



RESEARCH ARTICLE

EXAMINATION OF HANDWRITING FOR GENDER IDENTIFYING FEATURES

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ABSTRACT

Handwriting is a unique identity of every individual which can neither be copied nor be recreated. This uniqueness of handwriting in every individual is the product of variation which one makes either consciously or unconsciously but this uniqueness is the foremost requirement for handwriting analysis. An attempt was made to examine and analyse the various minute features possessed in handwriting and to classify them into macro and micro features. These features were further used to discriminate and divide handwritings on the basis of its capability of determining or predicting the gender of the writer. Over 130 samples of handwriting were examined and a promising result were observed proving the handwriting features to be gender identifying, further hypothesis testing of the same showed positive results up to some extent leading to rejection of null hypothesis that “there is no significant difference in handwriting of male and female”. The results observed in the examination may be said to be the great breakthrough in the field of graphology as well as forensic science if it became possible to predict the gender of the writing by examination of his/her handwriting and thus by knowing the gender, the suspect list for a particular case can be shortened, which will facilitate the examination / investigation.

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INTRODUCTION

Handwriting is one of the important evidence which is examined in the questioned document for its authentication. Handwriting is the written speech of individual with characteristic peculiar to himself intending to differentiate from all others. It is an acquired skill and a complex perceptual- motor task, sometimes referred to as a neuromuscular task (Huber, 1999). The factors such as visual observation, conception of outline, central nervous system pathways and the anatomy and physiology of the bones and muscles of the hand and arm all combine to produce the desired output i.e. handwriting (Hilton, 1982) (Huber, 1999). Writing acts as the function of the conscious and subconscious mind and of the motor, muscular and nerve movements of the body (Desai Bhavana, 2013). The skill to imitate the letter formations vary from one person to another and are based on every writer’s observation of the image and his or her capability to reproduce that visual perception. One is expertise in the act of handwriting through practice and repetition.

Handwriting has unique features and is inimitable to every individual which can be used for personal identification (Saini, 2015). The basic principle of handwriting identification is that no two people write exactly alike in an extended handwriting sample (Koppenhaver, 2007). It is considered as important supportive evidence of information for forensic examination generally in cases such as murder, suicides, kidnapping etc. Handwriting experts as well as forensic expert usually face the difficulties in examination of authenticating the original writer. The examination of shape variants of each letter is useful: in particular, word configuration in cursive writing lean to carry more individuality and patterns than individual letter shapes (Kumar Suneet, 2013). The possibility of distinguishing the sex of the writer from his/her handwriting has been the pursuit of many investigations. It has been proposed as a key step in the justification of Graphology (Huber, 1999). But these studies have inspired researchers to study more about handwriting and hence they are positively indulged in finding gender determining features in handwriting. Handwriting is said to be the brain writing, so the thinking of a male differs vastly from a female due to hormonal involvement and differences in their physiology which may not only alter their neuromotor functioning due to which writing work is done but also their way of thinking differs and hence characteristic,

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Table 1. Presentation of percentage of occurrence of handwriting feature in male and female

S.N	CHARACTERISTIC FEATURE	% in male	% in female
1.	Macrofeature Dispersivewriting	96	89
2.	Cursive writing	3	11
3.	Micro feature- Dot over "i"	84.6	69
4.	Hook at the start of "c"	9	18
5.	Hook at the end of "c"	4	14
6.	Hook at end of "d"	23	20
7.	Hook at end of "e"	7	12
8.	Hook at end of "h"	4	37
9.	Hook at the end of "u"	4	37
10.	Loop formation in stem of letter "b"	7	6
11.	Loop formation in stem of letter "d"	17	28
12.	Loop formation in stem of "h"	15	18
13.	Flourish at the start of "a"	34	32
14.	Flourish at start of "c"	23	22
15.	Flourish at start of "d"	35	42
16.	Flourish at start of "o"	45	34
17.	Flourish at start of "u"	31	29
18.	Consistency in the angle of crossbar on "t"	78	60
19.	Consistency in angle of crossbar on "f"	84	72
20.	Consistency in "X"	89	88
21.	Shape of "r"(arcade)	54	46
22.	Shape of "r" (parochial)	46	54
23.	Knot formation n the end of "w"	21	17
24.	Straight down stroke formation in "y"	46	25
25.	Angular base of letter "w"	92	91
26.	Pointed base of "w"	7	11
27.	Upward flourish letter "s"	50	54

Table 2. Values of hypothesis and z-test

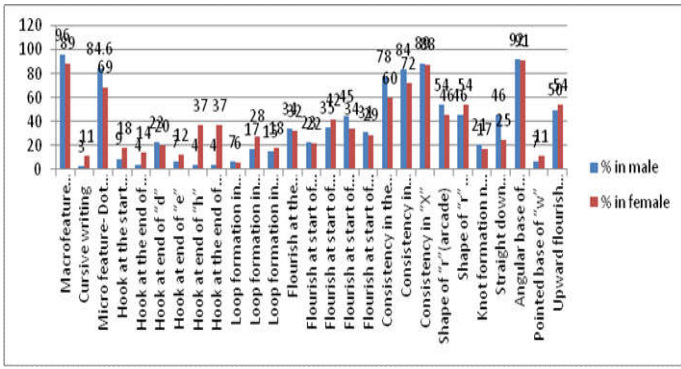
S.N	CHARACTERISTIC FEATURE	p1	p2	Z-value
1	Macrofeature- Dispersive writing	0.96	0.89	1.5
2	Cursive writing	0.03	0.1	-2.3
3	Micro feature- Dot over "i"	0.84	0.69	2.04
4	Hook at the start of "c"	0.09	0.18	-1.6
5	Hook at the end of "c"	0.04	0.13	-3
6	Hook at end of "d"	0.23	0.2	0.42
7	Hook at end of "e"	0.07	0.12	-1.25
8	Hook at end of "h"	0.4	0.36	0.57
9	Hook at the end of "u"	0.4	0.36	0.57
10	Loop formation in stem of letter "b"	0.07	0.06	0.3
11	Loop formation in stem of letter "d"	0.1	0.27	-2.83
12	Loop formation in stem of letter "h"	0.15	0.18	-0.5
13	Flourish at the start of letter "a"	0.33	0.32	0.14
14	Flourish at start of letter "c"	0.23	0.21	0.28
15	Flourish at start of letter "d"	0.35	0.14	3
16	Flourish at start of letter "o"	0.44	0.33	1.3
17	Flourish at start of letter "u"	0.3	0.29	0.14
18	Consistency in the angle of crossbar on letter "t"	0.78	0.6	2.5
19	Consistency in angle of crossbar on letter "f"	0.84	0.72	1.2
20	Consistency in "X"	0.89	0.87	0.14
21	Shape of "r"(arcade)	0.53	0.46	0.87
22	Shape of "r" (parochial)	0.46	0.53	-0.8
23	Knot in letter "w"	0.21	0.16	0.83
24	Straight downstroke in "y"	0.46	0.24	3.14
25	Angular base of "w"	0.92	0.9	0.45
26	Pointed base of "w"	0.07	0	-0.68
27	Upward flourish in "s"	0.5	0.53	-0.37

so handwriting which are observed during examination may be proven to be showing discriminatory features in handwriting of a male and female. This study may not only help in predicting the gender of writer but also help in identifying the culprit from the suspects and presenting strong evidence in the Court of Law.

MATERIALS AND METHODS

For the fulfilment of objectives in the present study, 130 handwriting samples were collected, 65 from males and 65 from female volunteers, from the higher secondary, graduated or post graduate and working individuals between the age

group of 18 to 30 years. They were all given a pangram to write on a white sheet of paper with Reynolds jetter dot pen. The handwriting samples of male and female volunteers were observed for presence of total 27 features of handwriting which were divided in two group's i.e. macro features (such as slant, word spacing, dispersive writing and cursive writing) and micro features (such as dot over "i", hook at the start of "c", hook at the end of "c", hook at end of "d", hook at end of "e", hook at end of "h") through magnifying lens, enlarger, scale and protector for the examination of gender identifying features in handwriting samples. According to the statistical z-test formula was used to signify the results of the study.



Graph showing distribution of feature in percentage for male and female of gender identifying features

$$Z = \frac{p1+p2}{\sqrt{\frac{p1(1-p1)}{n1} + \frac{p2(1-p2)}{n2}}}$$

p1=X1/n1
p2=X2/n2

where,

p1- proportion of male handwriting samples where the feature occurs

p2- proportion of female handwriting samples where the feature occurs

X1, X2 - frequencies of feature in males and females respectively

n1, n2- no. of samples of male and female handwriting respectively

Critical value: at 5% level of significance, the critical value of z=1.96

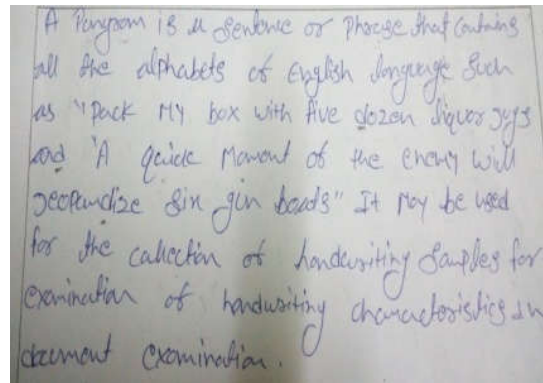


Fig.1.3. Left sided slant

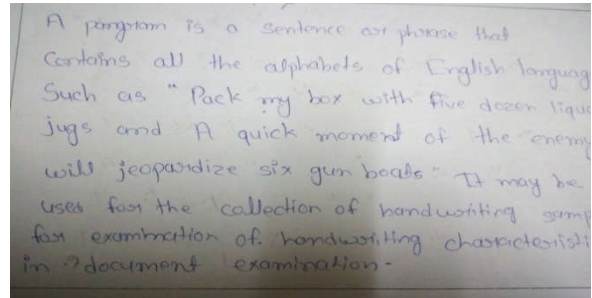


Fig. 2.1. Dispersive type

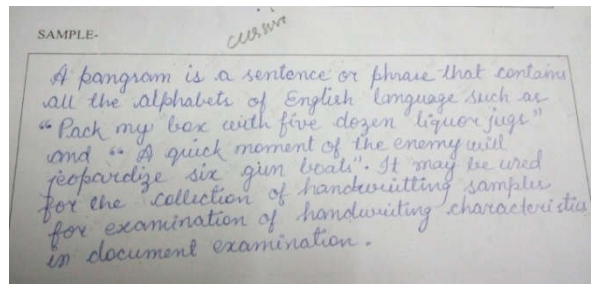


Fig. 2.2. Cursive type of writing

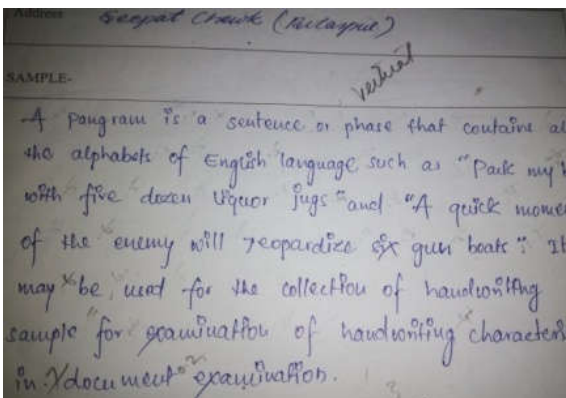


Fig. 1.1. Vertical type



Fig. 3.1. Dot of "i"

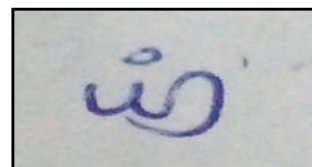


Fig. 3.2. Circular dot of "i"



Fig 4.1. Hook at start of "c"

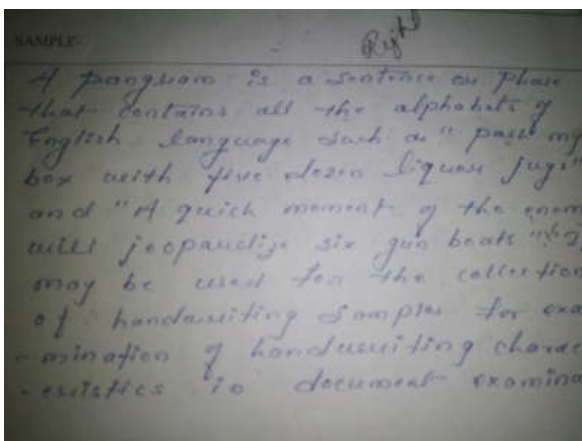


Fig. 1.2. Right side leaned writing



Fig. 4.2. Hook at end of “c”



Fig. 4.3. Hook at end of “d”



Fig. 4.4. Hook at end of “e”



Fig. 4.5. Hook at end of “h”



Fig. 4.6. Hook in end of “u”



Fig. 5.1. Loop in stem of “d”

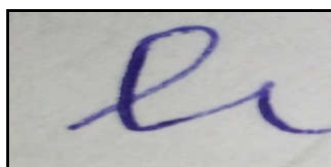


Fig. 5.2. Loop in stem of “h”



Fig. 6.1. Flourish at start of “a”



Fig. 6.2. Flourish at start of “c”

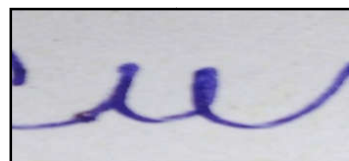


Fig. 6.3. Flourish at start of “o”



Fig. 6.4. Flourish at start of “o”



Fig. 7.1. Shape of “r” (arcade)



Fig. 7.2. Shape of “r” (parochial)

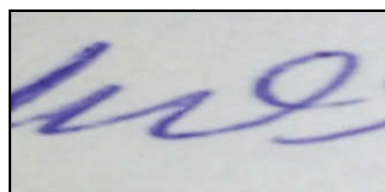


Fig. 8.1. Knot in “w”



Fig. 9.1. Straight stroke of “y”



Fig. 10.1. Angular base of “w”

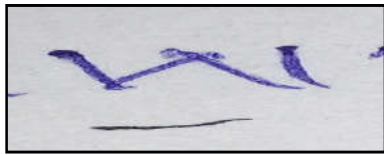


Fig. 10.2. Pointed base of "w"



Fig. 11.1. Upward flourish in "s"

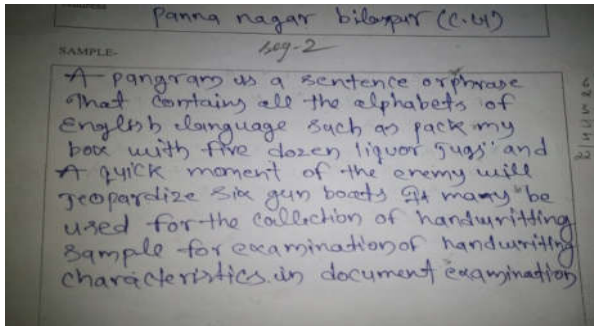


Fig.12.1. Handwriting sample of boy showing bold and heavy pressure of writing instrument

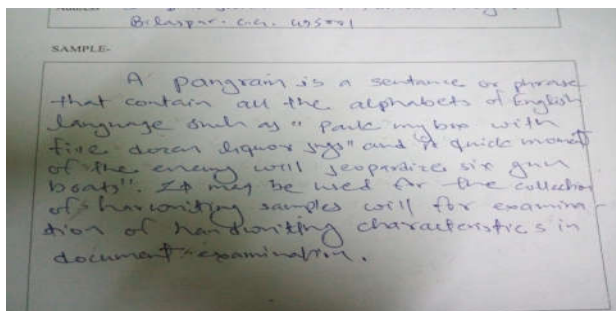


Fig.12.2. These male handwriting samples shows unpresentable and dispersive

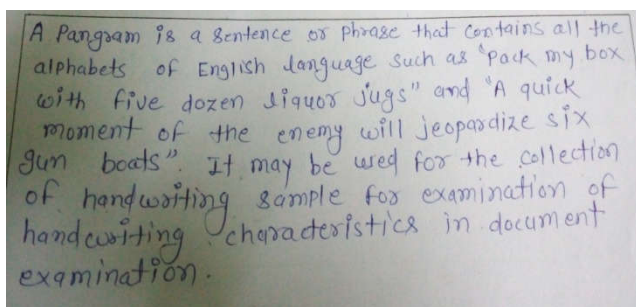


Fig.12.3. Handwriting sample of female with less pen pressure and rounded shape of letters are more

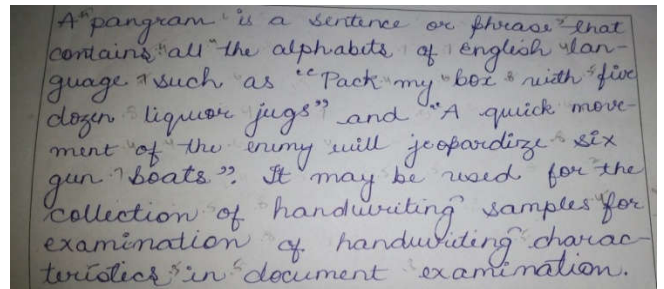


Fig.12.4. Handwriting samples of females were decorative and presentable proper spacing between letters and words were mostly found

17 samples were observed to be slanted towards right hand side, 20 left sided and 43 vertical position out of 65 male whereas in female 25 were in right, 11 in left and 31 in vertical position out of 65 samples. In the case of word spacing both male and female samples were having mean of word spacing, 0.35cm-0.96cm and 0.34-0.92cm, hence no significant difference was observed in the case of word spacing as range was near about similar in both. Whereas in the case of slant (macro feature) males were observed to be possessing slant in their writing in left and vertical position more than female on the other hand females were observed to be possessing slant in right hand side as compared to males. This could be used as one of the point in discriminating the handwriting samples on the basis of slant. On the basis of the study (Table-1), out of 27 characteristics feature of handwriting 10 feature i.e. dot over "i", straight down stroke formation of letter "s", consistency in angle of crossbar on "f", "t", flourish at letter "o", loop in stem of letter "d", hook at end of "u", h, and hook at start and end of letter "c" and cursive type of writing, were observed to be showing significant role in discrimination of male and female handwriting on the basis of their occurrence which was half in one sample and double on the other. In case of Hypothesis testing by z- test, Null hypothesis was taken that "there is no significant difference in male and female handwriting" and on the basis of value of z (table-2) at 5% level of significance with critical value of 1.96, out of 27 features for which z-test was performed, 7 showed value of z more than the critical value 1.96 i.e. cursive writing, dot over letter "i", hook at the end of letter "c", loop formation in stem of letter "d", flourish at start of letter "d", consistency of angle of crossbar on "t" and straight down stroke formation in "y". Hence in these 7 features null hypothesis was rejected and alternate hypothesis was accepted. These seven features could said to be gender identifying feature and may help in identifying the gender of the writer.

Conclusion

On the basis of above result in the present study, feature extraction and z-test may said to be the two methods which may explain about the utility of these tests for examination of handwriting for gender identifying features. Those characteristics features which showed positive results in the examination of 65 samples of male and female may be considered as gender identifying features. The result presented in the study may be said to be convincing that there is a significant differences between handwriting of a male and a female and hence a handwriting sample can also be examined for gender identification purpose.

RESULTS AND DISCUSSION

Since the main objective of the study was to examine gender identifying features in handwriting samples of male and female and a promising result were observed proving the handwriting features to be gender identifying, further hypothesis testing of the same showed positive results up to some extent leading to rejection of null hypothesis that "there is no significant difference in handwriting of male and female".

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