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Study on Class Characteristics of Handwriting Based on Emotions

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Abstract

The similarities between a group of people or individuals taught the same or similar writing patterns or systems are known as class characteristics. Class characteristics help to narrow down the search when a questioned writing is compared with several different writers. The aim of this study is to analyze the class characteristics of handwriting based on emotions. The study was conducted on 50 students who aged between 18 to 23 years old. The subjects were induced into three different states of emotions by showing videos of a particular emotion and this was verified using a psychological scale (EVEA scale). Three exemplars under each emotion were collected and were analyzed using hand magnifier, magnoscope and stereoscopic-microscope. Chi-square test values were calculated, and it was observed that emotions have fewer roles on handwriting characteristics.

Keywords : Questioned Documents; Handwriting Analysis; Class Characteristics; Graphology; Emotions

Introduction

Handwriting is an acquired skill and a neuro-muscular process, and it is unique to each individual. Handwriting process involves 27 bones and 40 muscles to work coordinately [1]. It includes two classes they are: Calligraphy (beautiful writing) and tachygraphy (method of rapid writing). Unconscious visible expression is nothing but natural writing. There are different movements in writing they are finger movement, hand movement, forearm movement, whole-arm movement and their combinations. These movements in writing influence the characteristics of handwriting of an individual. Few characteristics of handwriting are Line quality, Alignment, Size, Spacing, Connecting strokes, Pen lifts, Pen pressure and Slant [2]. Class characteristics may identify a species, but not an individual [3]. The cases of questioned documents may include signatures on wills, handwritten anonymous letters, figures and writing on cheques, agreements and contracts. Each questioned handwriting case is unique and is reviewed in an effort to reach a satisfactory conclusion [4].

If possible, it is preferable to examine the original document rather than the copy of a document, because the details which includes writing pressure and indentations on an original are lost on a copy, erasures may not be clear on copies. The colours of the ink is not visible and the condition of original documents cannot be determined from assessing photocopies. If originals are not available, good quality copies are acceptable [5]. Graphology is founded upon the careful and minute examination of a 'writing system,' of which there are many throughout the world. These are a defined set of graphic signs used to represent units of language through structured, specific and conventionally accepted rules. They record messages and ideas, words or sounds, used for human communication with everyone familiar with the encoding procedure (Webb, Handwriting Analysis | Graphology | Disputed Documents).

Methodology

The study was conducted in Bangalore City belonging to Karnataka of South Indian region. The method used to collect data was convenient sampling technique. Handwriting samples were collected from50 individuals of age group 18-23 years. The consent of the individuals were taken. The individuals were made to seat comfortably and brief instructions were given. Different video clips based on three different emotions (Happy, sad and aggressive) were shown on three different days. Immediately after watching the video clip the subjects were given with EVEA psychological scale to check the state of emotion at that moment. Immediately the subjects were provided with three sample sheets. A control passage was dictated to the subject so that the subject writes in his or her own handwriting as well as in order to maintain the standard protocol that is followed while collecting exemplars. The handwriting sample of the subject was collected on the second and third sheet in the same manner. Subject whose EVEA score was significant for a particular emotion was only selected. The samples were analyzed manually using different tools such as a hand magnifier, magnoscope, stereo microscope and scales to

check the degree of similarities and dissimilarities in handwriting characteristics between different emotions (happy– sad, happy – aggressive and sad–aggressive).

Result

Chi Square test

$$\Sigma_{44}=\frac{50\times124}{150}=41.3\ \Sigma_{2}=\frac{50\times10}{150}=3.3\ \Sigma_{4}=\frac{50\times16}{150}=5.3$$

$$\Sigma_{38}=\frac{50\times124}{150}=41.3\ \Sigma_{5}=\frac{50\times10}{150}=3.3\ \Sigma_{7}=\frac{50\times10}{150}=5.3$$

$$\Sigma_{42}=\frac{50\times124}{150}=41.3\ \Sigma_{3}=\frac{50\times10}{150}=3.3\ \Sigma_{5}=\frac{50\times10}{150}=3.3$$

DF (5%) = 9.488

Table 1: Representing the chi square value for Line quality.

Emotion	Smooth	Shaky	Juvenile	Row total
Happy	44	2	4	50
Sad	38	5	7	50
Aggressive	42	3	5	50
Column total	124	10	16	150

O	E	O-E	$(O-E)^2/E$
44	41.3	2.7	0.17
2	3.3	-1.3	0.51
4	5.3	-1.3	0.31
38	41.3	-3.3	0.26
5	3.3	1.7	0.87
7	5.3	1.7	0.54
42	41.3	0.7	0.01
3	3.3	-0.3	0.02
5	5.3	-0.3	0.01
			X2 = 2.7

The chi square for the line quality is 2.7 (Table 1). and the DF (Degree of freedom) value is 9.4888. The DF value is more than the X^2 value which means there are no changes in the line quality character of hand writing.

$$\Sigma_{24}=\frac{50\times72}{150}=24\ \Sigma_{9}=\frac{50\times27}{150}=9\ \Sigma_{9}=\frac{50\times14}{150}=4.6$$

$$\Sigma_{23}=\frac{50\times72}{150}=24\ \Sigma_{11}=\frac{50\times27}{150}=9\ \Sigma_{5}=\frac{50\times14}{150}=4.6$$

$$\Sigma_{25}=\frac{50\times72}{150}=24\ \Sigma_{7}=\frac{50\times27}{150}=9\ \Sigma_{0}=\frac{50\times14}{150}=4.6$$

$$\Sigma_{8}=\frac{50\times36}{150}=12\ \Sigma_{0}=\frac{50\times1}{150}=0.33\ \Sigma_{0}=\frac{50\times0}{150}=0$$

$$\Sigma_{8}=\frac{50\times36}{150}=12\ \Sigma_{1}=\frac{50\times1}{150}=0.33\ \Sigma_{0}=\frac{50\times0}{150}=0$$

$$\Sigma_{8}=\frac{50\times36}{150}=12\ \Sigma_{0}=\frac{50\times1}{150}=0.33\ \Sigma_{0}=\frac{50\times0}{150}=0$$

DF (5%) = 18.31

The chi square for the line quality is 16.44 (Table 2). and the DF (Degree of freedom) value is 18.31. The DF value is more than the X^2 value which means there are no changes in the Alignment character of hand writing (Table 3).

$$\Sigma_{28}=\frac{50\times84}{150}=28\ \Sigma_{12}=\frac{50\times37}{150}=12.3\ \Sigma_{10}=\frac{50\times29}{150}=9.6$$

$$\Sigma_{28}=\frac{50\times84}{150}=28\ \Sigma_{14}=\frac{50\times37}{150}=12.3\ \Sigma_{8}=\frac{50\times29}{150}=9.6$$

$$\Sigma_{28}=\frac{50\times84}{150}=28\ \Sigma_{11}=\frac{50\times37}{150}=12.3\ \Sigma_{11}=\frac{50\times29}{150}=9.6$$

$$\Sigma_{5}=\frac{50\times17}{150}=5.6\ \Sigma_{10}=\frac{50\times27}{150}=8\ \Sigma_{35}=\frac{50\times109}{150}=36.3$$

$$\Sigma_{6}=\frac{50\times17}{150}=5.6\ \Sigma_{8}=\frac{50\times27}{150}=8\ \Sigma_{36}=\frac{50\times109}{150}=36.3$$

$$\Sigma_{6}=\frac{50\times17}{150}=5.6\ \Sigma_{6}=\frac{50\times27}{150}=8\ \Sigma_{38}=\frac{50\times109}{150}=36.3$$

DF (5%) = 9.49

Table 2: Representing the chi square value for Line quality.

Emotion	Uphill	Downhill	Horizontal	Irregular	Garland	Arch	Row total
Happy	24	9	9	8	0	0	50
Sad	23	11	5	10	1	0	50
Aggressive	25	7	0	18	0	0	50
Column total	72	27	14	36	1	0	150

O	E	O-E	$(O-E)^2/E$
24	24	0	0
9	9	0	0
9	4.6	4.4	4.2
8	12	-4	1.3
0	0.33	-0.33	0.33
0	0	0	0
23	24	-1	0.05
11	9	2	0.44
5	4.6	0.4	0.03
10	12	-2	0.33
1	0.33	0.67	1.36
0	0	0	0
25	24	1	0.04
7	9	-2	0.44
0	4.6	-4.6	4.6
18	12	6	3
0	0.33	-0.33	0.33
0	0	0	0
			X^2 = 16.44

The chi square for the line quality is 1.212 (Table 4). and the DF (Degree of freedom) value is 9.49 The DF value is more than the X^2 value which means there are no changes in the size character of hand writing.

$$\Sigma_{17}=\frac{50\times32}{150}=10.6\ \Sigma_{33}=\frac{50\times118}{150}=39.3$$

$$\Sigma_{10}=\frac{50\times32}{150}=10.6\ \Sigma_{40}=\frac{50\times118}{150}=39.3$$

$$\Sigma_{5}=\frac{50\times32}{150}=10.6\ \Sigma_{45}=\frac{50\times118}{150}=39.3$$

DF (5%) = 5.99

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Table 3: Representing the Chi square value for pen pressure.

Emotions	Moderate	High	Light	Row total
Happy	28	12	10	50
Sad	28	14	8	50
Aggressive	28	11	11	50
Column total	84	37	29	150

O	E	O-E	$(O-E)^2/E$
28	28	0	0
12	12.3	-0.3	0.007
10	9.6	0.4	0.01
28	28	0	0
14	12.3	1.7	0.23
8	9.6	-1.6	0.26
28	28	0	0
11	12.3	-1.3	0.13
11	9.6	1.4	0.20
$X^2 = 0.9$			

Table 4: representing the Chi square value for size.

Emotions	Moderate	High	Light	Row total
Happy	5	10	35	50
Sad	6	8	36	50
Aggressive	6	6	38	50
Column total	17	24	109	150

O	E	O-E	E
5	5.6	-0.6	0.06
10	8	2	0.5
35	36.3	-1.3	0.04
6	5.6	0.4	0.02
8	8	0	0
36	36.3	-0.3	0.002
6	5.6	0.4	0.02
6	8	-2	0.5
38	36.3	1.7	0.07
$X^2 = 1.212$			

The chi square for the line quality is 8.61 (Table 5). and the DF (Degree of freedom) value is 5.99 The DF value is less than the X^2 value which means there are changes in the spacing character of hand writing.

$$\Sigma_{17}=\frac{50\times45}{150}=15\ \Sigma_{13}=\frac{50\times31}{150}=10.3\ \Sigma_{6}=\frac{50\times18}{150}=6$$

$$\Sigma_{17}=\frac{50\times45}{150}=15\ \Sigma_{11}=\frac{50\times31}{150}=10.33\ \Sigma_{6}=\frac{50\times18}{150}=6$$

$$\Sigma_{11}=\frac{50\times45}{150}=15\ \Sigma_{7}=\frac{50\times31}{150}=10.33\ \Sigma_{6}=\frac{50\times18}{150}=6$$

$$\Sigma_{14}=\frac{50\times56}{150}=18.6$$

$$\Sigma_{16}=\frac{50\times56}{150}=18.6$$

$$\Sigma_{26}=\frac{50\times56}{150}=18.6$$

DF (5%) =12.59

Table 5: Representing the Chi square value for spacing.

Emotion	Even	Uneven	Row total
Happy	17	33	50
Sad	10	40	50
Aggressive	5	45	50
Column total	32	118	150

O	E	O-E	E
17	10.6	6.4	3.8
33	39.3	6.3	1
10	10.6	-0.6	0.03
40	39.3	0.7	0.01
5	10.6	-5.6	2.95
45	39.3	5.7	0.82
$X^2 = 8.61$			

Table 6: Representing the Chi square value for slant.

Emotion	Left	Right	Vertical	Varied	Row total
Happy	17	13	6	14	50
Sad	17	11	6	16	50
Aggressive	11	7	6	26	50
Column total	45	31	18	56	150

O	E	O-E	E
17	15	2	0.26
13	10.33	2.67	0.69
6	6	0	0
14	18.6	-4.6	1.13
17	15	2	0.26
11	10.33	0.67	0.04
6	6	0	0
16	18.6	-2.6	0.36
11	15	-4	1.06
7	10.33	-3.33	1.07
6	6	0	0
26	18.6	7.4	2.94
$X^2 = 7.81$			

The chi square for the line quality is 7.81 (Table 6). and the DF (Degree of freedom) value is 12.59 The DF value is more than the X^2 value which means there are no changes in the slant character of hand writing.

$$\Sigma_{1}=\frac{50\times3}{150}=1\ \Sigma_{49}=\frac{50\times147}{150}=49$$

$$\Sigma_{1}=\frac{50\times3}{150}=1\ \Sigma_{49}=\frac{50\times147}{150}=49$$

$$\Sigma_{1}=\frac{50\times3}{150}=1\ \Sigma_{49}=\frac{50\times147}{150}=49$$

DF (5%) = 5.99

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Table 7: Representing the chi square value for pen lifts.

Emotions	Continuous	Discontinuous	Row total
Happy	1	49	50
Sad	1	49	50
Aggressive	1	49	50
Column total	3	147	150

O	E	O-E	E
1	1	0	0
49	49	0	0
1	1	0	0
49	49	0	0
1	1	0	0
49	49	0	0
X2 = 0			

The chi square for the line quality is 0 (Table 7). and the DF (Degree of freedom) value is 5.99 The DF value is more than the X^2 value which means there are no changes in the pen lifts character of hand writing. There was no significant change in the class characters line quality, alignment, pen pressure, size, slant and pen lifts. But there were significant changes in the spacing character of the handwriting based on the happy, sad and aggressive emotions.

Discussion

The similarities and dissimilarities in handwriting samples between happy, sad and aggressive emotions were compared. And based on the results obtained, chi square test values were found. The chi square test value for the character line quality was found to be 2.7, alignment is found to be 16.44, pen pressure is obtained as 0.9, size is found to be 1.212, spacing is obtained as 8.61, slant value is of 7.81 and pen lifts value is found to be as 0. The chi square values obtained for the characters line quality, alignment, pen pressure, size, slant and pen lifts did not exceed the table value. This shows that there were no significant changes in the above characters, but in the spacing character the chi square value exceeds the table value which shows that there are significant changes in the characters of spacing character. As the calculated chi square value of spacing character exceeds the table value we reject the null hypothesis and accept the alternative hypothesis.

Conclusion

There were insignificant changes observed in the alignment, line quality, pen pressure, size, slant and pen lifts characters of the handwriting and significant changes were seen in the spacing character of handwriting based on happy, sad and aggressive emotions.

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