

## VARIABILITY IN HUMAN HANDWRITINGS: AN INDIAN UNDERSTANDING

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### ABSTRACT

Handwriting is a complex neuromuscular task that imprints the brain impulses by use of hand with a writing instrument onto a surface. Peculiar to humans, writing aids to communicate oral efforts, beliefs, and traditions among individuals in the form of graphics. Handwriting, as a behavioral trait, is frequently and extensively utilized in personal identification but identification of ethnicity solely on the basis of handwriting is a rather unexplored horizon. The former perspective is strongly associated to a biometric system and forensic handwriting identification but the latter perspective dwells into an anthropological domain. Thus in this paper anthropo-forensic approach has been proposed to assess the ethnic identity of the writers on the basis of examination of handwriting attributes.

**KEYWORDS:** Acquired Skill, Neuro-Muscular Task, Natural Variation, Class Characteristics, Ethnic Identity, Behavioural Biometrics

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### INTRODUCTION

Writing, essentially, plays a crucial role in communication of oral efforts, ideas, beliefs and traditions among one another (either in a permanent or semi-permanent form). It evolved because humans felt the need to convey their oral traditions and ideas with others. Huber and Headrick (1999) stated that the development of writing is complex since it is, in part, culture -dependent, and cultures differ with locales and undergo constant change.

Moris and Moris (2000) emphasized that writing is a primarily a neuro-muscular task whereby the muscles of fingers, hand, and arm react to brain instructions communicated through the nerves. Handwriting is an acquired skill and complex perceptual-motor task which necessitates visual-motor co-ordination of a writer. In addition to the physical and psychological framework, the handwriting of an individual is influenced by his locale, writing practice and experience and occupation.

Handwriting of an each individual is composed of natural variations and a writer cannot exceed his or her writing ability in a short time period. Handwriting identification precisely relies upon differentiating the natural variation of one writer from another (Koppenhaver, 2007). Handwriting identification aims to capture the essence of the individuality on the basis of differences in handwriting attributes and neglects the content of the message (Srihari et al, 2001). Over last two decades, computer scientists have formulated several computational and pattern recognition techniques for handwriting

analysis and examination to address the problems of writer identification and the authenticity or individuality of handwriting (Sriahri and Leedham, 2003).

Handwriting-based personal identification is an important avenue in behavioral biometric domain. Writer Identification and Verification are two principal domains of Handwriting Biometrics. Bulacu (2007) stated that a writer identification system performs the one-to-many search in a large database and returns a likely list of candidates and writer verification system involves a one-to-one comparison with a decision whether or not the two samples are written by the same person.

A handwriting specimen, of a mature writer, consists of two types of characteristics- class characteristics (the products of prescribed writing systems) and individual characteristics (the particular idiosyncrasies of the individual). Handwriting-based population identification caters to the study and examination of these unique handwriting characteristics in the handwriting specimen of individuals of different population groups so as to recognize the population group of the writer (Saini, 2018). Further, this identification relies upon the premise that the members of a particular ethnic group share almost identical bio-physical and mental attributes owing to their common heredity and cultural background.

Handwriting analysis is often utilized in biometric recognition and forensic handwriting identification but assessing ethnic identity solely on the basis of handwriting attributes is a relatively new avenue of writer identification and dwells into the anthropo-forensic approach. The handwritten document should also be used to establish the ethnic identity of the writer on the basis of examination of class and individual features of handwriting.

The determination of the ethnic identity of a writer from handwriting is a novel concept emphasized in the present study. Thus the present paper provides an insight into ethnic identification on the basis of examination of handwriting attributes and capturing the essence of handwriting individuality.

### **Ethnicity and Ethnic Groups**

Ethnicity is a social-psychological process which gives an individual a sense of belonging and identity and ethnic identity can be defined as a manner in which persons, on account of their ethnic origin, locate themselves psychologically in relation to one or more social systems, and in which they perceive others as locating them in relation to those systems (Isajiw, 1992).

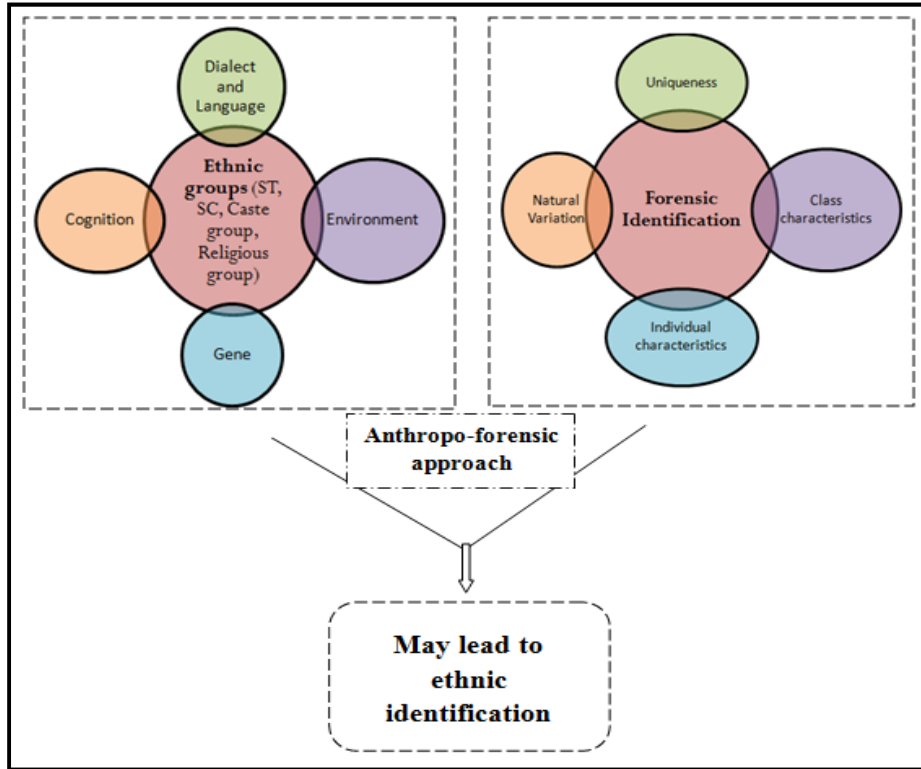
Bulmer (1996) defined ethnic group [as] a collectivity within a larger population having real or putative common ancestry, memories of a shared past, and a cultural focus upon one or more symbolic elements which define the groups' identity, such as kinship, religion, language, shared territory, nationality or physical appearance". Thus ethnic identity refers to ethnicity as an individually experienced phenomenon and can be addressed as a phenomenon in which individuals situate themselves psychologically with reference to one or more social systems on the basis of their ethnic origin and in which they discern and observe others as locating them in connection with those systems.

The objective dimensions of ethnic groups include presence of at least some community institutions or organizations, the fact of having descendants and ancestors, as focus of cultural transmission and identity formation and the fact that there is a "script" for cultural behaviour, in the form of customs, rituals, and preconceptions which provides the content to culture and its transmission and is manifested in overt behaviour patterns (Isajiw, 1992).

In Indian sub-continent, ethnicity is complex phenomenon connected with varied culture and religion and numerous ethnic groups reside in the sub-continent. The integration of biological and socio-cultural traits embodies an

ethnic group. Thus the ethnic groups share unique biological and cultural characteristics such as language and a particular type of people linked with specific ethnicity shares almost alike neuromuscular and motor functions because of their similar biological and physical bodily traits.

**Assessing Ethnicity Via Handwriting: An Anthro-Forensic Dimension**



**Figure 1: Assessing Ethnic Identity through Handwriting Attributes**

The present study emphasizes anthro-forensic approach in ethnic identification. Figure 1 demonstrates the anthro-forensic approach whereby the conceptual framework of anthropological and forensic sciences is combined so as to assess ethnicity of the writer. This approach will help to assess population differences via examination of handwriting attributes and can provide insight into variability at the population level.

Individuals linked with specific population group share almost alike neuromuscular and motor functions because of their similar biological and physical bodily traits. Handwriting is the function of neuromuscular activity controlled by the brain so it is likely to say that a certain degree of resemblance prevails in the handwriting attributes of the individuals of the same population group (Saini and Kapoor, 2014a).

Thus handwriting can serve as crucial identity markers so as to discern difference between ethnic groups at different levels of social framework . All the members of a particular population group share similar linguistic traits which enable them to communicate their ideas through oral efforts. Furthermore, Sebba (2009) suggested that writings system can help to delineate social groups at different levels of society as they are frequently linked with particular cultural tradition. Individuals belonging to similar ethnic group share similar oral traditions and writing systems. The use of native language can influence the handwriting attributes linked to the natural handwriting of a person and native-language skills can affect and modify handwriting in another language. These modifications are frequently observed in class characteristics. It has been earlier emphasized that native language impacts English handwriting (Cheng et al., 2005).

Handwriting is influenced by an admixture of both natures and nurture i.e. heredity and environment play a crucial role in the development of a person's handwriting. Here the environmental component comprises of influence from parents, friends and even fellow mates studying in the same educational institution such as school.

The prime motive of forensic studies field is to address individual identity. There are several discriminating elements in writing that have immense utility in writer identification. A discriminating element is described as a relatively discrete element of writing or lettering that varies observably or measurably with its author and may, thereby, contribute reliably to distinguishing between the inscriptions of different persons, or to evidence the sameness in those of common authors (Huber and Headrick, 1999). Design of allographs (alphabets) and their construction; dimensions (vertical and horizontal), average size and ratio of letters; slant or slope of letters; pressure; word and letter spacings and baseline alignment are certain crucial discriminating elements (or handwriting attributes) frequently used in handwriting based personal identification. Every element or quality of handwriting may have some value as a means of identifying it and the recognition, comparison and correct interpretation of all these various qualities are what constitute the theory and practice of scientific handwriting examination (Osborn, 1910).

Several 'extrinsic' and 'intrinsic' factors influence these elements or attributes of handwriting. Huber and Headrick (1999) emphasized that extrinsic factors are those factors which are not within the voluntary control and pertain to the nature of the writer and intrinsic factors are factors over which individual might exercise some control. The former include aspects such as writing systems (national, occupational and cultural); physiological constraints; genetic factors (Familial Relationships, Sex); physical factors (Maturity, Practice, Handedness, Illness) and the latter includes aspects such as imitation, literacy and education and circumstantial factors.

Limited research has been conducted (Saini and Kapoor, 2014a; b, Kumari and Kapoor, 2015, Kapoor and Saini, 2017; Saini, 2018) with an aim to examine the variation in handwriting patterns among different ethnic groups of India.

Kumari and Kapoor (2015) conducted a study with an aim to examine the variation in handwriting patterns among different population groups namely Patel, Macchi, and Muslim of Daman and Diu with respect to gender and ethnicity. Handwritten samples were analyzed on the basis of examination of class and minute characteristics and the result exhibited that the mean difference with reference to capital word size between Muslim and other two population groups exhibited statistical significance ( $p < 0.05$ ). But in relation to word spacing and letter spacing, the mean difference between all population groups did not exhibit statistical significance.

Saini and Kapoor (2014b) conducted an offline handwriting analysis with an objective to validate the hypothesis that handwriting is population or ethnic group-specific (for the Roman script). Variations were examined in handwriting features of seven ethnic groups (Brahmin, Panjabi, Jat, Baniya, Ahir, Bengali and Tamilian) residing in Delhi, India. It was found that the prominent handwriting traits of Brahmin ethnic group were the moderately right slant and inner loop formation in lower case 'o'. Whereas in Punjabi ethnic group vertical slant and relatively larger line spacing than other ethnic groups were prominent handwriting characteristics. Tamilian ethnic group exhibited lowest line spacing in their handwriting.

### **Implications and Suggestions**

The range of variation in handwriting attributes within members of same ethnic group is less in comparison to the range of variation in handwriting attributes among individuals of different ethnic groups. This could be attributed to the

fact that members of the same ethnic group share similar cultural and linguistic traits (often similar environment) and thus they may develop a certain level of similarity in their handwriting attributes. Therefore handwriting has the potential to serve a crucial identity marker so as to differentiate one ethnic group from another.

Anthropo-forensic approach relates to population aspects and elaborate use of this approach aids in the determination of various aspects (such as age and sex) linked with the identity of the individual. This can further help in funneling down the criminal investigation. The author emphasizes that the classification of writers on the basis of examination of handwriting attributes with reference to socio-demographic (age, sex, educational status) attributes has immense applications in the forensic domain and similar research should be conducted following this applied perspective.

Similar studies should be conducted in different scripts such that a multilingual reference database can be developed which represents peculiar handwriting features linked to a specific population/ ethnic group with reference to a particular language. Research should also be attempted to address local and regional differences in class characteristics of the handwriting of a particular ethnic group (following a specific native language). Several handwriting attributes such slant, baseline alignment, word and letter spacing, stroke formation, can be utilized to distinguish ethnic groups on the basis of their handwriting as these attributes are readily influenced by extrinsic and intrinsic factors.

Ethnic identification can also be conducted with the help of computational analysis of handwriting. Researchers frequently use the computational software in offline and online computational analysis of handwriting to automatically analyze and verify handwriting and signatures. Computational analysis of handwritten specimen contributes reproducibility and validation to research work and saves time and resources.

Such researchers can aid both ethnic groups and researcher. Besides national and state level institutes for research in handwriting identification should be formulated where document examiners can collaborate with an anthropologist, forensic scientists and computer scientists for holistic study of handwriting.

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## **Conflict of Interests**

None to declare.

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