



DISTRIBUTION OF VARIOUS FACTORS AFFECTING HANDWRITING AMONG NORTHERN AND NORTH-EASTERN POPULATION GROUPS OF INDIA

Forensic Science

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ABSTRACT

Background: Handwriting refers to writing on any surface with the help of any writing instrument like pen, pencil or marker. Handwriting of every individual is unique similarly to DNA and fingerprint of that individual. It is a subconsciously acquired visual-motor and cognitive skill. The uniqueness of handwriting characteristics is alike to peculiarity of genetic markers in a particular individual. As genome of an individual is affected by numerous extrinsic and intrinsic factors, as is the handwriting. The formation of allographs is intrinsically affected by numerous extrinsic and intrinsic factors. The data (handwriting exemplars) was collected from North Indians and North-East Indians, with the help of questionnaires having some questions related to personal information; moreover questions related to schooling and pen-holding style. This study was based on the comparative assessment of 5 extrinsic and 4 intrinsic handwriting affecting factors. Data was analyzed using the SPSS software. The chi-square analysis was performed in order to study the differences for variation. **Result:** After studying all the factors and analyzing the data it was observed that the distribution of some of the factors between two ethnic groups was highly variable whereas for some factors there was no significant difference observed. **Conclusion:** The distributive frequency of various intrinsic and extrinsic factors is crucial to development of some class characteristics of handwriting among two or more ethnic groups of a country. This study can be useful to learn the intra-ethnic and inter-ethnic effects of various intrinsic and extrinsic factors affecting handwriting which can pave a way to unfolds many knots in forensic linguistics.

KEYWORDS

Words: Handwriting, Allographs, Chi-square, Ethnic-groups, Visual-motor, Forensic Linguistics.

INTRODUCTION

Handwriting refers to writing on any surface with the help of any writing instrument like pen, pencil or marker. Handwriting of every individual is unique similarly to DNA and fingerprint of that individual. It is a subconsciously acquired visual-motor and cognitive skill. The uniqueness of handwriting characteristics is alike to peculiarity of genetic markers in a particular individual. As genome of an individual is affected by numerous factors, as is the handwriting. Handwriting as a task is a result of many numerous component skills that may interrupt handwriting performance. These component skills are fine motor control, motor planning, visual perception, bilateral & visual-motor integration, sensory working of fingers and in-hand manipulations. The skill of handwriting develops with practice. With the excessive use of computers, laptops, tabs and mobile phone for writing work, the handwriting skills of an individual doesn't develops for a good pace. Moreover the skill of handwriting is dependent upon the writing instrument used by the individuals at initial learning stages. Writing habits are greatly influenced and shaped by the culture and environment of a writer as handwriting is an acquired skill and environment is the matrix from which this art is acquired and cultivated [Huber RA, Headrick A.M]. Handwriting learning system and environment have a great impact on the handwriting characteristics of an individual. There are numerous conditions and circumstances that contribute to the nature of normal writing and the quality of the writing performance [Herrick, Virgil E].

Factors affecting handwriting

Handwriting is a neuromuscular task and such coordination of neurons and muscles is affected by various intrinsic and extrinsic factors. The influence of such factors can be seen specifically at different stage of handwriting development. During the course of early development, a child's increasing cognitive control results in increasing capacity to modulate emotional reactivity. Such cognitive processes which facilitate the control of emotional reactivity include regulation of attention, inhibitory control, and certain processes that have been called as executive function [Fox, Henderson, & Marshall, 2001; Ruff & Rothbart, 1996].

These factors are classified as following: -

Intrinsic factors: These factors are under writer's control. Intrinsic factors include the temperamental disposition of the child, certain cognitive skills, and the underlying neural and physiological systems that support and are engaged in the process of control [Calkins, 1994; Fox, 1994; Fox, Henderson, & Marshall, 2001]. Some of the examples of such factors are: visual-motor control and cognitive skills, emotional state, physical ability and neuromuscular co-ordination of the learner.

impairment in neuromuscular co-ordination can cause deterioration in letter formation, overwriting, high pen-pressure, and poor handwriting skill etc.

Extrinsic factors: These factors are not under control of writer. It includes the manner in which caregivers shape & socialize emotional responses of the child. Caregivers may utilize specific cultural, socio-ethnic appropriate behavioral strategies to enhance development of self-control by providing supportive and responsive environments to the child (Thompson, 1994, 1998). Some of the examples of such factors are: National writing system, occupation, learning environment and age of the learner. Lack of opportunities to learn with experiments, graphic materials and less playing affects handwriting development of a child. Moreover lack of resources like lightening, writing surface etc. also affects handwriting.

Injury or accident, impact of alcohol or drugs and some psychological constraints are also extrinsic factors affecting the quality of handwriting. Consumption of alcohol and drugs like analgesic, anesthesia, antidepressant, barbiturates, and tranquilizer results in handwriting impairment, like decrease in writing speed, tremors, irregular alignment, excessive large font of allographs, high pen-pressure, and errors & overwriting etc.

Methodology

In present study the factors affecting the handwriting were studied among NEI and NI populations. The objective which is to learn about the variation of some of these factors among both the populations has been conveyed to the study participants. A written consent has been received from each and every participant prior to start the data collection. The present study has been approved by the Department of Anthropology's Ethics Committee. The factors to be studied are 5 extrinsic factors and 4 intrinsic factors. A set of questions about general information like name, sex, age, date of birth, Indian-origin, caste, qualification, profession and schooling etc. are asked in the questionnaire. Moreover, some of the questions like handedness, use of chalk & slate, writing instrument preferred, and pen holding style are asked in the questionnaire.

Overall, 160 samples; 80 NI samples (40 females & 40 males) and 80 NEI (40 females & 40 males) were collected from respondents of age group 18-40 years from different colleges and departments of University of Delhi. Statistical analysis of 160 handwriting samples was done by SPSS version 20 software using windows 7. Analysis was made using frequency distribution tables for different factors related to handwriting. The chi-square analysis was performed in order to study the differences for variation.

RESULT

Objective: To study various factors affecting handwriting.

Nervousness causes tremors and lack of fluency to handwriting. Any

Table 1:- Distribution of respondents as per “schooling institution”

Geographical group		Private N(%)	Government N(%)	Chi-square value
Female	NI	24(60.0)	16(40.0)	7.033***
	NEI	30(75.0)	10(25.0)	
	Total	54(67.5)	26(32.5)	
Male	NI	20(50.0)	20(50.0)	30(37.5)
	NEI	30(75.0)	10(25.0)	
	Total	50(62.5)	30(37.5)	
Total	NI	44(55.0)	36(45.0)	60(75.0)
	NEI	60(75.0)	20(25.0)	
	Total	104(65.0)	56(35.0)	

*** (p<0.001)

Table 1 depicts that frequency for private schooling was higher among NEI (75%) than NI (55%) whereas for government schooling it is higher among NI (45%) than NEI (25%). Overall, majority of both NI & NEI population groups reported of belonging to “private” group. HSD (p<0.001) was reported between NI and NEI population groups for schooling types.

Table 2:- Distribution of respondents as per “schooling medium”

Geographical group		English N(%)	Hindi N(%)	Both N(%)	Chi-square value
Female	NI	35(87.5)	2(5.0)	3(7.5)	11.333***
	NEI	38(95.0)	1(2.5)	1(2.5)	
	Total	73(91.2)	3(3.8)	4(5.0)	
Male	NI	25(62.5)	7(17.5)	8(20.0)	11(13.8)
	NEI	37(92.5)	0(0.0)	3(7.5)	
	Total	62(77.5)	7(8.8)	11(13.8)	
Total	NI	60(75.0)	9(11.2)	11(13.8)	4(5.0)
	NEI	75(93.8)	1(1.2)	4(5.0)	
	Total	135(84.4)	10(6.2)	15(9.4)	

*** (p<0.001)

Table 2 depicts that the frequency for English medium of schooling was reported higher among NEI (93.8%) than NI (75%), for Hindi medium of schooling it was higher among NI (13.8%) than NEI with (5%) and for medium it was found to be higher among NI (13.8%) than NEI (5%). Overall, majority of both NI & NEI population groups reported of belonging to English medium group. HSD(p<0.001) was reported between NI and NEI population groups for schooling medium types.

Table 3:- Distribution of respondents as per “language known”

Geographical group		English N(%)	Hindi N(%)	Both N(%)	Chi-square value
Female	NI	0(0.0)		40(100.0)	64.578***
	NEI	28(70.0)		12(30.0)	
	Total	28(35.0)		52(65.0)	
Male	NI	2(5.0)	3(7.5)	35(87.5)	19(47.5)
	NEI	21(52.5)	0(0.0)	19(47.5)	
	Total	23(28.8)	3(3.8)	54(67.5)	

Table 6:- Distribution of respondents as per “pen-holding position”

Geographical group		Radial cross palmer grasp N(%)	Palmer supinate grasp N(%)	Grasp with extended fingers N(%)	Gross thumb grasp N(%)	Static tripod grasp N(%)	Dynamic quadrupod grasp N(%)	Lateral tripod grasp N(%)	Dynamic tripod grasp N(%)
Female	NI		2(5.0)	7(17.5)		7(17.5)	7(17.5)	1(2.5)	16(40.0)
	NEI		0(0.0)	18(45.0)		8(20.0)	0(0.0)	0(0.0)	14(35.0)
	Total		2(2.5)	25(31.2)		15(18.8)	7(8.8)	1(1.2)	30(37.5)
Male	NI	1(2.5)	0(0.0)	15(37.5)	1(2.5)	8(20.0)	5(12.5)		10(25.0)
	NEI	0(0.0)	1(2.5)	17(42.5)	0(0.0)	5(12.5)	4(10.0)		13(32.5)
	Total	1(1.2)	1(1.2)	32(40.0)	1(1.2)	13(16.2)	9(11.2)		23(28.8)
Total	NI	1(1.2)	2(2.5)	22(27.5)	1(1.2)	15(18.8)	12(15.0)	1(1.2)	26(32.5)
	NEI	0(0.0)	1(1.2)	35(43.8)	0(0.0)	13(16.2)	4(5.0)	0(0.0)	27(33.8)
	Total	1(0.6)	3(1.9)	57(35.6)	1(0.6)	28(17.5)	16(10.0)	1(0.6)	53(33.1)

Total	NI	2(2.5)	3(3.8)	75(93.8)	
	NEI	49(61.2)	0(0.0)	31(38.8)	
	Total	51(31.9)	3(1.9)	106(66.2)	

*** (p<0.001)

Table 3 depicts that the percentage for English language is higher among NEI (61.2%) than NI (2.5%), for Hindi language it is reported only among NI (3.8%) and for both languages known it is reported higher among NI (93.8%) than NEI (38.8%). Overall, majority of NI population is belonging to both languages known group whereas NEI group is belonging English language group. HSD (p<0.001) was reported between NI and NEI population groups for language known types.

Table 4:- Distribution of respondents as per “writing instrument preferred”

Geographical group		Fountain pen N(%)	Gel pen N(%)	Ball pen N(%)	Pencils N(%)	Others N(%)	Chi-square value
Female	NI	1(2.5)	7(17.5)	32(80.0)	0(0.0)		14.879***
	NEI	5(12.5)	3(7.5)	30(75.0)	2(5.0)		
	Total	6(7.5)	10(12.5)	62(77.5)	2(2.5)		
Male	NI	1(2.5)	10(25.0)	28(70.0)	1(2.5)	0(0.0)	2(2.5)
	NEI	5(12.5)	2(5.0)	30(75.0)	1(2.5)	2(5.0)	
	Total	6(7.5)	12(15.0)	58(72.5)	2(2.5)	2(2.5)	
Total	NI	2(2.5)	17(21.2)	60(75.0)	1(1.2)	0(0.0)	3(3.8)
	NEI	10(12.5)	5(6.2)	60(75.0)	3(3.8)	2(2.5)	
	Total	12(7.5)	22(13.8)	120(75.0)	4(2.5)	2(1.2)	

*** (p<0.001)

Table 4 depicts that frequency for preferring ball pen was reported equal among both NI & NEI population groups (75% each). The frequency for preferring fountain pen & pencil is higher among NEI (12.5% & 3.8%) than NI (2.5% & 1.2%); for preferring gel pen it was higher among NI (21.2%) than NEI (6.2%) and for preferring others it was reported only among NEI (2.5%). Overall, majority of both NI & NEI populations groups were reported preferring ball pen in present study. HSD (p<0.001) was reported between NI and NEI population groups for writing instrument preference types.

Table 5:- Distribution of respondents as per “learning cursive writing”

Geographical group		Yes N(%)	No N(%)	Chi-square value
Female	NI	30(75.0)	10(25.0)	6.957***
	NEI	34(85.0)	6(15.0)	
	Total	64(80.0)	16(20.0)	
Male	NI	20(50.0)	20(50.0)	9(22.5)
	NEI	31(77.5)	9(22.5)	
	Total	51(63.8)	29(36.2)	
Total	NI	50(62.5)	30(37.5)	15(18.8)
	NEI	65(81.2)	15(18.8)	
	Total	115(71.9)	45(28.1)	

*** (p<0.001)

Table 5 depicts that population of individuals who had learnt cursive handwriting was found to be higher among NEI (81.2%) than NI (62.5%). HSD (p<0.001) was reported between NI and NEI population groups for learning cursive writing types.

Table 6 depicts that occurrence of radial cross palmer grasp, gross thumb grasp & lateral tripod grasp was reported only among NI group (1.2% in each). The frequency for palmer supinate grasp, static tripod grasp & dynamic quadrupod grasp was higher among NI group (2.5%, 18.8% & 15%) than NEI group (1.2%, 16.2% & 5%); for grasp with extended fingers & dynamic tripod grasp it was higher among NEI group (43.8% & 33.8%) than NI group (27.5% & 32.5%). Overall, majority of NI population was reported of having dynamic tripod grasp whereas NEI group of having grasp with extended fingers grasp type. No significant difference ($p>0.5$) was reported between NI and NEI population groups for pen-holding types.

Table 7:- Distribution of respondents as per "handedness"

Geographical group		Dextral N(%)	Sinistral N(%)	Ambidextrous N(%)	Chi-square value
Female	NI	38(95.0)	1(2.5)	1(2.5)	.533*
	NEI	39(97.5)	0(0.0)	1(2.5)	
	Total	77(96.2)	1(1.2)	2(2.5)	
Male	NI	38(95.0)	2(5.0)	0(0.0)	
	NEI	37(92.5)	2(5.0)	1(2.5)	
	Total	75(93.8)	4(5.0)	1(1.2)	
Total	NI	76(95.0)	3(3.8)	1(1.2)	
	NEI	76(95.0)	2(2.5)	2(2.5)	
	Total	152(95.0)	5(3.1)	3(1.9)	

*($p>0.5$)

Table 7 depicts that majority of both NI & NEI population groups were reported of having dextral (right) handedness (95% each). The percentage for sinistral (left) handedness was higher among NI group (3.8%) than NEI group (2.5%); for ambidextrous (both right & left) handedness it was higher among NEI (2.5%) than NI (1.2%). Moreover, ambidextrous handedness was reported only 1.2% each among both NI and NEI population groups. No significant difference ($p>0.5$) was reported between NI and NEI population groups for handedness types.

DISCUSSION

The handwriting is a tool significantly used for the personal identification in criminal justice system. Its uniqueness to every individual is and attribute of various stages of handwriting development under the influence of various intrinsic and extrinsic factors. The uniqueness of handwriting characteristics is alike to peculiarity of genetic markers in a particular individual. Linguistic anthropology is the basic for forensic linguistics which involves study of different types of languages in the verbal and written format. The ethnic variation and geographical variation might influence the handwriting characteristics to some extent. Moreover, the distributive frequency of various intrinsic and extrinsic factors is crucial to development of some class characteristics of handwriting among two or more ethnic groups of a country. According to Bogner et al., (2002) it has been consistently observed by researchers and educators that students are motivated in literacy by motivational instructions which are the extrinsic factors for handwriting development. Such observations can contribute to our knowledge and guide our research if we are able to identify the instructional strategies that motivate students to write. In this study 5 extrinsic factors i.e. type of schooling institution (private or government), schooling medium, languages known, learning of cursive writing and use of slate & chalk in the initial stage; and 4 intrinsic factors i.e. writing instruments preferred, handedness, pen-holding position and pen placing while writing (inverted or non-inverted) were taken as the variables for studying their distributional frequency in both the population groups. Although at the initial stage of handwriting development the writer is provided with the writing instrument (pencil, chalk & slate, digital slates etc.) without his choice but after mature stage the writer has complete control over choosing the writing material as per his comfort. In a developing country like India the income divide is very high. The schooling type & medium, availability of writing instruments, learning of cursive writing might be affected by the economic condition of the learner. Majority of the private schools put a great emphasis on the good handwriting skills but, the exorbitant fee structure of private schooling might not be afforded by the low income families of Indian. Therefore the economic condition is a hidden extrinsic factor affecting the handwriting development. Another crucial extrinsic factor is the family environment; a child belonging to educated parents will be having a good learning environment but a child belonging to a non-educated tribal or labor class family might not get the necessary

learning environment.

All the factors, be it extrinsic or be it intrinsic, have a combined effect on the handwriting of an individual during all the handwriting developmental phases i.e. initial stage, formative stage, adolescent stage and mature stage. Although handwriting shows the phenomenon of natural variation but after mature stages handwriting characteristics become firm irrespective of being showing natural variation.

CONCLUSION

Both extrinsic and intrinsic factors contribute equally in learning process be it speech development or be it handwriting development. After studying all the factors and analyzing the data highly significant difference was observed for the distribution of some of the factors like type of schooling institution, medium of instructions in the school, pen-holding and language known between two ethnic groups were highly variable whereas for some factors like use of chalk & slate and pen-placing while writing no significant difference was observed. This study can be useful to learn the intra-ethnic and inter-ethnic effects of various intrinsic and extrinsic factors affecting handwriting. Ultimately it might prove significant to solve various questioned handwriting samples encountered as evidence in different criminal and civil cases.

ABBREVIATIONS

SPSS: Statistical Package for Social Sciences

NI: North Indians

NEI: North East Indians

HSD: Highly Significant Difference

DECLARATIONS

Submission Declaration

The article is an original work produced from a self-funded research. The article has not been published previously in any journal. Its publication is approved by the author and tacitly or explicitly by the responsible authorities where the work was carried out.

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REFERENCES

- Bogner, K., Raphael, L., & Pressley, M. (2002). *How grade 1 teachers motivate literate activity by their students*. Scientific Studies of Reading, 6, 135–15.
- Calkins, S. D. (1994). *Origins and outcomes of individual differences in emotional regulation*.
- Drempt et al. (2011), *Factors that influence adult handwriting performance*, Australian Occupational Therapy Journal, Vol. 58(5), 321-328.
- Fox, N. A., Henderson, H. A., & Marshall, P. J. (2001). The biology of temperament: An integrative approach. In C. A. Nelson & M. Luciana (Eds.), *The Handbook of Developmental Cognitive Neuroscience* (pp. 631–646). Cambridge, MA: MIT Press.
- Harrison, W.R., 1958, *Suspect Documents*, Frederick A. Praeger, New York, pp. 297–305.
- Herrick, Virgil E.: *Handwriting and related factors, 1890-1960*. (Washington, D.C. : Handwriting Foundation, [1961]
- Hilton, O. 1982 *Scientific Examination of Questioned Documents*. Revised Ed. (New York: Elsevier/North-Holland Inc.)
- Huber RA, Headrick A.M., (1999) *Handwriting identification: facts and fundamentals*. CRC press, USA, pp. 87-139.
- N. A. Fox (Ed.), *Emotion regulation: Behavioral and biological considerations*, Monographs of the Society for Research in Child Development (Vol. 59, Issue 2–3, Series 240). Chicago, Ill:
- Ruff, H., & Rothbart, M. K. (1996). *Attention in early development*. New York: Oxford University Press.
- Thompson, R. A. (1994). *Emotion regulation: A theme in search of definition*. In N. A. Fox (Ed.), *The development of emotion regulation: Biological and behavioral considerations*, Monographs of the Society for Research in Child Development, 59(2/3, Serial No. 240), 25–52. Chicago, Ill. University of Chicago Press.