Differentiation of Handedness of Writer Based on their Strokes and Characteristic Features

Vaibhav Saran*, Suneet Kumar, Gupta AK and Syeed Ahmad

Department of Forensic Science, SHIATS, Allahabad, India

Abstract

Handwriting is a person's particular & individual style of writing with pen or pencil, which contrasts with "Hand'' which is an impersonal and formalized writing style in several historical varieties. In the present study 100 samples of handwriting were collected for the "Identification of handedness of author on the basis of their strokes and characteristic features''. Out of 100 handwriting samples, 50 were left-handed writer and 50 were right-handed writer. The study was carried out at the School of Forensic-Science, SHIATS, Allahabad. Left-handed writing and Right-handed writing samples were identified on the basis of horizontal strokes and slope and the hypothesis considered that there is significant difference in left-handed writing and right-handed writing were checked.

Keywords: Handedness; Handwriting strokes; Left and right slope

Introduction

Handwriting is individual style of writing. When any person writes any letter, firstly the image of letter is cause in his mind and person tried to write this duplicate image of letter with the help of materials and hand muscles because our muscles control by the brain which guide the formation of letter and each vibration of movement is unconsciously affect the writer. In this study an attempt is made to differentiate the left handed and right handed writer by the horizontal stroke and the direction of slope. This is assumed that the Right Handed writers make strokes from left-to-right and Left Handed writers make strokes from right-to-left. The Right Handed writing and LH writing are differentiating by other characters like slope [1,2]. This slope can be examined in only cursive writing. The Right Handed writers makes forward slope and Left Handed writers makes backward slope. In the document cases document examiner eliminate many suspects with the help of this technique.

The role of probabilities of handwriting characteristics was recognized over a hundred years ago. However their use in court testimony is not currently feasible due to the complexity of the problem. There have been very few efforts to characterize the statistical characteristics of such features, a notable one being [3].

On the other hand there have been efforts to compute features automatically but the features tend to be gross approximations of the characteristics employed or the features do not correspond to human determined characteristics at all.

Methodology

Total 100 HW samples were collected for this study, 50 were left-handed writing and 50 were right-handed writing. The collected HW samples were examined by various type of optical instrument such as stereoscopic microscope, hand lens, flexible arm illuminated magnifier and grid scale. The HW samples of LH writing and RH writing was observed for the characteristic features like strokes and Slope. Direction of stroke was examine in which letters having cross bar like t, f, A, I, E, F has a significant degree of variation in their formation among the LH writer and RH writer, its been presumed from that the LH writer makes the horizontal stroke in R-to-L direction in contrast to the RH writer who write in L-to-R direction. The theory was postulated on hypothesis and was proved by statistical analysis. The slope was examined in only cursive writing. For the purpose of this study six letters was selected like t, l, d, f, g and y. For the measurement of direction of slope a base line was draw in the bottom of letter and then letter was divided by the vertical line and measure the direction of slope with the help of grid. The RH writers makes forward slope and LH writers makes backward slope.

Results and Discussion

The results are given in detail from Tables 1-4. It is remembered that the fundamental question behind this project are: "What % of LH writers and what % of RH writers on the basis of direction of strokes and slope?"

Discussion

The results reported here in from Tables 1-4 long with the related Figures 1-6 emphasizes on the difference between left-handed writer and right-handed writer it shows that the left-handed writer made strokes in right-to-left direction and the slope of letters has an inclination in backward direction where as right-handed writer made stokes in left-to-right direction and the inclination of slope was in forward direction. These data of samples were checked by Statistical-Analysis. Significant P-value supported the hypothesis that there is significant difference in HW of LH writer and RH writer. Statistical study using various methods to calculate the probabilities of nearly 1500 writing styles of "and" were determined and tabulated by Srihari and Ball [4], and suggested scope of further research in statistical analysis of handwriting.

Summary and Conclusion

In the present study 100 samples of handwriting was taken for the

Character observe	Valid samples	Total no. of letters	R-to-L	L-to-R	%		Statistical analysis			
					R-to-L	L-to-R	Group	Mean	SD	SEM
Stroke of "t''	50	987	692	295	70.11	29.88	1	76.3533	6.4857	2.647
Stroke of "f''	26	78	66	12	84.61	15.38	2	23.6383	6.4881	2.648
Stroke of "A''	22	43	32	11	74.44	25.58	Df	10		
Stroke of "I''	14	32	22	10	68.75	31.25	SED	3.745		
Stroke of "E''	25	52	43	9	82.69	17.30	Value of t	14.0753		
Stroke of "F''	20	49	38	11	77.55	22.44	Value of p	P-value is less than 0.0001.		

The P value found by t-test is less than 0.0001 which is statistically very significant and it supported the hypothesis that there is significant difference in HW of LH writer and RH writer

Table 1: Direction of strokes in LH writer.

Character observe	Valid samples	Total no. of letters	L-to-R	R-to-L	%		Statistical analysis			
					L-to-R	R-to-L	Group	Mean	SD	SEM
Stroke of "t''	50	826	822	4	99.51	0.484	1	99.9183	0.20004	0.08167
Stroke of "f''	22	198	198	0	100	0	2	0.08067	0.1975	0.0806
Stroke of "A''	20	69	69	0	100	0	Df	10		
Stroke of "I''	12	44	44	0	100	0	SED	0.115		
Stroke of "E''	14	38	38	0	100	0	Value of t	869.7489		
Stroke of "F''	15	45	45	0	100	0	Value of p	Two the tailed P-value is less than 0.0001.		

The P value found by t-test is less than 0.0001 which is statistically very significant and it supported the hypothesis that there is significant difference in HW of LH writer and RH writer

Table 2: Direction of strokes in RH writer.

Character observe	Valid samples	Total no. of letters	Backward slope	Forward slope	%		Statistical analysis			
					B.S.	F.S.	Group	Mean	SD	SEM
Slope in "l''	50	117	97	20	82.90	17.09	1	91.5717	6.9426	2.834
Slope in "t''	50	95	82	13	86.31	13.68	2	8.433	6.927	2.828
Slope in "d'	23	63	55	8	87.30	12.69	Df	10		
Slope in "f'	24	47	45	2	95.74	4.25	SED	4.004		
Slope in "g''	34	142	4	138	2.89	97.18	Value of t	20.7645		
Slope in "y''	45	87	0	87	0	100	Value of p	Two the tailed P-value is less than 0.0001.		

The P value found by t-test is less than 0.0001 which is statistically very significant and it supported the hypothesis that there is significant difference in HW of LH writer and RH writer

Table 3: Slope examination in LH writer.

Character observe	Valid samples	Total no. of letters	Forward slope	Backward slope	%		Statistical analysis			
					F.S.	B.S.	Group	Mean	SD	SEM
Slope in "l''	50	103	101	2	98.05	1.94	1	92.2217	5.4078	2.2077
Slope in "t''	36	129	126	3	97.67	2.32	2	36.1750	44.042	17.980
Slope in "d'	26	63	55	8	87.30	12.69	Df	10		
Slope in "f'	28	47	40	7	85.10	14.89	SED	18.115		
Slope in "g''	30	73	4	69	5.47	94.52	Value of t	3.093		
Slope in "y''	26	43	4	39	9.30	90.69	Value of p	Two the tailed P-value is less than 0.0114.		

The P value found by t-test is less than 0.0114 which is statistically very significant and it supported the hypothesis that there is significant difference in HW of LH writer and RH writer
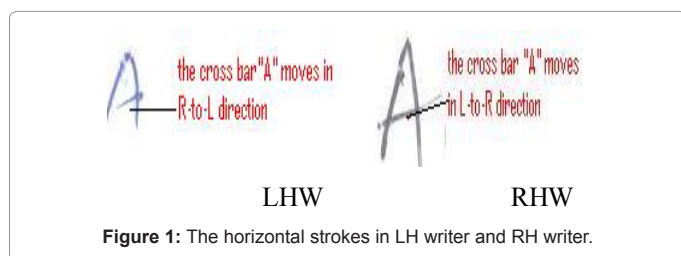
Table 4: Slope examination in RH writer.

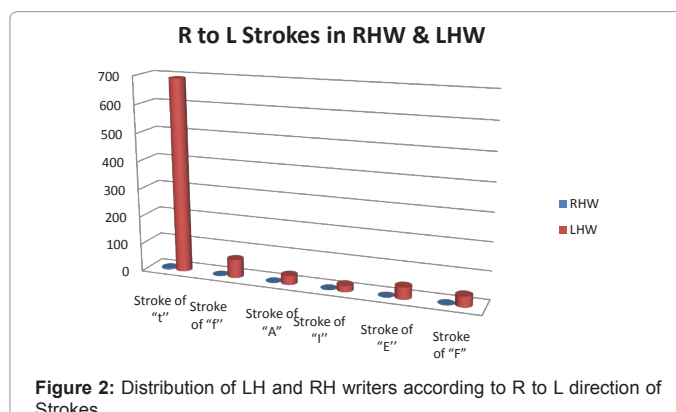**Figure 1:** The horizontal strokes in LH writer and RH writer.

Figure 2: Distribution of LH and RH writers according to R to L direction of Strokes.

identification of handedness of writer. The handwriting samples were collected from graduate, under graduate student of university, college, and office person. The age distribution was 18-30 years. All writers were asked to write the sample in English language. The motive of this

Figure 3: Distribution of LH and RH writers according to L to R direction of Strokes.

Figure 4: Direction of slope in LH writer and RH writer.

Figure 5: Distribution of LH and RH writers according to backward slope.

Figure 6: Distribution of LH and RH writers according to forward slope.
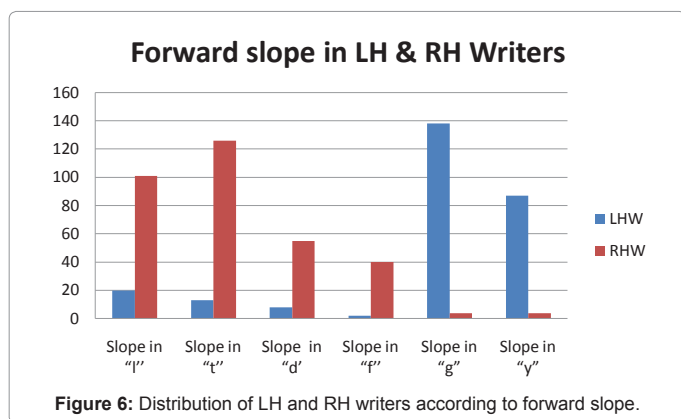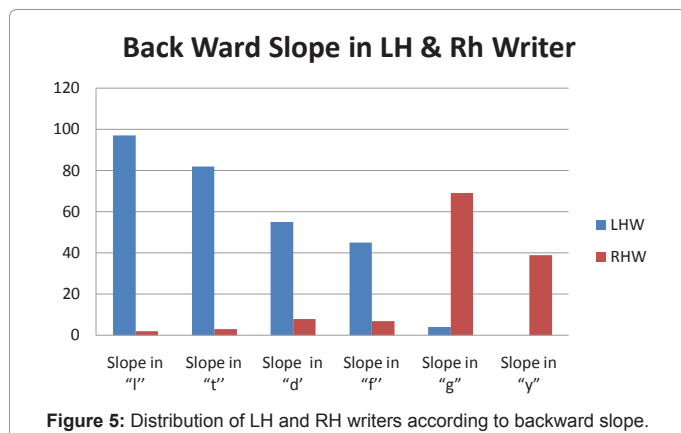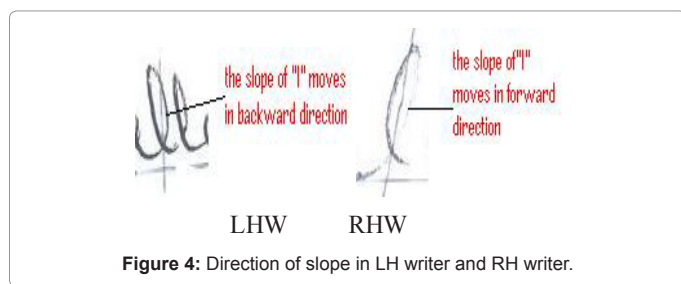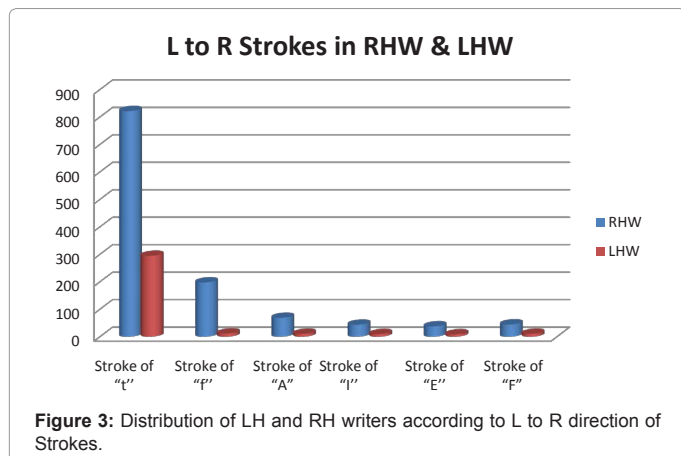
study was to determine the difference between left-handed writer and right-handed writer and from the results reported here in Tables 1-4 concluded that left-handed writer made strokes in right-to-left direction and the slope of letters has an inclination in backward direction where as right-handed writer made stokes in left-to-right direction and the inclination of slope was in forward direction. Before the identified the total sample of handwriting, these samples were examined under microscopic magnification. After thorough study these data of samples were checked by Statistical-Analysis. These methods are providing the significant results.

References

1. Franks JE, Davis TR (1985) Variability of stroke direction between left and right handed writer. Journal of the Forensic Science Society 28: 353-370.

2. Smart JL, Jeffery C, Richards B (1956) A retrospective of relationship between birth history and handedness at six years. Early Human Development 10: 56-60.

3. Totty RN, Hardcastle RA (1982) The dependence of slope of HW upon the handedness of writer. Journal of the Forensic Science Society 27: 237-240.

4. Ball GR, Srihari SN (2011) Statistical characterization of handwriting characteristics using automated tools. In Proc Document Recognition and Retrieval.