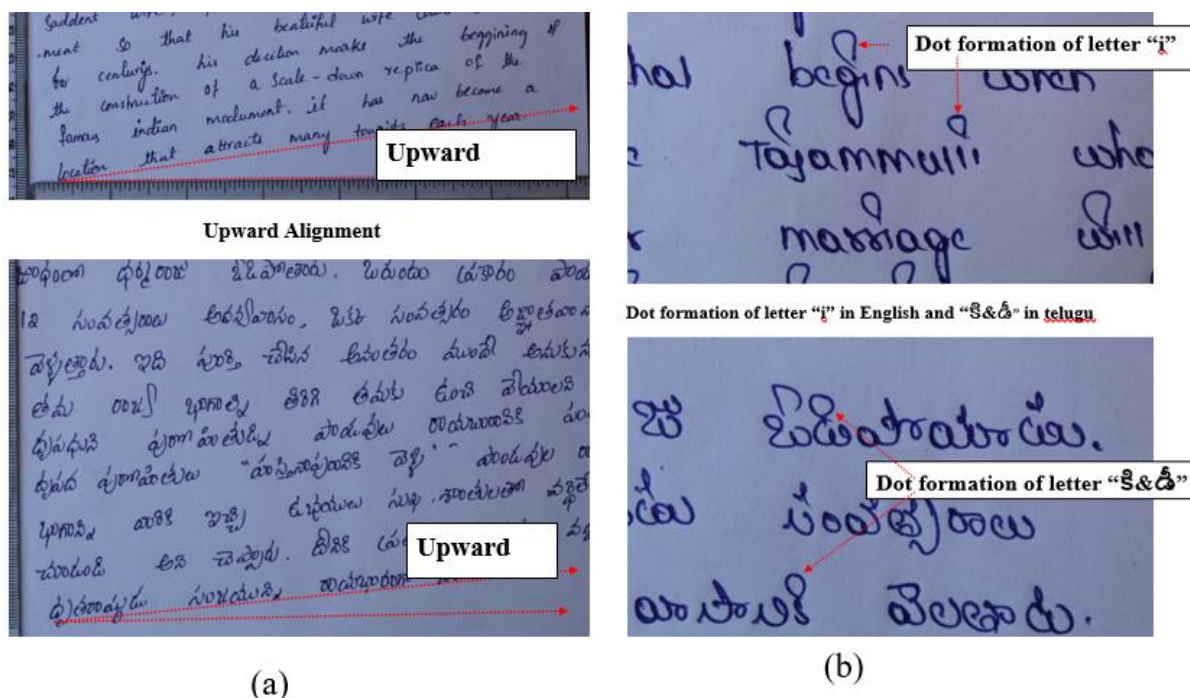


Figure 17. Upward slant and i – dot formation of two Telugu subjects



In the Figure 17 (a) it is observed that the handwriting of the person is moving upwards while he continues to write. The angle is calculated by marking the base line and the direction in which the words are written. By seeing the Figure 17 (a) one can say that the person has upward slant in both scripts. The i – dot formation is analyzed in Figure 17 (b) and it was observed that the shape is unique to the individual handwriting. The shape of dot formation in *i* alphabet of English script is found to be an oval in shape and similar kind of oval formation was observed for the similar words in Telugu script too. Further, the features used during the handwriting comparison of Telugu and English script, which are shown in Figure 13 to Figure 17, are depicted in Table 5.

Table 5. Salient features taken into consideration for Telugu subjects

Figure Number	Features in Telugu Subjects	
	A	b
1	Size of word	Interline spacing
2	Spacing between words	Punctuation
3	Pen rotation	Pictorial affect
4	Slant	Lower Zone
5	Slant	i – dot formation

6. Conclusions

Although the handwriting style of the writer is a unique for that particular person, but he or she also reflect many individual characters in the secondary language writing that he or she has acquired during the learning process, of his or her primary language handwriting. In this paper

the analysis was made on the three Dravidian languages such as Tamil, Telugu, Malayalam and their influence on the English script. During the analysis, there are many characters found which have the similar appearance in English handwriting from the considered Dravidian language. This paper clearly demonstrates in its observation that the individual characteristics which the person has acquired during his or her learning skill of primary language those unique characters appears in the secondary language (i.e., English language). This may be due to his or her subconscious mind that accepts the stimuli given to a make similar kind of character from his primary language to the secondary language. The outcome of this study will help in identifying the authorship of questioned document on the basis of one handwriting sample which is available in the form of either Regional or English and the other source of handwriting needs to be recognized.

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